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THE ENCYCLOPÆDIA BRITANNICA



FOURTEENTH EDITION

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THE ENCYCLOPÆDIA BRITANNICA

FOURTEENTH EDITION

A NEW SURVEY OF UNIVERSAL KNOWLEDGE

VOLUME
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A TO ANNOY



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TO

THE TWO HEADS OF THE ENGLISH-SPEAKING PEOPLES

HIS MAJESTY GEORGE THE FIFTH

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AND OF THE BRITISH DOMINIONS BEYOND THE SEAS

EMPEROR OF INDIA

AND

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EDITORIAL PREFACE

FORMERLY prefixed to encyclopaedias were general dissertations upon the body and divisions of knowledge, its life and advancement, its inspiration and utilities. D'Alembert's stately and vivacious discourse, introducing Diderot's *Encyclopédie*, "war-engine" of information and ideas before the French Revolution, filled more than forty pages. More voluminous, and considered more luminous by some at the time, were the prefatory essays by Dugald Stewart and others to early editions of the present work. This elaborate fashion has fallen out of use in all countries for an evident reason. Any attempt to give a unifying impression of the total sum, and a distinct sense of the countless components, of modern knowledge, as presented in many thousands upon thousands of ensuing pages, has long since passed beyond the power of man. The editorial introduction is still a necessary part of the archives of an institution like the *Encyclopædia Britannica*, now in its 160th year of existence and renewing itself at definite periods from one generation to another. But the preface must devote itself to a statement of the spirit animating this newest design; of the scope of its contents and what is most notable in their character; and of the methods whereby the whole has been framed.

Complete reconstruction now appears. The Fourteenth Edition is a "new model." Why this has been required by the duty of the task must be explained. Demanding a re-survey of all the realms and fields of information, to ascertain and embody the changes of twenty years, that task was found to be more extensive and intensive than had been imposed by the passage of any equal interval in the records of the *Encyclopædia Britannica*. A fresh system of construction was advisable. The system adopted required a large corps of Associate Editors each of them charged with the more or less autonomous organization of a main department. This method, never before brought into play on the same scale, is the vital principle of the " new model." At the same time, it was resolved to employ for the Fourteenth Edition, and upon a scale never attempted by any encyclopaedia before, every modern resource of illustration, including colour-printing. The scope and detail of this latter development are explained towards the end of the present *Introduction*.

THE ENGLISH-SPEAKING WORLD

THIS Edition, then, is the Fourteenth of the series which began with the modest issue of six-penny numbers ("or 8d on fine paper," said the Edinburgh printers) in December 1768 when George III. was King. The talk was all of Mr. Wilkes and of floods higher than could be remembered, spreading in many counties "like a sea." "Luckily," wrote Horace Walpole, "America is quiet."

The Thirteen Colonies, with Canada, were still an integral part of the Old Empire, and the English-speaking world was undivided. The numbers of those native to the mother-tongue or well acquainted with it were then about 14,000,000; they are now about 200,000,000. Recent years have enhanced their position and responsibilities among the peoples of mankind, and in several respects transformed their relations. Two-thirds of them belong to the United States and to Canada across the open frontier.

Even the earliest issues of the *Encyclopædia Britannica*, in a language already transoceanic, never were strictly insular in scope. Like the Authorized Version and Shakespeare; like Bunyan, the Spectator, Robinson Crusoe and Gulliver's Travels; like Locke, Blackstone, the great novelists, Gibbon and Adam Smith as they came out in their turn—the several eighteenth-century editions passed more and more across the Atlantic in those boxes of books so eagerly awaited by many active-minded Americans. We know from an incidental remark in one of Burke's speeches, that, when the *Encyclopædia Britannica* first came out, nearly as many copies of Blackstone's Commentaries were demanded by the Thirteen Colonies as by all Britain. George Washington possessed a copy of the *Encyclopædia Britannica's* Third Edition, which began to appear just when the United States was established and the French Revolution was imminent. Shortly after the middle of the nineteenth century the English readers overseas became more numerous than those living in the old islands. Now, the former are not far from being three times as numerous. Only by means of this expansion, especially during the last two generations—that is, well within the life-time of many persons who

will use these volumes—has the English tongue become so mightily predominant amongst the languages of western civilization. So recently as the 'Eighties of the last century the total number of its speakers rose to one hundred million. They have doubled in little more than forty years.

The *Encyclopædia Britannica* has remained through these changes the organ of general reference for the whole world-family. By the compulsion of that enlarging tradition, it must embrace fully the especial interests —geographical, historical, social, economic—of the multiplied communities of English-readers in three continents where once that language was unknown. Increase and change, advance and diversity, amongst that heavy majority of inheritors of the mother-tongue dwelling beyond its mother-island—that is one reason for the extent of re-construction and readjustment now shown.

MASS AND MINUTENESS OF PRESENT KNOWLEDGE

YET not the chief reason. Knowledge has its frontiers and boundaries, its networks of finer demarcating lines. But they are not drawn nor limited by race or speech. The collective knowledge possessed by mankind is like a universal and indivisible Mind and is of necessity more important for encyclopaedic purposes than that of the 200,000,000 English-speaking people alone. From some points of view, incomparably more important.

To refresh our sense of this salutary truth, we must glance at the origin of modern encyclopaedias and at the rapid evolution which alters their appearance and substance in each successive generation; more than ever in ours. Their ancient and mediaeval history will be found elsewhere under their heading. From the Renaissance and the Reformation; from the art of printing and revival of the classics; from wide discovery by land and sea and sky; from an epoch of double and triple revelation concerning man and the Earth and the heavens—we date the New Knowledge and the new spirit of enquiry. Again from Bacon and Harvey and Galileo, onwards through the great seventeenth century to Newton and Leibnitz, we have a double process still unceasing—now represented by incomputable accumulation of knowledge, with intense minuteness of research into its smallest elements. The telescope and microscope became efficient auxiliaries. (One day, spectroscopy would follow.) Thenceforward, human thought, reborn to free imaginative quest but bringing to bear vigour and penetration of attack on all appearances and all assumed voids, equipped itself by degrees with those instruments of vision and precision which to ordinary persons at present seem numberless in array and miraculous in exact ingenuity. In this second quarter of the twentieth century, the magnitude of amassed knowledge is such that the intellect of a Bacon or a Leibnitz by indefatigable pursuit through a long life could not hope to master more than a fraction. Many are the main divisions, myriad the subdivisions, endless the intricacies. But the methods of further wide conquest, and of still more delicate and piercing analysis, are being brought always to further degrees of power and finesse.

EARLIER AND LATER ENCYCLOPAEDIA-MAKING

HENCE encyclopaedias, containing the digest of all libraries, are more and more necessary. They were and remain an indispensable arm of intelligence to experts. No less have they become so to the generality. It has been surmised, indeed, that up to two hundred years ago an ability as majestic and elastic as that of Leibnitz, if devoted only to the object of acquiring all information as then existing, might have succeeded in grasping and retaining the whole of it. This conjecture we may well doubt when we remember for example the folios of Tillemont and Moréri, of Bayle's Dictionary and d'Herbelot's Oriental Compendium, to name only some French compilations; and the Alps of printed matter piled up by that time in other modern languages. Assuredly, soon after that era, it was no longer possible for any mortal brain, however sovereign in capacity, to entertain the most fleeting dream of attaining by superhuman exertion to "know everything." That frequent foible of scholastic ambition in the middle ages was for ever past. Now, it is as impossible for any single mind to know exhaustively any group of studies; or, independently of reference, any single study. For absolute mastery of one sub-section of one subject an unflagging half-century may not suffice. Further on, we shall see that the makers of encyclopaedias, for their part, are confronted with difficulties of increasing severity by this unbounded extension, with closer intensiveness, of thought and practice. With endless aggregation of knowledge and microscopic scrutiny of its particulars goes the multiplication of man's practical contrivances.

From the middle of the eighteenth century, encyclopaedias became a habit and a stimulus and a familiar part of the civilized apparatus. Developing from English incentives—but in Zedler's *Universal Lexicon*, over sixty volumes still respected, German erudition was already more solidly regimented than elsewhere—Diderot and his collaborators made their *Encyclopédie* a renowned historic force. An armoury of challenging ideas as well as a general storehouse of ascertained information, it was full of nimble description and temporary theory. The political obstacles and dangers surmounted were, let it be granted, extreme; the accomplishment heroic; the immediate social effect unprecedented then, and beyond emulation by any later work of this kind. None the less, the purely encyclopaedic affairs of comprehensiveness, proportion and arrangement were small by comparison with present work of that character. Voltaire said that the *Encyclopédie* was half marble, half wood; d'Alembert likened it to a harlequin's coat.

THE ENCYCLOPÆDIA BRITANNICA IN THE NINETEENTH CENTURY

WITHIN little more than a generation after Diderot's death in 1784, the *Encyclopædia Britannica* began

to acquire an international primacy amongst works of reference. We must glance at its former editions and supplements since 1768 onwards. The five editions in the half-century from 1768 to 1817 need not detain. The work, though counting a good and growing minority of American readers, and progressing in size from three volumes to twenty, was still mainly an insular matter. The island already was the home of steam-power, machinery and the industrial revolution. English books, as yet, were published in a language not by any means foremost in extent of use amongst the tongues of western civilization. It did not reckon yet as many readers as either French or German claimed. After Waterloo, Britain stood out as the foremost nation in power and finance and trade; in machine-industry, technical invention and decisive insight into the future of the physical sciences; in political and economic ideas; and also in originality of literature and art. Shakespeare inspired Dumas to pioneer, in 1829, the triumph of romanticism in Paris. Scott and Byron had a wider active influence in the world, especially in France, than Goethe. The exhibition of John Constable's pictures in Paris, in 1824, opened across the Channel a new era of landscape painting. Deeper powers, hardly to be understood abroad, were Wordsworth and Turner expressing in poetry and colour the atmospheric and almost incommunicable mysteries of island imagination at that great time.

Archibald Constable was then the "great Napoleon in the realms of print." He had become proprietor of the *Encyclopædia Britannica*. His munificent impulse inspired a six volume Supplement (December 1816 to April 1824) which was much more than insular. It enrolled eminent foreign contributors as well as brilliant talents at home. Continued and enlarged ever since, this example of wider fellowship gave the *Encyclopædia Britannica* its impress of world-thinking.

During the next half-century or so (from 1823 to 1875), the Sixth, Seventh and Eighth Editions were successively current. The chief contributors were always a strong band; Lord Macaulay as conspicuous in the later ranks as Sir Walter Scott in the earlier. But while, in a long period, the whole spirit of thought and enquiry had changed, there was no fundamental change of plan in this encyclopaedia. In the mind of man, former conceptions of life and the universe were beginning to be revolutionized by the cumulative effect of innovating thinkers and workers in many fields. The external activities of man had begun to be revolutionized no less, by industrial mechanism and engineering, by railways and steamships, by the telegraph, by the progress of applied science in every line. Charles Darwin, to name only one of the innovating workers and thinkers, may appear in the ultimate perspective, for all the quietness of his personality and methods, a more potent figure than Shakespeare, Kant, Napoleon or Goethe. And Karl Marx was Bismarck's contemporary. But even in the Eighth Edition, which remained more or less in use up to the last decade of the nineteenth century—that is, up to a date forty years after the publication of the epoch-making "Origin of Species"—the traditions of style and arrangement derived from the eighteenth century were not radically disturbed.

ROBERTSON SMITH AND THE NINTH EDITION (1875-1889)

A CHANGE came with the Ninth Edition, still celebrated. It keeps a name of monumental impressiveness and never can be disregarded by any historian or student of the state of civilized knowledge and thought in the latter part of the nineteenth century; especially during the fateful period in politics from the Franco-German war in 1870–71 to the accession of William II. as German Emperor in 1888. The forces of public control in that period were on the whole what may be called orthodox. But in every field of life and thought, small, trenchant minorities—foreshadowing as usual large movements of the future—challenged all orthodox positions. The massive Ninth Edition, with all its qualities, had an inherent disadvantage in the slow intermittent method of publication by volumes at intervals. From inception to completion this Egyptian achievement occupied about eighteen years. Much in the basis was antiquated when the apex came to its point. The editors indeed were conspicuous in ability and fortunate in circumstances of "time-space" belonging to a bygone age. If Baynes who began the work was no ordinary man, his assistant and successor William Robertson Smith, was, in this kind of duty, a great man—an organizer of thorough intellectual team-work on a scale of combination seldom equalled. His own articles on Biblical themes and Oriental origins were learned and bold. In a manner recalling Diderot's old troubles, a battle of belief ended by his removal from his professorial chair. Apart from this controversy on the Higher Criticism there was nothing very perturbing in the weighty volumes appearing at their uncovenanted times. The aim was exhaustiveness in the treatment of main subjects rather than extension of headings to cover as many subjects as possible—the proper object of modern encyclopaedias for general use. As a result the imposing and, as it were, "many-mansioned" structure was most notable as a collection of treatises so full and excellent that many of them were, as others might have been, reprinted as books.

Thus there were three serious defects in this grand achievement when at long last it stood complete. The first volumes, prepared in the early 'Seventies, were old-fashioned when the last volume appeared in 1889. To terminate this old and obsolete system of production would some day be the next step in the making of great encyclopaedias. The Ninth Edition was unwieldy in use. Book-like treatises, admirable to peruse with time enough, were not so convenient for reference in emergency. Above all, the treatment of science by experts for experts, was far beyond the understanding of the

vast majority of users. On this plan, many newer interests of mind and life could not be adequately reflected.

THE ELEVENTH EDITION (1910–11) AND ITS SUPPLEMENTS

YEARS were to pass, and the twentieth century entered upon, before the worst of these difficulties—protracted, intermittent publication—was overcome by the resources of Anglo-American effort. This association properly corresponded at last to the position of the *Encyclopædia Britannica* as the principal organ of reference for the English-speaking world as a whole. Mr. Horace E. Hooper, a man of genius, was an American who loved England, cherished the traditions of this work, and brought enthusiasm to its service. Coming to London, he first gave the Ninth Edition, for all its massiveness, a far larger vogue than it had ever approached before. He did this by allying it for some years with *The Times*. He initiated in 1902 a Supplement in no less than 11 volumes, Sir Donald Mackenzie Wallace and Mr. Hugh Chisholm being joined in the Editorship with President Arthur T. Hadley of Yale. Thus, he constituted the Tenth Edition.

Then, after thirty years since the last enterprise of the same magnitude had been undertaken, an entire renovation was planned. Executed under Mr. Chisholm's editorship, the Eleventh Edition appeared at the end of 1910 and beginning of 1911 under an arrangement with the Cambridge University Press. By a stroke of insight and resolution, unprecedented in this field, involving large expenditure and nevertheless perfectly successful, all the 29 volumes were published nearly simultaneously. This meant a public advantage hardly to be measured. The work was more nearly an organic whole. It represented, approximately, the latest state of knowledge in most divisions at the date of its appearance. Before treating of it further, we may note briefly that the addition of a three-volume Supplement prepared immediately after the World War, under the editorship of Mr. Hugh Chisholm with Mr. Franklin H. Hooper as American Editor, and mainly devoted to that upheaval of the world, constituted the Twelfth Edition in 1922. In that year Horace E. Hooper died too soon (and too soon Hugh Chisholm was to follow him) but the great system and spirit of English-speaking co-operation remained. Without that, it would have been impossible in post-war circumstances to continue the work on its former scale.

Another three-volume Supplement prepared under the Editorship-in-Chief of the present writer and in intimate colleagueship with Mr. Franklin H. Hooper, as American editor, came out in 1926, and was added to the 29 volumes issued in 1910. Thus was formed the Thirteenth Edition. The purpose of this final Supplement was to reflect, as fully as the available space enabled, all the new knowledge and evidences characteristic of the latest extraordinary phase of the world of knowledge and the other world of activities.

This effort was found to be of great experimental uses. It brought out with unexpected force several considerations. Separate matters needing to be dealt with under their own headings had greatly increased in number; information concerning every main subject had been similarly augmented in one decade and a half; even in so short a period many former standpoints of intellect had been for ever displaced; familiar conceptions of life and the universe were very widely altered. Plainly another reconstruction of the whole *Encyclopædia Britannica* was imperatively required. That formidable undertaking could be confronted the sooner because the final Supplement had encountered in advance, and solved in broad principle, the new problems of comprehensiveness and proportion in encyclopaedia-making at the present day.

"SPACE-TIME" AND "RELATIVITY" IN PRACTICE

THE late Lord Bryce said that every successive undertaking of this kind is "a sort of landmark in the history of knowledge." It is an enduring part of the records of its era. It must exhibit more or less the ideas and circumstances of a given generation; the range of mind in the period, and the play of actual life in all its outward forms. Behind the millions of details dealt with, it must show what were the prevailing affirmatives and the "obstinate questionings," what different ways and modes of *Weltanschauung* were striving for ascendancy. Here enters the duty of explaining more particularly why this Fourteenth Edition, appearing so close to the fourth decade of the twentieth century, is very distinct in design; and by what new means the construction has been effected.

We saw above that most of the territories of knowledge had been re-surveyed beforehand and their relative areas demarcated anew. Owing to this preliminary advantage, and to the system of co-editorial organization subsequently employed, it became possible to do in one way what had never been done. The Fourteenth Edition, by division of labour amongst the distinguished corps of co-editors administering the new system, has been produced in less than three years. This contrasts with the seven years employed on the Eleventh Edition and the eighteen years on the Ninth. The advantage here is conspicuous. All the volumes, animated through and through by freshness of mind, are abreast of the most recent information and research. Severe philosophers have dreamed of an ideal encyclopaedia taking a century to complete. That would lose the vital function. Its earlier portions would wither as the later came forth —a process like lighting candles in a long row and beginning when half-way to quench an early wick for each new one kindled. Or, alternatively, this kind of ambition may remind us of Andrew Marvell:

> "My vegetable love would grow
> Vaster than Empires, and more slow."

Ersch and Gruber's cyclopean compilation for strictly learned readers was founded more than a century ago

and having reached nearly 170 volumes is still unfinished. Dr. Merz in his *History of European Thought* makes a very practical observation upon this ponderous, interminable endeavour: "The promoters of it were evidently not sufficiently impressed with the two very essential conditions which make a work of this kind useful—*viz.*, that it must be finished, however imperfect it may be; and that it must be completed within a limited time, on account of the revolutions, and smaller changes, in thought and knowledge."

An equal factor with that of the time to be occupied upon this undertaking was the question of space, in the printer's sense, to be filled. It was judged reasonable to confine this Fourteenth Edition to twenty-four volumes. Nothing could be more facile and agreeable, given unlimited endowment and sufficient disregard of ordinary needs, than to produce in one decade an encyclopaedia running to a hundred large volumes—or even to a thousand and more according to Chinese precedents. But in practice it has been discovered that, beyond a certain point, usefulness for frequent reference diminishes as the stretch of volumes extends. In these matters, modern life allows less leisure to search and creates more need to find. The larger the number of volumes the easier is the task of editorial staffs and contributors. But by the extreme tribulation of those colleagues the modern general reader gains much. The plan of largely increased comprehensiveness within a given space enforces utmost compression without sacrifice of essentials or lucidity. In the process, each department of knowledge stresses valiantly its own paramount claims to latitude by comparison with the rest. Many devoted contributors cry humanly like Thackeray to Macvey Napier, "You are cutting away my flesh and blood." But the provision of a hundred volumes or more would not, in the last adjustment, solve these relative questions.

At first notion, twenty-four volumes each of some thousand pages in double columns, may seem an ample allowance for any human purpose especially when one considers that the twenty-four volumes contain thirty-five million words, the equivalent of 500 ordinary octavo books. The real fact, of course, is that a separate encyclopaedia for history, or for religion and philosophy, or for the physical sciences, or for international biography, or for law alone, not to speak of literature, might run to as many volumes, without containing one dead word. To attempt within the same limits, at this advanced stage of the twentieth century, a digest of universal information, as now assembled and differentiated—with its extent outranging the view of any one intelligence at any one moment; with its infinity, to speak figuratively, of molecules, atoms, particles and "wavicles", with its many divisional labyrinths themselves holding maze within maze—to attempt this was to face a task so redoubtable that no former method of organization could cope with it. The system of editorial association adopted has been mentioned at the outset. How it has worked, we shall see presently. But, first, compare in broadest terms the existing outlook of mind with that of twenty years ago. Then, the work on the last standard Edition was approaching its close; the general contents and arrangement were already determined.

TWENTY YEARS AGO

THE Eleventh Edition was begun in 1903 and finished, so far as the writers were concerned, in 1910. We may assume safely that its general standpoint cannot be dated later than 1908. It discussed some paramount subjects, like "Atom," in terms that are now ancient. "Cosmogony" was mainly mythological. "Electron" received only a few lines. There is no article on "Isotopes"; nor on "Quantum Theory" nor on "Brownian Movement." Turn to the biological side. The general article is confined to a couple of pages. "Hormones" have no heading and are only mentioned in a few sentences here and there. Not only is there no separate article on Biochemistry; it is not mentioned in the index. Einstein's earlier work on Relativity had been published but he is not mentioned even in the Index. These are but a few illustrations taken almost at haphazard. There was a very little about the "Cinematograph." At that date there was, of course, nothing about "Broadcasting." "Flight and Flying," as then treated, are but a record of the first infancy of these subjects. There is no separate contribution headed "Aeroplane." The themes of motors and motoring were then small and simple beside what they are now. It was the same and more markedly with "Wireless." A few pages about it came under the head of "Telegraph"; and nowhere is there any anticipation of "wireless" telephony. There was an excellent article of four pages about "Matter." Nothing at all, to anticipate a little, is more characteristic of the present Edition than that "Matter"—though everything concerning it receives more elaborate and subtle treatment than formerly—appears as a cross-reference guiding the reader to the pertinent articles written by contributors amongst the greatest of living experts; including many whose international pre-eminence has been signalized by the Nobel Prize. On the side of scientific thought and practice, generally, the difference between the Eleventh Edition and its present successor is like an advance not of twenty years but of a hundred. Between ordinary ideas in the first decade of the twentieth century and those in its second quarter the intervening World War made a gulf, if we reckon with psychological effect in all spheres as well as with external convulsions. But, far hence, even the World War may seem subordinate by comparison with the revolutions of scientific thought in our time.

CHANGES IN TWO DECADES

I. Thought

THE map of the intellectual world, more than that of the political, is changed beyond recognition. On every

side we see new mechanisms and agencies with consequent new social activities and habits: in many ways we are farther from the youth of our grandparents, even from the youth of our parents, than were they from the middle ages. This is ordinary evidence to the physical eye. But let the eye of the mind turn to inward views. In every direction new prospects and vistas stretch out. Studies amongst the most ancient are transformed, as, for instance, may be seen at once from contributions to the Fourteenth Edition by scientists like Professors Eddington, Michelson and Sir J. H. Jeans. In all the physical sciences, interacting more and more, the marches of experiment and perception during the last couple of decades are known even by every layman to be very wonderful. Many authorities pronounce that ideas in this sphere have been more profoundly altered than ever before in any equal period.

The new views concern every notion of form and substance and movement; the nature and working of matter itself; electromagnetic action as a pervading principle; the constitution and play of the atom; the origin and laws and effects of radiation; the relations and mutations of elements; above all, the deliberate, intermittent emission and absorption of energy throughout what we call the universe and space. These views by an astonishing succession of intellectual and experimental achievements have largely and for ever removed former acceptations of human thought. The mental habits of two thousand years and more are overturned by several propositions:—(*a*) the electric theory of matter; (*b*) the theory of relativity instead of former notions of absolutes and "iron laws"; (*c*) the conceptions of Time as an operator as well as a recorder—of Space as a process as well as a volume—of Time-Space as a blend, and, inseparably from this, the suggestion of Energy-Matter as another blend; (*d*) the perception of "Things" as "Events"; (*e*) the strange quantum laws showing that the sources of energy are not in continuous smooth flow, as lately supposed, but work by strictly measured jets and pauses, or shall we say (though it is illustrative, not scientific) by rhythm like heart-beats and poetry. None but an expert dare go in passing beyond simple mention of these mysterious "quantum laws" of inter-atomic action now held to determine, by delivery or reception of absolutely regulated amounts of energy, and those only, all the radiating vibration of what we call matter. Perhaps laws behind or beneath all other laws. But Professor Andrade remarks in another volume of this edition: "The explanation of matter in terms of electric charges was the great achievement of the first quarter of the present century. The next period bids fair to be one in which electric charges and radiation will be explained on a common basis as different manifestations of something more fundamental." So, Professor Eddington writes (in *The Nature of the Physical World*) that "An ideal shines in front of us, far ahead perhaps but irresistible, that the whole of our knowledge of the physical world may be unified into a single science." Sir J. H. Jeans adds (in *Astronomy and Cosmogony*): "Clearly our physics and chemistry are mere fragments of wider-reaching sciences." Geology and crystallography, popularly supposed to be amongst the more immobile studies, are animated in contrasting ways by the new insight into modes of action and formation. Chemistry, made inseparable from physics, connects itself by the recent rapid advance of biochemistry, with the secrets of Life; and none can set narrow limits to the practical possibilities of work in this direction.

Though biological sciences have not been as much as the physical transformed by single propositions, their course in the last twenty years has been that of revolution by gradualism. This results from the restless perseverance of research into the composition and behaviour of living matter; into its cells and tissues; into what we may call its internal administration and regulation; into its preservative needs and destructive hazards; into former suppositions concerning sex, heredity, growth, longevity and the possibilities of influencing all of them by scientific intervention. The rediscovery of Mendelism at the beginning of this century led to the throwing of great light upon the cell as the tenacious but susceptible unit of life; upon heredity and sex; and the possibilities of modifying "nature" by intellect. Methods of micro-dissection have been so far more perfected that objects 1/5,000 part of an inch long can be manipulated and even dissected inside the living cell. Evolution is the assumption of all science; and Darwinism, after re-examination, is accepted by all biologists. There is a sudden awakening to the social and economic—let us say the immensely "practical"—value of biology. The world of human concerns has no more urgent need than that of more trained workers of every nation in this field. Attention was drawn not long ago to various analogies respecting form and behaviour between physical atoms and some kinds of living organisms. To the interested outsider, the present atomistic view of the processes of life, biology and physics throwing cross-lights on each other, seems yet another instance of a unifying tendency in science. This is perhaps amongst the greatest things of the age. Medicine and surgery respond in saving practice. In a longer view, no doubt, the second law of thermodynamics, the decree of "running down," still points inexorably to the final death of the universe. But only after millions of millions of years. By nearer views concerning man we are taught to look on natural death itself as a biological novelty, incident to the latest and highest organisms, which in the end may become normally a deferred and tranquil conclusion exempt from disease. Biology and psychology are indissolubly associated. In effect, ultimately, on the future of civilization this may prove not inferior to any contemporary hint.

At the same time, the progress of spectroscopic analysis and stellar photography searches the Sun; extends the census of the stars and the nebulae; enables man to analyse more deeply their chemico-physical composition and activities; their internal proceedings and the stuffs

whereof they are made; their ways of birth and being and passing. "He weighs in his hands the stars; sifts them as gold-dust." Space and Time? All our ideas, up to a few years ago, of what we called "Space" are confounded when we must regard our whole solar system as a speck amongst many thousand millions of stars. In the newer astronomical thought, largely aided by the 100-inch reflector at Mount Wilson, the whole host of stars again appears as a pygmy array by comparison with the stupefying dimensions and distances of the nebulae outside them—the giant nebulae, larger than a thousand million suns, so remote in "Space" that light from them takes over one hundred million years to reach our planet. Well may Sir J. H. Jeans speak of "the magnificent, stupendous, almost terrifying universe" revealed to present astronomy.

And so with all our ideas up to a few years ago of what we called "Time." We have noted that from the farther nebulae, light, though travelling with almost unthinkable velocity, takes over one hundred million years to reach us. By comparison with twenty years ago, the geologists have put back by aeons the origin of man; they demand a far longer antiquity for the Earth; the astronomer reckons that the Sun, at lowest estimate, is older than the Earth to a degree not genuinely conceivable by the mind. According to an idea suggested by Sir J. H. Jeans, if in fancy we considered the Earth as aged 100 years, the human race would be little more than four days old; and all its civilization and knowledge a creation of the last few minutes.

Einstein by his doctrine of Relativity seems at present quite likely to modify the whole of human thinking as Darwin did in the nineteenth century, Newton in the eighteenth, and Bacon in the seventeenth. And this by altering those very concepts of Space and Time and other main attributes of the physical world, which ordinary educated minds up to yesterday regarded as the fixed foundations of intelligence. This must modify deeply the mood of civilized intellect and its way of approaching every subject. Not only do we see Physics, the most fundamental of the sciences, revolutionized and transformed. The whole mental method and outlook of mankind are modified. With regard to any question whatever, habits of looking and assuming that had lingered for over two thousand years, have been broken in the last two decades. Long before, Lotze had pointed in this direction when he defined "a thing" in effect as "something standing in relation." "Reality contains nothing that is or could be isolated in its own pure existence and out of all relation" (*Microcosmus*, Book IX, Chap. I.). Dr. Einstein himself has written: "What is *a priori* certain or necessary respectively in geometry (doctrine of space) or its bases? Formerly—we thought—everything; yes, everything. Nowadays—we think—nothing." And one of his disciples puts it: "Space in itself and Time in itself sink to mere shadows, and only a kind of union of the two retains an independent existence." Yet every discovery suggests so much more to be elucidated that each of the "widening chambers of surprise" brings science to another door hard to unlock. Einstein's mind, assimilating all the scientific and philosophic work of a number of remarkable contemporaries, has introduced a series of memorable simplifications. To many, the enigmas thus simplified seem more impenetrable. Not so to others. One of the great and veteran contributors to the *Encyclopædia Britannica*, Sir Oliver Lodge, writes in the present volumes (*Physics*): "All we can do now is . . . to realize that nothing like the last word has been spoken, to wonder at the genius which has so greatly illuminated and yet partly confused us, and to have faith in the advent of a great generalization." Curious, as has been noted, are some new analogies between living matter and what we yet name non-vital activities. In a word we have come again, in these twenty years, to regard the cosmos as more an organism than an engine.

II. Mechanisms and Customs of Life (1908-1929)

CONTRAST with these abstruse and chastening speculations an utterly opposite kind of picture. The outward activities of man presented a swarm of fresh forms when the collaborators in this Edition turned to the world-wide survey of what is called practical life. In ordinary human habit and its familiar appliances, there is, let us repeat it, as much difference in many ways between the present and the preceding generation as between the latter and the middle ages. In the last two decades the mastery of the air—effected by the heavier-than-air machine in the manner that seemed at first most daring and improbable—has surpassed in everyday usage a classic fable which even when this century opened seemed the vainest dream of antiquity. The Atlantic has been flown both ways. These isolated exploits may foreshadow regular services before another two decades are over. Some believe that in the end the great airships will best provide for long-distance voyages over the oceans and between the continents—especially between the several continents inhabited by the English-speaking communities. Mountain ranges and deserts have been crossed by aviators; little-known regions explored; historic and prehistoric sites alike surveyed from above. In the Old World and the New the aeroplane, already taken as a thing of course, has become the busy agent of passenger and packet traffic within nations and between them.

Air-craft are still but passing specks across the spaces of the sky, often not so conspicuous to an upward view as is a flight of birds. Far otherwise with things on the level. There, the dense increase of motor traffic by private cars, "taxis," and the bulkier public and commercial vehicles, has done more than any innovation for many centuries to alter the aspect both of crowded cities and of open roads, while accelerating the spirit of human movement and spreading manipulative skill. Wide economic interactions result. Motoring develops rubber production in the tropics, just as a hundred years ago

Lancashire manufacture and American cotton-growing were mutually impelled.

"Wireless" telegraphy and telephony were in their infancy when the last full reissue of the *Encyclopædia Britannica* was published in 1910. The former device now carries its invisible lines of communication round the globe—strongly stimulating, by competition, the transmitting capacity of cables. In mid-ocean it keeps ships, whether untroubled or imperilled, in touch with the shores or each other. World-telephony is beginning. It has happened to the present writer, expecting a London call, to find himself rung up for a quarter of an hour's conversation with Los Angeles over six thousand miles away. "Television" itself has become a real thing, starting modestly like all the other miracles of modern invention, but promising to reveal some day to each other faces and places at any distance apart. Will the time come ever, though far hence, when people anywhere without stirring shall be able to visit the National Gallery, the Prado, the Accademia, the Uffizi, the Louvre and the rest? Some experts say "Yes!" And who knows? Radio-broadcasting is now a universal addition to the conveniences. There seems no reason why London lovers of the Symphonies should not shortly listen at will to the Philadelphia Orchestra, or other music in America, as they do now to German performances, nor why American listeners-in should not simultaneously enjoy all the best music of Europe. "Loud speakers," again, as in the last great Presidential contest in the United States, carry one human voice to the simultaneous hearing of millions, and may so modify the effects of personality, by screening the orator's visible action from all but a fraction of his audience, that men of intellect, hitherto prevented from playing a due part in public life by the lack of what is called magnetism in countenance and gesture, may have a more equal opportunity with men of less able but more dramatic types. Thus, unless indeed this rational improvement be lost again by the perfecting of television, the working of free politics may be sensibly and wholesomely influenced.

We see ourselves at the outset of another potent agency—the creation of regional and national networks of electric supply whether generated by coal burned or by falling water. These volumes record the new researches looking to the conversion of crude coal, hitherto the most grossly misused mineral, into oil, and sundry chemical valuables, with a residual smokeless fuel. Success in this direction seems already fairly sure to attain that priceless gain to the comeliness and health of human conditions—a civilization industrialized and urbanized yet smokeless.

During these twenty years and more the lighter side of existence has seen a lively metamorphosis. All the associations belonging to the name of Hollywood have arisen. Throughout the world the picture-theatres are conspicuous. A more ubiquitous attraction than the living drama ever was, they entertain daily many millions of persons. They correspond with the play proper much as newspapers of all sorts correspond with literature or at least with books. Motion pictures have become a world-institution like printing. Their invasion of Asia, for instance, is a striking aspect of the Oriental awakening. Added lately to the silent film is the talking picture. It may be that these devices, apt to become stereotyped by accelerated exhaustion of all the readier ingenuities, will find a truer artistic basis of their own. The gramophone in its crudity a trained ear could not endure, it has become an apparatus capable of bringing much nearer the finest execution of the best music.

III. More Light on Pre-History and Human Origins

FROM this latter scene of the novelties of the day, we come to a contrast amongst the most impressive. While mind stretches ever forward in understanding and invention, it reaches further and further backward in its knowledge of human beginnings. Archaeology strikes into deeper layers over wider areas; disentombs ages of history long buried and forgotten. We know more already of the remote origins of Eastern and Mediterranean civilization than was guessed by all the schools of antiquity at the zenith of their learning. Our knowledge is enriched rapidly with every season of research. We gain ever more light on early contacts of races, early working of metals, and the beginning of city-dwelling societies. As between pre-dynastic Egypt and Sumerian Mesopotamia, the long-debated question of civilizing priority remains an unsolved secret but becomes yet more fascinating as investigation on each side extends and descends. A common source may be found elsewhere. The first organized civilizations which flourished thousands of years ago ranged from the Aegean to China and Japan. The conjecture that India, after all, may have been the primal mother remains pure surmise; but the discoveries at Mohenjo-Daro, Harappa and other places in the Indus valley open up a new vista. Exploration in that quarter is only starting. In the far-removed field of Central America, the Maya problem becomes more baffling as we learn more.

Immeasurably further back go the enquiries into the means and the stages whereby man emerged a little from the brute, and rose afterwards out of a semi-brute state, continued through hundreds of thousands of years. The last two decades have told us much more of the Old Stone Age and the New Stone Age—the latter flowering so suddenly, as it will seem until we know more, into the fuller civilizations. Combining city-life with skilled agriculture, the men of a new day possessed religious systems and State-forms. Carrying the use of metals from copper-working to bronze-making, adept in pottery and textiles, they evolved from pictorial signs the art of writing and the power of record.

Anthropology overlaps archaeology. It is the study of man in a fuller sense—chiefly the study physical, mental and social of primitive man and of his surviving representatives. It considers more remote and more

recent evidence touching bodily traits, race and colour, tribal customs and sex laws, religious gropings, typical implements and the rest. Rarely can anthropology make spectacular additions to its material data. Its landmarks, rather, are books like Sir James Frazer's, throwing a flood of new light upon the meaning of assembled evidence. But in the last twenty years, special investigation in many regions has resulted in far fuller acquaintance with the outwardness and inwardness of separated primitive cultures. As a result, almost needless to say, theoretical contests respecting evolution and distribution have not been composed but accentuated.

Two illustrations may be given of the present contrast between the length of the past and our inklings of the future. Sir Arthur Keith compares the lessons of various discoveries all made well within the last two decades. He concludes that man began to appear "certainly a million years ago, perhaps more." And this is a very short term relatively to his Earth's antecedents. Man is a biological novelty—like death. Here the special study of his origins and experiences links up with all the sciences. Sir J. H. Jeans has remarked: "While the geologist has been increasing his estimate of the Earth's age up to 1,400,000,000 years or more, astronomical research has been moving in the direction of asking for at least a thousand times this period for the sun and the stars in general." Since then he concludes "all available lines of evidence agree in assigning lives of the order of millions of millions of years to the stars."

IV. "Recorded" History

WHAT we call recorded history is thus but a brief trifle beside the time-conceptions of the astronomer, the geologist and the biologist. Yet history proper is of paramount value as an account, both stirring and warning, of human personality and human movements, of interrupting disasters and resumed creativeness, during those five or six thousand years in which the play of motive and ideas has been of a kind that admits of our own intimate comprehension and even assists our own experience. Ancient Egypt and Babylonia, for instance, are by no means irrelevant to the student and administrator to-day in the same regions and in India. In history proper, whether called ancient, mediaeval or modern—though all of it is so modern by comparison with the scientist's measures of time—we have had no single book in the twentieth century equal in lasting mastery to Gibbon's *Decline and Fall*, or to Ranke's *Popes* or to Mommsen's *Roman Provinces*, or to Fustel de Coulanges in *La Cité Antique*. Yet the twenty years have been full of searching work throwing new rays into every field of historical study. The mass of available information has been much enlarged by publication of original records, by detailed monographs, by studies scattered through periodicals. Few subjects could now be approached from the same standpoint as the more eminent minds might have taken twenty years ago.

V. The World War and a Complex of Revolutions

THIS general change of mood in viewing history is largely due also to the unparalleled catastrophe which swept civilization soon after the Eleventh Edition appeared. The interval is like an abyss between two political epochs. A rending convulsion continues its influence upon the circumstances and the thought of mankind. The World War is properly named. It involved the whole world directly or indirectly. The formal neutrals were a small fraction. European strife was imminently threatened by events in the Balkans in the very year after the *Encyclopædia Britannica* of the former epoch came out complete at the beginning of 1911. The general conflict of nations broke out in the summer of 1914 and lasted into November 1918.

The first years of nominal peace continued the abnormal course of events. Into less than a decade was crowded, as never before, tumult and revolution enough for an average century or more. In Europe, one ancient and spacious Empire disappeared; three great Imperial dynasties and a number of sub-dynasties vanished from their thrones; races long subjected, and in several cases dismembered as well, were reconstituted as independent peoples; defeated Germany became a Republic; Bolshevist fanaticism, seeking the utter extinction of private property and social privilege, swept Russia like a fire. Elsewhere with boundless audacity, like the first Napoleon, a young dictator seized and still retains the control of Greater Italy. Spain, Poland, Lithuania, Yugoslavia, Chile, Turkey, Persia and some other countries are under the essentially military rule of persons or camarillas. In Turkey, a fighting dictator of iron stamp defied the decrees and broke the efforts of the victorious Allies. He then rooted out national customs and institutions hitherto sacred to conservative Islam.

The vibrations went through all Asia. In India, the former stability of a British régime conducted in the spirit of beneficent despotism was replaced by all the hopes and hazards connected with a scheme of gradually enlarging self-government for a sub-continent containing several hundred millions of people divided as nowhere else by region, religion, language, race, caste, class; and including, under British suzerainty, many native monarchies, principalities and chieftaincies by no means firmly converted to the democratic principle. In a still larger and more populous part of Asia, the Chinese Republic was nominally established in 1911, well before the World War. But that eruption had the effect of aggravating in China chaotic struggles brought only of late to a partial settlement between the domestic factions. The ascendancy of the general spirit of Chinese nationalism is, however, unquestioned and has secured from most foreign nations recognition sufficient to guarantee that this new freedom in external relations will not be reversed, whatever form the internal Government may take. This situation was not so difficult for any other country as for Japan—raised by the World

War to still higher political and commercial position among the Great Powers, but more than ever dependent on trade with the Asiatic mainland; and regarding with very intelligible anxiety the possible consequences of Chinese consolidation and protectionist tariffs.

VI. A New Era in the English-Speaking World

WORKING as deeply for change, though in ways as yet less apparent, have been the results of the European cataclysm upon the English-speaking world. Such of these effects as concern the movement for world-peace and the political emancipation of women will be better taken in a later connection. There are other consequences of outstanding historical importance. Drawn late into the World War, the United States finally determined its issue as against the Central Empires, and emerged with a relative strength and wealth not attained nor approached before by any one country. The separate sea-supremacy of Britain ceased to be. Its increasing completeness, during two centuries and a half since Cromwell, had sheltered at first the rise of English-speaking America itself, and had been the decisive influence on world affairs. At the Washington Conference of 1921–22, Britain and the United States agreed that naval parity between them should be the principle of the future. In the entire period covered by this retrospect no single historic change was of more far-reaching significance.

Political relations within the British Empire itself were transformed in theory but not as much in reality—except in one respect. The larger part of Ireland, after a violent guerrilla, was recognized as the Irish Free State, wholly exempt, like Canada and Australia, from direct British rule, but owing like them allegiance to the King. The other self-governing Dominions had been in fact, before the War, as free from compulsion by the mother country as they are now. The British system, so far as its English-speaking constituents were concerned, became an association of co-equal commonwealths regulating their mutual affairs by discussion at periodical Conferences. This is a unique experiment. The daring genius of modern British belief in voluntary partnership has been justified hitherto in repeated crises, while often centralized systems superficially more coherent have failed.

VII. "The Economic Age"

WE COME to the final part, but a very large part, of the resurvey undertaken by the makers of the Fourteenth Edition of the *Encyclopædia Britannica*. The department remaining to speak of is that of Economics. Expansion and intensity in this field are beyond anything known to the pre-war epoch. We have entered upon an age when economics, whether we wholly like it or not, are preponderant as never before in politics and in all existence. This sphere contains indeed the entire apparatus, human and mechanical, of production, transport and exchange. Economics are affected day by day not only by every technical invention and by the progress of every applied science, but by every fluctuation of natural forces, every marked historical occurrence, every variation in political systems, every increase of insight gained through research into the psychology of human exertion; by every added instinct of democratic aspiration; every further admission of the claims of women; and even by every breath of fashion and by every fleeting movement of hope or fear amongst mankind. All the relations between employers and employed are involved; all theories of capitalism, socialism and of intermediate adjustments; all conceptions of aesthetics as applied to collective life; and all notable views of other sorts. Some of them are radically challenging to extreme industrialism and urbanization—rather regarding the use of life itself for the highest development of human faculty and happiness; enquiring keenly into what really constitutes "the greatest good of the greatest number."

Only a few salient features of the economic re-survey in the ensuing volumes can be indicated. Raw materials; processes of manufacture; engineering and machinery; power-generation; types of large scale organization in business—these had to be dealt with in the present undertaking far more variously than in any former Edition. Many new aspects of the relations between capital and labour are displayed. The new industries have their pages. Unemployment and migration in their later phases are dealt with as deeply altered problems. The economics of the World War demanded a long category of articles or additions bearing upon debts, reparations, the revolutions and restorations of currencies, upon banking, loans, tariffs. For in all these and other financial connections, the period since 1914 has been perhaps more surprising and instructive than the whole of former history.

A NEW SYSTEM OF ENCYCLOPAEDIA-MAKING

IT IS now easy to see why (in the judgment of the present writer) the circumstances required a bold departure from precedent and a fundamental change in the method of encyclopaedia-making. No one living person and no central staff can now pretend for a moment to draw out in the old way a sort of Mercator's projection of contemporary knowledge with its major and minor configurations and boundaries; with its "filling in" of details, multitudinous themselves, yet selected from the innumerable. We have in our day many-volumed compilations for separate branches of knowledge, but as they show by the reference to their sources, none of them affects to be exhaustive even in their special kinds. An encyclopaedia, proper and general, must seek to give much about every principal subject, something essential about other subjects, under tens of thousands of headings; but by no possibility, though it ran into thousands of volumes, could it contain everything about everything. Were that monstrous work within the dull power of misdirected

human effort; it would, of course, frustrate the purpose. No one could use it much, few could use it at all. The office of the *Encyclopædia Britannica* is to provide the fullest, most various digest of universal information in its articles—and its bibliographies are a guide to the rest.

The Eleventh Edition, then, could not be taken as a basis for rebuilding. An entirely new edifice was needed, starting from a new ground plan. The main proportions and measurements, external and internal, of a fresh design were soonest settled. Division of space to accommodate the competing needs of so many departments exacted, as we have seen, more prolonged consideration at the outset and much reconsideration afterwards. But when this too was determined only structural questions were settled. The vital problems remained—how to equip each department for organizing the best presentment of its own kind of information.

It was decided to abandon the tradition of wholly centralized government and to institute instead what may be called a federal system of co-operation. With due care for unifying the results of so many different responsibilities, the principle of autonomous organization was applied simultaneously to the great provinces. A corps of Associate Editors was formed, each an expert of recognized eminence. In addition, competent assistants were appointed for each of the many groups which in the schedules of modern encyclopaedia-planning are called intermediate or miscellaneous. The various functions were undertaken ultimately as follows:

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DR. S. A. COOK . . . . RELIGION (*Old Testament History*)
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As Co-editor of the whole work, Mr. Franklin H. Hooper, the head of the New York office, has been the invaluable colleague of the Editor-in-Chief, and, in addition, has been exclusively responsible for American contributions. Mr. Warren E. Cox, the Art Director, has been responsible for the illustrations as well as the articles on art. Mr Hooper found it necessary to secure the aid of a corps of associates, each an expert of recognized eminence. Their names and functions follow:

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Editor of Musical America.

E. R. WEIDLEIN — INDUSTRY AND ENGINEERING
Director, Mellon Institute of Industrial Research, Pittsburgh

FRANK C. WHITMORE . . — CHEMISTRY
Chairman, Division of Chemistry, National Research Council, Washington

C. C. WILLIAMSON — LIBRARY AND REFERENCE PRACTICE
Director of Libraries, Columbia University.

The co-ordinating work was executed by the central staffs in London and New York. In the London Office Mr. E. Ibbetson James was first lieutenant, Mr. R. W. Postgate gave special attention to the classical side, Mr. V. C. Clinton Baddeley to modern history, while Dr. Neville Whymant's personal acquaintance with lands and languages in the Far East was an exceptional reinforcement. On the organizing and administrative side, it is not easy to imagine duties more arduous, nor services more efficient than those of Mrs. G. E. Law and Miss Marjorie Hollowell.

In the New York Office, Dr. Walter B. Pitkin for the first year was first lieutenant; in the second year, Mr. Charles Johnston aided by general suggestion and in reading proofs; Mr. Frank W. Johnson in biology; and Mr. William H. Turner's services in economics and applied science were a great help to the Editors and to the usefulness of the work. To Mrs. L. P. Dudley, especially, the thanks of the American Editor are due for her highly capable services in organizing the administrative side of the New York Office.

Thousands of contributions, large and small, come under categories which no list like the above can include. In this connection many experts were consulted upon the preparation or revision of single articles and groups of articles, and thanks are due to numerous associations, libraries, universities, corporations and government departments for substantial aid or advice given to editors and contributors.

As this method of working marks a distinctive development in the methods of encyclopaedia-making, some words concerning it must be added here as part of the records of the *Encyclopædia Britannica*. Each Associate Editor made a separate survey of the area for which he was responsible; divided up that area according to his own judgment of modern requirements; and drew up a schedule of articles and writers. At headquarters these schedules were compared and a final disposition of the space available within the twenty-four volumes of about a thousand pages each

was made on paper. Needless to say, this finality in theory was subject to endless rearrangements in practice. Encyclopaedia-making is an organic process defying anything like exact mechanical regulation in advance. Nor in the full course and final stages of the work can its adjustments be made according to the old farmer's idea of verse as done "with a gauge and a chopper to measure the length of the lines." Labours such as these volumes represent are a human, indeed an extremely human, affair, involving as they do collaboration, visible and invisible, between a host of personalities rightly swayed at the outset by incompatible convictions about the relative importance of their subjects. The theme usually grows under the hand of an expert settling down to it. The allotted room is frequently exceeded, yet without waste of a word. Cogent always are the arguments in favour of compressing almost any valuable contribution except the one in question which perforce must be compressed if any assigned number of volumes is not to grow inordinately beyond the plan. But conflicting claims of this unavoidable kind, continually arising from beginning to end, and creating formidable hitches now and again, are always settled at last by the good humour of colleagueship, and the reasonable recognition of necessity.

SCIENCE. AUTHORITY AND SIMPLIFICATION

A PROMINENT purpose in distributing responsibilities amongst the Associate Editors for the scientific departments was to secure as far as possible a more simplified exposition of the sciences. This aim, to a remarkable degree, has been happily achieved; it could not be carried further at this period of civilization—terminology, formulas and the diagrammatic apparatus being what they are—without reducing the *Encyclopædia Britannica*, in this very large and ever-growing area of its task, to an elementary level. We all are apt to ask at some time why the treatment of science cannot be made throughout as generally intelligible to the ordinary educated person as the articles on history or literature. The suggestion is at first sight very persuasive. When well looked into, it is found practicable up to a certain point, but beyond that encounters insuperable obstacles. Each science expressing itself in any language has, as it were, a sub-language, an alphabet, and a grammar of its own. A general encyclopaedia cannot teach these any more than it can teach Latin or Greek, French or German. You cannot begin to understand mathematics without learning the rudiments; nor chemistry, by way of ready reference to pages like these, without some antecedent grip of the clear rationale of its formulas; nor biology without some preliminary acquaintance with its elements and its vocabulary. It is impossible to make any science as readable as history for a general reader who never has received a lesson in science, nor has read any ordinary text-book.

But much has been done. In the Fourteenth Edition the history of each science has been written in plainer language; the further exposition has been relieved from superfluous complication. It was said of an article in a former Edition of the *Encyclopædia Britannica* that when it had been written by one profound *savant* there was only one other in the world who could understand it. By contrast, the sciences in these new volumes are dealt with in a manner that makes them accessible to general readers. With good attention, the clue to the meaning and importance of leading ideas can be gained by lively-minded readers uninstructed in the detail of any science. This is eminently the case, for example, in the articles treating of the nature and properties of the atom; and also in the general (and many subsidiary) articles on astronomy, geology, physics and biology, to mention only these. They may well lead many minds to that fullest awakening of imagination which even literary genius cannot by itself rouse. In 1915 a young soldier was killed on the Gallipoli peninsula at the age of 28, but not before he had won an immortal name by detecting in the relationships of the elements as they increase in complexity a law of harmonic progression no less beautiful than enlightening. Professor Millikan does not necessarily say too much when he writes: "Some day a poet will arise who will make an epic for the ages out of young Moseley's discovery."

We must at least expel the mandarinesque fallacy which still lingers in too many minds—that the study of the sciences has no humanistic value. We may be certain that Plato and Lucretius with Dante, Milton and Goethe, could they bear witness together in our time, would protest to the contrary. Bacon by himself might be taken as sufficient witness. No true humanist can now suppose that gardens, mountains and stars are enriching influences; but not botany, nor geology nor astronomy. Mediaeval alchemy, and very rightly, is amongst the accepted romances of literary convention. But the actual chemistry and biochemistry of to-day are a thousand times more wonderful in their practice and not less so in their dreams.

EXPANSION AND CONDENSATION

THE more besetting business, when all else is said, was that of enlarging greatly the number and variety of the contributions, while making the whole work more compact than the Edition of 1910. The amount of pains expended by the editorial staffs in London and New York upon the solution of this difficulty does not lend itself to an easy description. The same problem always has been more or less incidental to every work of an encyclopaedic kind, purposing to be more modern and comprehensive than its predecessors. But the old difficulty increased to an unmatched degree in the making of the Fourteenth Edition of the *Encyclopædia Britannica*. The treatises or dissertations filling far-stretching expanses of print in every volume designed

twenty or fifty years ago could no longer be so numerous. Brevity to the utmost extent compatible with clearness and sufficiency had to be enforced. But at the same time, a full solution could not be obtained by any means so simple as reducing former subjects in unvarying proportion in order to make room for so many new ones. The *Encyclopædia Britannica* cannot become an encyclopaedic dictionary on the well-known German model, such as may well be compiled in half the number of volumes. It must provide, generally and throughout, more information under a given heading than any other work of universal reference; while on certain great matters old and new—notably in the spheres of history and literature—its now secular tradition of fullness and authority must be strongly maintained. Accordingly, many important articles remain of outstanding massiveness as before.

These are the equivalent of Leibnitz's approved "little books"—then, meaning not so little neither. But such instances of just and excellent amplitude only make more exacting the task of contriving such efficient economy and retrenchment elsewhere as might make place enough for thousands of new headings either required by the progress of knowledge and practice in the last twenty years, or recommended by the advisability, for modern convenience, of extricating many things formerly embedded in the long general articles. Relief fortunately offered itself in one respect. After the lapse of years much material which once had value in itself, or was prized for the sake of some eminent writer's name, was found to be dead wood and could be cut away. In the same manner, passages of disputable assertion or of moralization or large interrupting statements of fact could be excised not only without injury, but with profit. Biographies of persons who had but small importance in their day and have none in ours could be excluded altogether; while all biographies of secondary persons who remain interesting could be shortened without any loss of essentials. The space formerly given by Victorian habit to contemporary writers and politicians at home and abroad was usually far beyond historic proportion. In several cases what would once have been regarded as impiety or sacrilege has been committed in this Edition. For instance, Lord Macaulay's article on William Pitt has been replaced by a concise and dispassionate account. With all its gleaming rhetorical energy and abundant flow it was much disfigured by political prejudices then still surviving from the party heats of the previous generation; and as written in 1858, it has been displaced by later studies and more discriminating judgment. So, in other generations, Sir Walter Scott's article on the "Drama" was preserved through half a century untouched from one Edition to another in "homage due to the genius and fame of the illustrious author"; it was dropped at last from the Ninth Edition.

By themselves, however, the space-saving resorts thus indicated were not nearly enough. Success in combining the two principal objects, increased comprehensiveness of scope and more concise management of subjects, was attained mainly through the skill of the Associate Editors in ordering their provinces, and through the willing acceptance of a hard discipline by their regiments of writers. Authorities not inferior in eminence to any who ever wrote for the *Encyclopædia Britannica* have handled some of the largest themes more succinctly yet more lucidly than the best of their predecessors.

CONTRIBUTIONS AND CONTRIBUTORS

APART from the editorial names already enumerated, over 3,000 contributors from all parts of the world have been enrolled. It is impossible to name all the articles and writers deserving "mention in despatches." But it is proper to show by some representative selection from these how much care has been taken during the construction of the Fourteenth Edition to maintain the *Encyclopædia Britannica's* highest traditions of scholarly authority while modernizing resolutely its scope and form. Let us take some groups of studies in their contrasts.

RELIGION. Amongst the contributions on the OLD TESTAMENT, DR. STANLEY ARTHUR COOK has written an account equally new and important of *Hebrew Religion* while bringing up to our day his other well-known work on *Palestine* and the earlier *Books*. Other collaborators in this department are DR. HENSLEY HENSON, Bishop of Durham, RT. REV. WM. T. MANNING, Bishop of New York, PROFESSOR W. E. BARNES (Cambridge), DR. SHAILER MATHEWS (University of Chicago), PROFESSOR G. H. BOX (London), PROFESSOR F. M. T. BÖHL (Leyden), DR. CHARLES R. BROWN (Yale University), PROFESSOR G. A. COOKE (Oxford), BISHOP FRANCIS J. MCCONNELL of the Methodist Episcopal Church in the United States, DR. A. E. COWLEY (Librarian of the Bodleian), MR. G. R. DRIVER, of Magdalen, PROFESSOR W. A. L. ELMSLIE (Cambridge), PROFESSOR A. S. PEAKE (Manchester), PRINCIPAL WHEELER ROBINSON, DR. PETER GUILDAY (Catholic University of America, Washington), PROFESSOR THEODORE ROBINSON (Cardiff), PROFESSOR D. C. SIMPSON (Oxford). Under auspices like these, all needed revision has been carried out; while among newly written articles are *Jehovah*, *Abraham*, *Job*, *Psalms*, *Proverbs*, *Isaiah*, *Jeremiah*.

Those who have written or rehandled other subjects of THEOLOGICAL HISTORY and CRITICISM include PROFESSOR F. C. BURKITT (Cambridge), PROFESSOR J. M. CREED (Cambridge), PROFESSOR E. HIRSCH (Göttingen), PROFESSOR HANS LIETZMANN (Berlin), PROFESSOR C. H. TURNER (Oxford). These treat of the New Testament and the Creeds. Studies of note, bearing on recent controversies are *Eucharist* and *Sacrament*, and *Fundamentalism* and *Modernism*, the latter by DR. W. ADAMS BROWN of the Union Theological Seminary,

New York.' The article on *Jesus Christ* is by DR. ANDERSON SCOTT and DR. STANLEY ARTHUR COOK. *Religion* and *Theism* were undertaken, the former by PROFESSOR R. R. MARETT (Oxford) and PROFESSOR G. GALLOWAY (St. Andrews), the latter by PROFESSOR W. R. MATTHEWS (King's College). The article *Judaism* has been written by H. M. J. LOEWE, and the article *Jews* by H. M. J. LOEWE, S. A. COOK, L. H. D. BUXTON, CECIL ROTH and the CHIEF RABBI, J. H. HERTZ. Two articles retained though revised must be mentioned because of their authorship and excellence—*Gospel of John* by BARON FRIEDRICH VON HÜGEL and *Theosophy* by PROFESSOR A. S. PRINGLE-PATTISON. In SIR T. W. ARNOLD'S department are all the articles relating to the religious life of Islam.

CLASSICS. Much work was done on this side by PROFESSOR A. W. MAIR before his tragic death. From his own hand is the general study *Classics*. The late DR. J. P. POSTGATE'S well-known article on *Textual Criticism* has been revised by his son MR. R. W. POSTGATE.

HISTORY, of all things, was thought once to be outside the bounds of encyclopaedias (the *Encyclopédie* gives about one page to the heading *France* and one column to *Angleterre*). It now rightly occupies an immense proportion of their total space; so that amongst the crowd of eminent things in this part of the purview only a very few can be indicated. PROFESSOR F. Ll. GRIFFITH has revised all the pages on *Ancient Egypt*. *Athens*, *Greece*, *Rome*, and *Carthage* respectively are written, wholly or in large part, by MR. A. J. B. WACE, PROFESSOR E. M. WALKER, PROFESSOR TENNEY FRANK and MONSIEUR JEAN BABELON of Paris. The great veteran PROFESSOR EDUARD MEYER has brought forward his previous articles, *Media*, *Persia*, *Parthia* amongst others. DR. THOMAS ASHBY has devoted himself to *Sicily* and *Syracuse*. Nor from the briefest selection can we omit DR. G. B. GRUNDY'S restudy of the *Graeco-Persian Wars* or his *Economics of Greek History*. *Roman Britain* is in part by SIR GEORGE MACDONALD, chief specialist on the subject since the death of PROFESSOR HAVERFIELD.

PROFESSOR ERNEST BARKER'S revision of his very full and celebrated article on the *Crusades* adds the last word to that large theme. PROFESSOR J. B. BURY before his lamented death completed with mastery his treatment of the *Later Roman Empire*. PROFESSOR H. M. CHADWICK of Cambridge writes *Anglo-Saxons*, a heading formerly of a very small article. To the irreplaceable treatise on the *Renaissance* by JOHN ADDINGTON SYMONDS, PROFESSOR PRESERVED SMITH of Cornell University adds a note. The series of articles on the history of the Papacy have been further strengthened, especially in those sections dealing with the last three centuries, not hitherto handled in a manner harmonious with the learned and living accounts of earlier periods by DUCHESNE, LUCHAIRE and VON PASTOR. Enough to say that the *Reformation* is in the hands of MR. G. G. COULTON.

To single out from amongst the long list of contributions and contributors on other, mostly more modern, aspects is the hardest. There are all the national histories. England in later centuries is dealt with by PROFESSOR F. C. MONTAGUE, SIR CHARLES GRANT ROBERTSON, DR. HOLLAND ROSE, MR. D. C. SOMERVELL for the Victorian age and MR. R. H. GRETTON for the twentieth century. No book yet published furnishes what will be found in MR. FRANK BIRCH'S group of five articles on *The Cabinet*, *Prime Minister*, *Privy Council* and *Constitution of Great Britain;* and the *Court of High Commission*. Amongst constituent Dominions, *Canada* is by PROFESSOR G. M. WRONG of Toronto.

France is by MONSIEUR P. WIRIATH of Paris; *Germany* by PROFESSOR ERICH BRANDENBURG of Leipzig; *Spain* by DR. RAPHAEL ALTAMIRA and PROFESSOR S. DE MADARIAGA; *Russia* by the old cadet leader MR. PAUL MILIUKOV and by MR. MICHAEL FARBMAN (for 1917) and MR. WALTER DURANTY (since 1917); *Italy* largely by COMMENDATORE LUIGI VILLARI; and so onward. PROFESSOR CHARLES SEIGNOBOS handles *Europe*.

UNITED STATES HISTORY is treated in detail by PROFESSORS F. J. TURNER and ALBERT BUSHNELL HART of Harvard University, H. L. OSGOOD and D. S. MUZZEY of Columbia; *Constitution and Government* by PROFESSOR WALTER F. DODD of Yale; *Finances* by the HON. ANDREW W. MELLON, Secretary of the Treasury under three administrations; *Commerce and Manufactures* by DR. JULIUS KLEIN, Director of the U. S. Bureau of Foreign and Domestic Commerce, and the military effort of the United States in the World War by GENERAL PERSHING. But the United States is not simply a nation as is France or Italy; it is also a federal union of forty-eight "sovereign" States, varying in size from Texas, larger than the entire Japanese Empire, to Rhode Island, smaller than Cornwall; and in population from New York, with more inhabitants than Holland and Switzerland combined, to Nevada with a population one-third of Luxembourg's. The story of each of these States is told, some by their Governors, as *New York* by ALFRED E. SMITH, *Maryland* by ALBERT C. RITCHIE, *Ohio* by A. V. DONAHEY and *Virginia* by HARRY F. BYRD; others by one of their United States Senators, as *Idaho* by the HON. WILLIAM E. BORAH, *Montana* by the HON. THOMAS J. WALSH, *New Hampshire* by the HON. H. W. KEYES, and *Kansas* by the HON. ARTHUR CAPPER; some by writers who are accepted authorities on the history of their States, as JAMES TRUSLOW ADAMS for *Massachusetts*, PROFESSOR CHARLES E. CHAPMAN for *California*, PRESIDENT KENNETH C. M. SILLS for *Maine*, PROFESSOR D. D. WALLACE for *South Carolina*, DR. DAVID KINLEY, President of the University of Illinois for *Illinois*—in all a company of forty-eight scholars and men of affairs well able to reinforce the *Encyclopædia Britannica*.

For Latin America, PROFESSOR C. W. HACKETT contributes the history of *Mexico;* PROFESSOR PERCY MARTIN, *Brazil;* PROFESSOR MARK JEFFERSON, *Argentina;* PROFESSOR ISAAC COX, *Chile;* and MRS. M. T. BINGHAM, *Peru.*

A sad interest attaches to the article on the *Panama Canal,* for its builder, GENERAL GOETHALS, wrote part of it on his deathbed, and the Secretary of the Panama Commission, MR. JOSEPH B. BISHOP, died shortly after completing it.

On Asiatic themes, taking them in order from Near East to Far East, we have *Turkey* by DR. ADNAN and MADAME ADNAN of Constantinople; *Syria* and *Zionism* by MR. LEONARD STEIN; *Palestine* by SIR RONALD STORRS, former Governor of Jerusalem and now Governor of Cyprus; *Arabia* and *Trans-Jordan* by MR. H. ST. JOHN PHILBY; *Persia* by SIR PERCY SYKES, SIR PERCY COX and SIR ARNOLD WILSON; *Iraq* by SIR PERCY COX; *Afghanistan* by SIR WOLSELEY HAIG; *India* by LORD MESTON; *Ceylon* and *Malaya* by SIR HUGH CLIFFORD; *Tibet* by SIR CHARLES BELL; *China* by PROFESSOR KENNETH SCOTT LATOURETTE; and *Japan* by SIR CHAS. ELIOT, "Odysseus" in literature, and for seven years up to 1926 British Ambassador to Tokyo. Amongst articles relating to another Continent, Africa, MR. FRANK R.CANA, to whose long services the *Encyclopædia Britannica* is uncommonly indebted, has written many. *Egypt* has been entrusted to LORD MESTON. *Morocco* is by MONSIEUR HENRI BRENIER; *Algeria* by PROFESSOR AUGUSTIN BERNARD; *Abyssinia* in part by MR. C. F. REY, who writes from personal knowledge; the *Congo State* by MR. CANA; *Nigeria, Rhodesia* and *Cape Colony* by MR. BASIL WORSFOLD; *South Africa* by MR. BASIL WILLIAMS. We pass across the Indian Ocean to *Australia* and thence to *New Zealand.* Their annals are narrated by PROFESSOR DARNLEY NAYLOR and MR. PEMBER REEVES.

Various articles of mark cannot be classified under the usual periodical divisions of history. *Civilization* by PROFESSOR JAMES HARVEY ROBINSON is amongst the most meditative and suggestive work in these volumes. Imperial dynasties, vanished from their thrones since the Eleventh Edition of this Encyclopaedia appeared, Habsburgs, Hohenzollerns and Romanoffs—find their chroniclers and critics in MR. C. A. MACARTNEY, HERR EMIL LUDWIG and MONSIEUR PALEOLOGUE. PROFESSOR ALISON PHILLIPS has been, as formerly, one of the mainstays of the general work on the modern historical side.

Finally, the organization of the treatment of post-war history required exceptional pains and care. SIR ARTHUR SALTER and LORD CECIL contribute on the *League of Nations;* MR. ELIHU ROOT (American Secretary of State from 1905 to 1909) treats of the *Permanent Court of International Justice,* so largely his own creation; MR. CHARLES E. HUGHES, Secretary of State from 1921 to 1925, of the *Monroe Doctrine;* his successor, MR. FRANK B. KELLOGG (1925 to 1929), of *Outlawry of War;* MONSIEUR JULES CAMBON of *Security.* PROFESSOR NOEL BAKER takes *Disarmament* and *Sanctions and Guarantees;* DR. FRIDTJOF NANSEN, *Refugees and the Exchange of Populations;* SEÑOR P. DE AZCARATE Y FLORES, *Minorities;* MONSIEUR ALBERT THOMAS, the *International Labour Organization* which he directs; COLONEL HOUSE, the *Conference of Paris;* MR. GLASGOW, *Locarno;* DR. MORITZ BONN, the *Rhineland* and the *Ruhr* and PROFESSOR CHARLES SEYMOUR, the *Washington Conference. War-Guilt* is the theme of a trilogy by MONSIEUR PIERRE RENOUVIN for the most careful French view, by DR. HERMANN LUTZ for the German, and by the present writer, who gives another reading of historic forces and human psychology. The Editor-in-Chief has also written the new article on a subject not before viewed in connection—the *English-Speaking World;* its growth from small beginnings to its present magnitude, and the dominant question of its future inter-relations.

AVIATION, civil and military, is over-soaring, we may say, amongst all the practical subjects revolutionized since this twentieth century was in its infancy. We have the contributions of AIR VICE MARSHAL SIR SEFTON BRANCKER on *Civil Aviation,* AIR VICE MARSHAL SIR ROBERT BROOKE-POPHAM on *Air Warfare,* MR. D. R. PYE and DR. ELMER A. SPERRY on *Aero Engines,* MR. A. P. ROWE on *Aerial Navigation,* SIR R. T. GLAZEBROOK on *Aeronautics,* COMMANDER C. D. BURNEY on *Airship,* LT. COL. I. A. E. EDWARDS on *Air Routes.* The life and experiments of *Wilbur Wright* are told by his brother ORVILLE WRIGHT.

NAVAL. This sphere includes *Sea Power, Naval Strategy and Tactics,* and the *Battle of Jutland* by CAPTAIN E. ALTHAM (Associate Editor); REAR ADMIRAL J. E. T. HARPER writes on *Navigation;* PROFESSOR GEOFFREY CALLENDER, the famous sea battles in history; SIR WILLIAM J. BERRY contributes on ship construction; CAPTAIN S. T. H. WILSON writes *World War (Naval);* CAPTAIN ALTHAM and MR. FRANK BOWEN (Editor of "Merchant Ships of the World") collaborate on the *History of Ships;* VICE-ADMIRAL R. N. BAX writes on *Submarine Campaigns;* COMMANDER J. C. MATHESON on the technical aspects of *Coast Defence;* CAPTAIN A. H. WALKER on *Mines, Minelaying and Mine-sweeping.* REAR-ADMIRALS WM. L. RODGERS and CHARLES F. HUGHES of the United States Navy have contributed articles and given much aid in American naval matters

MILITARY. The new series of articles, necessarily very numerous, on Military History to the end of the World War, and on post-war developments have been brought together under the supervision of the Associate Editor in this province, CAPTAIN B. H. LIDDELL HART, who himself writes the articles *World War* and *Strategy.* His collaborators include the late MARSHAL FOCH (*Army: Morale in War*), GENERAL JOHN J. PERSHING (*United States: American Expeditionary Force*), BRIG.-GEN. SIR JAMES EDMONDS (*Battle of the Marne*), SIR

JOHN FORTESCUE, BRIGADIER-GENERAL H. A. DRUM, COLONEL FULLER, MAJOR-GENERAL EDGAR JADWIN, Chief of Engineers, U.S.A., DR. G. B. GRUNDY (*Graeco-Persian Wars*), COLONEL T. E. LAWRENCE (*Guerrilla Warfare*), LT.-COL. G. LEQ. MARTEL (*Tanks*), SIR CHARLES OMAN (*The Hundred Years' War*), GENERAL SERRIGNY (*France: Defence*), PROFESSOR SPENSER WILKINSON (*War*); PROFESSOR C. H. VAN TYNE (*American Revolution*), and MR. W. B. WOOD, chosen to write on the *American Civil War* because of the succinct ability of his previous work on the subject.

ARCHAEOLOGY AND ANTHROPOLOGY. MR. T. C. HODSON, Reader in Ethnology, University of Cambridge, Associate Editor for these subjects, has introduced a more thorough system of classification and presentation. Apart from early Egypt, already mentioned in connection with the name of PROFESSOR F. Ll. GRIFFITH, *Aegean Civilization* and *Prehistoric Greece* are undertaken by MR. A. J. B. WACE; *North-west Africa* and *Crete* by MR. E. J. FORSDYKE; the *Hittites* by PROFESSOR HROZNY of Prague; *Central Asia* by PROFESSOR ALBERT VON LE COQ; *North America* and *Cliff Dwellings* by F. W. HODGE of the Museum of the American Indian. *Anthropology* in general is treated by PROFESSOR R. R. MARETT; special aspects by PROFESSORS C. G. SELIGMAN and MALINOWSKI (who writes on *Marriage*); *Evolution of Man* by SIR ARTHUR KEITH; *Races of Mankind* by MR. L. H. DUDLEY BUXTON; while PROFESSOR WESTERMARCK discusses *Polygyny*, *Polyandry* and related matters.

In BIOGRAPHY many of the greatest lives in all ages are related afresh by a group of collaborators particularly apt and distinguished. PROFESSOR BREASTED portrays that first historic personality to whom we feel ourselves close, *Ikhnaton* of Egypt. PROFESSOR A. E. TAYLOR re-studies *Socrates* and *Plato;* PROFESSOR ERNEST BARKER, *Aristotle;* PROFESSOR GILBERT MURRAY, *Homer* and *Euripides*. *Horace* was undertaken by MR. E. V. KNOX; *Hannibal* by PROFESSOR GAETANO DE SANCTIS of Florence; *Plotinus* by DEAN INGE; *Charles the Great* by the late PROFESSOR H. W. C. DAVIS; *Joan of Arc* by MONSIEUR PIERRE CHAMPION; *Luther* by PROFESSOR MACKINNON of Edinburgh; *Bacon* by DR. CHARLES SINGER; *Spinoza* by PROFESSOR A. WOLF. SIR STANLEY LEATHES was persuaded to undertake *Cromwell*, with the desired result. For France, MONSIEUR EDOUARD HERRIOT depicts *Danton;* and the Editor-in-Chief felt himself fortunate in obtaining *Napoleon* from the pen of MONSIEUR JACQUES BAINVILLE. PROFESSOR ERICH BRANDENBURG consented to furnish the biographies of *Bismarck*, *Bülow* and *William II*. LADY GWENDOLEN CECIL writes on her father, the late *Lord Salisbury;* LORD ESHER on *Edward VII.*, and MR. ST. JOHN PHILBY on *Ibn Sa'ud*, now nearly overlord of all Arabia.

As for modern literary names *Boswell*—always a modern—is by one very well acquainted with him, MR. S. C. ROBERTS; PROFESSOR H. W. GARROD has written anew on *Wordsworth; Dickens* is by MR. G. K. CHESTERTON; *Blake* by MR. GEOFFREY KEYNES; *Victor Hugo* by MR. HAROLD NICOLSON; *Dostoievsky* and *Tolstoy* by PRINCE MIRSKY. Many biographies not entirely rewritten are renewed. Amongst these revisions are *Alexander the Great* by MR. EDWYN BEVAN; *Caesar* by PROFESSOR HENRY STUART JONES; *Dante* by PROFESSOR E. G. GARDNER; *Chaucer* by PROFESSOR A. W. POLLARD; *Shakespeare* by SIR E. K. CHAMBERS; *Goethe* by PROFESSOR JOHN G. ROBERTSON; *Pepys* by DR. J. R. TANNER; *Shelley* by MR. ROGER INGPEN; *Bernard Shaw* by MR. ST. JOHN ERVINE; *Thomas Hardy* by PROFESSOR LASCELLES ABERCROMBIE.

Amongst the American biographies are: *George Washington* by MR. ALLAN NEVINS; *Benjamin Franklin* by PROFESSOR BERNARD FAY; *Alexander Hamilton* and *Thomas Jefferson* by PROFESSOR FRANCIS S. PHILBRICK; *Edgar Allan Poe* by PROFESSOR CHARLES CESTRE of the University of Paris; *Daniel Webster* by GAMALIEL BRADFORD; *Nathaniel Hawthorne* by PROFESSOR VERNON L. PARRINGTON; *Abraham Lincoln* by PROFESSOR N. W. STEPHENSON; *Cardinal Gibbons* by the REV. FRANCIS DUFFY; *Admiral Peary* by COMMANDER RICHARD E. BYRD; *Walt Whitman* by EMERY HOLLOWAY; *Ralph Waldo Emerson* by DR. HENRY VAN DYKE; *Admiral Farragut* by REAR ADMIRAL W. L. RODGERS; *Edwin Booth* by WALTER HAMPDEN; *Theodore Roosevelt* by HERMANN HAGEDORN; *Woodrow Wilson* and *Calvin Coolidge* by PROFESSOR CHARLES SEYMOUR; *Thomas A. Edison* by DR. E. E. SLOSSON; and *Charles Dawes* by OWEN D. YOUNG.

LITERATURE AND DRAMA. Articles upon nations ancient and modern include, of course, studies of their literary history. Some outstanding biographies in this connection have been already mentioned. MR. ROBERT LYND is the Associate Editor, and amongst his corps are PROFESSOR GILBERT MURRAY, writing on *Greek Drama;* MR. STEPHEN GASELEE on *Mediaeval Latin Literature*—a new subject in the *Encyclopædia Britannica;* MR. J. C. SQUIRE on *Modern English Literature;* PROF. VERNON L. PARRINGTON and DR. HENRY SEIDEL CANBY on *American Literature;* MR. J. B. PRIESTLEY on *The Romantic Period in English Literature;* MR. HUMBERT WOLFE on *Modern Developments in English Poetry;* MR. LOUIS UNTERMEYER on *Modern Developments in American Poetry;* PROFESSOR GEORGE SAINTSBURY on *Romance;* MR. G. K CHESTERTON on *Humour*, and MR. STEPHEN LEACOCK on *American Humour;* MR. ARUNDEL ESDAILE, DR. E. A. BAKER, and DR. CHARLES C. WILLIAMSON on *Libraries*, and SIR ROBERT DONALD and MR. JAMES MELVIN LEE on *Newspapers*. The *Novel* is by the late SIR EDMUND GOSSE, as is also *Biography*, to which MR. GEORGE SAMPSON has added a word on modern aspects. *Ballad* is by PROFESSOR GREGORY SMITH; *Parody* and *Limericks* by MR. E. V. KNOX. MR. IVOR BROWN gives a fresh view of *Modern Drama*. DR. LION FEUCHTWANGER, a strong accession to our ranks, deals with *Modern*

Developments of the Novel. Other foreign colleagues are PROFESSOR DENIS SAURAT, PROFESSOR CESARE FOLIGNO, PRINCE DMITRI MIRSKY, PROFESSOR ROMAN DYBOSKI, who write respectively on the literatures of France, Italy, Russia and Poland; while the article on *Rumanian Literature* has been recast by PRINCE ANTOINE BIBESCO and that on *German Literature* by PROFESSOR J. G. ROBERTSON.

ART AND MUSIC. MR. ROGER FRY writes on *Cézanne*, that pathbreaking painter who, curious to say, received no biographical treatment in the Eleventh Edition, and though he died in 1906 has not been till now adequately noticed in any encyclopaedia. The comprehensive section of the main article *Painting* which treats of *Modern Painting* is written by J. B. MANSON (of the Tate Gallery); *Drypoint* by MR. MUIRHEAD BONE; *Greek Art* by PROFESSOR PERCY GARDNER; *Roman Art* by MRS. STRONG; *Mural Painting* by MR. FRANK BRANGWYN; *Chinese Painting* and *Japanese Painting and Prints* by MR. LAURENCE BINYON; *European Pottery* by MR. BERNARD RACKHAM; *Near and Far Eastern Pottery* by MR. R. L. HOBSON. Other writers in this field besides the Departmental Editor, MR. W. E. COX, who has himself contributed several articles, are MR. OSWALD SIRÉN of the Stockholm Museum, DR. JIRO HARADA, DR. A. K. COOMARASWAMY of the Boston Museum of Fine Arts, and PROFESSOR W. H. LAWRENCE of the Massachusetts Institute of Technology. Among those writing on the *Theatre* are MR. MAX REINHARDT and MR. CONSTANTIN STANISLAVSKY, the German and Russian producers respectively. The authorities on architecture include besides MR. HARVEY WILEY CORBETT (the Associate Editor), MR. TALBOT F. HAMLIN, MR. FISKE KIMBALL, HERR ERICH MENDELSOHN, SIGNOR CORRADO RICCI, PROFESSOR W. B. DINSMOOR, PROFESSOR C. H. REILLY, THOMAS ADAMS, PROFESSOR A. E. RICHARDSON and MR. HOWARD ROBERTSON. DR. D. F. TOVEY'S *Beethoven* is one of the very fine things in this work; worthy of it are his other studies of personalities in music; and he contributes also on *Counterpoint, Harmony, Instrumentation, Rhythm*, as on *Concerto* and *Chamber Music*. By the BISHOP OF TRURO is *Plainsong;* by MR. DEEMS TAYLOR, *American Music;* by MR. J. W. JOHNSON, *Negro Music;* by MR. A. H. FOX-STRANGWAYS, *Indian Music;* by MR. REINALD WERRENRATH, *American Song;* by SIR H. WALFORD DAVIES, *Teaching of Music.*

GEOGRAPHY. Contributors in general geography include DR. H. R. MILL (*Geography*); SIR C. F. CLOSE and COL. WINTERBOTHAM (*Map*); CAPT. EDGELL (*Chart*); PROFESSOR PROUDMAN (*Tides*); PROFESSOR G. SCHOTT of Hamburg (the great oceans and seas); MR. E. OWER (*Anemometry*); DR. C. E. P. BROOKS (*Climatic History*); DR. F. J. W. WHIPPLE (*Thunderstorms*). Numbers of contributions to physical geography and to articles on Europe are by MR. W. E. WHITEHOUSE (*Norway*), MR. J. I. PLATT, DR. ASHBY (*Italy*), MR. R. AITKEN and MR. AUBREY BELL (*Spain* and *Portugal*), PROFESSOR MYRES, DR. M. I. NEWBIGIN, MR. S. GASSON, MRS. ALEXANDER and MR. C. A. MACARTNEY (South East Europe), PROFESSOR W. S. LEWIS (East Central Europe), PROFESSOR A. B. BOSWELL (*Poland*), MISS R. M. FLEMING (*Russia*), PROFESSOR MICHOTTE (*Belgium*).

Asia has been treated by LORD MESTON, SIR E. MACLAGAN, SIR G. MACMUNN, MR. L. S. O'MALLEY, MR. A. V. WILLIAMSON and MR. O. J. R. HOWARTH, SIR HUGH CLIFFORD, DR. J. PEARSON, MR. E. YOUNG, DR. L. D. STAMP, MME. BRESSON, DR C. HOSE, MR. E. E. LONG (*S. E. Asia*), PROFESSOR ROXBY (*China*), MR. ROY CHAPMAN ANDREWS (*Explorations in Mongolia*), SIR P. Z. COX (*Persia*), MR. L. H. D. BUXTON (*Mesopotamia*), MR. H. ST. J. PHILBY (*Arabia*), PROFESSORS W. M. CALDER and E. ROBERTSON (Western Asia).

The African articles were prepared by PROFESSOR AUGUSTIN BERNARD, MME. BRESSON, MR. R. U. SAYCE, REV. H. L. BISHOP, MR. F. R. CANA, MR. C. F. REY.

For the Americas, DR. ISAIAH BOWMAN, Director of the American Geographical Society of New York, gave constant and valuable advice on all that relates to the Western hemisphere. PROFESSOR WILLIAM H. DAVIS on *North America;* PROFESSOR N. M. FENNEMAN on the *United States;* PROFESSOR G. C. ENGERRAND on *Mexico;* PROFESSOR PERCY MARTIN on *Brazil;* PROFESSOR MARK JEFFERSON on *Argentina;* and DR. WILLIAM H. HAAS on *Chile*. Among special articles may be mentioned that on the *Galapagos* by WILLIAM BEEBE, on the *Yellowstone National Park* and *Geology of the United States* by DR. W. ELMER EKBLAW; the *Philippine Islands* by DR. JAMES A. ROBERTSON; and *Porto Rico* by GOVERNOR HORACE M. TOWNER.

Again, PROFESSOR COLEMAN, MR. W. S. WALLACE, PROFESSOR RUDWELL JONES and MR. O. J. R. HOWARTH wrote articles relating to *Canada*, while SIR W. GRENFELL dealt with *Newfoundland* and *Labrador* and LORD OLIVIER with *Bermuda*, the *Bahamas*, *Jamaica* and *British Honduras*.

DR. HADDON and MR. E. E. LONG contribute on *New Guinea*, PROFESSOR RISHBETH on *Australia*, MR. H. J. B. DREW on *New Zealand* and SIR EVERARD IM THURN on the Pacific Islands. The *Arctic* regions were treated by DR. R. N. RUDMOSE BROWN and VILHJALMUR STEFANSSON and the *Antarctic* by MR. F. DEBENHAM. The departmental editor, PROFESSOR FLEURE, wishes to have his thanks expressed to MR. E. G. BOWEN, his chief assistant throughout; and to those other expert geographers, MESSRS. E. E. EVANS, S. J. JONES, J. E. J. JONES and MRS. NOELLE DAVIES, who gave much help. They, with MISS S. HARRIS, MRS. ORMSBY, MR. J. I. PLATT and MR. O. J. R. HOWARTH and MR. C. MARLOWE, contributed most of the work on the British Isles. The help of several Embassies and Legations and of the Society for Cultural Relations with Russia is warmly acknowledged.

Turn to PHILOSOPHY AND PSYCHOLOGY. The articles here show marked advance in the contents of the *Encyclopædia Britannica*. SIGNOR BENEDETTO CROCE'S article on *Aesthetics* is in the judgment of other experts *chef d'oeuvre* amongst the new articles. GENERAL SMUTS compacts for this Edition his doctrine of *Holism*. PROFESSOR ERNST CASSIRER of Hamburg University (leader of the Neo-Kantian Movement in Germany) writes on *Neo-Kantianism*, *Transcendentalism*, *Truth*. Some other contributors on this side are PROFESSOR S. ALEXANDER (*Primary, Secondary and Tertiary Qualities*); PROFESSOR G. S. BRETT of Toronto University (*History of Psychology*); PROFESSOR L. T. HOBHOUSE (*Comparative Ethics* and *Comparative Psychology*); PROFESSOR E. HUSSERL of Freiburg-im-Breisgau (*Phenomenology*, where the author writes as an originator); PROFESSORS EDWARD G. BORING and LEONARD T. TROLAND, both of Harvard (*Visual Sensations* and other articles); MONSIEUR MEYERSON of the Institut de Psychologie in Paris (*Explanation*); PROFESSOR JOHN B. WATSON, formerly of Johns Hopkins (*Behaviourism*); PROFESSOR S. RADHAKRISHNAN of Calcutta (*Indian Philosophy*); PROFESSOR E. L. THORNDIKE of Columbia University (*Intelligence Test*); while PROFESSOR R. M. WENLEY, formerly of Glasgow University, later of the University of Michigan, wrote just before his death on *Scepticism*, a subject which he pondered more than anyone.

Next, THE PHYSICAL AND BIOLOGICAL SCIENCES, to use imperfect distinctions for lack of a more satisfactory definition. We are far from the day when d'Alembert could draw up a *Système Général de la Connaissance Humaine, suivant le Chancelier Bacon*. An accepted new classification, even though it were recognized as only a working compromise, would be a signal service to the ordinary intelligence now that the circles of the sciences intersect more and more. Sufficient here must be the alphabetical order.

(a) *Astronomy*. PROFESSOR EDDINGTON, the Associate Editor, writes on *Astronomy* generally and on *Star;* SIR J. H. JEANS on *Cosmogony;* SIR FRANK DYSON, Astronomer Royal, takes *Parallax*. *Star Cluster* is by PROFESSOR HARLOW SHAPLEY of Harvard Observatory; *Nebula* by DR. KNOX SHAW of Radcliffe Observatory; *Mars* by PROFESSOR W. H. WRIGHT of the University of California; *Spectroheliograph* by DR. GEORGE E. HALE, Director of the Mount Wilson Observatory.

(b) *Biology*. PROFESSOR J. ARTHUR THOMSON reviews the general subject. DR. C. S. ELTON and PROFESSOR E. S. GOODRICH, both of the University Museum, Oxford, deal respectively with *Ecology* and *Evolution*. DR. J. B. S. HALDANE writes on *Heredity;* DR. F. A. E. CREW of Edinburgh on *Sex;* PROFESSOR D. S. M. WATSON of University College, London, on *Zoology;* DR. HENRY FAIRFIELD OSBORN and DR. WILLIAM K. GREGORY, both of the American Museum of Natural History, on *Mammalian Palaeontology;* and DR. LELAND O. HOWARD, of the Department of Agriculture, Washington, contributes a number of articles on injurious insects.

(c) *Botany*. PROFESSOR W. BROWN and PROFESSOR R. J. TABOR, both of the Imperial College of Science, contribute on *Plant Pathology* and *Fungi* respectively; PROFESSOR F. E. FRITSCH of East London College on *Algae;* MR. W. T. SAXTON on *Gymnosperms;* DR. E. J. SALISBURY on *Ecology of Plants;* DR. M. C. RAYNER on *Mycorrhiza;* DR. WILLIAM CROCKER, Director of the Boyce Thompson Institute for Plant Research, on *Weeds;* and PROFESSOR V. H. BLACKMAN, the Associate Editor for this section, on *Physiology of Plants*.

(d) *Chemistry*. In this division again experts are crowded. The historical introduction is by PROFESSOR H. B. DIXON; *Argon* by LORD RAYLEIGH; *Carbohydrates* by PROFESSOR W. N. HOWARTH; *Applied Chemistry* by DR. HARRISON E. HOWE, Editor of "Industrial and Engineering Chemistry"; *Synthetic Dyes* by PROFESSOR A. G. GREEN; *Stereochemistry* by DR. W. H. MILLS; *Chlorophyll* by PROFESSOR R. ROBINSON; *Valency* by DR. N. V. SIDGWICK; *Atomic Weights* by PROFESSOR THEODORE W. RICHARDS; *Chemical Warfare* by BRIG. GEN. SIR HAROLD B. HARTLEY, C. G. DOUGLAS, MAJ. GEN. AMOS A. FRIES and PROF. J. E. ZANETTI; *Flame* by PROFESSOR A. SMITHELLS; *Thermochemistry* by MR. H. T. TIZARD, permanent Secretary to the British Government's Department of Scientific and Industrial Research.

(e) *Geology*. The general article is by the Associate Editor, DR. R. H. RASTALL; and *Sedimentary Rocks* by PROFESSOR P. G. H. BOSWELL; *Ore Deposits* by DR. F. H. HATCH; *Origin of Continents* and *Geology of Asia* by MR. PHILIP LAKE of Jesus College; the geology of the South American countries by MR. GEORGE MCL. WOOD; *Crystallography* and *Mineralogy* by DR. L. J. SPENCER; *Petrology* and *Metamorphism* by DR. C. E. TILLEY.

(f) *Mathematics*. PROFESSOR DAVID EUGENE SMITH of New York, who has devoted a life-time to the history of mathematics, has arranged the work of this department. The articles on *Geometry* in its principles and applications, on *Forms* and *Numbers*, are chiefly by American experts like DEAN EISENHART, PROFESSOR R. C. ARCHIBALD, PROFESSOR BATEMAN, PROFESSOR E. BELL, PROFESSOR L. E. DICKSON and PROFESSOR OSCAR VEBLEN.

(g) *Medicine*. DR. W. S. LAZARUS-BARLOW has been the Associate Editor for this great department to which he has himself contributed several articles. His collaborators include: SIR GEORGE BUCHANAN and SIR GEORGE NEWMAN of the Ministry of Health, dealing respectively with *Public Health* and *Preventive Medicine;* SIR HUMPHREY ROLLESTON on *Medicine* generally; PROFESSOR R. T. LEIPER on *Parasitic Diseases;* DR. GEORGE A. SOPER, Managing Director of the American Society for the control of Cancer, on *Cancer Control;* DR. C. S. READ on *Insanity;* PROFESSOR CLAUDE REGAUD of the Radium Institute, Paris, on *Radium Therapy;* Dr. EDWARD C. ROSENOW of the Mayo Foundation and DR.

J. OPPIC MCCALL, New York University, on *Focal Infection;* DR. CHARLES SINGER on the *History of Medicine;* SIR WILLIAM WILLCOX of the Home Office on *Poisons.* Other contributors are PROFESSOR HAVEN EMERSON, who holds the chair of Public Health Administration, in Columbia University, and DR. SIMON FLEXNER, Director of the Rockefeller Institute for Medical Research.

(h) *Physics.* In this department, more than in any other during the last twenty years, conceptions, as we saw, have been radically changed. The Associate Editor, PROFESSOR ANDRADE (who himself writes on essential themes *Nucleus, Radiation* and *Vacuum,* and on an always fascinating one, *Transmutation of Elements*), has enlisted a famous corps. Among them are many holders of the Nobel prize. By comparison with former full Editions of the *Encyclopædia Britannica* a new age of knowledge is represented in this group. *Atom* is by PROFESSOR NIELS BOHR; *Electron* by PROFESSOR R. A. MILLIKAN; *Radioactivity* by SIR ERNEST RUTHERFORD; *X-Rays* by PROFESSOR MANNE SIEGBAHN and the DUC DE BROGLIE; *Positive Rays* and *Isotopes* by DR. F. W. ASTON; *Conduction of Electricity in Gases* and *Electric Waves* by SIR J. J. THOMSON; the *Solid State* by PROFESSOR LINDEMANN of Oxford; *Terrestrial Magnetism* and *Atmospheric Electricity* by DR. WILLIAM F. G. SWANN, Director of the Franklin Institute; the *Kinetic Theory of Matter* and *Relativity* by SIR J. H. JEANS; *Spectroscopy* by PROFESSOR A. FOWLER of the Imperial College of Science; *Quantum Theory* by PROFESSOR WILLIAM WILSON of the University of London; *Thermionics* by PROFESSOR O. W. RICHARDSON; *Brownian Movement* by PROFESSOR JEAN PERRIN. *Electricity* is by PROFESSOR HAROLD A. WILSON of the Rice Institute, Houston, Texas. *Heat* is by PROFESSOR H. L. CALLENDAR; the theory of light-waves is expounded under *Light* by PROFESSOR C. G. DARWIN; *Fluorescence* and *Phosphorescence* by MR. ROBERT W. WOOD of Johns Hopkins; *Photo-Electricity* by DR. C. D. ELLIS; *Compton Effect* by PROFESSOR A. H. COMPTON; *Velocity of Light* by PROFESSOR A. A. MICHELSON. *Wireless Telegraphy* is by PROFESSOR E. V. APPLETON for theory and DR. ECCLES for practice; *Television* by DR. HERBERT E. IVES of the Bell Telephone Laboratories, New York; *Photography, History and Technique* by MR. GEORGE EASTMAN and DR. C. E. K. MEES. DR. EINSTEIN'S own article on *Space-time* as prepared for the recent Supplement is retained. One other name is reserved to the last in order that it may stand out as that of the doyen on this side of knowledge amongst veteran contributors to successive Editions of the *Encyclopædia Britannica;* we mean SIR OLIVER LODGE, who takes *Physics* generally and *Ether.*

(i) *Physiology.* The Associate Editor is PROFESSOR JOSEPH BARCROFT of Cambridge. Amongst his chief colleagues are SIR CHARLES SHERRINGTON on the *Spinal Cord;* DR. W. B. CANNON of the Harvard Medical School on *Hunger and Thirst;* DR. A. CARREL of the Rockefeller Institute, who revises *Tissue Culture;* PROFESSOR A. V. HILL on *Muscle and Muscular Exercise;* PROFESSOR J. J. R. MACLEOD of Toronto on *Insulin;* PROFESSOR G. H. PARKER on *Comparative Nervous Systems;* SIR J. H. PARSONS of the London Ophthalmic Hospital on *Vision.*

LAW. Amongst authorities here are a former Lord Chancellor, the EARL OF BIRKENHEAD, LORD JUSTICE SANKEY, LORD LUGARD, LORD ATKIN, MR. JUSTICE EVE, SIR FREDERICK POLLOCK and SIR LESLIE SCOTT. But in the forefront of contributors in this department is its Associate Editor, PROFESSOR J. H. MORGAN, K. C., in the World War ranking as Brigadier-General. Equally notable are some of the American law contributors, especially DEAN ROSCOE POUND of the Harvard Law School, and his colleagues PROFESSORS BEALE, POWELL and LANDIS, PROFESSOR WALTER F. DODD of the Yale Law School, SILAS H. STRAWN and FRANCIS RAWLE, both past Presidents of the American Bar Association, and WILLIAM DRAPER LEWIS, Director of the American Law Institute.

ECONOMICS, including AGRICULTURE TECHNICS AND SOCIOLOGY. *Agriculture,* with its tropical aspects, demands scores of headings. The general article is by SIR DANIEL HALL, and PROFESSORS G. F. WARREN and F. A. PEARSON. Particular attention is given to modern improvements in organization and to the new arrival of scientific aid. SIR JOHN RUSSELL amongst others writes on *Soil, Fertilizers* and *Research;* PROFESSOR C. O. REED of the College of Agriculture, Ohio State University, on *Agricultural Machinery;* MR. F. L. ENGLEDOW on *Plant-Breeding;* DR. W. BROWN on *Plant-Pathology;* SIR HENRY REW on a series of interests; SIR HORACE PLUNKETT on *Co-operation in Ireland;* DR. W. M. JARDINE, Secretary of Agriculture in the cabinet of President Coolidge, on *Farmers' Organizations.* We may add here *Irrigation* by SIR MURDOCH MACDONALD; *Fixation of Nitrogen* by PROFESSOR J. T. HEWITT and DR. HARRISON E. HOWE.

Amongst articles on the great general subjects of economics, *Population* is by PROFESSOR CARR-SAUNDERS; *Birth Control* by SIR JAMES MARCHANT; *Economic Man* by PROFESSOR CHARLES GIDE; and *Mass Production* by HENRY FORD. No edition has approached the same range of contributions on the world's basic materials, mineral and vegetable. *Gold Mining and Metallurgy* is by SIR THOMAS KIRKE ROSE and *Coal* and its mining by SIR RICHARD REDMAYNE and R. DAWSON HALL; *Petroleum* by MR. L. M. FANNING; *Rubber* by MR. G. MARTIN of the Imperial Institute and MR. J. W. SCHADE, Director of Research, the B. F. Goodrich Company. The late PROFESSOR ALLYN YOUNG, too early lost to scholarship, was familiarly acquainted with theories and conditions both in Britain and the United States. He took the classical headings: *Economics, Capital, Labour, Wages, Wealth, Land, Rent, Price, Supply and Demand.*

On the sides of applied science and engineering, we have SIR J. A. FLEMING and MR. EMIL GARCKE on

Electricity Supply; SIR ALFRED EWING on *Steam* and the *Steam Engine;* MR. G. A. BURLS on *Internal Combustion Engines;* DR. FRANK J. SPRAGUE on *Electric Traction;* PROFESSOR W. E. DALBY and MR. STANIER on *Mechanical Power Transmission;* PROFESSOR ARNOLD GIBSON on *Hydraulic Power Transmission* and other themes of hydraulics. *Railways* are dealt with by MR. G. J. PONSONBY and MR. C. E. R. SHERRINGTON; *Shipbuilding* by SIR WESTCOTT ABELL; *Motor Car* by MR. C. F. KETTERING, Vice-President of the General Motors Corporation; *Motoring and Motor Transport* by the late LORD MONTAGU of Beaulieu; *Traffic and Traffic Regulation* by SIR HENRY MAYBURY and GEN. WILLIAM BARCLAY PARSONS; *Tunnel* by MR. ROBERT RIDGWAY who is in charge of Transit Construction, New York; *Alloys* by DR. ZAY JEFFRIES of the Aluminum Company of America; *Aeronautics* and *Industrial Research* by SIR RICHARD T. GLAZEBROOK; *Airship* by COMMANDER C. D. BURNEY; *Telegraph* by MR. NEWCOMB CARLTON, President of the Western Union Telegraph Company; *Telephone* by MR. WALTER S. GIFFORD, President of the American Telephone and Telegraph Company.

Take next the great economic movements and controversies concerning human relations and political management. *Socialism* is by MR. GEORGE BERNARD SHAW and MR. G. D. H. COLE; *Guild Socialism, Factory System* and *Wage System in Industry* by MR. G. D. H. COLE; *Communism* by PROFESSOR EMIL LEDERER and *Bolshevism* by PROFESSOR HAROLD J. LASKI; *Economics of Fascism* by SIGNORA AGRESTI; *Capitalism* by the present Editor-in-Chief; *Trade Unions* by MR. ARTHUR GREENWOOD; *General Strike* by the RT. HON. WILLIAM GRAHAM; and *Strikes and Lockouts* (*U. S. Section*) by PROFESSOR JOHN R. COMMONS of the University of Wisconsin; *Land Nationalization* by PROFESSOR CHARLES GIDE; *Profit Sharing* by MR. JOHN HILTON and MR. MAGNUS ALEXANDER. MR. HILTON, Director of Statistics for the British Ministry of Labour, writes further on many questions of vital importance at the present day, and amongst them are *Rationalization of Industry, Combination in Industry, Trust, Monopoly, Competition in Industry, Unemployment, Wages. Cartel* (*Kartel*) is by PROFESSOR ROBERT LIEFMAN, and Federal Reserve System by MR. BENJAMIN STRONG, late Governor of the Federal Reserve Bank of New York. To MR. R. G. HAWTREY we owe the treatment of *Money, Banking, Finance.* PROFESSOR HENRY CLAY restates the theory of *Free Trade;* PROFESSOR W. A. S. HEWINS the theory of *Protection;* PROFESSOR FRANK W. TAUSSIG writes *Tariff.* Bearing on both sides of that controversy is the important article on *Balance of Trade,* which though based on a former study by no less an authority than SIR ROBERT GIFFEN has been virtually re-written by SIR JOSIAH STAMP.

The latter authority, though practically and intellectually one of the busiest men in the world, has been generous enough to undertake more specific themes concerning legislators and politicians in all counties. Amongst these are *Taxation, Income Tax, Wealth and Income, National Savings, Inheritance, Capital Levy.* Professor A. L. BOWLEY deals with *Cost of Living* and *Price Statistics.* SIR ALFRED WATSON, Government Actuary in London, writes *Insurance: an Introduction.*

Next we must glance at the group of articles devoted to objects of social progress and humanitarian reform which are in principle above debate. DR. RAYMOND UNWIN treats of *Housing,* as also, with MR. THOMAS ADAMS, of *Town Planning;* SIR ALEXANDER C. HOUSTON of *Water Purification;* MR. JULIUS ROSENWALD of *Philanthropy;* MR. SEEBOHM ROWNTREE deals with *Poverty Line;* PROFESSOR SAMUEL MCCUNE LINDSAY with the question of *Prohibition;* SIR THOMAS OLIVER with *Dangerous Trades;* MISS ELEANOR RATHBONE with *Family Allowances;* MR. C. M. LLOYD with *Poor Law;* MISS MARGARET G. BONDFIELD, with *Maternity and Infant Welfare;* DR. ARTHUR SHADWELL with *Prostitution* and *Temperance.* GENERAL SIR ROBERT BADEN-POWELL himself discusses *Boy Scouts.* DAME RACHEL CROWDY writes on *Child Labour, Opium Traffic, White Slave Traffic.*

There is an array of contributions upon economic aspects during the World War. In this category are *War Control of Food* by SIR WILLIAM BEVERIDGE; *War Control of Industry* by MR. BERNARD M. BARUCH and E. M. H. LLOYD; *Ministry of Shipping* by SIR JOHN ANDERSON; *Ministry of Munitions* by DR. CHRISTOPHER ADDISON; *War Pensions* by SIR ADAIR HORE.

Post-war economics play an extraordinary part. SIR JOSIAH STAMP writes on *Reparations and the Dawes Plan;* SIR OTTO ERNST NIEMEYER on *Debt Conversion;* while amongst articles on the experiences of various nations are *Great Britain: National Finance* by MR. R. G. HAWTREY. Studies of economic and social conditions in countries like France, Germany, Belgium, Italy, Russia are respectively by MR. J. R. CAHILL of the British Embassy, Paris, PROFESSOR MORITZ J. BONN, MONSIEUR EMIL VANDERVELDE, SIGNORA AGRESTI and MR. MAURICE DOBB of Cambridge.

PAST AND PRESENT

It would be out of place here to dwell on the repute of these representative writers, many of them acknowledged to be the first experts in the world on the subjects they treat in these volumes. They would be the first to admit that numbers of their colleagues, unmentioned here only because this part of the Introduction must put some limit to the list, are as well worthy to be named. The *Encyclopædia Britannica* has not marshalled together at any time since its birth in 1768 an equally large, various and world-wide array of strong contributors. The number and the repute of the writers belonging to the continental scholarship of Europe should be remarked. This organ of reference for the English-speaking world has owed much for

many years to a wider representation of international learning than any other encyclopaedia has attempted to organize.

THE RESULT: TWELVE ASPECTS OF THE FOURTEENTH EDITION

THE outcome of these manifold labours appears in the Fourteenth Edition as now completed. In the broad, it cannot be superseded for many years, though unending research and discovery modify or amplify every day the details of all knowledge; and though in the spheres of the sciences on the one hand and perhaps of pre-history on the other, some suppositions now assumed to be fundamental may be changed at any moment. In form and arrangement, this Edition then is a "new model." As regards form, it may stand for some generations to come, initiating, as it does in several respects, a considered break with traditions of construction derived from the earlier part of the nineteenth century or even from the eighteenth. Its chief distinctive features may now be recapitulated.

I. The articles in general are more concise and perspicuous; but many still retain the character of monographs on the most important subjects. Amongst the fullest are those on *Greece* and *Rome*, *English History*, the *United States*, *France*, *Germany*, *Italy*, and other accounts of the chief nations. Next in amplitude are the contributions on subjects so various as *World War*, *Bible*, *Evolution*, *Painting*, *Potteries* and *Theatres;* on *Coal and Coal Mining*, *Iron and Steel*, *Motor-Cars*, *Unemployment*. The space given to *Shakespeare* would fill a hundred pages of an ordinary octavo volume. MR. OSWALD BARRON has revised his former study of *Heraldry;* and on its subject, it still stands pre-eminent in encyclopaedias.

II. There are about 45,000 separate headings in the Fourteenth Edition by comparison with 37,000 in the Eleventh. But this total is no adequate measure of the real number of articles in the work, for there are tens of thousands of subheadings which cover information and ideas often quite new. The Index with approximately half a million items tells the full story.

III. All articles bearing on the progressive aspects of science, of medicine and surgery, technical inventions and improvements (as to this, see particularly the salient sections on "wireless" transmission and on aviation) have been originally written in the light of present knowledge. The same is true of economics and industry, sociology and politics.

IV. The new articles on anthropology, archaeology and ethnology are a much wider and more systematic array.

V. Since the Eleventh Edition the World War has intervened. Its enormous events; its ceaseless consequences, political, economic, social, in the post-war years; and the immeasurable suggestions of further consequences in the future—these are narrated, examined and explained in the course of some hundreds of articles and some thousands of pages. For it must be remembered that this theme enters more or less into the recent history of all nations; into their literature and drama, as well as into their political, economic and other social movements. All the newly independent States have required and received study in a manner unthinkable when the Eleventh Edition was organised well before the war-period.

VI. Especially, the articles upon the League of Nations with the collateral peace-policy of the United States, and upon all subjects connected with these—particularly questions of armament and disarmament, security and reconciliation, minorities and treaties—are a landmark.

VII. The political and social interests of women, their household and personal interests, occupy a far larger place than in any former work of this nature. In the long run, the transformation, as we may well call it, of the position of women, by the recognition of their equal status in citizenship and by their rapid approach to equal opportunity in education and economics (and, we may add, in athletics), may be remembered as the most profound and far-reaching consequence of the World War. Women are not only fully enfranchised amongst the English-speaking societies, and in other countries, but in an unexpected sense of an old word they form in Great Britain, Germany and elsewhere the "better half" of the electorate.

VIII. Amongst the biographies many more living persons are noticed. But articles entirely rewritten for the present Edition include the following names predominant in the world's memory (the authors have already been mentioned):—Homer, Plato, Aristotle, Shakespeare, Cromwell, Newton, Washington, Napoleon, Bismarck, Lincoln, Bach, Beethoven, Dostoievsky, Tolstoi.

IX. In the number of bibliographies appended to articles there is a very large increase. These concluding references to the literature of the subject are an immediate guide to readers who desire to pursue a special study. No feature of the Fourteenth Edition is more useful to intellectual workers who may become interested in a line of enquiry not hitherto familiar. The late Lord Bryce, in a manner very typical of his own many-sided interests, praised this part of the apparatus, when its employment was much less extended than now, in words that cannot be bettered. "One of the difficulties which the increase of specialization has caused is that of knowing what books to consult for a general view of any large subject, and what other books for its special departments. . . . The selection of the best becomes harder as the volume of literature on every subject grows. There is no more lamentable waste of time than that spent on reading a second- or third-rate work when a first-rate one is available; and there is

no better test of the utility of an encyclopaedia article than the amount of help to the student which a carefully selected list of book supplies."

X. *Illustration.*—The Fourteenth Edition, as may be seen at a glance into any volume, differs very vividly in one respect not only from all its own predecessors, but from any work of the kind yet undertaken. In the history of encyclopaedias it is the first to be furnished with every resource of illustration. No pictorial equipment on this scale, or on any scale approaching to this, has been attempted up to now. There are over fifteen thousand illustrations of all varieties in the entire array of volumes—from eight to nine hundred in each volume. Amongst these the full plates are commanding, for by themselves they number about fifteen hundred and many are in colour. The quality of the technique may be judged by the facsimile of an illuminated page from the Gutenberg Bible—so far as we know, the first book printed from movable type—where the gold embellishment is preserved as faithfully as the tints. The other plates in colour are drawn from the most various sources. They represent prehistoric cave-painting; the arts and crafts of early Egyptian, Mesopotamian and Aegean civilization; ceramics, bronzes, jewels, tapestries and tissues belonging to many epochs; painting and sculpture; historical documents; architectural designs and stage-costumes, as well as birds, fishes, insects and the general life of nature. Particular attention has been devoted in the coloured illustrations, as in the printed text, to Asiatic art—Chinese, Japanese, Indian and Persian—so much more acutely considered by experts, and widely appreciated by amateurs, since the character of the Eleventh Edition was determined. The full plates not coloured show the range of modern photography, now recording the strokes of forked lightning, now discerning from the air the immemorial lines of prehistoric habitation and agriculture. Thousands of small vignettes in black and white are distributed through the text. In addition are the plans, charts, diagrams and patterns. It is proper to note that this work of illustration was carried out by a lively equality in combination between the London and New York offices; but for the whole result, the credit is due to Mr. Warren E. Cox, departmental Editor for the fine and applied arts, and responsible for the illustrations.

XI. *Maps.*—For purity of colour and clearness of inscription the maps, from the standpoint of the general reader's convenience, show a very apparent and agreeable gain in the geographical part of illustration. The principal plates executed by John Bartholomew and Son of Edinburgh are ranged as a general Atlas bound up in the twenty-fourth, and last, volume of the work. The greater number of these maps are political, showing with admirable distinctness all places of importance, as well as the river-systems, the frontiers, the internal boundaries and the railway-lines. Other maps give the physical features of the different continents; and of countries whose geographical relief is of exceptional interest, like Switzerland, Canada, the United States, India and the British Isles. Needless to say that all the new demarcations resulting from the World War and decreed by the Peace Treaties—or effected at some points by later changes—are shown in line and tint on the political maps. Apart from the Atlas, many maps, some in black and white, some in colour, are inserted in the text of the other volumes. These elucidate many regional features, especially the lay-out of the great mountain-systems and the plains they dominate. Again they show the physical resources of the world; the changes of nations; the growth of the United States from the original Thirteen Colonies to its present boundaries. And yet again the state of countries or continents at different moments as ancient Greece, conquering Rome, the Europe of Napoleon and so on. The map of eastern Ecuador, based on Mr. Joseph Sinclair's exploration and published here for the first time, is an important addition to geographical knowledge of South America. The world's sources of raw materials are displayed on a new plan. The present relations of visible supplies to annual demands are made clear. Aeroplane views are used for modern cities as for the traces of pre-history.

XII. *Aids to Reference.*—More pains than ever before have been taken and more devices employed to assist the eye. What we may call the mechanical aids to rapid and sure use have been bettered in every way. The Index is of course the great engine of reference, unique amongst encyclopaedias. Though too few take full advantage of its resources, wise readers know how to make it an intimate and incessant friend. It is the real key to that present degree of all-knowledge whereof only a fraction can now be contained by any human memory. This time, the Index comprises half a million headings. It is embodied in a separate volume; but as it is good to save the minutes and even the seconds of readers, pains have been taken also to make all the volumes as far as possible self-indexing throughout. To this end cross-references have been multiplied. As well, in all but the shortest articles, cross-headings and side-headings in stronger print light up the text; so that at need, the eye may travel as quickly as possible to any required particular of an extended subject. The small type, used to a very large extent in earlier editions, has been abandoned entirely except in bibliographies and extended quotations. The body of the new typography speaks for itself. It is probably a pattern of clean, shapely printing for the purposes of the *Encyclopædia Britannica*, which on this occasion has had to put about thirty-five millions of words into its twenty-four thousand pages.

DIDEROT AND THE LITTLE THINGS

FOR the inclusion in the Fourteenth Edition of so many familiar little things and of all the lighter interests of life, its sports and pastimes, there is the best precedent. This aspect, so far from being an affront to the proper dignity of encyclopaedias, is only a return to the most famous of examples—that of Diderot himself, one of the nimblest and most humorous as well as powerful of all intelligences. As "politics are present history," so modern dress and fashion—typical, as it happens, of the emancipation of women—demand notice no less than ancient and mediaeval costume. If cookery receives more detailed and practical attention, that is certainly what Montaigne as well as Mrs. Glass would have approved. "Cross-words" have been brought in. What precisian would be stiff enough to exclude them? Or the article upon "Children's Games"? Discovery in the greatest sciences may have the most intimate and sometimes disconcerting reactions on the small affairs. Under some rays, pure diamonds and other gems are instantly distinguished from imitations. All this only brings us back to Voltaire's celebrated passage about Diderot's *Encyclopédie* as discussed in a royal conversation at Trianon. There were differences of ideas as to how gunpowder was made. The Duc de Nivernois thought it curious that people should shoot partridges and each other "without knowing exactly how the killing is done."

"Alas," said Madame de Pompadour, "we are reduced to that about everything in the world: I don't know how they compound the rouge that I put on my cheeks and I should be vastly puzzled if they were to ask me how they made my silk stockings."

"'Tis a pity, then," said the Duc de la Vallière, "that his Majesty should have confiscated our encyclopaedias which cost us a hundred pistoles apiece; we should soon find there an answer to all our difficulties."

After dinner they sent three lackeys for the volumes containing Powder and Rouge. "Then Madame de Pompadour learnt the difference between the old rouge of Spain, with which the ladies of Madrid coloured their faces, and the rouge of the ladies of Paris." Voltaire's memory here is not quite up to his wit. Madame de Pompadour herself was dead before the scene he describes could have occurred. But some other beauty of the Court may well have made the remark he attributes. The substance of the story is usually held to be well founded, and its spirit is true to the time. There is no more refreshing gift in men and women than intelligent and ever-active curiosity instead of the dull acceptance of results without any effective desire to understand more of processes. The editing of this Edition has gone back very consciously to Diderot's conception, too often forgotten by some of his ablest successors—that an encyclopaedia ought to be not only an abstract of learning but a mirror of the world. Diderot includes a miniature article on "Blushing," which quotes in English a flow of graceful lines by Dryden.

FOUR IDEALS

YET we cannot think of the lighter precedents without remembering the greater. An old weighty question recurs. Is it permissible, and if so is it possible, for an undertaking like the *Encyclopædia Britannica* to pursue any ideal aim of its own through all the intricacies of the practical task? Nothing can be allowed to interfere with the duty of organizing with an unbiassed mind the presentment of facts and opinions in all their modern range. No form of religion, for instance, and no particular race or nation must suffer prejudice. Gibbon remarks somewhere to this effect that it is a right mark of civilized temper always to respect that which is respectable to others. Views which we most dislike may be none the less a power requiring to be examined and comprehended like natural forces. We must see Bolshevism and Fascism as they see themselves before criticism of either can begin to be effectual.

This admitted obligation of detachment and impartiality may seem to make more doubtful the answer to the question whether it is permissible and possible for a great work of general reference to serve any particular ideal. But the answer is affirmative in several respects; for some ideals are above controversy. There will appear in these pages an endeavour so to deal with all questions bearing on war and peace as to promote international reconciliation and enable people on matters where they are still at variance to arrive at a clearer understanding of each other's standpoints and motives. The trilogy on what was absurdly called "War Guilt"—one might as well attribute to part of mankind the "double dose of original sin"—is worked out in the spirit of "The Ring and the Book," showing in what different lights the same question may be seen.

Again, in this encyclopaedia, once more re-made for the use of the English-speaking world, there is a definite design to forward by information and explanation the cause of closer moral sympathy and practical concord amongst those communities now nearing an aggregate of 200,000,000 souls who hold the language in common. For there can be no deeper conviction than one which possesses the present writer—that without the assured political harmony of the English-speaking peoples, no confident belief in the future of any civilized hope can be entertained. The names of His Majesty the King and of the President of the United States stand together on the dedication page not only as a unique honour conferred upon these volumes, but as a symbol of that one good cause which is the key of success to the largest number of others.

Thirdly, it is the definite ideal of the Fourteenth Edition to promote throughout the English-speaking world a general interest in science and to enlist stronger support for its purposes. The future of civilization

depends more on this than on any other factor. For various reasons—material, imaginative and what we venture to call spiritual. Literature and art themselves would be renewed by closer contact with modern science than is yet usual. On the material side, we are so deeply involved mid-way that we must go further to extricate ourselves. In this respect the world beyond doubt is in its crude infancy. For one instance, it is in our power beyond doubt with sufficient public energy to supersede the dirt, foulness, ugliness derived from the industrial revolution and to replace these offensive and injurious defects by a smokeless civilization and by a seemly ordering, without and within, of industrial and domestic architecture. But even this is the least by comparison with other needs and means in human life. By the aid of science, productivity in agriculture and industry alike may be augmented so as to improve incalculably the conditions and opportunities of the common lot throughout the world. The call for more and more chemists and physicists is heard well enough though by no means adequately answered. There is at least equally urgent need in every nation, and especially in those with tropical responsibilities, for more and more biologists. Everywhere in that sphere a strong and well-aided reinforcement of trained men and women is required. Again in a manner far removed from the beneficent utilities, science to-day has an imaginative quality, and possibilities of artistic stimulus, unknown since the Renaissance. Literature and art, to be very great once more, must assimilate and make luminous the essential ideas emerging from the new, noiseless, controlled revolutions of thought in the spheres both of physics and biology formerly quite apart, now more and more significantly associated. On the spiritual side, to repeat that unexpected term in this connection, the temper of modern science contrasts with that of the former generation. The old, deterministic dogmas have been dissolved. Instead, we have the recognition of unfathomable mysteries regarding on one hand the infinitesimal particle, if we can any longer conceive a "particle," and on the other hand, a universe, reaching beyond the remoter nebulae, which profound speculation may conceive as finite, but which is far vaster than former more anthropomorphic conceptions of "infinity" could conceive. From modern science a new, coherent idealism, adequate for at least some generations, may emerge. It can never be supplied by literature and ethics irrationally dissociated from what we call the scientific part of knowledge.

Finally, an encyclopaedia like this, on a scale extensive enough to reflect the ideas of an age as well as its operations, does what the single intellect, however potent, can no longer do; what no private library even, however ample, can do. It assimilates what is essentially instructive in the contents of all the vast libraries and in the ideas of all living brains, so far as these have been publicly communicated; and it thus represents the abiding truth that knowledge in itself is none the less a unity because its totality is beyond our grasp. That it might be within the grasp of some higher order of beings is what we implicitly assume in all our ways of thinking and imagining. As gain rarely occurs without loss of some kind, specialization in more and more contracted limits, in more and more intent and absorbing forms, is that inescapable modern method for which an increasing price has to be paid, not only by the expert individual, but perhaps by society in ways easy to feel but hard to measure. Concerning the varieties of work in which we are respectively steeped, we are apt to become less intelligible to each other. General conversation more rarely takes a wide intellectual play. It is no paradox to say that probably in this clamorous age there are more silences of individuals about their deepest interests than ever before.

Modern philosophers—and physicians—have insisted that some general effort of will ought to be made to correct this tendency in the intellectual field; that every specialist should cultivate other mental interests. Increasing pressure and preoccupation through the day's hours forbid at present any facile solution of this characteristic modern difficulty. Yet, leaving apart that idea of happiness which has been described as the fullest rational development and exercise of all faculties, and taking only the point of utility, it seems certain that our best thoughts about our special subjects often come when we have disengaged our minds and turned them freely to something quite different. The *Encyclopædia Britannica* opens to the specialized intelligence the readiest means of entering into other spheres of enquiry and insight. Fresh imagination gained in ways seeming at first sight the most remote from the day's usual work may throw unexpected light upon it. A map of the world is not less an excellent device because none of us can travel all the territories it displays. Some real sense of the range and main divisions and real unity of the universe of knowledge, however untraversable by any single person most of the regions on the mental map may be, is a benefit to any mind; and so much without extreme difficulty is manageable.

Goethe had the nobler thought that each of us must "have the nerve," as he said, to make ourselves feel one with the whole. It is good to understand as much as we may of the life of other persons and other nations. "Der Einzelne nur froh und glücklich sein kann, wenn er den Muth hat, sich im Ganzen zu fühlen." Sympathy in this higher sense is apt to grow with variety of acquirements. The specialist most appreciates the discovery of simplifying laws. The movement for peace would have no meaning if its part of the sense of unity did not spring from a deeper philosophy than as a rule it knows.

As often has been said, every main Edition of the *Encyclopædia Britannica* has historic significance.

Recording the stages of thought, methods of work, action of circumstances and manners of life belonging to the world at a given date, it keeps in its way irreplaceable value as the contemporary chronicle of one generation; and it provides a standard of measurement by which a later generation may most easily reckon the degree of its own further progress. In this aspect, the Fourteenth Edition seems to the present writer as significant as any encyclopaedia hitherto known; but so far as any credit may be deserved, never was more of it due to close colleagues, associates and collaborators on both sides of the Atlantic.

J. L. GARVIN.

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A. B. C.	A. B. Culley, F.I.A. The Eagle Star and British Dominions Insurance Co.	**Agents in Business.**
A. Be.	Augustin Bernard. Professor of Geography and of Colonization of the Peoples of North Africa, at the Sorbonne, Paris. Author of *L'Archipel de la Nouvelle Calédonie; Les Régions Naturelles de l' Algérie;* etc.	**Algeria;** **Algiers** (*in part*).
A. B. R.	Alfred Barton Rendle, M.A., D.Sc., F.R.S. Keeper of the Department of Botany, British Museum (Natural History).	**Angiosperms** (*in part*).
A. B. W.	A. B. Wollam. President, American Sugar Refining Company, New York.	**American Sugar Refining Company.**
A. C.	Albert Calmès. Professor at the University of Frankfurt, Germany. Conducted an enquiry into the economic and financial situation of Albania for the League of Nations.	**Albania** (*in part*).
A. C. I.	Andrew Conway Ivy. Nathan Smith Davis Professor of Physiology and Head of the Division of Physiology and Pharmacology, Northwestern University Medical School, Illinois.	**Anaemia** (*in part*).
A. D. H.	Sir Alfred Daniel Hall, K.C.B., M.A., Hon.LL.B., Hon.D.Sc., F.R.S. Director of the John Innes Horticultural Institution. Chief Scientific Adviser to the Ministry of Agriculture and Fisheries. Formerly Director of the Rothamsted Experimental Station.	**Agricultural Organization;** **Agriculture: A General Survey** (*in part*).
A. D. L.	Alexander Dunlop Lindsay, C.B.E., Hon.LL.D. Master of Balliol College, Oxford. Professor of Moral Philosophy, Glasgow University, 1922–4. Author of *The Philosophy of Bergson;* etc.	**Adult Education** (*in part*).
A. D. M.	A. D. Mitchell, D.Sc., F.I.C. Assistant Editor to the *Journal of the Chemical Society;* Assistant Examiner in Chemistry, University of London and Institute of Chemistry.	**Acid** (*in part*); **Allotropy;** **Ammonia.**
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A. F. B.	Aldred Farrer Barker. Professor of Textile Industries, Leeds. Author of *Wool and the Textile Industries;* etc.	**Alpaca** (*in part*).
A. Fo.	Alexander Forbes, A.M., M.D. Associate Professor of Physiology, Harvard Medical School. Author of papers on the Physiology of the Nervous System.	**All-or-None Law.**
A. F. P.	Alfred Francis Pribram, Ph.D. Professor of Modern History in the University of Vienna.	**Aehrenthal, Aloys Lexa von.**
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A. G. McC.	Arthur Gillet McCall. Soil Scientist, United States Department of Agriculture. Author of *Physical Properties of the Soil; Studies of Crops.*	**Alkali Soils.**
A. G. P.	Andrew G. Pierce. President, American Woolen Company.	**American Woolen Company, The.**
A. H.	Sir Alfred Hopkinson, K.C., M.A., B.C.L., Hon.LL.D. Vice-Chancellor, Victoria University (Manchester) 1910–3. Treasurer of Lincoln's Inn, 1921.	**Adoption.**
A. H. D.	A. H. Davis. The National Physical Laboratory, Teddington, England. Joint Author with G. W. C. Kaye, of *Acoustics of Buildings.*	**Acoustics of Buildings, The.**
A. H. Q.	Mrs. A. H. Quiggin, M.A. Lecturer, Department of Geography, University of Cambridge.	**Agriculture, Primitive.**
A. J. B. W.	Alan John Bayard Wace, M.A. Deputy Keeper, Victoria and Albert Museum, London. Late Director of the British School of Archaeology, Athens. Norton Lecturer, American Archaeological Institute, 1923–4. Author of *A Catalogue of The Sparta Museum; Prehistoric Thessaly;* etc.	**Aegean Civilization** (*in part*).

A. J. R.	MISS A. J. ROBERTSON, M.A.	**Anglo-Saxon Law** (*in part*).
A. L. K.	A. L. KROEBER, PH.D. Professor of Anthropology in the University of California. Author of *Zuni Kin and Clan, Anthropology;* etc.	**Algonkin.**
A. L. W.	REV. A. LUKYN WILLIAMS, D.D. Hon. Canon of Ely Cathedral. Examining Chaplain to the Bishop of Durham, 1901–13.	**Aceldama.**
A. M.	ALLEN MAWER, M.A. Baines Professor of English Language at the University of Liverpool; Director of Survey of English Place Names.	**Aethelflaed or Ethelfleda; Aethelstan.**
A. M. B.	A. M. BOAL. United States Shipping Board, Washington.	**Admiralty Jurisdiction** (*in part*).
A. Me.	ANTOINE MEILLET. Membre de l'Institut, Professor at the Collège de France, Paris.	**Albanian Language.**
A. P. R.	A. P. ROWE. Scientific Officer, Air Ministry, London. Lecturer on Air Navigation and Instruments, Imperial College of Science, London.	**Aerial Navigation.**
A. R. S.	A. R. SMYTHE. Professor at the Royal Veterinary College, Camden Town, London.	**Abortion, Contagious.**
A. Sa.	SIR JAMES ARTHUR SALTER, K.C.B. Director of the Economic and Finance Section of the League of Nations. General Secretary to the Reparations Commission, 1920–2. Secretary of the British Department of the Supreme Economic Council, 1919 Secretary of the Allied Maritime Transport Council and Chairman of the Allied Maritime Transport Executive, 1918. Author of *Allied Shipping Control, an Experiment in International Administration.*	**Allied Maritime Transport Council.**
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A. Si.	ARTHUR SIDGWICK, M.A., LL.D. Fellow of Corpus Christi College, Oxford; formerly Reader in Greek, Oxford University.	**Aeschylus.**
A. T. P.	ALBERT T. POFFENBERGER, PH.D , SC.D Professor of Psychology, Columbia University, New York. Author of *Psychology in Advertising.*	**Advertising** (*in part*).
A.W.H.E.W.	WING COMMANDER A. W. H. E WYNN, O.B.E. Member of the Staff of the Intelligence Department of the Air Ministry, 1916–22.	**Air Forces** (*in part*).
A. W. McK.	ANDREW W. MCKAY, B.SC. Assistant Chief, Division of Co-operative Marketing, United States Department of Agriculture, Washington Author of *Practical Co-operative Marketing.*	**Agricultural Co-operation** (*in part*).
A. Wo.	A WOLF, M.A., D.LITT. Professor of Logic and Scientific Method in the University of London, sometime Fellow of St. John's College, Cambridge; Fellow of University College, London. Editor of the Philosophy and Psychology section, 14th Edition, *Encyclopædia Britannica.* Author of *The Oldest Biography of Spinoza, Textbook of Logic*	**Absolute; Abstract and Abstraction; Analogy.**
B. Cr.	BENEDETTO CROCE Senator of the Kingdom of Italy, 1910–7; Minister of Public Instruction, 1920–1; Secretary of the Historical Society of Naples, Doctor *honoris causa* of the University of Oxford, Hon Doctor of Philosophy, University of Fribourg (Baden); Member of the *Academia Nazionale dei Lincei* and of the Prussian Academy. Author of *Filosofia dello spirito; Problemi di Estetica; Nuovi Saggi di Estetica; Frammenti di Etica;* etc., etc.	**Aesthetics.**
B. F. C. A.	B. F. C. ATKINSON, PH D. Under-Librarian, University Library, Cambridge.	**A; Achaeans; Alphabet.**
B. H. L. H.	CAPT. B. H. LIDDELL HART, F.R.HIST.S. Military Historian and Critic. Military Correspondent to the *Daily Telegraph,* London. Editor of the Military History section, 14th Edition, *Encyclopædia Britannica*	**Allenby, Edmund Henry Hynman.**
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B. M.	BUDGETT MEAKIN. Author of *The Moors, The Land of the Moors; The Moorish Empire.*	**Almohades** (*in part*); **Almoravides** (*in part*).
B. M. J.	B. MELVILL JONES, A.F.C., M.A., F.R.AE.S. Francis Mond Professor of Aeronautical Engineering in the University of Cambridge.	**Aerodynamics.**
C. A. B.	C. A. BROWNE, D.SC., PH.D. Chief of Chemical and Technological Research, United States Department of Agriculture, Washington. Editor, *A Half Century of Chemistry in America.* Author of *Chemical Analysis of American Honeys; Handbook of Sugar Analysis.*	**Adulteration** (*in part*); **Agriculture: A General Survey** (*in part*).
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J. A. R.	JAMES ALEXANDER ROBERTSON, PH.B., L.H.D. Research Professor of American History, John A. B. Stetson University, De Land, Fla ; Chancellor Emeritus, Philippine Academy. Co-Editor of Blair and Robertson's *The Philippine Islands.*	**Aliaga.**
J. A. Th.	JOHN ARTHUR THOMSON, M A., LL.D. Regius Professor of Natural History in the University of Aberdeen. Gifford Lecturer, St. Andrews, 1915. Terry Lecturer, Yale University, 1924. Author of *The Study of Animal Life; Outlines of Zoology; Heredity; Darwinism and Human Life; What is Man?, Concerning Evolution.* Joint Author (with Professor Patrick Geddes) of *Evolution, Sex, Biology.*	**Acclimatization; Animal Sociology.**
J. B. B.	JOHN BAGNELL BURY, D.LITT., LL.D., D.C.L. Late Regius Professor of Modern History, University of Cambridge. Regius Professor of Greek, Trinity College, Dublin, 1898–1902. Author of *History of the Roman Empire, 27 B.C —A.D. 180, History of Greece to the Death of Alexander the Great.* Editor of Gibbon's *Decline and Fall of the Roman Empire* (1896–1900). *See* the biographical article. BURY, JOHN BAGNELL.	**Alexius I.; Alexius II.; Alexius III.**
J. C.	SIR JOHN CADMAN, K.C.M.G., D.Sc., F.G.S., M.I.C.E. Emeritus Professor, Birmingham University; Chairman, Anglo-Persian Oil Company, late Consulting Petroleum Adviser, H.M. Government.	**Anglo-Persian Oil Company, Ltd.**
J. C. McG.	JAMES CLARKE MCGUIRE. Engineering Assistant, Port of New York Authority. Author of *Airports and Landing Fields.*	**Aerodrome** (*in part*); **Alcohol in Industry** (*in part*)
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J. H.	JOHN HILTON. Director of Statistics, Ministry of Labour, London.	**Amalgamation** (*in part*)
J. H. B.	JOSEPH H. BONNEVILLE, A.M. Department of Banking and Finance, New York University School of Commerce, Accounts and Finance. Author of *Elements of Business Finance.*	**Acceptance; Accrued Dividends; Accrued Interest.**
J. H. D.	J. H. DRIBFRG. Author of *The Lango, A Nilotic Tribe of Uganda.*	**Africa** (*in part*); **Age-grades; Angoni; Ankole.**
J. H. H.	J. H. HUTTON, C.I.E., D.Sc. Director of Ethnology, Assam. Deputy Commissioner, Naga Hills. Author of *The Angami Nagas; The Sema Nagas.*	**Aeta.**
J. H. R.	JOHN HORACE ROUND, M.A., LL.D. Late Historical Adviser to the Crown. President, Essex Archaeological Society, 1916–21. Author of *Feudal England, Peerage and Pedigree;* etc.	**Aids.**
J. Hu.	J. HUTCHINSON. Royal Botanic Gardens, Kew.	**Africa** (*in part*).
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J. N. P.	JOHN NORMAN PRING, M.B.E., D.Sc. Head of Physical Chemistry Branch, Research Department, Woolwich Arsenal. Member of Council of Faraday Society since 1922. Author of a number of textbooks and publications of original research in scientific journals.	**Accumulator.**

J. R.	J. ROMANES, M.A., F.G.S. Petroleum Geologist.	**Albertite.**
J. S. F.	SIR JOHN SMITH FLETT, K.B.E., M.A., D.Sc., F.R.S. Director, Geological Survey of Great Britain and Museum of Practical Geology. Formerly Lecturer on Petrology in Edinburgh University.	**Andesite.**
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J. St.	LIEUTENANT-COLONEL JOHN STEPHENSON, C.I.E., B.Sc., M.B., F.R.C.S., F.R.S.E. Lecturer in Zoology, Edinburgh University.	**Annelida** (*in part*).
J. Sw.	JOSEPH SWIRE, F.R.G.S. Member of the Royal Institute of International Affairs, and Member of the Balkan Committee.	**Albania** (*in part*).
J. T. Ma.	JOHN THOMAS MADDEN, B.S.S., M.A. Dean, New York University School of Commerce, Accounts and Finance President, American Association of Collegiate Schools of Business Director of the Institute of International Finance. Author of *Elementary Accounting Problems; Accounting Practice and Auditing.*	**Accountancy and Accountants** (*in part*).
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J. W. G.	JOHN WALTER GREGORY, D.Sc., F.R S Professor of Geology in the University of Glasgow. President, Geological Section, British Association, 1907, and of Geographical Section, 1924. Hon. Member of New Zealand Institute, Geographical Society of Queensland and Geological Society of South Africa. Author of *The Foundation of British East Africa;* etc.	**Africa** (*in part*).
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L. Ha.	LOUIS HALPHEN. Professor of History in the University of Bordeaux. *See* also biographical article: HALPHEN, LOUIS.	**Anjou.**
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N. A. O.	NILS ANDREAS OLSEN, A.M. Chief, Bureau of Agricultural Economics, United States Department of Agriculture, Washington. Author of Department of Agriculture Bulletins.	**Agricultural Credit** (*in part*).
N. C. R.	NATHAN CHAMBERLAIN ROCKWOOD, B.S. Editor *Rock Products;* Vice-President, Tradepress Publication Corporation. Compiler of *Engineering News*, Chicago.	**Aggregate.**
O. E. W.	ORLAND E. WHITE, M.S., SC.D. Professor of Agricultural Biology, Director of the Blandy Experimental Farm, University of Virginia, Charlottesville, Va.	**Amazon** (*in part*).
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R. A. Kn.	R. A. KERN, A.B., M.D. Assistant Professor of Medicine, University of Pennsylvania, Philadelphia. Author of numerous medical articles.	**Anaphylaxis.**
R. B.-Po.	AIR VICE-MARSHAL SIR ROBERT BROOKE-POPHAM, K.C.B., C.M.G., D S.O., A.F C Air Officer Commanding Iraq Command. Air Officer, commanding Fighting Area Air Defences of Great Britain, 1926–8. Commandant of the Royal Air Force Staff College, 1921–6.	**Air Warfare.**
R. E.	RALPH ENFIELD. Ministry of Agriculture and Fisheries, London.	**Agricultural Co-operation** (*in part*); **Agricultural Credit** (*in part*); **Agricultural Insurance.**
R. E. M. C.	R. E. M. COWIE. President, American Railway Express Company, New York.	**American Railway Express Company.**
R. E. S.	R. E. STANLEY. Secretary of Agricultural Wages Board, London.	**Agricultural Wages** (*in part*).
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R. H. R.	SIR HENRY REW, K.C.B. Board of Agriculture and Fisheries, 1898, Assistant Secretary, 1906–18. President, Royal Statistical Society, 1920–2; Secretary to the Ministry of Food, 1916–7; Chairman Inter-Departmental Committee on Unemployment Insurance in Agriculture, 1925–6. Author of *A Primer of Agricultural Economics;* etc.	**Agricultural Economics; Agricultural Labourer** (*in part*); **Agricultural Prices** (*in part*); **Agricultural Statistics; Agricultural Wages** (*in part*); **Agriculture, Census of** (*in part*).
R. H. Ra.	ROBERT HERON RASTALL, SC.D., F.G.S. University Lecturer in Economic Geology, Cambridge; Fellow of Christ's College; Member of Council of the Geological Society, 1915, and Mineralogical Society, 1918. Attached to War Office, 1915–9. Author of *Geology of the Metalliferous Deposits;* etc.	**Alabaster; Alluvium.**
R. L. Wi.	RAYMOND LOUIS WILDER, PH.D. Assistant Professor of Mathematics, University of Michigan.	**Analysis Situs.**
R. M. L.	RUSSELL MORTIMER LUCKOCK, C.M.G., D.S.O. Brigadier, General Staff, Southern Command, Salisbury, since 1928. Formerly Commandant, Small Arms School, India, and O.C , 163rd Infantry Brigade, Territorial Army, 1926–8.	**Amiens, Battle of.**

R. N. B.	ROBERT NISBET BAIN. Late assistant Librarian, British Museum. Author of *Scandinavia: The Political History of Denmark, Norway and Sweden, 1513–1900, The First Romanovs, 1613–1725; Slavonic Europe: The Political History of Poland and Russia from 1469 to 1796.*	**Absalon.**
R. P. C.	ROBERT PIERCE CASEY, PH.D. Associate Professor of History and Philosophy in the University of Cincinnati.	**Anathema.**
R. R.	SIR RICHARD AUGUSTINE STUDDERT REDMAYNE, K.C.B., M.SC., M.INST.C.E. Member of Institute of Mining and Metallurgy (Past President); H.M. Chief Inspector of Mines, 1908–20. Author of *The British Coal Industry.*	**Adit;** **Airway.**
R. R. M.	ROBERT RANULPH MARETT, M.A., D.SC., F.R.A.I. Rector of Exeter College, Oxford. University Reader in Social Anthropology. Author of *Anthropology; Psychology and Folklore;* etc.	**Animatism;** **Animism.**
R. Ro.	SIR ROBERT ROBERTSON, K.B.E., M.A., D.SC., LL.D., F.R.S. Director of Explosives Research Department, Royal Arsenal, Woolwich; President Chemistry Section, British Association, 1924. Secretary, Royal Institution, 1926.	**Alcohol in Industry** (*in part*).
R. R. P.	RAYE R. PLATT. American Geographical Society, New York.	**Andes.**
R. S.	RICHARD SELIGMAN, PH.D., A.C.G.I. Sometime Chief Chemist to the British Aluminium Company, Ltd., London. Now Technical Managing Director of the Aluminium Plant and Vessel Company, Limited, Wandsworth. Vice-President, Institute of Metals.	**Aluminium;** **Aluminium Bronze.**
R. S. C.	REV RICHARD SEYMOUR CRIPPS, M.A. Vicar of Horningsea, Cambs.	**Amen.**
R. T. Gl.	SIR RICHARD TETLEY GLAZEBROOK, K.C.B., M.A., D.SC., F.R.S. Fellow of Trinity College, Cambridge; Chairman Aeronautical Research Committee Director of the National Physical Laboratory 1899–1919. Zaharoff Professor of Aviation and Director of the Department of Aeronautics, Imperial College of Technology 1920–3. Editor of *Dictionary of Applied Physics.*	**Aeronautics.**
R. V. L. H.	R. V. L. HARTLEY, A.B., B.SC. Transmission Research Director, Bell Telephone Laboratories, Inc., New York.	**Amplifiers.**
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R. W. S.-W.	ROBERT WILLIAM SETON-WATSON, LITT.D. Masaryk Professor of Central European History at King's College, University of London. Founder and Joint-editor of *The New Europe* 1916–20. Joint-editor of *The Slavonic Review.* Author of *The Rise of Nationality in the Balkans;* etc.	**Alexander I.**
S. D. C.	SANFORD D. COLE. Of the Middle Temple, Barrister-at-Law Assistant Editor of seventh edition of *Carver on Carriage of Goods by Sea.* Author of *Insurance Law,* etc. Formerly Board of Trade Pilotage Commissioner.	**Affreightment.**
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S. K. L.	SAMUEL K. LOTHROP, A.B., PH.D. Museum of American Indian, Heye Foundation, New York. Author of *Tulum, an Archaeological Study of Eastern Yucatan; Pottery of Costa Rica and Nicaragua.*	**Alacaluf.**
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S. Po.	SAMUEL POLLARD, M.A. Fellow of Trinity College, Cambridge, and University Lecturer in Mathematics.	**Aggregates, Theory of.**
S. W.	SYDNEY WALTON, C.B.E., M.A., B.LITT. Journalist and publicist; Director of Publicity for British Victory Loan (1919).	**Advertising** (*in part*).
T. A.	THOMAS ASHBY, D.LITT., F.B.A., F.S.A., HON.A.R.I.B.A. Formerly Director of the British School at Rome. Author of Turner's *Vision of Rome; The Roman Campagna in Classical Times; Roman Architecture.* Revised and completed for the press a Topographical Dictionary of Ancient Rome (by the late Professor J. B. Plattner). Author of numerous archaeological articles.	**Agrigentum.**
T. A. H.	THOMAS ANDERSON HENRY, D.SC. Director of Wellcome Chemical Research Laboratories, London.	**Alkaloids.**
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W. P. R.	WILDS PRESTON RICHARDSON. Colonel, United States Army, Washington (retired). Author of Reports of Alaska Road Commission.	**Alaska** (*in part*).
W. R. M. L.	WALTER RANGELEY MAITLAND LAMB, M.A., M.V.O. Secretary of the Royal Academy of Arts.	**Academy, Royal** (*in part*).
W. S. D.	WING COMMANDER W. SHOLTO DOUGLAS, M.C., D.F.C., P.S.A. Royal Air Force. Graduate of the Royal Air Force Staff College and of the Imperial Defence College.	**Air Combat.**
W. S. F.	WILLIAM SCOTT FARREN, M.B.E., M.A. Consultant in Aeroplane Design. Lecturer in the Engineering Department, Cambridge University, and at the Royal College of Science, London.	**Aeroplane.**
W. S. G.	WALTER SHERMAN GIFFORD, A.B., LL.D. President American Telephone and Telegraph Company, New York. Director of Associated Telephone Companies of the Bell System.	**American Telephone and Telegraph Company, The.**
W. S. L.-B.	WALTER SYDNEY LAZARUS-BARLOW, B.A., M.D., F.R.C.P. Member of Cancer Committee, Ministry of Health; formerly Professor of Experimental Pathology, Middlesex Hospital Medical School, London University. Editor of Medical Science section, 14th Edition, *Encyclopædia Britannica.* Author of *A Manual of General Pathology; Elements of Pathological Anatomy and Histology for Students.*	**Abscess; Albuminuria; Animals, Experiments on** (*in part*).
W. S. S.	WILLIAM STANLEY SYKES, M.A., M.D., B.Ch., M.R.C.S., L.R.C.P., D.P.H. Formerly of St. Bartholomew's Hospital, London.	**Acetylene, in Medicine.**
W. Ts.	WILLIAM THOMAS, M.A., D.SC., PH.D. Principal, Denbighshire Technical Institute, Wrexham.	**Adsorption.**
Z. J.	ZAY JEFFERIES, B.S., D.SC. Consulting Metallurgist of the Aluminum Company of America, New York. President of American Society for Steel Treating. Co-Author of *The Science of Metals.*	**Alloys.**

KEY TO PRONUNCIATION

Vowels

ă, fat, man, pang
ā, fate, mane, dale
ah, father, far, guard
aw, fall, talk, naught
å, ask, fast, path*
ĕ, met, pen, bless
ē, mete, meet, meat
ur, her, fern, heard
ĭ, pin, it, biscuit
ī, pine, fight, file
ŏ, not, on, pot
ō, note, poke
o͞o, move, spoon
ŭ, tub, son, blood
ū, mute, acute, few
o͝o, pull, book, could
ü, German ü, Fr. u
ö, as in Fr. peu, feu

*The sound here indicated may vary between *ah* and *ă*.

Modification of Vowels

A single dot under a vowel in an unaccented syllable indicates its abbreviation and lightening. Thus:

ạ, prelate, courage, America
ẹ, allegation, episcopal
ọ, abrogate, actor, democrat

Composite Sounds

oi, oil, joint, boy
ow, pound, proud, now
a͝r, fair, hare, bear
e͝r, era, chimaera
o͝r, floor
ṅ, French nasalized n, as in ton, en

Consonants

The consonants have their ordinary English value. It should be noted, however, that:
c is not used, but represented by k or s as the case may be.
g is always hard.
y has always its consonantal value.

Modified Consonants

tu, nature, adventure
sh, pressure
zh, seizure
th, thin
t͟h, then
ċh, as in German ach, Scotch loch
ly, French liquid l, as in mouillé
ɬ, Welsh ll, as in Llandudno, and Slav. palatal l

' denotes a primary, " a secondary accent.

THE ENCYCLOPÆDIA BRITANNICA

FOURTEENTH EDITION

VOLUME I

A TO ANNOY

A

THIS letter has stood at the head of the alphabet during the whole of the period that it can be traced historically. The name of the letter in the Phoenician period resembled the Hebrew name *aleph* and was taken over by the Greeks in the form of *alpha*. In the Phoenician alphabet the letter stood for a species of breathing or inherent sound, since vowels were not represented in the Semitic alphabets. The view that the Greeks received their alphabet directly from the Phoenicians has now been largely abandoned. The character may therefore have stood for a vowel in the alphabet before the Greeks took it over. It must indeed almost certainly have done so if it was in use among the peoples of Asia Minor previous to its use by the Greeks. Throughout its history variations have occurred in the form of the latter. The Phoenician form was  . In the Lydian alphabet of the fifth century B.C. it appeared as  , in the Carian alphabet or . In the early Greek alphabet from the island of Thera, which may possibly be dated as far back as the eighth or ninth century B.C., its form was  or . In the Greek alphabet of classical times its form was usually . Early Italian and Latin forms are  and  . As early as the middle of the second century A.D. we find  as a form of  , and this is the ancestor of our present minuscule printed a by way of uncial  (fourth century) and  (eighth century), uncial writing being the name given to the round hand which in late Roman times superseded the square capitals that had been suitable for inscription in stone. Under the influence of the uncial hand this form was adopted into Carolingian minuscules Our rounded minuscule *a* derives from Latin cursive, in which in the fifth century A.D. appears the astonishing form  . This is a hastily-written majuscule  distorted by its apex having fallen to the left. In the sixth century the cursive form was  , and from this in the seventh century develops the form , from which the rounded form of the Irish and early English hands grew. The rounded capital  that sometimes appears in handwriting is the minuscule letter written large.

The sound for which the letter consistently stood in Greek and Latin, and doubtless, generally speaking, in its immediate pre-Greek history, was the open low back vowel, usually known in modern English as continental *a*. There are of course countless slight variations in the method of pronouncing this sound. In English the sound has undergone far-reaching changes during and since the Middle English period. These are due to *fronting*, that is to say, pronouncing the sound more towards the front of the

mouth, or to *rounding*, slightly rounding the lips, which has the effect of causing the sound to be pronounced higher in the mouth At the present time the letter represents six principal vowel-sounds. (1) its original value, the low back vowel, as in *father;* (2) an intermediate vowel, as in *man;* (3) a closer vowel, further fronted, as in *hare,* occurring only before the liquid *r;* (4) a diphthong (*ei*) as in *take, spade.* This is the sound that the letter now normally represents when the vowel is long. (3) represents a stage in the development of the sound on its way from (1) to (4) which was arrested at this point when the vowel was followed

NAME OF FORM	APPROX-IMATE DATE	FORM OF LETTER
PHOENICIAN	B.C 1200	
CRETAN	1,100-900	
THERAEAN	700-600	
ARCHAIC LATIN	700-500	
ATTIC	600	
CORINTHIAN	600	
CHALCIDIAN	600	
IONIC	403	
ROMAN COLONIAL	PRE-CLASSICAL AND CLASSICAL TIMES	
URBAN ROMAN		
FALISCAN		 and
OSCAN		
UMBRIAN		
CLASSICAL LATIN AND ONWARDS		

THE DEVELOPMENT OF THE LETTER A FROM PHOENICIAN TIMES, THROUGH CLASSICAL GREEK AND LATIN, TO THE PRESENT DAY

by *r*. A similar fronting of this sound took place in the Ionic-Attic dialects of Greek, where sounds derived from the *a*-sound and represented in other dialects by *a* are represented by *η*.

The two remaining developments of the sound are due to rounding: (5) the vowel of *water* and (6) the vowel of *was* This development is due to the influence of the preceding bilabial spirant *w* (B F. C A)

In Music, A is the name of the first note of the musical alphabet and constitutes the 6th degree of the scale of C. In respect of pitch A=435·4 vibrations per second, this being the standard pitch or *diapason normal.* A is the note always given to orchestral players, usually by the oboe, for tuning purposes. (*See* PITCH.)

A1 AT LLOYD'S, a popular expression denoting super-excellence, derived from the prestige of the world's chief shipping registry, Lloyd's Register of British and Foreign Shipping. In fact, the highest classification assigned to iron and steel ships is "100 A1." In this symbol, "100 A" denotes the condition of the hull, while the "1" denotes efficiency of equipment. "A1" is almost obsolete, being the symbol of the highest classification of wooden vessels.

(*See* LLOYD'S REGISTER OF BRITISH AND FOREIGN SHIPPING.)

AA, the name of many small European rivers. The word is derived from the O. G. *aha,* cognate to the Latin *aqua,* water (*cf.* Ger. *-ach;* Scand. *å, aa,* pronounced *ô*). Among the streams of this name are:—Two rivers in west Russia, falling into the Gulf of Riga with Riga lying between their mouths; a river in northern France flowing through St. Omer and Gravelines, and a river of Switzerland, in the cantons of Lucerne and Aargau, which carries the waters of Lakes Baldegger and Hallwiler into the Aar. In Germany there are the Westphalian Aa, joining the Werre at Herford, the Munster Aa, a tributary of the Ems, and others.

AABENRAA, a town of Denmark, in Slesvig, at the head of a bay of that name, being an arm of the Little Belt. It has a good harbour and a large carrying trade. Pop. about 6,000. Until 1919 it was in the German province of Schleswig.

AACHEN (Fr. *Aix-la-Chapelle;* Dutch *Aken*), ancient city and spa, Rhenish Prussia, Germany, under the northern slopes of the Ardennes, on the Cologne-Brussels main line, 44m. W. by S. of Cologne. Pop. (1925) 155,300. Its municipal boundaries coincide on the west with the frontiers of Belgium and Holland. In general appearance a prosperous, modern commercial town, it is full of mediaeval associations. The outer town is mainly new; while the ramparts of the old inner town are now promenades, with two ancient gates, Ponttor and Marschiertor, remaining. The hot sulphur springs have been celebrated for centuries The conspicuous cluster of buildings in the centre of the city includes the cathedral and the Rathaus (town hall), a Gothic structure (1353–1370) built on the ruins of Charlemagne's palace, which contains the magnificent coronation hall of the emperors (143ft. by 61ft). The two original towers, Granusturm and Glockenturm, were all but destroyed by fire in 1883; their restoration was completed in 1902. Near the Rathaus is the Grashaus, restored in 1889 to house the municipal archives The cathedral, or minster, is in two distinct styles The Romanesque *Octagon,* begun in 796, the finest extant Carolingian structure, was modelled on San Vitale at Ravenna, and consecrated by Pope Leo III in 805 Emperor Otto III. rebuilt it, on the original lines, in 983, after its destruction by Norman raiders. It is surrounded on the first storey by a gallery (the Hochmünster) with antique marble and granite columns, of various sizes, brought from Rome, Ravenna and Trier, removed by Napoleon to Paris, but restored after 1815. The mosaic representing Christ surrounded by "the four-and-twenty elders," which originally lined the cupola, was executed in 1881 from a 17th century copy of the ancient originals. The bronze west doors date from 804. Underneath the dome, tradition places the tomb of Charlemagne, said to have been opened by Otto III. in 1000 and to have shown the emperor's body on a marble chair which was removed and long used for coronations. It is now in the gallery. The site of the tomb is marked by a stone slab, with the inscription *Carlo Magno,* and above it hangs the famous bronze chandelier presented by the emperor Barbarossa in 1168. In the Hungarian chapel, to the south-west, is the rich Cathedral Treasury, with fine mediaeval work such as the 13th century gold casket containing the relics of Charlemagne. The Gothic choir was added during the 14th and 15th centuries and contains the tomb of the emperor Otto III. The pulpit, a gift of emperor Henry II , dates from *c.* 1020. The cathedral possesses many relics, the more sacred of which are exhibited only once every seven years, when they attract large crowds.

The churches of St. Foillan (founded in the 12th century, but twice rebuilt, in the 15th and 17th centuries, and restored in 1883) and St. Paul, with its beautiful stained-glass windows, are interesting. The Suermondt museum contains fine pictures by early German, Dutch and Flemish masters. There are many fine streets, squares and public monuments. The fountain in the market square is surmounted by a statue of Charlemagne. In the principal square, Friedrich-Wilhelmplatz, is the Elisenbrunnen, with its colonnade and garden, the chief resort of visitors taking the baths and waters.

Since the working of extensive coalfields in the district almost every branch of iron industry has been carried on. Cloth, glass, needles and pins are important products. The suburb of Burtscheid, incorporated with Aachen in 1897, has old-established manufactures of cloth and needles and contains, among frequented thermal springs, the Schwertbad-Quelle (171°F.), the warmest spring in Germany.

History.—The ancient city and watering place of Aachen represents the Aquisgranum of the Romans, named after Apollo Granus, who was worshipped in connection with hot springs. As early as A.D. 765 King Pippin had a "palace" there, in which it is probable that Charlemagne was born. The greatness of Aachen was due to the latter, who between 777 and 786 built a magnificent palace on the site of that of his father, raised the place to the rank of the second city of the Empire, and made it for a while the centre of Western culture and learning. From the coronation of Louis the Pious in 813 until that of Ferdinand I. in 1531 the sacring of the German kings took place at Aachen; as many as 32 emperors and kings were crowned there. Late in the 12th century (1172–76) the city was surrounded with walls by order of the emperor Frederick I., to whom (in 1166)



BY COURTESY OF REICHSZENTRALE FÜR DEUTSCHE VERKEHRSWERBUNG

THE RATHAUS OR TOWN HALL AT AACHEN, ERECTED IN 1353–70 ON THE SITE OF THE PALACE OF THE EMPEROR CHARLEMAGNE

and to his grandson Frederick II. (in 1215) it owed its first important civic rights. In the 16th century Aachen began to decline. It lay too near the French frontier to be safe, and too remote from the centre of Germany to be convenient, as a capital; and in 1562 the election and coronation of Maximilian II. took place at Frankfort-on-Main, a precedent followed till the extinction of the Empire. The city suffered gravely in the religious wars, being twice put under the ban of the Empire for Protestantism. By the Treaty of Lunéville (1801) Aachen was incorporated with France as chief town of the department of the Ruhr. In 1815 it was given to Prussia. In Nov. 1918, at the conclusion of the World War, Aachen was occupied for a period by Belgian troops.

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AAHMES: *see* AMASIS.

AAL, also known as A'L, ACH, or AICH, the Hindustani names for the *Morinda tinctoria* and *Morinda citrifolia,* plants extensively cultivated in India on account of the reddish dye-stuff which their roots contain. The name is also applied to the dye, but the common trade name is *Suranji.* Its properties are due to the presence of a glucoside known as *Morindin,* which is compounded from glucose and probably a trioxy-methyl-anthraquinone.

AALBORG, seaport on the south bank of the Limfjord, North Jutland, Denmark, capital of Aalborg *amt,* and one of Denmark's oldest towns. Pop. (1927), 42,819. It is the seat of a bishop (1554) and has some old buildings, Jens Bangs Stenhus, the castle called Aalborghus, the Holy Ghost monastery and the Budolfi church. The municipal privileges date from 1342. Industries include cement works, tobacco works, distilleries, chemical works (sulphuric acid and superphosphate), cloth mills and the ship yard.

AALEN, a town in Württemberg, Germany, situated on the Kocher, a tributary of the Neckar, at the foot of the Swabian Alps, about 50m. E. of Stuttgart. Pop. (1925) 12,250. Woollen and linen goods and ribbons are manufactured, and there are tanneries and large iron works. Aalen was a free imperial city from 1360 to 1802, when it was annexed to Württemberg.

AALESUND, seaport of Norway, in Møre fylke (county), 160m. N. by E. of Bergen by sea. Pop. (1926) 18,238. It is built on three islands, Nørvø, Aspø and Hissen, enclosing the harbour. Founded in 1824, Aalesund is one of the most important export towns of Norway for fish and fish products. It lies in a very productive fishing district; to the north-west lie the great cod-banks of Storeggen and Nyeggen. Vessels also fish off Iceland, while a fleet of sealing boats is sent to the Arctic ocean. There are numerous factories connected with the fish industry and oil refineries, engineering works and a seining factory. Aalesund is a port of call for the Norwegian South American Line (on account of the export of klip-fish) and for the routes Trondhjem–Hamburg, Trondhjem–France and Trondhjem–England, and also for most coasting vessels trading in Western Norway. There is some tourist industry connected with the adjacent centres of Geiranger and Jørund fjords. In 1904 Aalesund was wasted by a terrible fire, a fate which has befallen many Norwegian towns, built largely of wood. In the following years the town was planned on new lines and the houses in the centre were built of brick.

AALI, MEHEMET, PASHA (1815–1871), Turkish statesman, was born at Constantinople, the son of a government official. He was ambassador in London (1842–45), and then foreign minister under Reshid Pasha. He took part in the congress of Vienna (1855) and in the congress of Paris (1856), and was five times grand vizier. Aali Pasha was one of the most zealous advocates of the introduction of Western reforms under the Sultans Abdul-Mejid and Abdul-Aziz. He died at Erenkoi in Asia Minor on Sept. 6, 1871.

AALSMEER, a town in the province of North Holland, Holland, situated in low country about 10m. S.W. of Amsterdam. Pop. (1927) 7,288. It has railway communication with Haarlem and Utrecht. The flat country with its fertile sandy soil, which can be easily watered, provides ideal conditions for horticulture, and the town is surrounded by flower gardens and plant nurseries. Large quantities of plants, bulbs and blooms are exported annually.

AAR or **AARE,** the largest river entirely within Switzerland. It rises in the great Aar glaciers, in the canton of Berne, west of the Grimsel pass. Beyond the Handegg waterfall the river traverses the Hasli Thal and expands into the Lake of Brienz, where it becomes navigable. It then crosses the swampy plain of the Bödeli, between Interlaken (left) and Unterseen (right), before again expanding into the Lake of Thun. Running north-north-west it encircles the lofty bluff on which the town of Berne is built, and then turns west, and later north. Near Aarberg its stream is diverted west by the Hagneck canal into the Lake of Bienne whence the Nidau canal runs east to Büren. Henceforth its long north-east valley drains the central lowland of north Switzerland, parallel to the Jura. The chief tributaries in this stretch are the Grosse Emme, Wigger, Suhr and Aa, all from the right. Below Brugg it receives first the Reuss, and then the Limmat or Linth. It now turns due north, and soon becomes itself an affluent of the Rhine (left), which it surpasses in volume when they unite at Coblenz, opposite Waldshut. Length of river, 181m. Area of basin, 6,804sq.m.

AARAU, the capital of the Swiss canton of Aargau. Pop. (1928), 11,500, mostly German-speaking Protestants. It is on the right bank of the Aar at the southern foot of the Jura, about 50m. by rail north-east of Berne, and 31m. north-west of Zürich. An ancient fortress, it was taken by the Bernese in 1415, and in 1798 became for a time the capital of the Helvetic republic.

Eight miles by rail north-east are the famous sulphur baths of Schinznach, near which is the ruined castle of Habsburg, the original home of that house. The industrial museum contains good painted glass of the 16th century, from the neighbouring Benedictine monastery of Muri (founded 1027, suppressed 1841—the monks are now quartered at Gries, near Bolzano). The cantonal library contains many works relating to Swiss history and many mss. coming from the suppressed Argovian monasteries The industries include silk-ribbon weaving, foundries, cutlery, electrotechnical products and scientific instruments. The novelist and historian, Heinrich Zschokke (1771–1848), spent most of his life here, and a bronze statue has been erected to his memory. Aarau is an important military centre.

AARD-VARK (ard' vark), "earth-pig," the Dutch name for ant-eating mammals of the genus *Orycteropus,* confined to Africa (*see* EDENTATA). The typical form is *O. capensis,* or Cape-ant-bear from South Africa, the northern aard-vark (*O. aethiopicus*) of north-eastern Africa, extends into Egypt The body is stout, with arched back, the limbs are short and stout, armed with strong, blunt claws; the ears long; and the tail thick at the base and tapering gradually. The elongated head is set on a short thick neck, and at the extremity of the snout is a disc in which the nostrils open The mouth is small and tubular, furnished with a long extensile tongue. A large individual measured 6ft 8in. In colour the Cape aard-vark is pale sandy or yellow, the hair being scanty and allowing the skin to show; the northern aard-vark has a still thinner coat, a shorter tail and longer head and ears. These animals are nocturnal and burrowing The strong claws make a hole in the side of the ant-hill, and the insects are collected on the extensile tongue.



THE CAPE AARD-VARK OR ANT-EATER OF AFRICA WHICH GROWS TO ABOUT 5FT

AARD-WOLF (earth-wolf), a South and East African carnivorous mammal (*Proteles cristatus*), like a small striped hyena, but with a more pointed muzzle, sharper ears, and a long erectile mane. It is burrowing in habit, and sometimes attacks lambs.

AARGAU, a canton of north Switzerland, comprising the lower course of the River Aar (*q v*), whence its name. Its total area is 548sq m. It forms the north-eastern section of the great Swiss plateau which occupies the trough between the Alps and the Jura. Its fertile valleys alternate with pleasantly-wooded hills

In 1415 the Aargau region, previously the centre of the Habsburgs, was taken from them by the Swiss Confederates. Berne kept the south-west portion (Zofingen, Aarburg, Aarau, Lenzburg and Brugg), but some districts, named the *Freie Ämter* or "free bailiwicks" (Mellingen, Muri, Villmergen and Bremgarten), with the county of Baden, were ruled as "subject lands" by all or certain of the Confederates. In 1798 the Bernese part became the canton of Aargau of the Helvetic republic, the remainder forming the canton of Baden. In 1803 the two halves (plus the Frickglen, ceded in 1802 by Austria to the Helvetic republic) were united under the name of Canton Aargau, which was then admitted a full member of the reconstituted Confederation.

The estimated population of the canton in 1925 was 247,100, almost exclusively German-speaking with Protestants predominating. The capital is Aarau (*q.v.*), while other towns are Baden, Zofingen, Reinach, Rheinfelden, Wohlen and Lenzburg. Aargau has profited from the exploitation of hydro-electric power. Silk-ribbon weaving is an old industry and electro-technic production has been developed, while tobacco and wines are produced. There are extensive saline-springs at Rheinfelden, while Baden (*q.v.*) has a tourist industry dependent on its hot sulphur springs. The cantonal constitution dates mainly from 1885, but since 1904 the election of the executive council of five members is made by a direct vote. The canton sends 12 members (on the basis of the 1920 census) to the federal *Nationalrat* and two to the *Ständerat.*

See E. Zschokke, *Geschichte des Aargaus,* Aarau, 1903; W. Merz, *Die mittelalt Burganlagen und Wehrbauten d. Kant. Aargau,* Aarau, 1904–06.

AARHUS, seaport and second city of Denmark, capital of Aarhus amt, east coast of Jutland, on Aarhus bay. Pop. (1927) 76,226. It was a district of prehistoric settlement and has five runic stones of the 10th–11th century A.D. It is first mentioned as a town in the 12th century, since when, at least, it has been the seat of a bishop. A small cathedral of stone of that date is incorporated in the later Church of Our Lady The town had ramparts and moats. St. Clemens cathedral was first built in the Romanesque style (1201), but later rebuilt in Gothic (14th and 15th centuries). The town's first charter is dated 1441. Aarhus has a large harbour of three basins, water area 110 hectares, quay length 13km , and even this is being largely extended (1928). It is the shipping and commercial centre for Jutland; also known for its iron and its oil industries. The district is low-lying, fertile and well wooded.

AARON, the traditional founder and head of the Jewish priesthood, who, in company with Moses, led the Israelites out of Egypt (*see* EXODUS, THE, MOSES) His association with Moses in this matter goes back to an ancient tradition, current in northern Israel, though the records derived from the south do not seem to mention him till after the Exile.

In the earlier narratives of the Pentateuch Aaron is mentioned in connection with four events only, (*a*) the Exodus itself, where he appears as the companion of Moses, (*b*) as supporting Moses at the battle of Rephidim, (*c*) as the maker of the golden calf (*see* CALF, GOLDEN) and (*d*) as rebelling, along with his sister Miriam, against the authority of Moses, on the ground that the latter had married a foreign wife (Num xii) It may be conjectured that his name did not occur in the original story from which the narrative of Ex xxxii was ultimately derived, but as it stands the passage suggests—as does also (*d*)—that there was a tradition of hostility between Moses and Aaron, rather than one of association.

Throughout the period of the monarchy (at least since the death of David) and even in Ezekiel, the legitimate priests at Jerusalem belong to the house of Zadok. It is only after the Exile that Aaron takes his place In the whole of the sacerdotal literature, commonly ascribed to P, Aaron stands by the side of Moses. The latter is the representative of the secular power of Yahweh, Aaron is his religious vice-gerent Thus he takes a share in producing the plagues in Egypt, stands by his brother's side (in the pre-exilic narratives he is called the brother of Miriam, but not of Moses) by the Red sea, wields the sacred rod, is chosen and miraculously vindicated as high priest, and is made the centre of the whole ritual system.

The process by which tradition changed Aaron from being a possible rival to Moses into his ecclesiastical counterpart, has never been satisfactorily explained R. H Kennett has advanced the theory that the Aaronides were originally the priests of Bethel, and that their post-exilic position in Jerusalem was due to a compromise made during or shortly after the Exile This theory certainly offers an explanation of several difficulties, but there are others which it fails to meet, and hence it has not met with general acceptance. (T. H. R)

AARON'S ROD, the popular name given to various tall flowering plants such as garden orpine, or live-for-ever, great mullein and goldenrod In architecture the term is given to an ornamental rod with sprouting leaves, or sometimes with a serpent entwined round it (from the Biblical references in Exodus vii. 10 and Numbers xvii. 8).

AARSSENS or AARSSEN, **FRANCIS VAN** (1572–1641), Dutch diplomatist and statesman. Johan van Oldenbarneveldt sent him, at the age of 26 years, as a diplomatic agent of the States-General of the United Provinces to the court of France He helped to negotiate the 12 years' truce in 1606. Recalled from his post by Oldenbarneveldt in 1616, he was one of the "packed" court of judges who in 1619 condemned the aged statesman to death. For his share in this judicial murder a deep stain rests on the memory of Aarssens. He was confidential adviser on foreign affairs to Maurice, prince of Orange, and afterwards to Frederick Henry, and was sent on special embassies to Venice, Germany and England.

AASEN, IVÅR (1813–1896), Norwegian philologist and lexicographer, was born at Aasen i Orsten, in Sondmore, Norway, Aug. 5, 1813, the son of a small peasant-farmer. Gradually, by dint of infinite patience and concentration, the young peasant became master of many languages, and began the scientific study of their structure. His first publication was a small collection of folk-songs in the Sondmore dialect (1843). The *Grammar of the Norwegian Dialects* (1848) and the *Dictionary of the Norwegian Dialects* (1850) prepared the way for the wide cultivation of the popular language in Norwegian, since Aasen really did no less than construct, out of the different materials at his disposal, a popular language or definite *folke-maal* for Norway

With certain modifications, the most important of which were introduced later by Aasen himself, this artificial language is that which has been adopted ever since by those who write in dialect, and which later enthusiasts have once more endeavoured to impose upon Norway as her official language in the place of Dano-Norwegian. Aasen composed poems and plays in the composite dialect and continued to enlarge and improve his grammars and his dictionary He lived quietly in lodgings in Christiania, but his name grew into wide political favour as his ideas about the language of the peasants became more and more the watchword of the popular party.

Quite early in his career (1842), he had begun to receive a stipend to enable him to give his entire attention to his philological investigations; and the *Storting*—conscious of the national importance of his work—treated him with more generosity as he advanced in years After the 1873 edition of his *Dictionary,* he added but little to his stores. Ivar Aasen holds perhaps an isolated place in literary history as the one man who has invented, or at least selected and constructed, a language which has pleased so many thousands of his countrymen that they have accepted it for their schools, their sermons and their songs. He died in Christiania, Sept 23, 1896.

AASVOGEL, the name by which the South African species of vultures are known. Literally it means "carrion-bird"

"A" BATTERY, a battery which provides heating current for the filament of a vacuum tube (*see* VACUUM TUBE)

AB, the fifth month of the ecclesiastical year of the Jews It corresponds to the period of July 15 to Aug 15 The word is of Babylonian origin, adopted by the Jews after the Babylonian exile. On the ninth is kept the Fast of Ab, or the Black Fast, to bewail the destruction of the first temple by Nebuchadrezzar (586 B.C.) and of the second by Titus (A.D. 70).

ABA, (1) a form of altazimuth instrument, invented by, and called after, Antoine d'Abbadie (*see* ASTRONOMY); (2) a rough homespun manufactured in Bulgaria; (3) a long coarse shirt worn by the Bedouin Arabs.

ABĀBDA, a nomad tribe of Arabs who reach northward to the Kena-Kuṣayr road, in the country east of Luxor Dirán, Aswán and the Northern Atbai. They call themselves "sons of the Jinns," and they are the Gebadei of Pliny and probably the Troglodytes of classical writers. From time immemorial they have acted as guides to caravans through the Nubian desert and up the Nile valley as far as Sennar. Many of them are employed in the telegraph service across the Arabian desert. They are great trade carriers, and visit far away districts The Abābda of Egypt, numbering some 30,000, are governed by an hereditary "chief"; they generally speak Arabic mingled with Barabra words. As a tribe they claim descent from Selman, an Arab of the Beni Hilál. They have adopted the dress and habits of the fellahin. In Nubia they live in villages and employ themselves in agriculture. Others fish in the Red Sea and hawk the salt fish in the interior. Others are pedlars, while charcoal-burning, wood-gathering and trading in gums and drugs, especially in senna leaves, occupy many. The Abābda build huts with hurdles and mats, or live in natural caves. They have few horses, using the camel as beast of burden or their "mount" in war. They live chiefly on milk and durra, the latter eaten either raw or roasted. They are very superstitious, believing, for example, that evil would overtake a family if a girl member should, after her marriage, ever set eyes on her mother: hence the Abābda husband has to make his home far from his wife's village. In the Mahdist troubles (1882–98) many "friendlies" were recruited from the tribe

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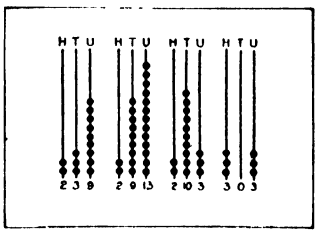
ABACA or **ABAKA,** a native name for the plant *Musa textilis,* which produces the fibre called manila hemp (*q.v.*).

ABACUS, an early device for tracing numerals on a dust covered board There have been three standard types (1) a board covered with dust, whence the derivation, or, at a later period, with wax, and serving the same purpose as a slate in the 19th century or as the modern pad of paper; (2) a table marked with lines upon or between which were placed loose counters in the form of small discs of metal, bone, glass or other material, or (in China) in the form of rods; and (3) a table on which the counters were fastened by means of grooves, wires or rods as seen in the modern number frames often used in teaching children.

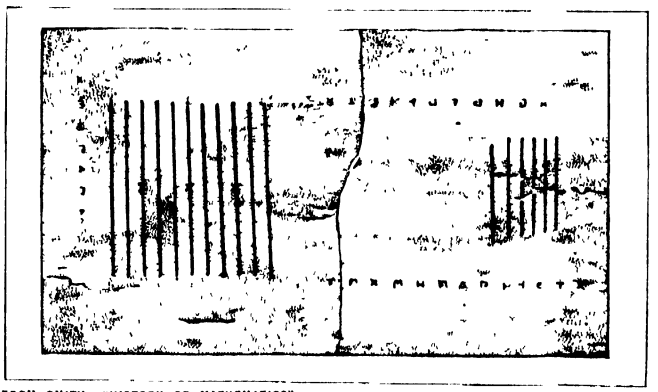


FROM SMITH, "HISTORY OF MATHEMATICS"

FIG. 1.—A PROBABLE FORM OF EARLY COMPUTATION

The lines represent hundreds, tens and units. The computation represented is: 239 + 64=29[13]+2[10]3=2[10]-3=303

The early counter abacus was a table with lines to represent units, tens, hundreds, etc., or to represent different units of value, like pounds, shillings and pence Addition on such an abacus was doubtless performed as represented in fig. 1, which shows the successive steps in the addition of 64 and 239 Subtraction was simply the process of taking away counters, multiplication was considered as repeated addition, and division as repeated subtraction. This type of abacus was known in the Mediterranean countries, and Herodotus (*c* 450 B.C.) is authority for the statement that the Egyptians wrote their figures and reckoned with pebbles "bringing the hand from right to left," while the Greeks proceeded in the opposite direction. There are several references to the abacus in Roman literature, and what is apparently a Greek computing table of some kind was found in the 19th century on the island of Salamis, being still preserved in the Epigraphical museum at Athens (fig 2)



FROM SMITH, "HISTORY OF MATHEMATICS"

FIG 2.—THE SALAMIS ABACUS

Made of white marble, this abacus was found on the island of Salamis. It is of uncertain date but "in some features it is not unlike the tables used by bankers of the middle ages"

Latin writers tell of three types of abacus in use in Rome, namely: (1) the sand board or the wax tablet, (2) a marked table for counters, and (3) a table with grooves in which the counters were free to slide. Fig. 3 shows a late Roman abacus now in the British Museum, each upper button representing five units of the order in which the column stands, and each lower button representing one unit of the same order. Cicero (*Phil Frag.,* V., 59) speaks of the counters as *aera* (bronzes), but the common name was *calculi* (pebbles) or *abaculi,* the pieces being made of

stone, ivory (Juvenal, xi., 131), metal or coloured glass (Pliny, *Hist. Nat.*, xxxvi, 26, 67).

The earliest type of abacus in China seems to have been the "bamboo rods," that served instead of counters. These were known as early as the sixth century B.C. and they survived in Korea until the close of the 19th century (fig. 4). They found

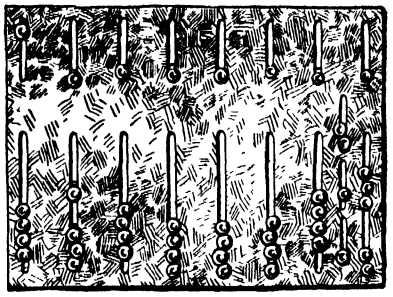


FIG. 3

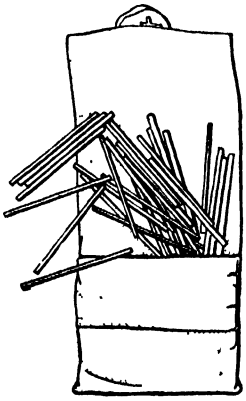


FIG. 4

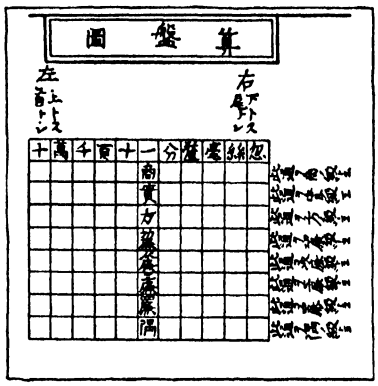


FIG. 5

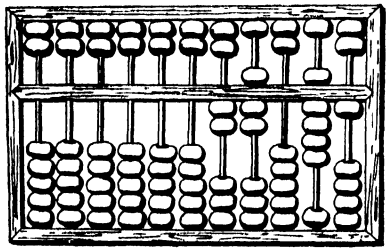


FIG. 6

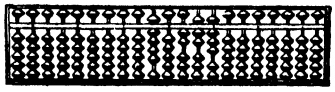


FIG. 7

FROM SMITH, "HISTORY OF MATHEMATICS"

VARIOUS TYPES OF EARLY COMPUTING DEVICES

Fig. 3.—A late Roman abacus, now in the British Museum. This bronze piece of uncertain date has grooves in which the counters slide. Each upper button represents five units and each lower button one unit of the order in which the column stands

Fig. 4.—Korean computing rods. Made of bone, these rods were used in the native Korean schools until the end of the 19th century

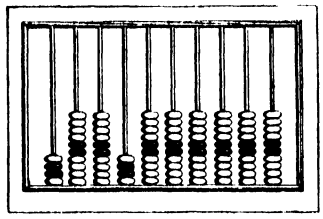
Fig. 5.—A Japanese ruled "Sangi" board. Upon this board the computing rods ("Sangi") were placed to represent algebraic coefficients

Fig. 6.—A modern Chinese abacus. The "suan-pan" was used as early as the 12th century. The number represented is 27091. Each upper bead has a value of five of its order and each lower bead the value of one of its order. Often employed in Chinese laundries

Fig. 7.—A Japanese abacus. The "soroban" was in use as early as the 16th century. The number represented in the central part is 90278

their way into Japan about the year 600 and were known as *sangi* or *sanchu*. Until recent times they were used to represent algebraic coefficients, being placed on a board ruled as shown in fig. 5. Since the 12th century the *suan-pan* (computing tray; *see* fig. 6) has been generally used throughout China. The chief difference between this and the Roman abacus lies in the fact that it has one more bead in each section. In the 16th century this type, slightly changed and bearing the kindred name of *soroban* (fig. 7), found its way into Japan where it is still in use. An abacus differing considerably from the Roman or oriental types is found in the middle eastern countries. The Turks call it the *coulba;* the Armenians, the *choreb;* and the Russians, the *s'choty* (fig. 8). As in the case of the *suan-pan* and the *soroban,* this permits of rapid computation and serves a purpose similar to that of the modern calculating machines (*q.v.*).

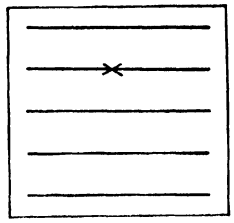
There appeared in Europe in the middle ages the line abacus. This type of abacus somewhat resembled the Salamis table. It consisted of a table ruled with horizontal lines representing the



FROM SMITH, "HISTORY OF MATHEMATICS"

FIG 8.—A RUSSIAN ABACUS

The "s'choty" of the Russians, "choreb" of the Armenians or "coulba" of the Turks. The wires are slightly arched, a feature which is not shown in the illustration



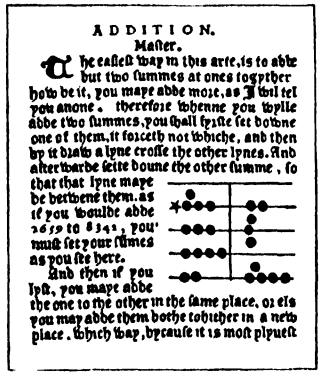
FROM SMITH, "HISTORY OF MATHEMATICS"

FIG. 9.—A MEDIAEVAL COMPUTING TABLE

This method of ruling the computing board was extensively used in the middle ages

successive powers of ten, each space representing half the value of the line immediately above it (fig 9). This type was in use until well into the 18th century. A pupil who could compute on such a table was said to "know the lines," and the verb "to abacus" was used as the equivalent of the verb "to compute." The method employed may be inferred from a passage in Robert Recorde's (*q.v.*) *Ground of Artes* (*c.* 1542) as shown in fig. 10, while the general appearance of the table is seen in fig 11 (taken from the same book).

The discs that were used in computing were commonly known in Great Britain as "counters" (countures, cowntouris); in the Latin books as *projectiles* (*pro,* forward, + *jacere,* to throw), being thrown or cast upon the counting board, or as *denarii supputarii* (computing pennies); and in France as *jetons* (with many



ADDITION.
Maſter.

The eaſieſt way in this arte, is to adde but two ſummes at ones together how be it, you maye adde more, as I wil tel you anone. therefore whenne you wylle adde two ſummes, you ſhall fyrſte ſet downe one of them, it forceth not whiche, and then by it drawe a lyne croſſe the other lynes. And afterwarde ſette doune the other ſumme, ſo that that lyne maye be betweene them. as if you wouldе adde 2659 to 8342, you muſt ſet your ſummes as you ſee here.

And then if you lyſt, you maye adde the one to the other in the ſame place, or elſe you may adde them bothe together in a newe place. whych way, becauſe it is moſt playneſt

FIG 10.—A FACSIMILE PAGE FROM ROBERT RECORDE, "GROUND OF ARTES"

This reduced page, from the edition of 1558, shows the first step in the addition of 2659 and 8342



AFTER RECORDE, "GROUND OF ARTES"

FIG. 11.—ENGLISH COUNTER RECKONING IN THE MIDDLE AGES

The most common of the English names for the small desks used with the line abacus was "counter." Counters passed out of common use only in the last half of the 16th century

such variants as *gects, jectoirs, gietons* and *jettons,* from *jacere,* to throw). In Germany a counter was called a *Rechenpfennig* (translation from the Lat. *denarius supputarius*) or *Zahlpfennig* (number penny). Such later expressions as "cast an account," "borrow one," "carry two," and possibly "lay a wager" have their origin in this kind of computation. The Court of the Exchequer (Fr., *chambre de l'échiquier;* Lat., *scaccarium*), the "counting house," the "counter" in the modern shop, billiard counters, poker "chips," and various games trace their origin to the counting board.

Gerbert (*c.* 1000), who became Pope Sylvester II., invented an "arc abacus" in which each counter bore a certain Indo-Arabic numeral excepting the zero. the periods in groups of three being united by an arc. It had little recognition, however, for as soon as the significance of the zero became apparent (*see* NUMERALS) it was manifestly of no value.

(*See* NUMERALS, CALCULATING MACHINES, FINGER SYMBOLS.)

BIBLIOGRAPHY.—On the history of the abacus, D. E. Smith, *History of Mathematics,* Boston, Ginn, 1925, vol ii., pp. 156–195 (Bibl. for further study, p. 157); C. G. Knott, "The abacus in its historic and scientific aspects," *Transactions of the Asiatic Society of Japan,* Yokohama, 1886, vol. xiv., p. 18 (particularly valuable with respect to the Japanese soroban); F. P Barnard, *The Casting-counter and the Counting-board,* Oxford, 1916 (the standard treatise on counters; numerous illus.). (D. E. S.)

ABACUS, in architecture, the upper member of a column capital whose function is to provide a supporting surface for the structure above. In Egyptian capitals it is smaller than the parts below and in the late work it has great height. In the Greek Doric order it is a plain square slab, but in the Roman Doric it is usually crowned by a moulding. In the Greek Ionic order it is at first rectangular, to cap the projection of the volutes, but later becomes square, except at corner capitals where it is curved out over the angle volutes. In both Greek and Roman Corinthian orders and in the composite and four-sided or Scamozzi Ionic order it is moulded with concave sides and usually the corners are cut off slightly. In Romanesque architecture the abacus usually is square, with sides splayed or moulded, and in the Gothic, outside of England, it is square or octagonal and richly moulded. In English Gothic, however, circular forms are frequent, especially in 13th century work. The diminutive, *abaciscus*, is applied to the squares of a tessellated pavement.

ABADAN (Persia), an island situated in the delta of the Shatt al 'Arab (*q v*), 40 miles in length, from 2 to 12 miles in breadth, bounded on the north and east by the Karun river (*q.v.*) and its tributary, the Bahmishir, on the west by the Shatt al 'Arab, and on the south by the Persian gulf. It is known to Arabs as Jazirat-ul-Khidhr from a tomb situated on the Bahmishir dedicated to the saint of that name. Abadan is referred to by the historian Nasir Khusrau, writing in the 13th century, as the most southerly settlement of Mesopotamia, and it is not improbable that it is identical with the site of the port Charax mentioned by Herodotus. The possession of this island was long in dispute between Persia and Turkey. It was definitely allotted to Persia by the Treaty of Erzerum, 1847, the Turks however retaining control of the whole of the Shatt al 'Arab whilst ensuring to Persia freedom of navigation.

In 1909 the Anglo-Persian Oil Company, Ltd. (*q v*), under a lease agreement with the local overlord, the sheikh of Mohammerah, established its pipe-line terminus and refinery on the island between the hamlets of Braim and Bawardah, and this settlement, now known as Abadan (lat. 30° 21′ N. long 48° 17′ E), has developed into a town of 30,000 people organized by the Persian Government as a municipality. Fifteen deep-water jetties have been built along the foreshore to facilitate the loading of tankers and the unloading of machinery, etc. Exports of oil during 1927 from Abadan totalled nearly 4,500,000 tons. During the same period imports of machinery, etc., unloaded at Abadan totalled about 100,000 tons. Over 500 tankers were loaded and some 40 merchant vessels unloaded, whilst miscellaneous local imports of building material totalled about 100,000 tons. The distance along the pipe-line from Masjid Suleiman (*q v*) to Abadan is 137 miles. Communication exists by roads passable by motor cars from Abadan to Mohammerah, 9 miles; from Abadan to Ahwaz up the pipe-line, 78 miles, and thence to Masjid Suleiman a further 68 miles. A motor road also exists from Basrah (*q v*) to Sibah, opposite Abadan, on the right bank of the Shatt al 'Arab.

See J. W. Williamson, *In a Persian Oil Field* (1927).

ABADDON, a Hebrew word meaning "destruction." In poetry it comes to mean "place of destruction," and so the underworld or Sheol (*cf.* Job xxvi. 6). In Rev. ix. 11 Abaddon is used of hell personified, the prince of the underworld. The term is here explained as Apollyon (*q.v*), the "destroyer."

ABADEH, a small walled town of Persia, lying over 6,000ft. above sea-level in a fertile tract on the road between Ispahan and Shiraz. It has telegraph and post offices, and is famed for its carved wood-work, small boxes, trays, etc., made of pear and box wood

ABAE, a town, Greece, in the northeastern corner of Phocis, famous in early times for its oracle of Apollo, one of those consulted by Croesus (Herod. i. 46). Its rich treasures (Herod. viii 33) were sacked by the Persians, and the temple remained ruinous. The oracle was, however, still consulted, *e.g.*, by the Thebans before Leuctra (Paus iv. 32. 5). The temple, burnt again during the Sacred War, was very dilapidated when seen by Pausanias (x 35); some restoration and the building of a new temple, was undertaken by Hadrian. Privileges due to the sanctity of the shrine (*Bull. Corresp. Hell. vi 171*), were confirmed to the people of Abae by the Romans. The polygonal walls of the acropolis may still be seen, with one gateway and traces of town walls below

See W. M. Leake, *Travels in Northern Greece,* ii. p. 163; V. W. Yorke, *Journal of Hellenic Studies,* xvi. pp. 291–312.

ABAILARD: *see* ABÉLARD.

ABAKANSK, a town in the Abakansk section of Minusinsk province (Siberia) of the R S F S R Pop of section (1926) 37,281, mainly Russians and Tatars. It is situated in 54° 26′ N. and 91° 15′ E, north of the junction of the Abakan river with the Yenisei river; it is a river port with a wharf. It lies in the fertile and sheltered Minusinsk oasis and is linked by river to Krasnoyarsk on the Trans-Siberian railway; the railway from Achinsk to Minusinsk passes it on the west bank of the river. It is a centre for grain, potatoes, cattle, beekeeping products, etc, but is liable to occasional severe floods. Near it are tumuli of the Li-Kitai and statues 7 to 9ft. high, covered with hieroglyphs

ABALONE (a Spanish word of unknown derivation), the name given in California to various species of molluscs of the widely distributed genus *Haliotis* ("ear shells," Ormers). The shell of these animals yields mother-of-pearl and is used in button-making and inlaying. The abalone was a favourite article of food among the Californian Indians and is still eaten in Japan and China. The Californian abalone is represented by three species, *Haliotis splendens, H. rufescens,* and *H. cracherodii.* (*See* ORMER)

BIBLIOGRAPHY.—*See* H. Pilsbry, *Manual of Conchology* (1890); J. Keep, *The Nautilus* (1880). (G. C. R.)

ABANA (or, as indicated to be read in the Hebrew text, *Amana,* classical *Chrysorrhoas*) and PHARPAR (Heb *Parpar*) the "rivers of Damascus" (II. Ki v 12). They are commonly identified with the two most important rivers of the district, the Barada, flowing through Damascus from its source in the Anti-Lebanon, and the 'Awaj, some 8m S of Damascus with its source in the Hermon range. The size of the rivers was probably of less moment than the sacredness of their waters. Abana (or Amana) may well be the Barada A tributary, the Nahr Banias, perhaps retains an echo of the name. North of the 'Awaj is the independent Barbar in which we seem to have the name Pharpar. All the rivers of the district are either entirely dissipated in irrigation or eventually lose themselves in marshes to the east.

ABANCOURT, CHARLES XAVIER JOSEPH DE FRANQUEVILLE D' (1758–1792), French statesman, was Louis XVI.'s last minister of war (July 1792), and organized the defence of the Tuileries for Aug. 10. He was arrested for treason to the nation and sent to Orleans to be tried At the end of August the Assembly ordered Abancourt and the other prisoners at Orleans to be transferred to Paris. At Versailles the escort learned of the massacres at Paris, and Abancourt and his fellow-prisoners were murdered on Sept. 8, 1792.

ABANDONMENT, in law, the relinquishment of an interest, claim, privilege or possession. Its signification varies according to the branch of the law in which it is employed, but the more important uses of the word are summarized below.

ABANDONMENT OF AN ACTION is the discontinuance of proceedings commenced in the High Court of Justice either because

the plaintiff is convinced that he will not succeed in his action or for other reasons. Previous to the Judicature Act of 1875, considerable latitude was allowed as to the time when a suitor might abandon his action, and yet preserve his right to bring another action on the same suit; but since 1875 this right has been considerably curtailed, and a plaintiff who has delivered his reply, and afterwards wishes to abandon his action, can generally obtain leave so to do only on condition of bringing no further proceedings in the matter. (*See* PRACTICE and PROCEDURE)

ABANDONMENT IN MARINE INSURANCE is the surrender of the ship or goods insured to the insurers, in the case of a constructive total loss of the thing insured. For the requisites and effects of abandonment in this sense *see* INSURANCE, MARINE.

ABANDONMENT OF WIFE AND CHILDREN is dealt with under DESERTION, and the *abandonment or exposure* of a young child under the age of two, which is an indictable misdemeanour, is dealt with under CHILDREN, CRUELTY TO

ABANDONMENT OF DOMICILE is the ceasing to reside permanently in a former domicile coupled with the intention of choosing a new domicile. The presumptions which will guide the court in deciding whether a former domicile has been abandoned or not must be inferred from the facts of each individual case (*See* DOMICILE)

ABANDONMENT OF AN EASEMENT is the relinquishment of some accommodation or right in another's land, such as right of way, free access of light and air, etc. (*See* EASEMENT.)

ABANO, PIETRO D' (*c.* 1250–*c.* 1316), known also as PETRUS DE APONO or APONENSIS, Italian physician and philosopher, was born at Abano in 1250 or 1246. After studying medicine and philosophy at Paris he practised at Padua. He was twice brought to trial by the Inquisition on a charge of practising magic; on the first occasion he was acquitted, and he died before the second trial was completed His best known works, in which he advocates the systems of Averroes and other Arabian writers, are the *Conciliator differentiarum quae inter philosophos et medicos versantur* (Mantua, 1472; Venice, 1476); and *De venenis eorumque remediis* (1472; French trans. Lyons, 1593).

ABANO TERME, a town in the province of Padua, Italy, on the eastern slope of Monti Euganei, 6m. S W. by rail of Padua. Pop. (1921) 948 (town), 6,100 (commune). Its popular hot springs and mud baths were known to the Romans as *Aponi fons* or *Aquae Patavinae.* Ancient remains have been found. The Italian *Comando Supremo* was fixed here from Jan 1918 to the signing of the Armistice, Nov. 3, in the local Villa Giusti

ABANTES, the traditional name of the ancient inhabitants of Euboea, to whom was also ascribed the building of the town of Abae in Phocis.

ABARBANEL: *see* ABRABANEL

ABATED, an obsolescent technical term applied in masonry and metal work to portions sunk beneath the general surface, as in panels where the background is sunk so as to leave letters or ornament in relief.

ABATEMENT, a beating down or diminishing, a term used especially in various legal phrases

Abatement of a nuisance is the remedy of destroying or removing, allowed by law to a person or public authority injured by a public nuisance, provided no breach of the peace is committed in doing so. In the case of private nuisances abatement is also allowed provided there be no breach of the peace, and no damage be occasioned beyond what the removal of the nuisance requires (*see* NUISANCE).

Abatement of freehold takes place where, after the death of the person last seised, a stranger enters upon lands before the entry of the heir or devisee, and keeps the latter out of possession. It differs from intrusion, which is a similar entry by a stranger on the death of a tenant for life, to the prejudice of the reversioner, or remainder man; and from disseisin, which is the forcible or fraudulent expulsion of a person seised of the freehold (*see* FREEHOLD).

Abatement of debts and legacies.—When the assets (*see* ASSETS) of a deceased person are not sufficient to satisfy fully all the creditors, their debts must abate proportionately, and they must accept a dividend. Also, in the case of legacies, when the funds or assets out of which they are payable are not sufficient to pay them in full, the legacies abate in proportion, unless there is a priority given specially to any particular legacy (*see* LEGACY). Annuities are subject to the same rule as general legacies.

Abatement in pleading, or plea in abatement, was directed to defeating or quashing a particular action by some matter, such as a defect in form or the personal incompetency of the parties suing, pleaded by the defendant. All pleas in abatement are now abolished (Rules of the Supreme Court Order 21). In criminal proceedings the plea in abatement was nullified by the Criminal Law act, 1826, which required the court to amend according to the truth, and the Criminal Procedure act, 1851, which rendered description of the defendant unnecessary.

Abatement in litigation.—In civil proceedings, no action abates by reason of the marriage, death or bankruptcy of any of the parties, if the cause of action survives or continues, and does not become defective by the assignment, creation or devolution of any estate or title *pendente lite* (R S C. Order 17). Criminal proceedings do not abate on the death of the prosecutor, being in theory instituted by the Crown, but the Crown itself may bring about their termination without any decision on the merits and without the assent of the prosecutor.

Abatement in heraldry is a badge in coat-armour, indicating some kind of degradation or dishonour. It is called also *rebatement.*

Abatement in taxation.—A reduction in assessment to taxation or in rate of tax, which is made to remove anomalies, mitigate hardship or refine a scale of duties. Abatements have long been a special feature of the British income-tax system. For many years a rough-and-ready graduated income-tax was formed by imposing a fixed poundage rate upon all incomes of whatever size, and providing in the Finance Act for (1) the total exemption of very small incomes and (2) the reduction or "abatement" of the assessments made upon incomes above the exemption limit and not exceeding certain moderate amounts. This abatement system has been swept away, but abatements of assessment to mitigate rate of tax are still made in respect of the maintenance of wife and young children and the payment of a life insurance premium. *See* INCOME TAX.

In the United States abatement of State and local taxation is governed solely by statute, and the laws of the various States and the court decisions thereunder should therefore be consulted for specific information on this subject. Abatement of Federal taxation is likewise purely statutory; and the question is governed exclusively by numerous Acts of Congress, including Section 3220 of the Revised Statutes (as amended) and the various Federal revenue acts together with the regulations thereon. (*See* TAXATION)

ABATI (ah-bah'tē), **NICCOLO** or DELL' ABBATO (1512–1571), a celebrated fresco-painter of Modena, whose best works are there and at Bologna. He accompanied Primaticcio to France, and assisted in decorating the palace at Fontainebleau (1552–71). A fine example of his work, representing the martyrdom of St. Peter and St. Paul, is in the Dresden Gallery.

ABATIS, ABATTIS or ABBATTIS (a French word meaning a heap of material thrown), a term in field fortification for an obstacle formed of the branches of trees laid in a row, with the tops directed towards the enemy and interlaced or tied with wire. The abatis is used alone or in combination with wire-entanglements and other obstacles.

ABATTOIR, a place in which the slaughter of animals for human food is concentrated, and in which subsidiary activities associated therewith are carried on. The term is not quite synonymous with the equivalent English word slaughter-house, which is applied indiscriminately to small private establishments in individual occupation, and to the more comprehensive buildings provided to meet the needs of a community, or of special branches of the meat industry. The latter include meat packing, the oversea trade in frozen and chilled meat, and the large scale curing of bacon and ham. The industrial abattoir differs in detail of arrangement and equipment from its municipal or communal equivalent. Well organized and intensive team work through which the animal passes rapidly from the slaughtering pen to the cooling

room as a finished dressed carcase is an essential feature in the management of the industrial abattoir. This requirement is therefore kept in view in the arrangement of the buildings as well as in the equipment with which they are furnished. The communal abattoir on the other hand must meet the needs of many individual traders, and provision must be made for individual rather than for team work.

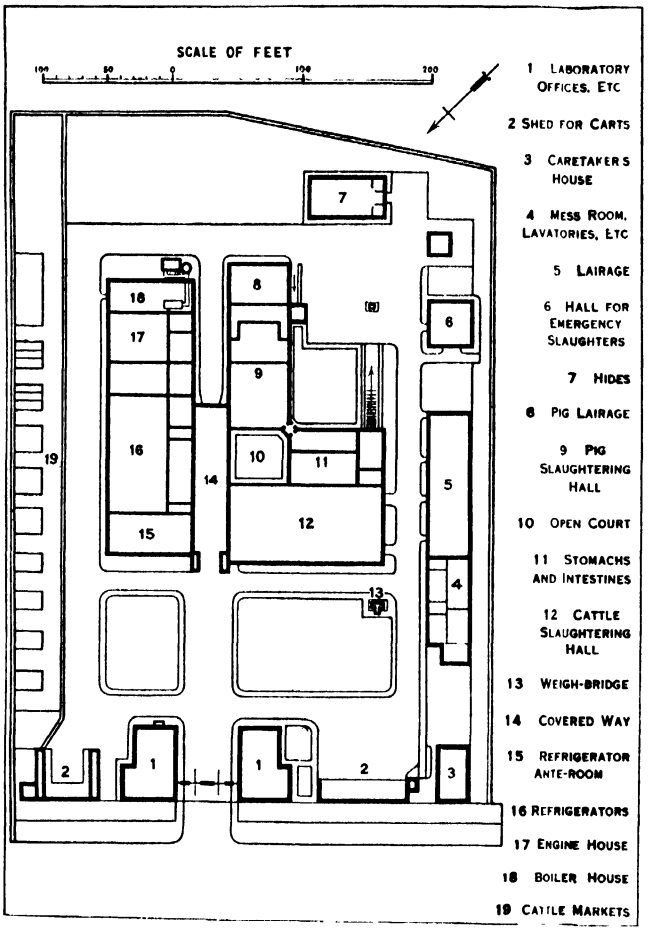
The public or communal abattoir is an important factor in the interests of public health. The slaughter of animals for human food is classified as an offensive trade in all public health legislation and it has been so classified for centuries. No matter what the conditions under which the trade is conducted, objectionable features are inseparably associated with it The aim and purpose of an abattoir is to reduce these to a negligible minimum by the provision of a building properly constructed and equipped in which the best hygienic conditions can be maintained. Further, by concentrating the slaughter of animals for human food, the systematic examination of all carcases is rendered practicable and the rejection of those which are diseased and unsound is ensured Incidentally, the public abattoir possesses an economic value it affords opportunity for the profitable treatment of blood, tallow, condemned carcases and other residues.

The Private Slaughter-house.—In the provision of public abattoirs, England is remarkably behind her continental neighbours and her own colonies There are approximately 20,000 private slaughter-houses in England and Wales and probably less than 100 public abattoirs (Report of Departmental Commission on Meat Inspection, Ministry of Health, 1921.) In every country in which the abattoir system has been developed, experience has proved that no progress could be made until the law gave power not only to erect public abattoirs but also simultaneously to close slaughter-houses in private occupation. In the latter respect the law of England and Wales is defective. Local authorities have hesitated to exercise the power to erect public abattoirs which was conferred on them in 1848, since it is obvious that no useful purpose would be served by their establishment unless it was reasonably clear that the butchers would use the abattoirs when provided. The continued existence of many private slaughter-houses in London, Birmingham, Manchester and other large English cities which have public abattoirs is evidence of the difficulty of concentrating slaughter in the public establishment when its use is dependent on voluntary agreement between meat traders and the local sanitary authorities.

Scotland has been more progressive. In 1862 the General Police and Improvement Act empowered the commissioners of burghs to erect and maintain abattoirs and on so doing to prohibit the slaughter of cattle in the burgh or within two miles of its boundary elsewhere than in the abattoir which had been provided With the single exception of Aberdeen, all the large towns in Scotland and the majority of the smaller burghs have provided public abattoirs and abolished private slaughter-houses.

European and American Advance.—During the greater part of the 19th century France led the way in the development of the public abattoir system. In the last quarter of the century, however, outbreaks of meat food poisoning, trichinosis and other diseases of man which were largely attributable to defective meat inspection stimulated Germany to activity and led to remarkable developments and improvements in the design and arrangement of abattoirs. Holland, Belgium and most other European countries followed suit General laws were passed permitting or making compulsory the provision of abattoirs with the result that in these countries the public abattoir has almost entirely superseded and displaced the slaughter-house in individual occupation. Almost coincidently with these developments in Europe, the large industrial abattoirs of the meat packing trade of the U.S A made their appearance, and later, when experiment had proved that the transport of frozen meat by sea to Europe was practicable and much more economical than the shipment of live cattle, the export slaughter-houses of South America, Australia and New Zealand came into existence. They were constructed on the scientific and hygienic principles, which marked the latter half of the 19th century.

The Paris abattoirs which were completed in 1818 provided a model for the design and arrangement of public slaughter-houses during a period of nearly 70 years. Many abattoirs planned on the Paris model continue in daily use in Scotland and on the continent of Europe. As time has progressed hygienic improvements have, of necessity, been introduced to bring them into line with modern requirements This old type of abattoir comprises a series of booths arranged side by side and completely partitioned off one from another. Each booth is, in effect, the equivalent of a



BY COURTESY OF DR BERGER

PLAN OF ABATTOIR AT TILBURG, HOLLAND

Modern abattoirs have many features designed after operating theatres in hospitals. Inner walls have smooth polished surfaces. Wall heads are built up, corners are rounded, which, with water-tight floors to facilitate cleansing, and a plentiful water supply, ensures a high standard

small individual slaughter-house. It is provided in the rear with appropriate lairage for the accommodation of animals awaiting slaughter. Sanitary and other necessary services are shared in common by the occupants of the individual booths In comparison with the modern abattoir this arrangement is less economical and much less hygienic.

The German Model.—The first departure from the Paris model was made by Germany during the years 1875–80, and to the German architects and hygienists is due credit for the design of the modern abattoir. Their conception of the plan of an abattoir seems to have been prompted by two main motives. The first was reduction of labour, and resulted in the introduction of mechanical equipment and of overhead transporter rails to facilitate the handling and movement of carcases, etc. Incidentally, it contributed to the second and more important aim which was hygienic. Individual interests were subordinated as far as was necessary to secure the main object of safeguarding the public health Separate booths were abolished and replaced by an open slaughter-hall in which the whole of the work of the abattoir could be maintained under continuous supervision and control. Rooms were set apart for the reception of stomachs and intestines in order that the floor of the slaughter-hall should cease to be polluted

with their contents, and healthy carcases should no longer be exposed to the risk of contamination with these materials to the prejudice and danger of the consumer. The open hall facilitated the work of meat inspection and contributed to a higher degree of efficiency. Refrigerators were introduced to ensure safe storage and preservation of meat irrespective of climatic conditions.

Importance of Site.—The site of an abattoir should be carefully chosen. Plenty of light, proper ventilation and the free circulation of air round the buildings are primary essentials. An open situation is, therefore, desirable, but the close proximity of human habitations should always be avoided. Sewage effluents contain much solid matter and the site should permit of drainage with a good fall to secure free and continuous flow of the liquid discharges. Easily accessible railway facilities are of inestimable value in the interests of live stock and of the public, to remove from the streets an undesirable traffic which contributes to congestion. For the same reason live stock markets and the public abattoir whenever practicable should occupy adjoining sites. As a rule these conditions can be secured better and more economically on the outskirts of a town than near its centres of shopping or industry. The general arrangement of the different buildings contributes to the smooth and easy working of an abattoir. Reception of the living animals in the rear buildings and discharge of dressed carcases from the front saves cross currents of traffic and ensures regular circulation as the work proceeds. Hides, stomachs, etc., are passed in the same direction to the apartments in which they are dealt with. Where practicable, it is a convenient and suitable arrangement to provide the appropriate receiving rooms on a lower level and to pass hides and stomachs to them by means of chutes. In the larger abattoirs separate halls are provided for the slaughter of cattle, sheep and pigs, but even in relatively small establishments, the differences of procedure make the provision of separate accommodation for the slaughter, scalding and dressing of pigs desirable. The slaughter-hall in the modern abattoir is a plain open apartment plotted out in stances but without divisions or partitions of any kind. Hand winches enable the heaviest carcases to be raised during the process of dressing, and then transferred easily to trolleys on overhead rails.

Industrial Abattoirs.—It has already been stated that the fundamental difference between the public abattoir and the industrial abattoir associated with the export of meat, etc., is that the former must provide for individual work and the latter for team work. Whereas the slaughter-hall of the public abattoir is plotted out in stances, each of which is allotted to an individual butcher or a small gang of three or four workers who carry out the work of slaughter and dressing of the animal carcases, the whole of the slaughter-hall of the industrial abattoir is for all practical purposes the equivalent of one large slaughtering and dressing stance. Definite stations are fixed on the stance and to each is assigned a member of a team of workers who thus constitute a chain extending from the slaughtering pen at one end to the cooling room for finished carcases at the other. In the preparation of the carcase a specific piece of work is allotted to each worker, who performs it with the rapidity of experience and a high degree of skill. The living animal is received into the slaughtering pen and is stunned. The weight of the falling body automatically releases a simple mechanical device by means of which the carcase is ejected from the pen on to the bleeding floor. Thence it is hoisted to an overhead rail, suspended from which it is passed rapidly from station to station along the chain of workers. The hide and internal organs, as each is removed, are passed through apertures in a side wall or by means of chutes into rooms specifically provided for their reception and handling. At fixed points meat inspectors meet each carcase as it passes along and, in combination, they carry out a complete systematic examination for the detection of disease. Diseased carcases are marked to be side-tracked from the main route which leads to the cooling rooms, and later they are subjected to more detailed examination and judgment. Diseased viscera are similarly side-tracked for destruction. By means of this team work carcases are passed from the slaughtering pen to the cooling room at the rate of 60 to 120 per hour according to the skill of the workers and the kind of animal handled.

The subsidiary trades of the slaughter-house, to which reference has already been made, play an important rôle in the industrial abattoir. Properly conducted, they contribute in an appreciable measure to the financial success of the undertaking.

The refrigerator constitutes a vital part of the export abattoir. The nature of the trade makes ample accommodation necessary. The carcases, having been allowed to hang till the natural body heat has been dissipated, are introduced into the freezing chambers where they are gradually completely frozen and held till ready for shipment. In the still frozen condition they are transferred rapidly and direct into the freezing chambers of the hold of the ship by which they are to be transported. During recent years material developments have taken place in the "chilled" meat trade. Meat which has been maintained in the exporting abattoir and on board ship at a temperature just above freezing point commands a better market and is preferred by the consuming public to meat which has been frozen. But time limits the possibilities of the oversea transport of chilled as against frozen meat. Experience has demonstrated that, to be successful, chilled meat must reach its market within six weeks of the date of slaughter, a fact which, unfortunately, prevents some of the British colonies from participating in this trade in the home market. (A. G.)

ABAUZIT, FIRMIN (ah-bō-zē) (1679–1767), French scholar, was born of Protestant parents at Vries, in Languedoc, Nov. 11, 1679, and died at Geneva, March 20, 1767. After the revocation of the Edict of Nantes in 1685 the family took refuge in Geneva where the boy received his education. Abauzit visited Holland and England, and was one of the earliest defenders of the discoveries of Sir Isaac Newton. He declined an offer from William III. to settle in England, also the offer of the chair of philosophy at Geneva. A sinecure as librarian to the city of Geneva provided him with leisure to pursue his multifarious studies. Rousseau praises him in his *Nouvelle Héloïse,* and Voltaire, when a visitor told him he had come to see a great man, asked if he had seen Abauzit. A collection of his writings was published at Geneva in 1770, and another in London in 1773.

Information regarding Abauzit will be found in J. Senebier's *Histoire littéraire de Genève,* Harwood's *Miscellanies,* and W. Orme's *Bibliotheca Biblica* (1824).

'ABBA 'ARIKA, the name of the Babylonian *'amora* (q v) of the 3rd century, who established at Sura the systematic study of the Rabbinic traditions which, using the Mishnah as text, led to the compilation of the Talmud. He is commonly known as Rab.

ABBADIDES, a Mohammedan dynasty which arose in Spain on the downfall of the western caliphate. The founder of the house was Abd-ul-Qāsim Mohammed, the cadi of Seville in 1023. When he died in 1042 he had created a State which, though weak in itself, was strong as compared with the little powers about it. He had made his family the recognized leaders of the Mohammedans of Arab and native Spanish descent against the Berber element, whose chief was the king of Granada. Abbad, surnamed El Motaḍḍid, his son and successor, is one of the most remarkable figures in Spanish Mohammedan history. A poet and a lover of letters, he was also a poisoner, a drinker of wine, a sceptic and treacherous to the utmost degree. He killed with his own hand one of his sons who had rebelled against him. On one occasion he trapped a number of his enemies, the Berber chiefs of the Ronda, into visiting him in the Alcazar at Seville, and got rid of them by smothering them in the hot room of a bath. It was his taste to preserve the skulls of the enemies he had killed—those of the meaner men to be used as flower-pots, while those of the princes were kept in special chests. His reign until his death on Feb. 28, 1069, was mainly spent in extending his power at the expense of his smaller neighbours, and in conflicts with his chief rival the king of Granada. After 1063 he was assailed by Fernando El Magno of Castile and Leon, who marched to the gates of Seville, and forced him to pay tribute. His son, Mohammed Abd-ul-Qāsim Abenebet—who reigned by the title of El Motamid—was the third and last of the Abbadides. He went further in patronage of literature than his father, for he chose as his favourite and prime minister the poet Ibn Ammar. He carried

on the feuds of his family with the Berbers, and in his efforts to extend his dominions could be as faithless as his father. In 1080 he brought down upon himself the vengeance of Alphonso VI. of Castile by a typical piece of flighty oriental barbarity. He had endeavoured to pay part of his tribute to the Christian king with false money. The fraud was detected by a Jew, who was one of the envoys of Alphonso. El Motamid, in a moment of folly and rage, crucified the Jew and imprisoned the Christian members of the mission. Alphonso retaliated by a destructive raid When Alphonso took Toledo in 1085, El Motamid called in Yusef ibn Tashfin, the Almoravide (*see* SPAIN: *History* and ALMORAVIDES). During the six years which preceded his deposition in 1091, El Motamid behaved with valour on the field, but with much meanness and political folly. It was probably during this period that he surrendered his beautiful daughter Zaida to the Christian king, who made her his concubine, and is said by some authorities to have married her after she bore him a son, Sancho. In 1091 the Almoravides stormed Seville. El Motamid, who had fought bravely, was weak enough to order his sons to surrender the fortresses they still held, in order to save his own life. He died in prison in Africa in 1095

See R. P. A. Dozy, *Histoire des Musulmans d'Espagne* (Leyden, 1861); and *Historia Abbadidarum* (*Scriptorum Arabum loci de Abbadidio*, Leyden, 1846). (D. H.)

ABBADIE, ANTOINE THOMSON D' (1810–1897), and **ARNAUD MICHEL D'** (1815–1893), travellers, were born in Dublin, of a French father and an Irish mother. The parents removed to France in 1818. In 1835 the French Academy sent Antoine on a scientific mission to Brazil, the results being published in 1873 under the title of *Observations Relatives à la physique du globe faites au Brésil et en Éthiopie*. The younger Abbadie spent some time in Algeria before the two brothers started for Abyssinia in 1837, landing at Massawa in Feb. 1838. After collecting much information on the geography, geology, archaeology and natural history of Abyssinia, the brothers returned to France in 1848

The younger brother, Arnaud, paid another visit to Abyssinia in 1853. Antoine became involved in various controversies relating both to his geographical results and his political activities in Abyssinia. Time and the investigations of subsequent explorers have shown that Abbadie was quite trustworthy as to his facts, though wrong in his contention that the Blue Nile was the main stream. The topographical results of his explorations were published in Paris in 1860–73 in *Géodésie de l'Éthiopie*. Of the *Géographie de l'Éthiopie* (1890) only one volume has been published. *Un Catalogue raisonné de manuscrits éthiopiens* (1859) contains a description of 234 Ethiopian manuscripts collected by Antoine. He published numerous papers dealing with the geography of Abyssinia, Ethiopian coins and ancient inscriptions. His *Reconnaissances magnétiques* (1890) is an account of the magnetic observations made by him in the course of several journeys to the Red Sea and the Levant.

The general account of the travels of the two brothers was published by Arnaud in 1868 under the title of *Douze ans dans la Haute-Éthiopie*. Antoine died in 1897, and bequeathed an estate in the Pyrenees, yielding 40,000 francs a year, to the Academy of Sciences, on condition of its producing within fifty years a catalogue of half a million stars. His brother Arnaud died in 1893.

'ABBAHU, the name of a Palestinian rabbi who flourished *c.* 279–320. 'Abbahu encouraged the study of Greek by Jews. He is very often cited in the Talmud

ABBA MARI (in full, Abba Mari ben Moses ben Joseph), French rabbi, was born at Lunel, near Montpellier, towards the end of the 13th century. He is also known as Yarhi from his birthplace (Heb. *Yerah; i.e.*, moon, *lune*), and he further took the name Astruc, Don Astruc or En Astruc of Lunel. In Montpellier, where he lived from 1303 to 1306, he was much distressed by the prevalence of Aristotelian rationalism, which, through the medium of the works of Maimonides, threatened the authority of the Old Testament, obedience to the law, and the belief in miracles and revelation. He, therefore, in a series of letters (afterwards collected under the title *Minhat Kenaot; i.e.*, "Jealousy Offering") called upon the famous rabbi Solomon ben Adret of Barcelona to come to the aid of orthodoxy. Ben Adret, with the approval of other prominent Spanish rabbis, sent a letter to the community at Montpellier proposing to forbid the study of philosophy to those who were less than 30 years of age, and, in spite of keen opposition from the liberal section, a decree in this sense was issued by ben Adret in 1305 The result was a great schism among the Jews of Spain and southern France, and a new impulse was given to the study of philosophy by the unauthorized interference of the Spanish rabbis. On the expulsion of the Jews from France by Philip IV. in 1306, Abba Mari settled at Perpignan, where he published the letters connected with the controversy

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'ABBAS I. (*c.* 1557–1628 or 1629), shah of Persia, called the Great, was the son of Shah Mohammed (d 1586). In the midst of general anarchy in Persia, he was proclaimed ruler of Khurāsān, and became shah in 1586 Determined to raise the fallen fortunes of his country, he first directed his efforts against the predatory Uzbegs, who occupied and harassed Khurāsān. After a long struggle, he regained Meshed, defeated them in a great battle near Herat in 1507, and drove them out of his dominions. In the wars he carried on with the Turks during nearly the whole of his reign, he acquired, or regained, a large extent of territory.

By the victory he gained at Basra in 1605 he extended his empire beyond the Euphrates; Sultan Ahmed I. was forced to cede Shirvan and Kurdistan in 1611; the united armies of the Turks and Tatars were completely defeated near Sultanieh in 1618, and 'Abbas made peace on very favourable terms; and on the Turks renewing the war, Baghdad fell into his hands after a year's siege in 1623. In 1622 he took the island of Ormuz from the Portuguese, by the assistance of the British, and much of its trade was diverted to the town of Bander-Abbāsi, which was named after the shah When he died (Jan 27, 1628) his dominions reached from the Tigris to the Indus. Abbas distinguished himself, not only by his successes in arms, and by the magnificence of his court and of the buildings which he erected, but also by his reforms in the administration of his kingdom

He encouraged commerce by constructing highways and building bridges To foreigners, especially Christians, he showed a spirit of tolerance; two Englishmen, Sir Anthony and Sir Robert Shirley, or Sherley, were admitted to his confidence His fame is tarnished by numerous deeds of tyranny and cruelty His own family, especially, suffered from his fits of jealousy; his eldest son was slain, and the eyes of his other children were put out, by his orders

BIBLIOGRAPHY.—See *The Three Brothers, or Travels of Sir Anthony, Sir Robert Sherley*, etc. (1825), Sir C. R. Markham, *General Sketch of the History of Persia* (1874).

ABBAS I. (1813–1854), pasha of Egypt, was a son of Tusun Pasha and grandson of Mohammed Ali. As a young man he fought in Syria under Ibrahim Pasha (*q v.*), his real or supposed uncle. The death of Ibrahim in Nov. 1848 made Abbas regent of Egypt, and in Aug. 1849 following, just before the death of Mohammed Ali, Abbas succeeded to the pashalik. He was a reactionary, cruel, morose and taciturn, and spent nearly all his time shut up in his palace He undid, as far as lay in his power, the works of his grandfather, good and bad. Among other things he abolished trade monopolies, closed factories and schools, and reduced the strength of the army to 9,000 men. At the instance of the British Government he allowed the construction of a railway from Alexandria to Cairo. On July 13, 1854, he was murdered in Benha palace by two of his slaves.

ABBAS II. (1874–), khedive of Egypt. Abbas Hilmi Pasha, great-great-grandson of Mohammed Ali, born on July 14, 1874, succeeded his father, Tewfik Pasha, as khedive of Egypt on Jan. 8, 1892. He was still studying in Vienna when the sudden death of his father raised him to the khedivate; and he was barely of age according to the Turkish law of succession. For some time he did not co-operate very cordially with Great Britain. He vis-

ited England in 1900, when he declared himself ready to co-operate with the British officials administering Egyptian affairs. He interested himself in the establishment of a sound system of native justice, the great remission of taxation, the reconquest of the Sudan, the inauguration of the irrigation works at Aswan, the increase of education and especially in farming and stock-raising. On Dec 18, 1914, a British protectorate over Egypt was declared, and on Dec. 19 Abbas Hilmi was deposed in favour of Hussein Kâmil (1854–1917). By the rescript of April 13, 1922, establishing the law of succession the ex-khedive was definitely excluded from the succession, though without prejudice to any rights of his direct and lawful male descendants

See Lord Cromer, *Abbas II.* (1915).

ABBASIDS, the name generally given to the second of the two great dynasties of the Mohammedan empire. The Abbasid caliphs based their claim on their descent from Abbas (A D. 566–652), the eldest uncle of Mohammed, and regarded themselves as the true heirs of the Prophet as opposed to the descendants of Omayya. Throughout the second period of the Omayyads, representatives of this family were among their most dangerous opponents. In the reign of Merwan II. this opposition culminated in the rebellion of Ibrahīm the Imam who achieved considerable success, but was captured (A D. 747) and died in prison. The quarrel was taken up by his brother Abdallah, who after a decisive victory on the Greater Zab (750) finally crushed the Omayyads and was proclaimed caliph.

The new dynasty encouraged the development of luxury and the liberal arts The reigns of Harun al-Rashid (786–809) and Mamun (813–833) at Baghdad were periods of extraordinary splendour. But the empire as a whole stagnated and then decayed Independent monarchs established themselves in Africa and Khūrāsān The ruin of the dynasty came, however, from those Turkish slaves who were constituted as a royal bodyguard by Moqtasim (833–842). Their power grew until Radi (934–941) was constrained to hand over most of the royal functions to Mohammed b. Raik. Province after province renounced the authority of the caliphs, who were merely lay figures, and finally Khulagu, the Tatar chief, burned Baghdad (Feb. 28, 1258). The Abbasids still maintained a feeble show of authority, confined to religious matters, in Egypt under the Mamelukes, but the dynasty finally disappeared when Motawakkil III. was carried as a prisoner to Constantinople by Selim I. (*See* CALIPHATE.)

'ABBAS MIRZA (1783–1833), Persian prince, was a younger son of Feth Ali, shah of Persia, and was nominated to succeed him. But he predeceased his father and the succession fell to his son, Mohammed Mirza. 'Abbas Mirza conducted many campaigns against Russia between 1800 and 1813 when, by the Treaty of Gulistan, Georgia and other provinces were ceded to Russia. In 1826–28 he and his son were again campaigning against Russia, again with no final success, for the khanates of Erivan and Nakhichevan were ceded to Russia. In the interval of the Russian wars he fought against the Turks, winning a complete victory near Erzerum in 1821. After the final peace with Russia 'Abbas Mirza set about the reorganization of the province of Khūrāsān and died at Meshed in Dec. 1833. Although 'Abbas was unsuccessful in the wars against Russia, he displayed great skill as a general, and learned something from the European soldiers who helped him to reorganize his army. He was cultivated and intelligent, and lived more simply than was the custom with the Persian royal house.

ABBAS-TUMAN, a spa in the Georgian S S R. (41° 44′ N., 42° 46′ E.). Its hot sulphur springs (93½°–118½° F.) and astronomical observatory (4,240ft.) are noted. Pop. (1926) 1,243.

ABBAYE, the name given to a group of French writers, painters and musicians who, in 1906, formed a community at Créteil, where they set up a printing press and published their works. Their number included Roger Allard, René Arcos, Henri Barzun, Albert Doyen, Georges Duhamel, Jules Romains, Charles Vildrac, etc.

ABBAZIA, province of Fiume, Italy, 56m. S.E. of Trieste by rail. Pop. (1921), 2,479 (town), 5,062 (commune, which is called Volosca-Abbazia). It is on the Gulf of Quarnero at the foot of the Monte Maggiore (4,580ft), sheltered and surrounded by laurel woods. The average temperature is 50°F. (winter), and 77°F. (summer). The old abbey, San Giacomo al Palo, whence the town's name, is now a villa. Abbazia used to have 50,000 visitors per annum. The whole sea-coast to the north and south is rocky and picturesque.

ABBE, CLEVELAND (1838–1916), American meteorologist and astronomer, was born in New York city on Dec. 3, 1838. His training as astronomer under B. A. Gould, Brunnow and Struve (Pulkova, 1865–66) and work at the U S. Naval observatory developed his interest in weather changes. As director of the Cincinnati observatory, 1869–73, he demonstrated the practicability of weather forecasts based on daily telegraphic synoptic charts, and in 1870 joined the U S. signal corps to organize and direct its weather forecasts. When this greatly expanded service was transferred to the Department of Agriculture in 1891, he went as senior professor of meteorology. Abbe was often and justly called the "father of the weather bureau." *The Monthly Weather Review,* which he edited, and the introduction of the system of standard time, were both due to his initiative.

Among his works are: *Report on Standard Time* (1879); *Mechanics of the Earth's Atmosphere* (1892–1910); *Preparatory Studies for Deductive Methods* (1890); *Relation between Climate and Crops* (1901); *Physical Basis of Long-range Forecasting* (1902).

ABBE, ERNST (1840–1905), German physicist, was born in Eisenach, Thuringia, Jan. 23, 1840. He was educated at Gottingen and Jena. In 1863 he became an instructor, and in 1870 was made a professor, in the University of Jena, at which in 1878 he was appointed director of the astronomical and meteorological observatories. In 1866 he became connected with the optical works of Carl Zeiss, was made a partner in 1875, and contributed in a very large degree through his experiments to the excellence of the instruments and lenses made by the firm. In 1884, with Zeiss and Schott, he established important works for the production of technical glass. Upon the death of Zeiss in 1888 he became the sole owner of the Zeiss optical works, which he reorganized as a co-operative establishment in the profits from which the officials, the workmen and the university participated. He invented the Abbe refractometer and made many improvements in microscopic and photographic lenses. His *Gesammelte Abhandlungen* were published in 1903–06. He died in Jena, Jan. 14, 1905.

See F. Auersbach, *Ernst Abbe* (1918).

ABBESS, the superior of a community of nuns. The mode of election, position, rights and authority of an abbess correspond generally with those of an abbot (*q v*); but she cannot exercise priestly functions. An abbess is elected by the secret votes of the sisters, installed solemnly by episcopal benediction, and has the abbatial cross, staff and ring; she holds office usually for life. The Council of Trent fixed the qualifying age at forty, with eight years of profession. In England abbesses attended ecclesiastical councils, *e g* , that of Becanfield in 694, where they signed before the presbyters.

Abbesses presided over many of the early joint-houses of monks and nuns, *e g* , at Whitby; and later the whole "double" order of Fontevraud (founded *c.* 1100) was governed by an abbess.

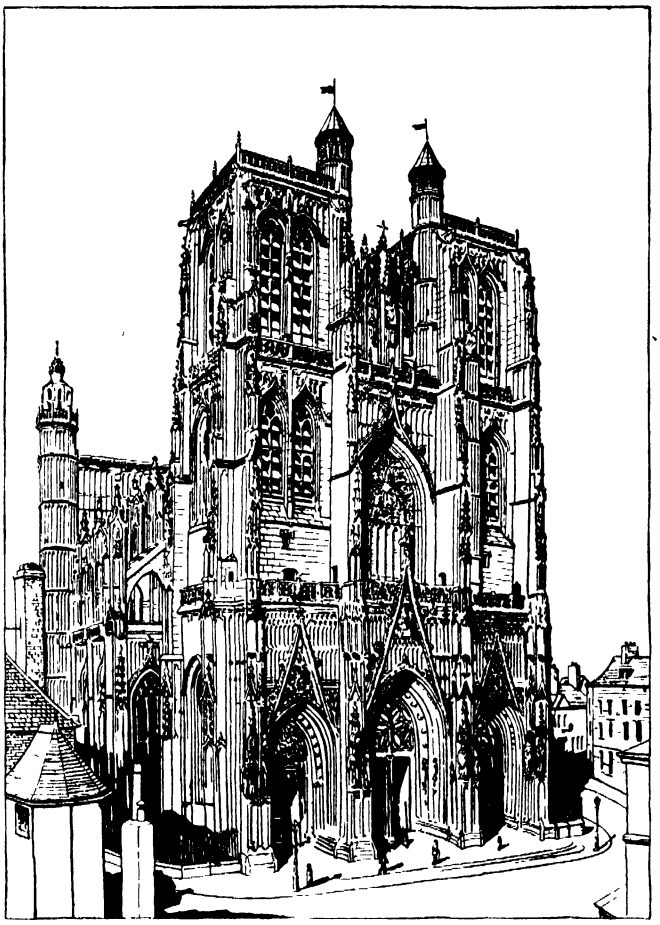
In the German Evangelical Church the title of abbess (*Aebtissin*) has survived for the heads of abbeys which since the Reformation have continued as *Stifter, i.e.,* collegiate foundations for the maintenance of unmarried ladies, generally of noble birth, called *Stiftsdamen.*

ABBEVILLE, a city in the western part of South Carolina, U S A., 20m. from the Savannah river; the county seat of Abbeville county. It is served by the Seaboard Air Line and the Southern railways. The population was 4,570 in 1920 (39% negroes), and was estimated locally at 5,500 in 1928. Cotton, tobacco and poultry are raised in this region, and clay is mined near the city. There are cotton-mills operating nearly 30,000 spindles. Abbeville was settled about 1710 and incorporated in 1840.

ABBEVILLE, a town of northern France, the capital of an arrondissement, department of Somme, on the Somme, 12m. from the English channel, and 28m. N.W. of Amiens on the Northern railway. Pop. (1926) 19,125. It is built partly on an island and

partly on both sides of the river, which is canalized from this point to the estuary. The tradition of settlement extends from the Palaeolithic through the late Bronze Age (when the area was very important).

• Abbeville, chief town of Ponthieu, belonged in the 9th century to the abbey of St. Riquier, and afterwards to the counts of Ponthieu. It passed to the Alençon and other French families, and afterwards to the house of Castille, from whom by marriage it went to Edward I. of England. French and English ruled it



THE CHURCH OF ST. VULFRAN, ONE OF THE MOST REMARKABLE OF THE SEVERAL OLD CHURCHES OF ABBEVILLE, DATES FROM THE 15TH CENTURY

by turns till 1435 when it was ceded to the duke of Burgundy In 1477 it was annexed by Louis XI, and held by branches of the family until it was reunited to the Crown in 1696 The streets are narrow and present an almost mediaeval appearance. The church of St. Vulfran, erected in the 15th, 16th and 17th centuries, was not entirely completed. The façade is a magnificent specimen of flamboyant Gothic flanked by two Gothic towers. Abbeville has other old churches and an hôtel de ville, with a belfry of the 13th century. Among the old houses, the Maison de François I. dates from the 16th century. Situated on one of the main entries into France it became a great British base during the World War Abbeville is an industrial centre; in addition to its old-established manufacture of cloth, hemp-spinning, sugar-making, shipbuilding and locksmiths' work are carried on; there is active commerce in grain, but the port has little trade. It has a tribunal of commerce and a board of trade-arbitrators.

ABBEY, EDWIN AUSTIN (1852–1911), American painter, was born at Philadelphia April 1, 1852. He left the schools of the Pennsylvania Academy of Fine Arts at the age of 19 to enter the art department of the publishing house of Harper and Brothers in New York, where, in company with such men as Howard Pyle, Charles Stanley Reinhart, Joseph Pennell and Alfred Parsons, he became very successful as an illustrator. In 1878 he was sent by the Harpers to England to gather material for illustrations of the poems of Robert Herrick. These, published in 1882, attracted much attention, and were followed by illustrations for Goldsmith's *She Stoops to Conquer* (1887), for a volume of *Old Songs* (1889), and for the comedies (and a few of the tragedies) of Shakespeare. His water-colours and pastels were no less successful than the earlier illustrations in pen and ink. Abbey now became closely identified with the art life of England, and was elected to the Royal Institute of Painters in Water-Colours in 1883. Among his water-colours are "The Evil Eye" (1877); "The Rose in October" (1879); "An Old Song" (1886); "The Visitors" (1890), and "The Jongleur" (1892). Possibly his best-known pastels are "Beatrice," "Phyllis," and "Two Noble Kinsmen." In 1890 he made his first appearance with an oil painting, "A May Day Morn," at the Royal Academy in London He exhibited "Richard duke of Gloucester and the Lady Anne" at the Royal Academy in 1896, and in that year was elected A R A., becoming a full R A. in 1898. Apart from his other paintings, special mention must be made of the large frescoes entitled "The Quest of the Holy Grail," in the Boston Public Library, on which he was occupied for some years; and in 1901 he was commissioned by King Edward VII. to paint a picture of the coronation, containing many portraits elaborately grouped The dramatic subjects, and the brilliant colouring of his oil pictures, gave them pronounced individuality among the works of contemporary painters. Abbey became a member not only of the Royal Academy, but also of the National Academy of Design of New York, and honorary member of the Royal Bavarian Society, the Société Nationale des Beaux Arts (Paris), the American Water-Colour Society, etc. He received first-class gold medals at the International Art Exhibition of Vienna in 1898, at Philadelphia in 1898, at the Paris Exhibitions of 1889 and 1900, and at Berlin in 1903; and was made a chevalier of the French Legion of Honour.

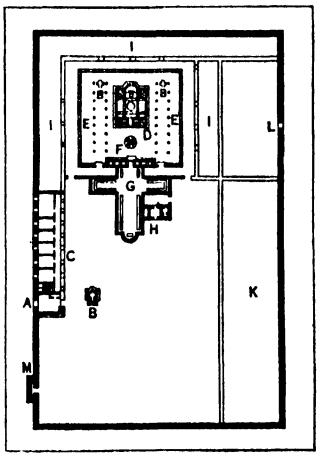
The last years of his life were devoted to mural paintings for the capitol at Harrisburg, Pa. Of these he completed three, one for the House of Representatives, another for the Senate Chamber and the third for the ceiling of the dome In 1910 there was completed under his supervision the decoration of the Peers' corridor of the Houses of Parliament at Westminster. He left bequests of his work to the Metropolitan Museum of Art in New York, the Boston Museum of Fine Arts and the National Gallery, London He died in London on Aug 1, 1911.

ABBEY, a monastery, or conventual establishment, under the government of an ABBOT or an ABBESS (Lat *abbatia;* from Syr. *abba,* father).

The earliest Christian monastic communities (*see* MONASTICISM) with which we are acquainted consisted of groups of cells or huts collected about a common centre, which was usually the abode of some anchorite celebrated for superior holiness or singular asceticism. The formation of such communities in the East precedes Christianity, the example having been already set by the Essenes in Judea and the Therapeutae in Egypt.

In the earliest age of Christian monasticism the ascetics were accustomed to live singly, independent of one another, at no great distance from some village, supporting themselves by the labour of their own hands, and distributing to the poor the surplus after the supply of their own scanty wants Increasing religious fervour, aided by persecution, drove them farther and farther away from the abodes of men into mountain solitudes or lonely deserts. The deserts of Egypt swarmed with the "cells" or huts of these anchorites. Anthony, who had retired to the Egyptian Thebaid during the persecution of Maximin, A.D. 312, was the most celebrated among them for his austerities, his sanctity, and his power as an exorcist. His fame collected round him a host of followers, emulous of his sanctity. The deeper he withdrew into the wilderness the more numerous his disciples became. They refused to be separated from him, and built their cells round that of their spiritual father. Thus arose the first monastic community, consisting of anchorites living each in his own little dwelling, united together under one superior. By degrees order was introduced in the groups of huts. They were arranged in lines like the tents in an encampment, or the houses in a street. From this arrangement these lines of single cells came to be known as

Laurae, Λαῦραι, "streets" or "lanes." The real founder of coenobian (*κοινός*, common, and *βίος*, life) monasteries in the modern sense was Pachomius, an Egyptian of the beginning of the 4th century. The first community established by him was at Tabennae, an island of the Nile in Upper Egypt. Eight others were founded in his lifetime, numbering 3,000 monks Within 50 years from his death his societies could reckon 50,000 members. These coenobia resembled villages peopled by a hard-working religious community, all of one sex. The buildings were detached, small, and of the humblest character. The coenobia of Syria belonged to the Pachomian institution. We learn many details concerning those in the vicinity of Antioch from Chrysostom's writings. The monks lived in separate huts, *καλύβια*, forming a religious hamlet on the mountain side. They were subject to an abbot, and observed a common rule. (They had no refectory, but ate their common meal, of bread and water only, when the day's labour was over, reclining on strewn grass, sometimes out of doors) Four times in the day they joined in prayers and psalms.



AFTER LENOIR

FIG. 1.—MONASTERY OF SANTA LAURA, MOUNT ATHOS. THE OLDER ABBEYS, CONSTRUCTED TO OFFER DEFENCE AGAINST ATTACKS, WERE BUILT WITH STRONG OUTER WALLS AND FEW ENTRANCES SANTA LAURA HAD BUT TWO, THE MAIN ENTRANCE A AND THE POSTERN L

A. Gateway	G. Refectory
B. Chapels	H. Kitchen
C. Guest house	I. Cells
D. Church	K. Storehouses
E. Cloister	L. Postern gate
F. Fountain	M. Tower

The necessity for defence from hostile attacks, economy of space, and convenience of access from one part of the community to another, by degrees dictated a more compact and orderly arrangement of the buildings of a monastic coenobium. Large piles of building were erected, with strong outside walls, capable of resisting the assaults of an enemy, within which all the necessary edifices were ranged round one or more open courts, usually surrounded with cloisters. The usual Eastern arrangement is exemplified in the plan of the convent of Santa Laura, Mount Athos (*Laura*, the designation of a monastery generally, being converted into a female saint).

This monastery, like the oriental monasteries generally, is surrounded by a strong and lofty blank stone wall, enclosing an area of between 3 and 4 acres. The longer side extends to a length of about 500ft. There is only one main entrance, on the north side (A), defended by three separate iron doors Near the entrance is a large tower (M), a constant feature in the monasteries of the Levant. There is a small postern gate at L. The *enciente* comprises two large open courts, surrounded with buildings connected with cloister galleries of wood or stone. The outer court, which is much the larger, contains the granaries and storehouses (K), and the kitchen (H) and other offices connected with the refectory (G). Immediately adjacent to the gateway is a two-storied guest-house, opening from a cloister (C). The inner court is surrounded by a cloister (EE), from which open the monks' cells (II). In the centre of this court stands the catholicon or conventual church, a square building with an apse of the cruciform domical Byzantine type. In front of the church stands a marble fountain (F), covered by a dome supported on columns. Opening from the western side of the cloister, but actually standing in the outer court, is the refectory (G), a large cruciform building, about 100ft. each way, decorated within with frescoes of saints. At the upper end is a semi-circular recess, in which is placed the seat of the *hegumenos* or abbot. This apartment is chiefly used as a hall of meeting, the oriental monks usually taking their meals in their separate cells.

Benedictine.—Monasticism in the West owes its extension and development to Benedict of Nursia (born A D. 480). His rule was diffused with miraculous rapidity from the parent foundation on Monte Cassino through the whole of western Europe, and every country witnessed the erection of monasteries far exceeding anything that had yet been seen in spaciousness and splendour. Few great towns in Italy were without their Benedictine convent, and they quickly rose in all the great centres of population in England, France, and Spain. The number of these monasteries founded between A D. 520 and 700 is amazing. Before the Council of Constance, A D. 1415, no fewer than 15,070 abbeys had been established of this order alone. The buildings of a Benedictine abbey were uniformly arranged after one plan, modified where necessary (as at Durham and Worcester, where the monasteries stand close to the steep bank of a river) to accommodate the arrangement to local circumstances (*see* BENEDICTINES). We

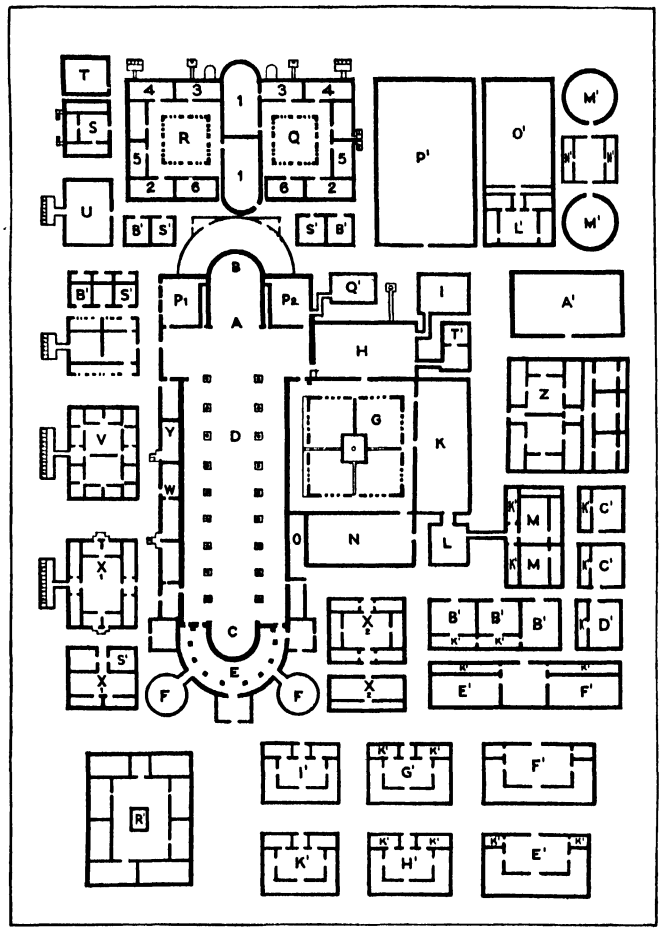


FIG. 2.—GROUND PLAN OF THE ABBEY OF ST GALL, BUILT A D 820. THIS ABBEY FOLLOWED THE BENEDICTINE RULE OF BEING SELF-CONTAINED, AND HAD ITS OWN MILL AND BAKEHOUSE, TOGETHER WITH ACCOMMODATION FOR CARRYING ON ALL NECESSARY MECHANICAL ARTS

CHURCH: A. High Altar. B. Altar of St. Paul. C. Altar of St. Peter. D. Nave. E. Paradise. FF. Towers. MONASTIC BUILDINGS: G. Cloister. H. Calefactory with dormitory situated above. I. Necessary. K. Refectory. L. Kitchen. M. Bakehouse and Brewhouse. N. Cellar. O. Parlour. P1. Scriptorium, with library over. P2. Sacristy and vestry. Q. House of novices: 1. Chapel. 2. Refectory. 3. Calefactory. 4. Dormitory. 5. Master's room. 6. Chambers. R. Infirmary: 1-6 as above In house of novices. S. Doctor's house. T. Physic garden. U. House for bloodletting. V. School. W. School-master's lodgings. X_1X_1. Guest-house for those of superior rank. X_2X_2. Guest-house for the poor. Y. Guest-chamber for strange monks. MENIAL DEPARTMENT: Z. Factory. A'. Threshing-floor. B'. Work-shops. C'. Mills. D'. Kiln. E'. Stables. F'. Cowsheds. G'. Goatsheds. H'. Pigsties. I'. Sheep-folds. K'. Servants' and workmen's sleeping-chambers. L'. Gardener's house. M'. Hen and duck house. N'. Poultry-keeper's house. O'. Garden. P'. Cemetery. Q'. Bakehouse for sacramental bread. R'. Unnamed on plan. S'. Kitchens. T'. Baths

have no existing examples of the earlier monasteries of the Benedictine order. But we have fortunately preserved to us an elaborate plan of the great Swiss monastery of St. Gall, erected about A D. 820, which puts us in possession of the whole arrangements of a monastery of the first class towards the early part of the 9th century. This curious and interesting plan has been made the

subject of a memoir both by Keller (Zürich, 1844) and by Professor Robert Willis (*Arch. Journal*, 1848, vol. v., pp. 86–117). To the latter we are indebted for the substance of the following description, as well as for the plan, reduced from his elucidated transcript of the original preserved in the archives of the convent. The general appearance of the convent is that of a town of isolated houses with streets running between them. It is evidently planned in compliance with the Benedictine rule, which enjoined that, if possible, the monastery should contain within itself every necessary of life, as well as the buildings more intimately connected with the religious and social life of its inmates. It should comprise a mill, a bakehouse, stables, and cow-houses, together with accommodation for carrying on all necessary mechanical arts within the walls, so as to obviate the necessity of the monks going outside its limits.

The general distribution of the buildings may be thus described. The church, with its cloister to the south, occupies the centre of a quadrangular area, about 430ft. square. The buildings, as in all great monasteries, are distributed into groups The church forms the nucleus, as the centre of the religious life of the community. In closest connection with the church is the group of buildings appropriated to the monastic life and its daily requirements—the refectory for eating, the dormitory for sleeping, the common room for social intercourse, the chapter-house for religious and disciplinary conference. These essential elements of monastic life are ranged about a cloister court, surrounded by a covered arcade, affording communication sheltered from the elements between the various buildings. The infirmary for sick monks, with the physician's house and physic garden, lies to the east. In the same group with the infirmary is the school for the novices. The outer school, with its headmaster's house against the opposite wall of the church, stands outside the convent enclosure, in close proximity to the abbot's house, that he might have a constant eye over them The buildings devoted to hospitality are divided into three groups—one for the reception of distinguished guests, another for monks visiting the monastery, a third for poor travellers and pilgrims. The first and third are placed to the right and left of the common entrance of the monastery—the hospitium for distinguished guests being placed on the north side of the church, not far from the abbot's house; that for the poor on the south side next to the farm buildings The monks are lodged in a guest-house built against the north wall of the church. The group of buildings connected with the material wants of the establishment is placed to the south and west of the church, and is distinctly separated from the monastic buildings The kitchen, buttery, and offices are reached by a passage from the west end of the refectory and connected with the bakehouse and brewhouse, which are placed still farther away. The whole of the southern and western sides is devoted to workshops, stables and farm-buildings. The buildings, with some exceptions, seem to have been of one storey only, and all but the church were probably erected of wood.

Canterbury Cathedral.—A curious bird's-eye view of Canterbury cathedral and its annexed conventual buildings, taken about 1165, is preserved in the Great Psalter in the library of Trinity college, Cambridge. As elucidated by Prof. Willis,[1] it exhibits the plan of a great Benedictine monastery in the 12th century, and enables us to compare it with that of the 9th as seen at St. Gall. We see in both the same general principles of arrangement, which indeed belong to all Benedictine monasteries, enabling us to determine with precision the disposition of the various buildings, when little more than fragments of the walls exist. From some local reasons, however, the cloister and monastic buildings are placed on the north, instead, as is far more commonly the case, on the south of the church. There is also a separate chapter-house, which is wanting at St. Gall.

The buildings at Canterbury, as at St. Gall, form separate groups. The church forms the nucleus. In immediate contact with this, on the north side, lie the cloister and the group of buildings devoted to the monastic life. Outside of these, to the west and east, are the "halls and chambers devoted to the exercise of hospitality, with which every monastery was provided, for the purpose of receiving as guests persons who visited it, whether clergy or laity, travellers, pilgrims, or paupers." To the north a large open court divides the monastic from the menial buildings, intentionally placed as remote as possible from the conventual buildings proper, the stables, granaries, barn, bakehouse, brewhouse, laundries, etc., inhabited by the lay servants of the establishment At the greatest possible distance from the church, beyond the precinct of the convent, is the eleemosynary department. The *almonry* for the relief of the poor, with a great hall annexed, forms the paupers' hospitium.

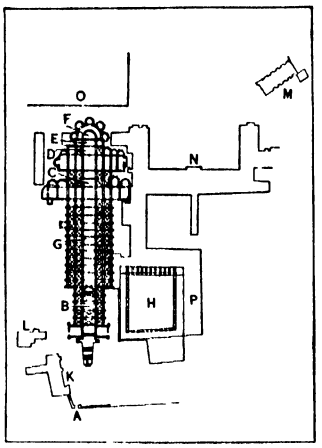


FIG. 3.—PLAN OF ABBEY OF CLUNY, FRANCE AFTER VIOLLET-LE-DUC CLUNY WAS THE MOST FAMOUS MONASTERY OF THE REFORMED ORDER OF BENEDICTINES IT WAS SWEPT AWAY AT THE END OF THE 18TH CENTURY

A. Gateway	H Cloister
B Narthex	K. Abbot's house.
C. Choir	L. Guest-house
D. High altar	M. Bakehouse
E. Retro-altar	N. Abbey buildings
F. Tomb of St. Hugh	O. Garden
G. Nave	P. Refectory

Westminster Abbey.—Westminster abbey is another example of a great Benedictine abbey, identical in its general arrangements, so far as they can be traced, with those described above. The cloister and monastic buildings lay to the south side of the church Parallel to the nave, on the south side of the cloister, was the refectory, with its lavatory at the door, and on the eastern side the remains of the dormitory, raised on a vaulted substructure and communicating with the south transept. The chapter-house opened out of the same alley of the cloister. The small cloister lay to the south-east of the larger cloister, and still farther to the east the remains of the infirmary with the *table hall*, the refectory of those who were able to leave their chambers The abbot's house formed a small courtyard at the west entrance, close to the inner gateway. Considerable portions of this remain, including the abbot's parlour, celebrated as "the Jerusalem Chamber," his hall, now used for the Westminster king's scholars, and the kitchen and butteries beyond.

Cluny.—The history of monasticism is one of alternate periods of decay and revival. With growth in popular esteem came increase in material wealth, leading to luxury and worldliness. The first religious ardour cooled, the strictness of the rule was relaxed, until by the 10th century the decay of discipline was so complete in France that the monks are said to have been frequently unacquainted with the rule of St Benedict, and even ignorant that they were bound by any rule at all. The reformation of abuses generally took the form of the establishment of new monastic orders, with new and more stringent rules, requiring a modification of the architectural arrangements. One of the earliest of these reformed orders was the *Cluniac*, taking its name from the little village of Cluny, 12m N W. of Mâcon, near which, about A D. 909, a reformed Benedictine abbey was founded by William, duke of Aquitaine and count of Auvergne, under Berno, abbot of Beaume He was succeeded by Odo, who is often regarded as the founder of the order. The fame of Cluny spread far and wide Its rigid rule was adopted by a vast number of the old Benedictine abbeys, who placed themselves in affiliation to the mother society, while new foundations sprang up in large numbers, all owing allegiance to the "archabbot," established at Cluny. By the end of the 12th century the number of monasteries affiliated to Cluny in the various countries of western Europe amounted to 2,000. The monastic establishment of Cluny was one of the most extensive and magnificent in France. We may form some idea of its enormous dimensions from the fact recorded, that, when, A D 1245, Pope Innocent IV , accompanied

[1] *The Architectural History of the Conventual Buildings of the Monastery of Christ Church in Canterbury.* By the Rev. Robert Willis. Printed for the Kent Archaeological Society, 1869.

by twelve cardinals, a patriarch, three archbishops, the two generals of the Carthusians and Cistercians, the king (St. Louis), and three of his sons, the queen mother, Baldwin, count of Flanders and emperor of Constantinople, the duke of Burgundy, and six lords, visited the abbey, the whole party, with their attendants, were lodged within the monastery without disarranging the monks, 400 in number. Nearly the whole of the abbey buildings, including the magnificent church, were swept away at the close of the 18th century. When the annexed ground-plan was taken, shortly before its destruction, nearly all the monastery, with the exception of the church, had been rebuilt.

The church, the ground-plan of which bears a remarkable resemblance to that of Lincoln cathedral, was of vast dimensions It was 656ft. by 130ft. wide. The nave was 102ft. and the aisles 60ft. high. The nave (G) had double vaulted aisles on either side. Like Lincoln, it had an eastern as well as a western transept, each furnished with apsidal chapels to the east. The western transept was 213ft. long, and the eastern 123ft. The choir terminated in a semicircular apse (F), surrounded by five chapels, also semicircular. The western entrance was approached by an ante-church, or *narthex* (B), itself an aisled church of no mean dimensions, flanked by two towers, rising from a flight of steps bearing a stone cross. The first English house of the Cluniac order was that of Lewes, founded by the earl of Warren, *c.* A.D. 1077. Of this only a few fragments of the domestic buildings exist. The best preserved Cluniac houses in England are Castle Acre, Norfolk, and Wenlock, Shropshire.

The Cluniac revival, with all its brilliancy, was but short-lived. The celebrity of this, as of other orders, worked its moral ruin. With their growth in wealth and dignity the Cluniac foundations became as worldly in life and as relaxed in discipline as their predecessors, and a fresh reform was needed

Cistercian.—The next great monastic revival, the Cistercian, arising in the last years of the 11th century, had a wider diffusion, and a longer and more honourable existence. The rapid growth and wide celebrity of the order are undoubtedly to be attributed to the enthusiastic piety of St Bernard, abbot of the first of the monastic colonies, subsequently sent forth in such quick succession by the first Cistercian houses, the far-famed abbey of Clairvaux, A.D. 1116 The rigid self-abnegation, which was the ruling principle of this reformed congregation of the Benedictine order, extended itself to the churches and other buildings erected by them. The characteristic of the Cistercian abbeys was the extremest simplicity and a studied plainness. Only one tower—a central one—was permitted, and that was to be very low. Unnecessary pinnacles and turrets were prohibited The windows were to be plain and undivided, and it was forbidden to decorate them with stained glass. All needless ornament was proscribed. The crosses must be of wood; the candlesticks of iron. The renunciation of the world was to be evidenced in all that met the eye. The same spirit manifested itself in the choice of the sites of their monasteries. The more dismal, the more hopeless a spot appeared, the more did it please their rigid mood. But they came not merely as ascetics, but as improvers The Cistercian monasteries are, as a rule, found placed in deep well-watered valleys. They always stand on the border of a stream; not rarely, as at Fountains, the buildings extend over it. These valleys, now so rich and productive, wore a very different aspect when the brethren first chose them as the place of their retirement. Wide swamps, deep morasses, tangled thickets, wild impassable forests, were their prevailing features. The "bright valley," *Clara Vallis* of St. Bernard, was known as the "valley of Wormwood," infamous as a den of robbers.

All Cistercian monasteries, unless the circumstances of the locality forbade it, were arranged according to one plan. The general arrangement and distribution of the various buildings which went to make up one of these vast establishments may be gathered from that of St. Bernard's own abbey of Clairvaux, which is here given. It will be observed that the abbey precincts are surrounded by a strong wall, furnished at intervals with watch-towers and other defensive works. The wall is nearly encircled by a stream of water, artificially diverted from the small rivulets which flow through the precincts, furnishing the establishment with an abundant supply in every part, for the irrigation of the gardens and orchards, the sanitary requirements of the brotherhood and for the use of the offices and workshops.

The precincts are divided across the centre by a wall, running from north to south, into an outer and inner ward—the former containing the menial, the latter the monastic buildings. The pre-

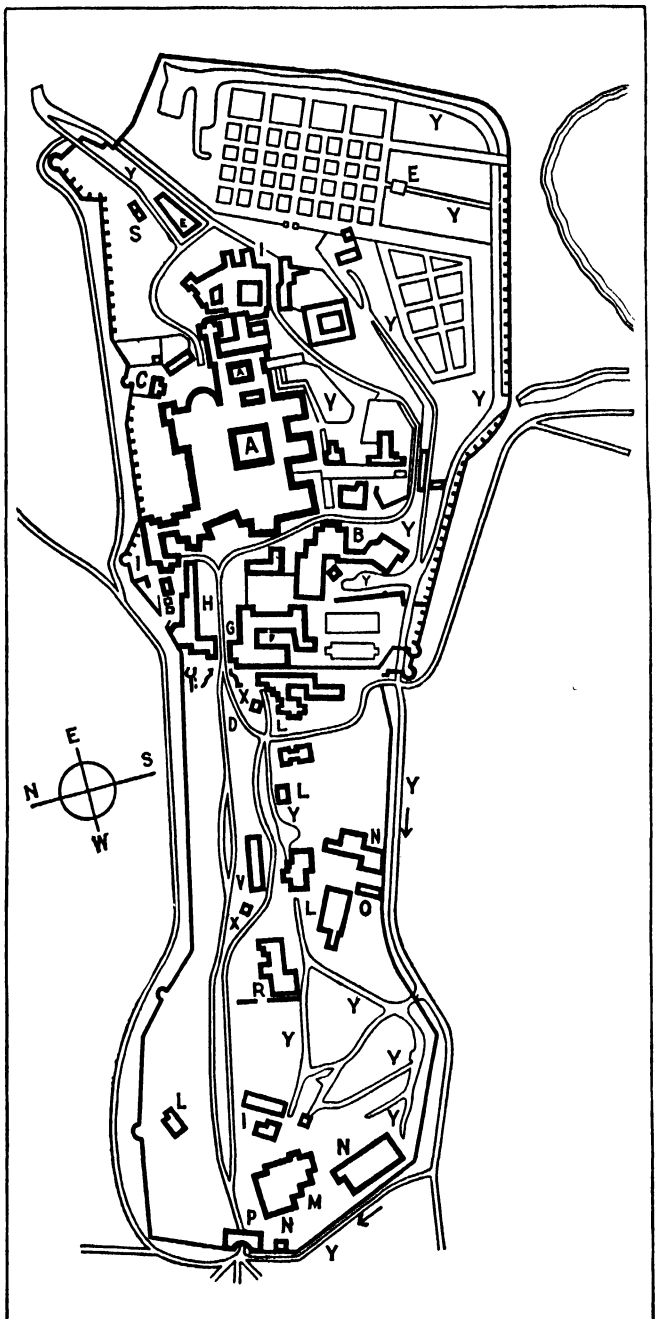
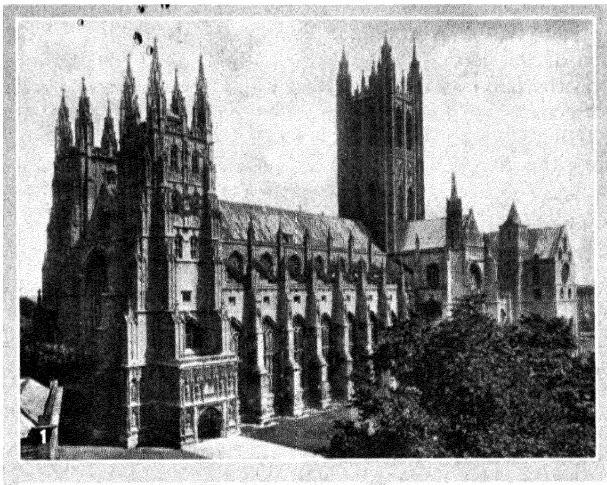
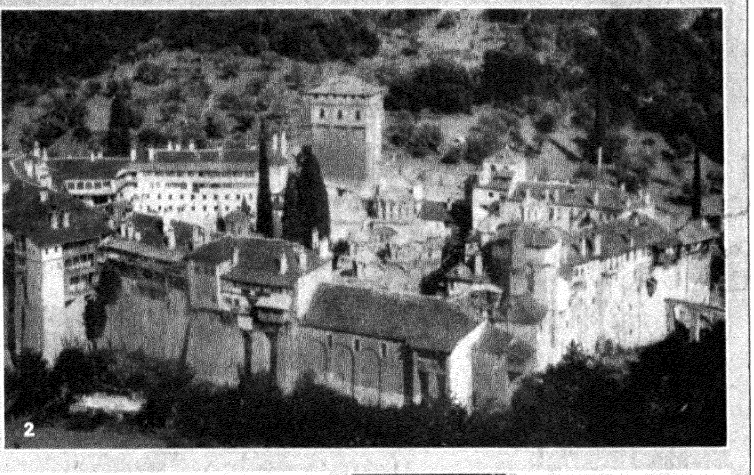


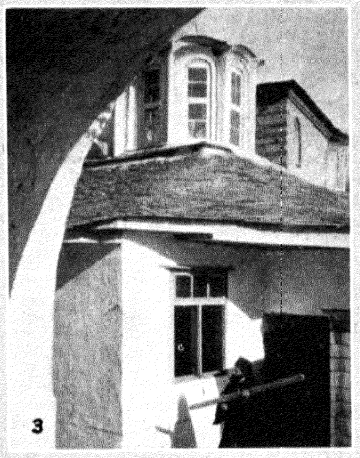
FIG. 4.—GENERAL PLAN OF CLAIRVAUX (CISTERCIAN). BUILT A.D. 1116. THE CISTERCIANS WERE A REFORMED CONGREGATION OF THE BENEDICTINE ORDER. CISTERCIAN ABBEYS WERE NOTED FOR THEIR SIMPLICITY OF DESIGN

A. Cloisters
B. Ovens, and corn and oil mills
C. St. Bernard's cell
D. Chief entrance
E. Tanks for fish
F. Guest-house
G. Abbot's house
H. Stables
I. Wine-press and hay chamber
L. Workshops and workmen's lodgings
M. Slaughter-house
N. Barns and stables
O. Public presse
P. Gateway
R. Remains of old monastery
S. Oratory
V. Tile-works
X. Tile-kiln
Y. Water-courses

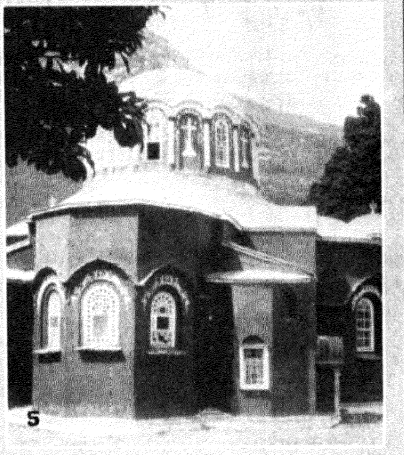
cincts are entered by a gateway (P), at the extreme western extremity, giving admission to the lower ward. Here the barns, granaries, stables, shambles, workshop and workmen's lodgings



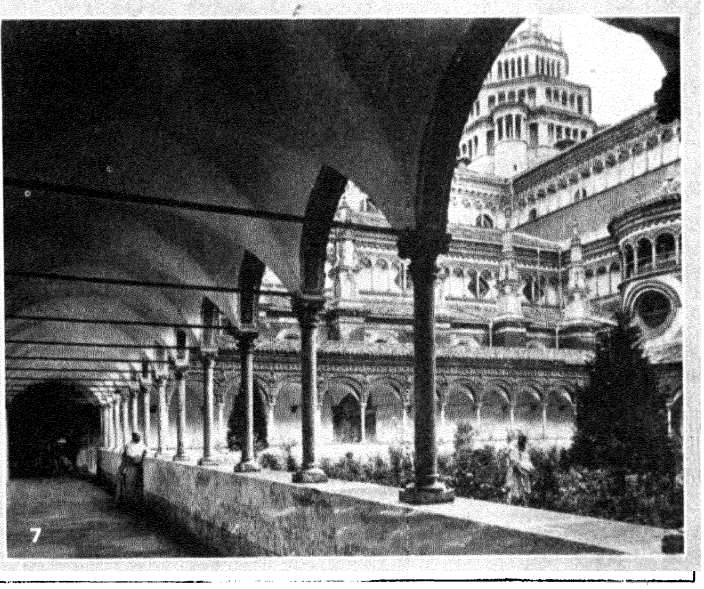






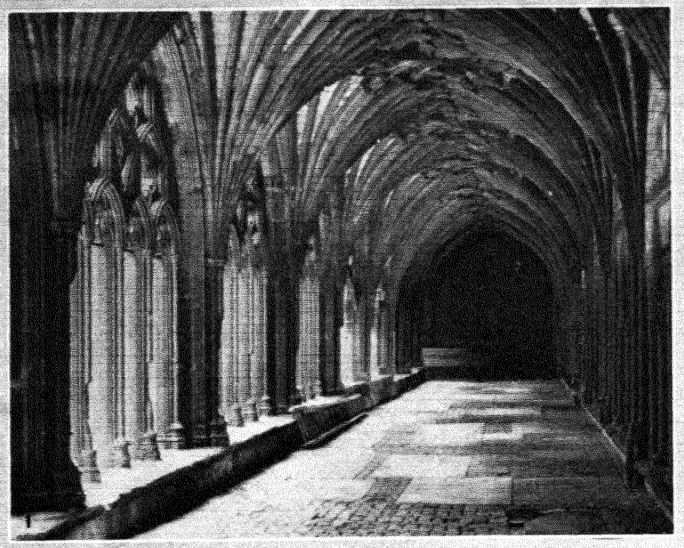


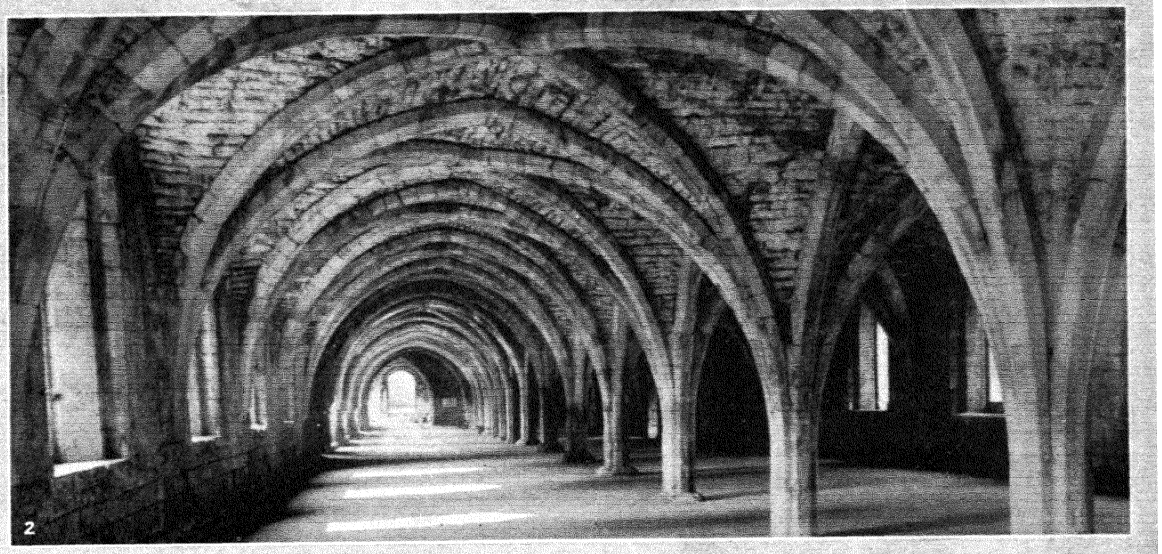


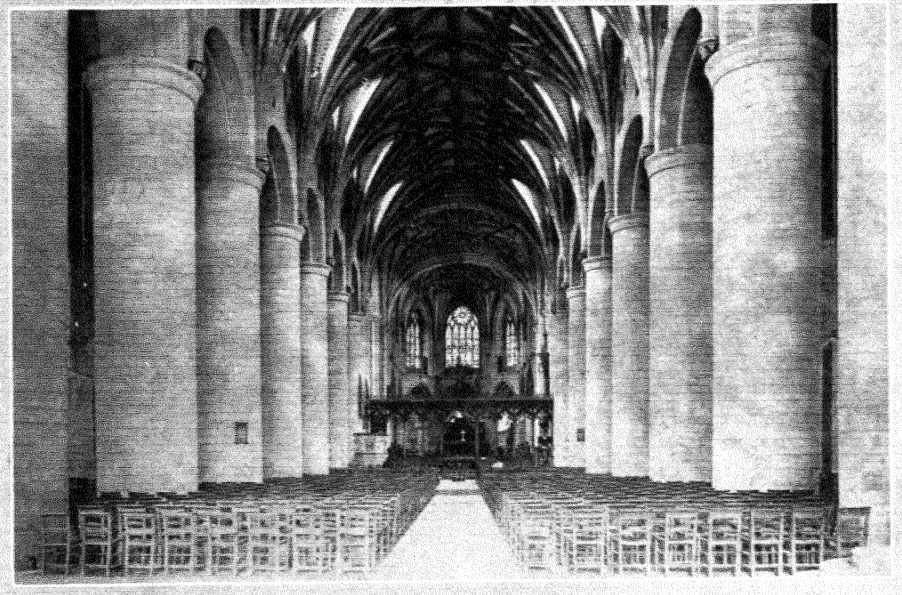


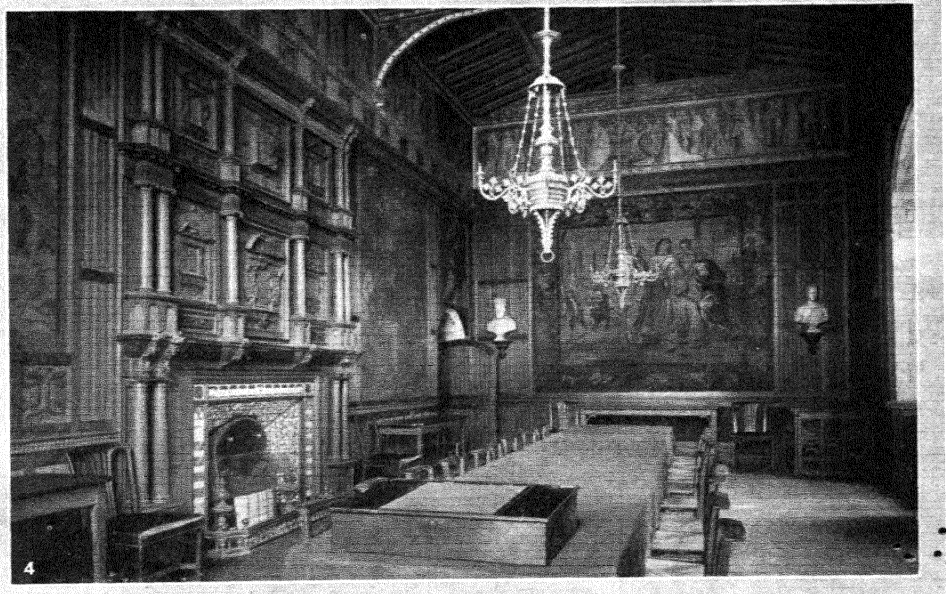
EUROPEAN ABBEY ARCHITECTURE

1. Canterbury Cathedral from the southwest, showing the distant tower known as the Angel or Bell Tower, which was completed in 1472
2. Chilandari, one of the Serbian monasteries at Mount Athos, founded in 1197 by Stephen Nemanja, showing the buildings grouped around a central church
3. Corner of the church of the monastery of Gregoriou, showing a monk tapping the semantor to summon the order to vespers
4. Cloisters of the convent of Santo Tomas at Avila, Spain
5. East end of the apse of the church of the monastery of the Laura, one of the twenty monasteries of the order of St. Basil
6. A Franciscan hermitage, part of the great monastery at Assisi, Italy, built after the canonization of St. Francis in 1228
7. Cloister of the Carthusian monastery, Certosa di Pavia, situated some five miles north of Pavia. The monastery church is visible beyond









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INTERIORS OF MEDIAEVAL ENGLISH ABBEYS

1. Cloisters of Canterbury Cathedral, Benedictine Order, showing fan-vaulting of the late 14th century
2. Day room of Fountains Abbey, Cistercian Order, erected about 1132
3. Nave of Tewkesbury Abbey, built 1125, by the Benedictine order. The choir is of the 14th century
4. Jerusalem Chamber or Abbot's Parlour, in Westminster Abbey, built in the 11th century and used now for the Westminster King's scholars

were placed, without any regard to symmetry, convenience being the only consideration. Advancing eastwards, we have before us the wall separating the outer and inner ward, and the gate-house (D) affording communication between the two. On passing through the gateway, the outer court of the inner ward was entered, with the western façade of the monastic church in front. Immediately on the right of the entrance was the abbot's house (G), in close proximity to the guest-house (F). On the other side of the court were the stables, for the accommodation of the horses of the guests and their attendants (H). The church occupied a central position. To the south was the great cloister (A), surrounded by the chief monastic buildings, and farther to

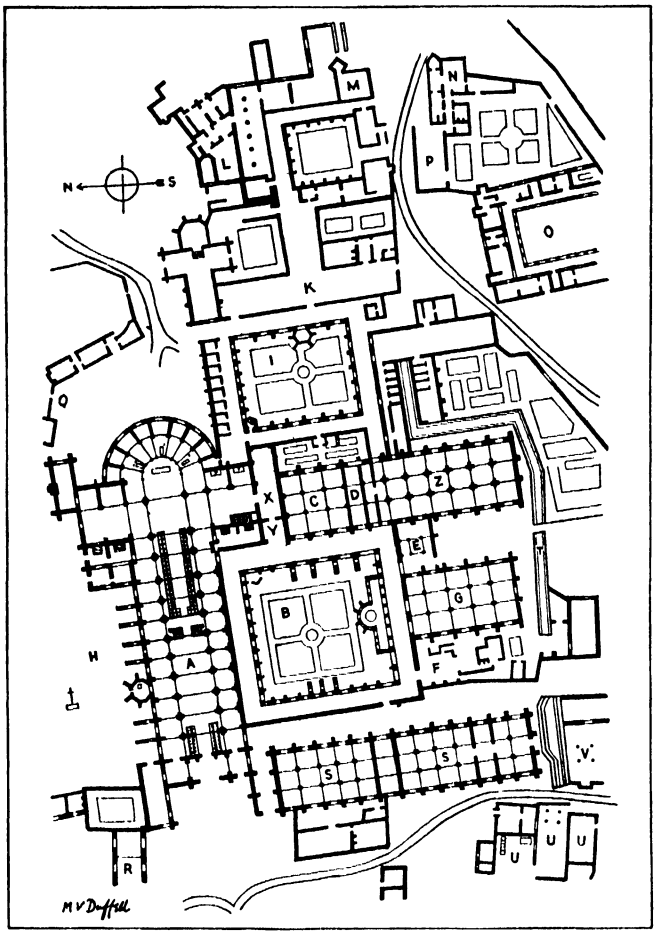

FIG. 5.—GENERAL PLAN OF THE MONASTIC BUILDINGS AT CLAIRVAUX. A WALL SEPARATED THE MONASTIC BUILDINGS OF CLAIRVAUX, HERE SHOWN ON A LARGER SCALE, FROM THE MENIAL DEPARTMENTS. THE POSITION OF THE REFECTORY IS USUALLY A MARKED POINT OF DIFFERENCE BETWEEN BENEDICTINE AND CISTERCIAN ABBEYS

A. Church
B. Cloister
C. Chapter-house
D. Monks' parlour
E. Calefactory
F. Kitchen and court
G. Refectory
H. Cemetery
I. Little cloister
K. Infirmary
L. Lodgings of novices
M. Old guest-house
N. Old abbot's lodgings
O. Cloister of supernumerary monks
P. Abbot's hall
Q. Cell of St. Bernard
R. Stables
S. Cellars and storehouses
T. Water-courses
U. Saw-mill and oil-mill
V. Currier's workshop
X. Sacristy
Y. Little library
Z. Undercroft of dormitory

the east the smaller cloister, opening out of which were the infirmary, novices' lodgings, and quarters for the aged monks. Still farther to the east, divided from the monastic buildings by a wall, were the vegetable gardens and orchards, and tank for fish. The large fish-ponds, an indispensable adjunct to any ecclesiastical foundation, on the formation of which the monks lavished extreme care and pains, and which often remain as almost the only visible traces of these vast establishments, were placed outside the abbey walls.

Figure 5 furnishes the ground-plan of the distinctly monastic buildings on a larger scale. The usually unvarying arrangement of the Cistercian houses allows us to accept this as a type of the monasteries of this order. The church (A) is the chief feature. It consists of a vast nave of eleven bays, entered by a narthex, with a transept and short apsidal choir. (It may be remarked that the eastern limb in all unaltered Cistercian churches is remarkably short, and usually square.) To the east of each limb of the transept are two square chapels, divided according to Cistercian rule by solid walls. Nine radiating chapels, similarly divided, surround the apse. The stalls of the monks, forming the ritual choir, occupy the four eastern bays of the nave. There was a second range of stalls in the extreme western bays of the nave for the *fratres conversi*, or lay brothers. To the south of the church, so as to secure as much sun as possible, the cloister was invariably placed, except when local reasons forbade it. Round the cloister (B) were ranged the buildings connected with the monks' daily life. The chapter-house (C) always opened out of the east walk of the cloister in a line with the south transept. In Cistercian houses this was quadrangular, and was divided by pillars and arches into two or three aisles. Between it and the transept we find the sacristy (X), and a small book-room (Y), *armariolum*, where the brothers deposited the volumes borrowed from the library. On the other side of the chapter-house, to the south, is a passage (D) communicating with the courts and buildings beyond. This was sometimes known as the *parlour, colloquii locus*, the monks having the privilege of conversation here. Here also, when discipline became relaxed, traders, who had the liberty of admission, were allowed to display their goods. Beyond this we often find the *calefactorium* or *day-room* —an apartment warmed by flues beneath the pavement, where the brethren, half frozen during the night offices, betook themselves after the conclusion of lauds, to gain a little warmth, grease their sandals and get themselves ready for the work of the day. In the plan before us this apartment (E) opens from the south cloister walk, adjoining the refectory. The place usually assigned to it is occupied by the vaulted substructure of the *dormitory* (Z). The *dormitory*, as a rule, was placed on the east side of the cloister, running over the *calefactory* and *chapter-house*, and joined the south transept, where a flight of steps admitted the brethren into the church for nocturnal services. Opening out of the dormitory was always the *necessarium*, planned with the greatest regard to health and cleanliness, a water-course invariably running from end to end. The refectory opens out of the south cloister at (G). The position of the refectory is usually a marked point of difference between Benedictine and Cistercian abbeys. In the former, as at Canterbury, the refectory ran east and west parallel to the nave of the church, on the side of the cloister farthest removed from it. In the Cistercian monasteries, to keep the noise and smell of dinner still farther away from the sacred building, the refectory was built north and south, at right angles to the axis of the church. It was often divided, sometimes into two, sometimes, as here, into three aisles. Outside the refectory door, in the cloister, was the *lavatory*, where the monks washed their hands at dinner-time. The buildings belonging to the material life of the monks lay near the refectory, as far as possible from the church, to the south-west. With a distinct entrance from the outer court was the kitchen court (F), with its buttery, scullery, and larder, and the important adjunct of a stream of running water. Farther to the west, projecting beyond the line of the west front of the church, were vast vaulted apartments (SS), serving as cellars and storehouses, above which was the dormitory of the *conversi*. Detached from these, and separated entirely from the monastic buildings, were various workshops, which convenience required to be banished to the outer precincts, a saw-mill and oil-mill (UU) turned by water, and a currier's shop (V), where the sandals and leathern girdles of the monks were made and repaired.

Returning to the cloister, a vaulted passage admitted to the small cloister (I), opening from the north side of which were eight small cells, assigned to the scribes employed in copying works for the library, which was placed in the upper story, accessible by a turret staircase. To the south of the small cloister a long hall will be noticed. This was a *lecture-hall*, or

rather a hall for the religious disputations customary among the Cistercians. From this cloister opened the *infirmary* (K), with its hall, chapel, cells, blood-letting house, and other dependencies. At the eastern verge of the vast group of buildings we find the *novices' lodgings* (L), with a third cloister near the novices' quarters and the original guest-house (M). Detached from the great mass of the monastic edifices was the original abbot's house (N), with its dining-hall (P). Closely adjoining this, so that the eye of the father of the whole establishment should be constantly over those who stood the most in need of his watchful care—those who were training for the monastic life, and those who had worn themselves out in its duties—was a fourth cloister (O), with annexed buildings, devoted to the aged and infirm members of the establishment. The cemetery, the last resting-place of the brethren, lay to the north side of the nave of the church (H).

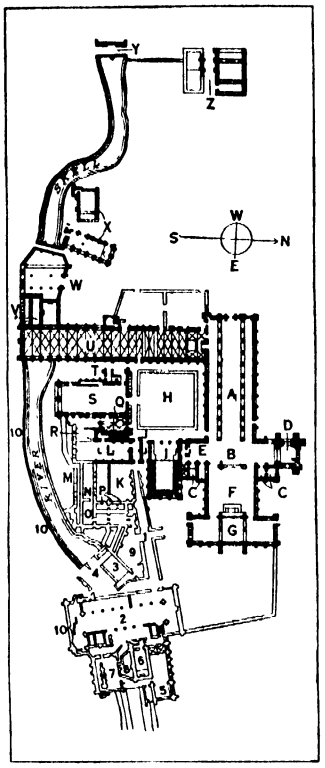

FIG. 6.—PLAN OF FOUNTAINS ABBEY, YORKSHIRE, FOUNDED A D 1132. ADDITIONS SHOWING A WIDE DEPARTURE FROM THE SIMPLICITY OF THE ORIGINAL FOUNDATIONS WERE MADE TO THE ABBEY IN SUCCEEDING CENTURIES UNTIL IT BECAME ONE OF THE MOST SPACIOUS IN ENGLAND

MONASTIC BUILDINGS: A. Nave of church. B. Transept. C. Chapels. D. Tower. E. Sacristy. F. Choir. G. Chapel of Nine Altars. H. Cloister. I. Chapter-house. K. Base court. L. Calefactory. M. Water-course. N. Cellar. O. Brewhouse. P. Prisons. Q. Kitchen. R. Offices. S. Refectory. T. Buttery. U. Cellars and storehouses. V. Necessary. W. Infirmary (?). X. Guest-houses. Y. Mill bridge. Z. Gate-house.

ABBOT'S HOUSE: 1. Passage. 2. Great hall. 3. Refectory. 4. Buttery. 5. Storehouse. 6. Chapel. 7. Kitchen. 8. Ashpit. 9. Yard. 10. Kitchen tank

It will be seen from the above account that the arrangement of a Cistercian monastery was in accordance with a clearly defined system, and admirably adapted to its purpose. The base court nearest to the outer wall contained the buildings belonging to the functions of the body as agriculturists and employers of labour. Advancing into the inner court, the buildings devoted to hospitality are found close to the entrance; while those connected with the supply of the material wants of the brethren—the kitchen, cellars, etc.—form a court of themselves outside the cloister and quite detached from the church. The church, refectory, dormitory and other buildings belonging to the professional life of the brethren, surround the great cloister. The small cloister beyond, with its scribes' cells, library, hall for disputations, etc., is the centre of the literary life of the community. The requirements of sickness and old age are carefully provided for in the infirmary cloister and that for the aged and infirm members of the establishment. The same group contains the quarters of the novices

The English Cistercian houses, of which there are such extensive and beautiful remains at Fountains, Rievaulx, Kirkstall, Tintern, Netley, etc., were mainly arranged after the same plan, with slight local variations.

Fountains Abbey.—Fountains abbey, first founded A D. 1132, is one of the largest and best preserved Cistercian houses in England. Earlier buildings received considerable additions and alterations in the later period of the order, causing deviations from the strict Cistercian type. The church stands a short distance to the north of the River Skell, the buildings of the abbey stretching down to and even across the stream. We have the cloister (H) to the south, with the three-aisled chapter-house (I) and calefactory (L) opening from its eastern walk, and the refectory (S), with the kitchen (Q) and buttery (T) attached, at right angles to its southern walk. Parallel with the western walk is an immense vaulted substructure (U), incorrectly styled the cloisters, serving as cellars and store-rooms, and supporting the dormitory of the *conversi* above. This building extended across the river. At its south-west corner were the necessaries (V), also built, as usual, above the swiftly flowing stream. The monks' dormitory was in its usual position above the chapter-house, to the south of the transept. As peculiarities of arrangement may be noticed the position of the kitchen (Q), between the refectory and calefactory, and of the infirmary (W) (unless there is some error in its designation) above the river to the west, adjoining the guest-houses (XX). We may also call attention to the greatly lengthened choir, commenced by Abbot John of York, 1203–11, and carried on by his successor, terminating, like Durham cathedral, in an eastern transept, the work of Abbot John of Kent, 1220–47, and to the tower (D), added not long before the dissolution by Abbot Huby, 1494–1526, in a very unusual position at the northern end of the north transept. The abbot's house, the largest and most remarkable example of this class of buildings in the kingdom, stands south to the east of the church and cloister, from which it is divided by the kitchen court (K), surrounded by the ordinary domestic offices. A considerable portion of this house was erected on arches over the Skell. The size and character of this house, probably, at the time of its erection, the most spacious house of a subject in the kingdom, not a castle, bespeaks the wide departure of the Cistercian order from the stern simplicity of the original foundation. The hall (2) was one of the most spacious and magnificent apartments in mediaeval times, measuring 170ft by 70ft. Like the hall in the castle at Winchester, and Westminster hall, as originally built, it was divided by 18 pillars and arches, with 3 aisles. Among other apartments, for the designation of which we must refer to the ground-plan, was a domestic oratory or chapel, (6) 46½ft. by 23ft. and a kitchen (7), 50ft. by 38ft.

Feudal Character.—The arrangement of the building bespeaks the powerful feudal lord, not the humble father of a body of hard-working brethren, bound by vows to a life of poverty and self-denying toil. In the words of Dean Milman, "the superior, once a man bowed to the earth with humility, care-worn, pale, emaciated, with a coarse habit bound with a cord, with naked feet, had become an abbot on his curvetting palfrey, in rich attire, with his silver cross before him, travelling to take his place amid the lordliest of the realm." (*Lat. Christ.* vol iii p. 330)

The buildings of the *Austin canons* or *Black canons* (so called from the colour of their habit) present few distinctive peculiarities. This order had its first seat in England at Colchester, where a house for Austin canons was founded about A D. 1105, and it very soon spread widely. As an order of regular clergy, holding a middle position between monks and secular canons, almost resembling a community of parish priests living under rule, they adopted naves of great length to accommodate large congregations.

The *Premonstratensian* regular canons, or White canons, had as many as 35 houses in England, of which the most perfect remaining are those of Easby, Yorkshire, and Bayham, Kent. The head house of the order in England was Welbeck. This order was a reformed branch of the Austin canons, founded, A D. 1119, by Norbert (born at Xanten, on the Lower Rhine, *c.* 1080) at Prémontré, a secluded marshy valley in the forest of Coucy in the diocese of Laon. The order spread widely. Even in the founder's lifetime it possessed houses in Syria and Palestine. It long maintained its rigid austerity, till in the course of years wealth impaired its discipline, and its members sank into indolence and luxury. The Premonstratensians were brought to England shortly after A.D. 1140, and were first settled at Newhouse, in Lincolnshire, near the Humber. The ground-plan of Easby abbey, owing to its situation on the edge of the steeply-sloping banks of the Swale, is singularly irregular. The cloister is duly placed on the south side of the church, and the chief buildings occupy their usual positions round it. But the cloister garth, as at Chichester, is not rectangular, and all the surrounding buildings are thus made to sprawl in a very awkward fashion. The church

follows the plan adopted by the Austin canons in their northern abbeys, and has only one aisle to the nave—that to the north; while the choir is long, narrow and aisleless. Each transept has an aisle to the east, forming three chapels.

The church at Bayham was destitute of aisles either to nave or choir. The latter terminated in a three-sided apse. This church is remarkable for its exceeding narrowness in proportion to its length. Extending in longitudinal dimensions 257ft., it is not more than 25ft. broad. Stern Premonstratensian canons wanted

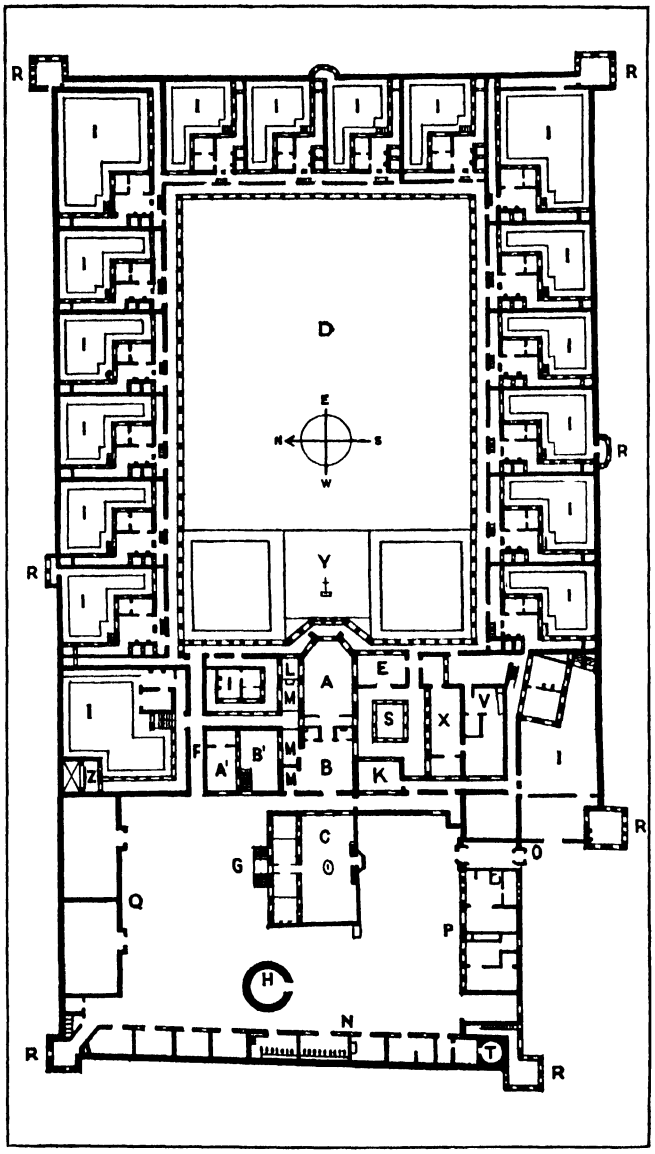

FIG. 7.—PLAN OF THE CARTHUSIAN MONASTERY OF CLERMONT, FRANCE. THE PRINCIPLES OF THE CARTHUSIAN ORDER DEMANDED A DISTINCT FORM OF MONASTIC INSTITUTION IN WHICH THE BROTHERHOOD COULD LIVE IN SOLITUDE AND SILENCE—HENCE THE SEPARATE CELLS

A. Church	K. Chapel of Pontgibaud	S. Little cloister
B. Monks' choir	L. Sacristy	T. Bakehouse
C. Prior's garden	M. Chapel	V. Kitchen
D. Great cloister	N. Stables	X. Refectory
E. Chapter-house	O. Gateway	Y. Cemetery
F. Passage	P. Guest-chambers	Z. Prison
G. Prior's lodgings	Q. Barns and granaries	A'. Cell of sub-prior
H. Dovecot	R. Watch-tower	B'. Garden of sub-prior
I. Cells		

no congregations, and cared for no possessions; therefore they built their church like a long room.

Carthusians.—The *Carthusian* order, on its establishment by St. Bruno, about A.D. 1084, developed a greatly modified form and arrangement of a monastic institution. The principle of this order, which combined the coenobitic with the solitary life, demanded the erection of buildings on a novel plan. This plan, which was first adopted by St. Bruno and his twelve companions at the original institution at Chartreux, near Grenoble, was maintained in all the Carthusian establishments throughout Europe, even after the ascetic severity of the order had been to some extent relaxed, and the primitive simplicity of their buildings had been exchanged for the magnificence of decoration which characterizes such foundations as the *Certosas* of Pavia and Florence. According to the rule of St. Bruno, all the members of a Carthusian brotherhood lived in the most absolute solitude and silence. Each occupied a small detached cottage, standing by itself in a small garden surrounded by high walls and connected by a common corridor or cloister. In these cottages or cells a Carthusian monk passed his time in the strictest asceticism, only leaving his solitary dwelling to attend the services of the Church, except on certain days when the brotherhood assembled in the refectory. The peculiarity of the arrangements of a Carthusian monastery, or *charter-house*, as it was called in England, from a corruption of the French *chartreux*, is exhibited in the plan of that of Clermont, after Viollet-le-Duc

Clermont Abbey is surrounded by a wall, furnished at intervals with watch towers (R). The enclosure is divided into two courts, of which the eastern court, surrounded by a cloister, from which the cottages of the monks (I) open, is much the larger. The two courts are divided by the main buildings of the monastery, including the church, the sanctuary (A), divided from B, the monks' choir, by a screen with two altars, the smaller cloister to the south (S) surrounded by the chapter-house (E), the refectory (X)—these buildings occupying their normal position—and the chapel of Pontgibaud (K). The kitchen with its offices (V) lies behind the refectory, accessible from the outer court without entering the cloister. To the north of the church, beyond the sacristy (L), and the side chapels (M), we find the cell of the sub-prior (A') with its garden. The lodgings of the prior (G) occupy the centre of the outer court, immediately in front of the west door of the church, and face the gateway of the convent (O). A small raised court with a fountain (C) is before it. This outer court also contains the guest-chambers (P), the stables, and lodgings of the lay brothers (N), the barns and granaries (Q), the dovecot (H), and the bakehouse (T). At Z is the prison. (In this outer court, in all the earlier foundations, as at Witham, there was a smaller church in addition to the larger church of the monks) The outer and inner courts are connected by a long passage (F), wide enough to admit a cart laden with wood to supply the cells of the brethren with fuel. The number of cells surrounding the great cloister is 18. They are all arranged on a uniform plan. Each little dwelling contains three rooms: a sitting room (C), warmed by a stove in winter; a sleeping-room (D), furnished with a bed, a table, a bench, and a book-case; and a closet (E). Between the cell and the cloister gallery (A) is a passage or corridor (B), cutting off the inmate of the cell from all sound or movement which might interrupt his meditations. The superior had free access to this corridor, and through open niches was able to inspect the garden without being seen. At I is the hatch or turn-table, in which the daily allowance of food was deposited by a brother appointed for that purpose, affording no view either inwards or outwards. H is the garden, cultivated by the occupant of the cell. At K is the wood-house. F is a covered walk, with the necessary at the end.

The above arrangements are found with scarcely any variation in all the charter-houses of western Europe. The Yorkshire Charter-house of Mount Grace, founded by Thomas Holland, the young duke of Surrey, nephew of Richard II. and marshal of England, during the revival of the popularity of the order, about A.D. 1307, is the most perfect and best preserved English example.

Mendicant Friars.—An article on monastic arrangements would be incomplete without some account of the convents of the Mendicant or Preaching Friars, including the Black Friars or Dominicans, the Grey or Franciscans, the White or Carmelites, the Eremite or Austin Friars. These orders arose at the beginning of the 13th century, when the Benedictines, together with their various reformed branches, had terminated their active mission, and Christian Europe was ready for a new religious

revival. Planting themselves, as a rule, in large towns, and by preference in the poorest and most densely populated districts, the Preaching Friars were obliged to adapt their buildings to the requirements of the site. Regularity of arrangement, therefore, was not possible, even if they had studied it. Their churches, built for the reception of large congregations of hearers rather than worshippers, form a class by themselves, totally unlike those of the elder orders in ground-plan and character. They were usually long parallelograms unbroken by transepts. The nave very usually consisted of two equal bodies, one containing the stalls of the brotherhood, the other left entirely free for the congregation The constructional choir is often wanting, the whole church forming one uninterrupted structure, with a continuous range of windows Taken as a whole, the remains of the establishments of the friars afford little warrant for the invective of Matthew Paris, benedictine of St. Albans. "The friars who have been founded scarcely 40 years have built residences as the palaces of kings. These are they who, enlarging day by day their sumptuous edifices and encircling them with lofty walls, lay up in them their incalculable treasures, transgressing the bounds of poverty and violating the fundamental rules of their profession"

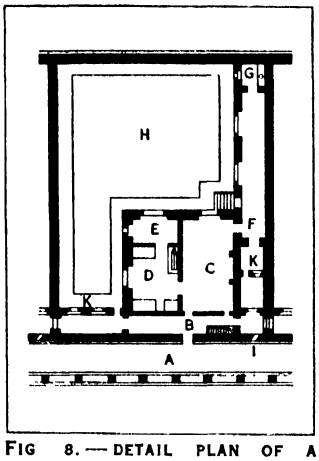

FIG 8.—DETAIL PLAN OF A CARTHUSIAN CELL AT CLERMONT THE GENERAL PLAN OF CLERMONT PROVIDES FOR SEPARATE CELLS FOR EACH MONK. THE ORDER WAS FOUNDED BY ST. BRUNO, 1084

A. Cloister gallery
B. Corridor
C. Living-room
D. Sleeping-room
E. Closet
F. Covered walk
G. Necessary
H. Garden
I. Hatch
K. Wood-house

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ABBON OF FLEURY or ABBO FLORIACENSIS (*c* 945–1004), French scholar. He spent two years in England, and was abbot of Romsey. After his return to France he was made abbot of Fleury on the Loire (988). He was twice sent to Rome by King Robert the Pious (986–96), and on each occasion succeeded in warding off a threatened papal interdict. He was killed at La Réole in 1004, in endeavouring to quell a monkish revolt. He wrote an *Epitome de vitis Romanorum pontificum*, besides controversial treatises, letters, etc. (*see* Migne, *Patrologia Latina*). His life, written by his disciple Aimoin of Fleury, in which much of Abbon's correspondence was reproduced, is of great importance as a source for the reign of Robert II., especially with reference to the papacy (*cf.* Migne, *op cit.* vol. cxxxix)

See Ch. Pfister, *Études sur le règne de Robert le Pieux* (1885)· Cuissard-Gaucheron, "L'École de Fleury-sur-Loire à la fin du 10e siècle," in *Mémoires de la société archéol. de l'Orléanais*, xiv. (Orleans, 1875); A. Molinier, *Sources de l'histoire de France.*

ABBOT, CHARLES GREELEY (1872–), American astrophysicist, was born in Wilton, N H., on May 31, 1872. He graduated in 1894 from the Massachusetts Institute of Technology, and after a year of graduate study there joined the staff of the astrophysical observatory of the Smithsonian Institution. Here he served first as assistant, 1895–96, and then as acting director in charge from 1896 until 1907, when he was appointed director. He made original investigations in solar physics, studying especially the infra-red solar spectrum, the solar constant of radiation, the variability of solar and terrestrial temperatures and the utilization of solar heat. In connection with his researches he conducted expeditions to observe total eclipses of the sun in 1900, 1901, 1908 and 1919. In collaboration with S. P. Langley he completed the mapping of the infra-red spectrum, published in the *Annals* (vol. i.) of the astrophysical observatory. With F. E. Fowle and L. B. Aldrich he published also in the *Annals* (vol. iii, iv.) proofs of the variability of the sun, as shown by experiments conducted simultaneously in California and Algeria and from observations made in expeditions to Arizona and Chile. In recognition of his discoveries he was awarded the Draper medal (1910), and the Rumford medal (1916). To scientific journals he has contributed numerous articles on the apparatus, methods and results of solar research. He published *The Sun* (1907), *Everyday Mysteries* (1923) and *The Earth and the Stars* (1925). In 1918 he was made assistant secretary, and in 1928 secretary, of the Smithsonian Institution.

ABBOT, EZRA (1819–1884), American biblical scholar, was born at Jackson, Me, April 28, 1819. He graduated at Bowdoin college in 1840; and, after being principal of a public school in Cambridge, became assistant librarian of Harvard university, and from 1872 until his death Bussey Professor of New Testament Criticism and Interpretation in the Harvard divinity school His studies were chiefly in oriental languages and the textual criticism of the New Testament, though he was a remarkable bibliographer. His publications were largely dispersed in the pages of reviews and other publications, but to the enlarged American edition of Smith's *Dictionary of the Bible* (1867–70), he contributed more than 400 articles besides greatly improving the bibliographical completeness of the work. His principal single production, representing his scholarly method and conservative conclusions, was *The Authorship of the Fourth Gospel* (1880; second edition, by J H. Thayer, with other essays, 1889), up to that time probably the ablest defence, based on external evidence, of the Johannine authorship, and certainly the most complete treatment of the relation of Justin Martyr to this gospel He died in Cambridge, Mass, March 21, 1884

See S. J. Barrows, *Ezra Abbot* (1884).

ABBOT, GEORGE (1562–1633), Archbishop of Canterbury, was born on Oct 19, 1562, at Guildford, Surrey, the son of a cloth-worker. Educated at Balliol College, Oxford, he became master of University College (1597) and dean of Winchester (1600).

He was one of those who prepared King James's Version of the Bible James I. sent him to Scotland in 1608 to arrange for the establishment of episcopacy there On his return he was preferred to the bishopric of Lichfield and Coventry (1609), London (1609) and Canterbury (1611). As vice-chancellor of the University of Oxford at different times between 1600 and 1605, he had come into conflict with Laud, and at court he supported Puritan measures. He promoted the marriage between the Elector Palatine and Princess Elizabeth, and resisted the proposal for the marriage of the Prince of Wales to the Spanish infanta.

Under Charles I. he was suspended from his functions of primate for refusing to license the Assize sermon preached by Robert Sibthorp at Northampton (Feb. 22, 1627), advocating non-resistance to the royal demands, however arbitrary. He died at Croydon, Aug. 5, 1633, and was buried at Guildford, where he had endowed a hospital. Abbot's later years were clouded by the fact that in 1622 he had accidentally shot a keeper while hunting His enemies maintained that the homicide, though accidental, disqualified him from office, and the matter had to be referred to a commission, on which King James had to exercise his casting vote in the archbishop's favour.

ABBOT, WILLIAM (1798–1843), English actor, was born in Chelsea, and made his first appearance on the stage at Bath in 1806, and his first London appearance in 1808. He created the parts of Appius Claudius in Sheridan Knowles's *Virginius* (1820) and of Modus in his *Hunchback* (1832). In 1827 he organized the company, including Macready and Miss Smithson, which acted Shakespeare in Paris. Two of Abbot's melodramas, *The Youthful Days of Frederick the Great* (1817) and *Swedish Patriotism* (1819), were produced at Covent Garden. He died in poverty at Baltimore, Maryland.

ABBOT, the head and chief governor of a community of monks, called also in the East *hegumenos* or *archimandrite*. The title abbot is derived ultimately from the Hebrew *ab*, "father," through

the Syriac *abbas*, and had its origin in the monasteries of Syria, whence it spread through the East, and soon became accepted in all languages as the designation of the head of a monastery. But though general in the West, it was never universal Among the Dominicans, Carmelites, Augustinians, etc., the superior was called *Prior;* among the Franciscans, *Custos* ("guardian").

In Egypt, the first home of monasticism, the abbot or archimandrite sometimes ruled over only one community, sometimes over several, each of which had its own abbot as well. By the rule of St. Benedict, which, until the reform of Cluny, governed monasticism in the West, the abbot has jurisdiction over only one community The rule was subject to frequent violations; but it was not until the foundation of the Cluniac Order that the idea of a supreme abbot, exercising jurisdiction over all the houses of an order, was definitely recognized New styles expressed this new relation, thus the abbot of Monte Cassino was called *abbas abbatum* ("abbot of abbots"), while the chiefs of other orders had the titles *abbas generalis* ("abbot general"), or *magister* ("master") or *minister generalis* ("minister general").

Monks, as a rule, were laymen, nor at the outset was the abbot any exception. All orders of clergy, therefore, took precedence of him. For religious offices the abbot and his monks were commanded to attend the nearest church.

Abbots were originally subject to episcopal jurisdiction, and continued generally so in the West till the 11th century. The first case recorded of the partial exemption of an abbot from episcopal control is that of Faustus, abbot of Lerins, at the council of Arles, AD 456; but the exorbitant claims and exactions of bishops rendered it increasingly frequent, and, in the 6th century, the practice of making religious houses responsible to the Pope alone received an impulse from Gregory the Great These exceptions, introduced with a good object, had grown into a widespread evil by the 12th century, the bishop being deprived of all authority over the chief centres of influence in his diocese. Abbots more and more assumed almost episcopal state, and adopted the episcopal insignia of mitre, ring, gloves and sandals, a custom which arose out of the granting by the Pope of the right to wear the mitre to particular distinguished abbots

The first undoubted instance is the bull by which Alexander II in 1063 granted the use of the mitre to Egelsinus, abbot of St Augustine at Canterbury (*see* MITRE)

The adoption of episcopal insignia by abbots was followed by an encroachment on episcopal functions, which was ineffectually guarded against by the Lateran Council, AD 1123 In AD 1489 they were permitted by Innocent IV. to confer both the subdiaconate and diaconate. They always and everywhere had the power of admitting their own monks and vesting them with the religious habit. Originally the bishop of the diocese chose the abbot out of the monks of the convent, but the right of election was transferred by jurisdiction to the monks themselves, reserving to the bishop the confirmation of the election and the benediction of the new abbot. In abbeys exempt from episcopal jurisdiction the confirmation and benediction had to be conferred by the Pope in person, the house being taxed with the expenses of the new abbot's journey to Rome. An abbot had to be at least 25 years of age, of legitimate birth, and a monk of the house, unless it furnished no suitable candidate. The election was for life, unless the abbot was canonically deprived by the chiefs of his order, or, when he was directly subject to them, by the Pope or the bishop. The power of the abbot was absolute, limited only by the canons of the church and, until the general establishment of exemptions, by episcopal control. As a rule, however, implicit obedience was enforced.

The abbot was treated with the utmost reverence by the brethren of his house. If he gave a command, the monk receiving it was to kneel. No monk might sit in his presence, or leave it without his permission. In the East he was commanded to eat with the other monks. In the West the rule of St. Benedict appointed him a separate table, at which he might entertain guests and strangers. This permission opening the door to luxurious living, the Council of Aix, A.D. 817, decreed that the abbot should dine in the refectory on the same fare as the monks, unless he had to entertain a guest. These ordinances proved, however, generally ineffectual, and contemporaneous literature abounds with satirical remarks and complaints concerning the inordinate extravagance of the tables of the abbots.

The ordinary dress of the abbot was according to rule to be the same as that of the monks But by the 10th century the rule was commonly set aside, and we find frequent complaints of abbots adopting sumptuous attire. They sometimes even laid aside the monastic habit altogether. With the increase of wealth and power, abbots, in fact, lost much of their religious character, and vied in magnificence with the first nobles of the realm They rode on mules with gilded bridles, rich saddles and housings, carrying hawks on their wrists, followed by an immense train of attendants They associated on equal terms with laymen of the highest distinction, and shared all their pleasures and pursuits This rank and power was, however, often used most beneficially For instance, Richard Whiting, the last abbot of Glastonbury, judicially murdered by Henry VIII in 1539, educated in his household as many as 300 sons of noblemen and gentlemen, besides others of a meaner rank, whom he fitted for the universities The abbots of Cluny and Vendôme were, by virtue of their office, cardinals of the Roman church

In process of time the title abbot was improperly transferred to clerics who had no connection with the monastic system, as to the principal of a body of parochial clergy It even came to be adopted by purely secular officials Thus the chief magistrate of the republic at Genoa was called *Abbas Populi* ("the abbot of the people"). Lay abbots were the outcome of the growth of the feudal system from the 8th century onwards The practice of *commendation,* by which (to meet a temporary emergency) the revenues of the community were handed over to a lay lord and in return for his protection, early suggested to the emperors and kings the expedient of rewarding their warriors with rich abbeys held *in commendam* During the Carolingian epoch the custom grew up of granting these as regular heritable fiefs or benefices, and by the 10th century the system was firmly established The example of the kings was followed by the feudal nobles, sometimes by making a temporary concession permanent, sometimes without any form of commendation whatever.

These lay abbacies were not merely a question of overlordship, but implied the concentration in lay hands of all the rights, immunities and jurisdiction of the foundations; *i e*, the more or less complete secularization of spiritual institutions. The lay abbot took his recognized rank in the feudal hierarchy, and was free to dispose of his fief as in the case of any other.

In conventual cathedrals, where the bishop occupied the place of the abbot, the functions usually devolving on the superior of the monastery were performed by a prior.

The title *abbé* (Ital *abbate*), as commonly used in the Roman Catholic church on the European continent, is the equivalent of the English "Father," being loosely applied to all who have received the tonsure. In the German Evangelical church the title of abbot (*Abt*) is sometimes bestowed, like *abbé,* as an honorary distinction, and sometimes survives to designate the heads of monasteries converted at the Reformation into collegiate foundations Of these the most noteworthy is the abbey of Lokkum in Hanover, founded as a Cistercian house in 1163 by Count Wilbrand of Hallermund, and reformed in 1503.

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ABBOTSFORD, former residence of Sir Walter Scott, on south bank of the Tweed, about 3m W. of Melrose, Roxburghshire, Scotland, and nearly 1m from Abbotsford Ferry Station, L N E R. branch line. Cartleyhole, nicknamed Clarty (muddy) Hole, a farm of 100ac., was bought by Scott (1811) when his lease of Ashestiel, near by, lapsed; he added to it and finally bought Toftfield (afterwards Huntlyburn) in 1817, building his house in Scottish baronial style with relics from historical structures such as the doorway of the old Tolbooth in Edinburgh. A reverse of

fortune in 1825 involved Scott in debt, but the creditors made him a free gift of the library in 1830 and Robert Cadell the publisher cancelled all mortgages in 1847 in exchange for the family's share in the copyright of Sir Walter's works. The house has remained in the hands of descendants of Scott. Abbotsford gave its name to the Abbotsford club, a successor of the Bannatyne and Maitland clubs, founded by W. B. D. D. Turnbull in 1834 in Scott's honour, for printing and publishing historical works connected with his writings. Its publications extended from 1835 to 1864.

ABBOTT, EDWIN ABBOTT (1838–1926), English schoolmaster and grammarian, succeeded G. F. Mortimer as headmaster of the City of London School in 1865 He was the author of a *Shakespearian Grammar* (1870), which is a permanent contribution to English philology, and of many theological works, among them the article on the Gospels in the 9th ed. of the *Encyclopædia Britannica.*

His brother, Evelyn Abbott (1843–1901), was a tutor of Balliol, Oxford, and author of a scholarly *History of Greece.*

ABBOTT, EMMA (1849–1891), American singer, was born in Chicago, Ill, and studied in Milan and Paris. She had a fine soprano voice, and appeared first in opera in London at Covent Garden, also singing at important concerts She organized an opera company known by her name, and toured extensively in the United States, where she had a great reputation In 1873 she married E. J. Wetherell. She died at Salt Lake City (Utah), Jan. 5, 1891.

ABBOTT, GEORGE (1887–), American playwright and actor, was born in Forestville, N.Y., in 1887. He graduated at the University of Rochester (1911), where he wrote and acted for the dramatic club. The following year he studied dramatic writing with Prof. George Pierce Baker at Harvard, had a one-act play produced by the Harvard dramatic club, and won a prize play contest at the Keith Bijou theatre. In order to learn more about the stage and before having any plays accepted for professional productions he became an actor. He appeared in important rôles in *Zander the Great*, with Alice Brady; *Hell Bent for Heaven* and *Processional,* where his acting of the blinded Ishmaelite was particularly outstanding, and other Broadway productions. His first play to be produced, *Fall Guy* (published in the *Best Plays of 1924–25*), was written in collaboration with James Gleason; the next, *Love 'Em and Leave 'Em*, with John V. A. Weaver; *The Holy Terror,* with Winchell Smith; and *Four Walls,* with Dana Burnet. His *Broadway* (published in the *Best Plays of 1926–27*), written with Phillip Dunning, was one of the dramatic successes of 1926–27 His *Coquette,* a play memorable for its rendering of life in the southern United States, was likewise a notable production of the season 1927–28.

ABBOTT, GRACE (1878–), American social worker, was born Nov. 17, 1878, at Grand Island, Nebraska. She graduated from Grand Island college in 1898, and, after teaching for nine years, became in 1908 director of the Immigrants' Protective League and a resident of Hull House, Chicago. She received the degree of M A. from the University of Chicago in 1909. From 1917 to 1920 she was director of the child labour division of the children's bureau at Washington, D C , and subsequently executive secretary of the Illinois immigrants' commission, returning to Washington in 1921 as chief of the children's bureau. She served in 1923 as consultative member for the United States on the advisory committee of the League of Nations on traffic in women and children, now a sub-committee of the commission on the welfare of children and young persons. She was president of the National Conference of Social Workers in 1924. She is the author of *The Immigrant and the Community* (1917) and a number of reports and articles on immigration and child welfare.

ABBOTT, JACOB (1803–1879), American writer of books for the young, was born at Hallowell (Me.) on Nov. 14, 1803. He graduated at Bowdoin college in 1820; studied at Andover Theological Seminary. He was tutor in 1824–25, and from 1825 to 1829 was professor of mathematics and natural philosophy in Amherst college; was licensed to preach by the Hampshire Association in 1826; founded the Mt. Vernon School for young ladies in Boston in 1829, and was principal until 1833; was pastor of Eliot Congregational church (which he founded) at Roxbury (Mass.), in 1834–35; and was, with his brothers, a founder, and in 1843–51 a principal, of Abbott's Institute, and in 1845–48 of the Mt. Vernon School for boys, in New York city. He was a prolific author, writing juvenile stories, brief histories and biographies, and religious books for the general reader, and a few works in popular science. He died on Oct. 31, 1879, at Farmington (Me.), where he had spent part of his time since 1839. The best known of his writings are those which feature the boyish paragon Rollo—*Rollo at Work, Rollo at Play, Rollo in Europe,* etc. (28 vol). In these didactic tales Abbott did for one or two generations of young American readers a service not unlike that performed earlier by the author of *Sandford and Merton.* Of his other writings the best are the *Franconia Stories* (10 vol.), 22 vol. of biographical histories, and the *Young Christian*—all of which had enormous circulations.

See his *Young Christian, Memorial Edition, with a Sketch of the Author by one of his sons, i.e ,* Edward Abbott (1882), with a bibliography of his works; also Lyman Abbott, *Silhouettes of My Contemporaries* (1921).

ABBOTT, SIR JAMES (1807–1896), British soldier, educated at the Military College, Addiscombe. He served in the Bengal Artillery at the siege of Bhurtpore, 1825–26. He was the first Englishman to visit Khiva, where he was sent on a mission in 1839. During the Sikh war in 1849–50, he held Hazara, of which he was commissioner from 1847–54. He died Oct 6, 1896.

ABBOTT, JOHN STEVENS CABOT (1805–1877), American writer, was born in Brunswick, Me , on Sept 18, 1805. He was a brother of Jacob Abbott, with whom he was associated in the management of Abbott's Institute, New York city, and in the preparation of his series of brief historical biographies. He is best known, however, as the author of a partisan and unscholarly but very readable *History of Napoleon Bonaparte* (1855). Dr. Abbott graduated at Bowdoin college in 1825, studied at Andover theological seminary, and between 1830 and 1844, when he retired from the ministry, preached successively at Worcester, Roxbury and Nantucket, Massachusetts. He died at Fair Haven, Conn., on June 17, 1877. He was a voluminous writer of books on Christian ethics, and of popular histories

ABBOTT, LYMAN (1835–1922), American divine and author, was born at Roxbury (Mass), on Dec. 18, 1835, the son of Jacob Abbott He graduated at New York university in 1853, studied law, and was admitted to the bar in 1856; but abandoning the legal profession, after studying theology with his uncle, J S. C. Abbott, he was ordained a minister of the Congregational church in 1860. After pastorates in Terre Haute (Ind), and New York City, he became an associate editor of *Harper's Magazine,* editor of the *Illustrated Christian Weekly,* and co-editor (1876–81) of *The Christian Union* with Henry Ward Beecher, whom he succeeded in 1888 as pastor of Plymouth church, Brooklyn. From this pastorate he resigned 11 years later. From 1881 he was editor-in-chief of *The Christian Union,* renamed *The Outlook* in 1893; this periodical reflected his efforts toward social reform and his humane and liberal theology. To the end of his long life he continued to take an active and authoritative part in the discussion of public questions. He died in New York City on Oct. 22, 1922.

The serenity and dignity of his life are reflected in his works which include, besides his many magazine articles, *Jesus of Nazareth* (1869); *Evolution of Christianity* (Lowell Lectures, 1896); *The Theology of an Evolutionist* (1897); *Christianity and Social Problems* (1897); *Life and Letters of Paul* (1898); *Problems of Life* (1900); *The Rights of Man* (1901); *Henry Ward Beecher* (1903); *The Christian Ministry* (1905); *The Personality of God* (1905); *Industrial Problems* (1905); *America in the Making* (1911); and *Reminiscences* (1915).

ABBOTT, WILBUR CORTEZ (1869–), American educator and historian, was born in Kokomo, Ind., Dec. 28, 1869. Following his graduation from Wabash college, Crawfordsville, Ind., in 1892, he pursued graduate studies at Cornell university in 1892–95 and in Europe during 1895–96. Upon returning from Europe he taught history in the University of Michigan in 1897–99, was assistant professor of history in Dartmouth college in

1899–1902 and professor of European history in the University of Kansas from 1902 to 1908. He entered the faculty of Yale university in 1908 as professor of history and served in this chair until 1920 when he became professor of history in Harvard university. Among his published writings are *Colonel Blood, Crown Stealer* (1911), *The Expansion of Europe* (1917), *Colonel John Scott of Long Island* (1918), *Conflicts with Oblivion* (1924), *The New Barbarians* (1925) and various contributions to periodicals

ABBOTTABAD, a town of British India, 4,120ft. above sea-level, 63m. from Rawalpindi, the headquarters of the Hazara district in the North West Frontier Province, called after its founder, Sir James Abbott, who settled this wild district after the annexation of the Punjab It is an important military cantonment and sanatorium, being the headquarters of a brigade in the Rawalpindi division of the northern army. It is remarkable for the rock inscription of Asoka close by It is now on a branch railway from the main line at Hasan Abdal.

ABBREVIATION, strictly a shortening; more particularly, an "abbreviation" is a letter or group of letters, taken from a word or words, and employed to represent them for the sake of brevity. Abbreviations, both of single words and of phrases, having a meaning more or less fixed and recognized, are common in ancient writings and inscriptions (*see* PALAEOGRAPHY) and very many are in use at the present time The commonest form of abbreviation is the substitution for a word of its initial letter; but, with a view to prevent ambiguity, one or more of the other letters are frequently added Letters are often doubled to indicate a plural or a superlative.

There is no occasion to explain here the common abbreviations used for Christian names, books of Scripture, months of the year, points of the compass, grammatical and mathematical terms, or familiar titles, like "Mr ," etc.

The list of abbreviations that follows is divided into (1) those now or recently in use, (2) mediaeval, and (3) classical:

I. ABBREVIATIONS NOW IN USE

1. ABBREVIATED TITLES AND DESIGNATIONS

A.A.	Associate of Arts.
A.B.	Able-bodied seaman, Bachelor of Arts.
A.D.C.	Aide-de-Camp.
A F C.	Air Force Cross.
A G	Adjutant-General.
A.M.	(*Artium Magister*), Master of Arts.
A.O C.	Army Ordnance Corps.
A.R.A	Associate of the Royal Academy.
A R.C M.	Associate, Royal College of Music.
A R.C S.	Associate, Royal College of Science.
A R.I B.A.	Associate of the Royal Institution of British Architects.
A R.S.A.	Associate of the Royal Scottish Academy.
B A.	Bachelor of Arts.
B Arch.	Bachelor of Architecture.
Bart.	Baronet.
B.Ch.D.	Bachelor of Dental Science.
B C L	Bachelor of Civil Law.
B Com *or* Comm.	Bachelor of Commerce.
B D.	Bachelor of Divinity.
B D S	Bachelor of Dental Surgery.
B Ed	Bachelor of Education
B Litt.	Bachelor of Letters.
B M	Bachelor of Medicine.
B Mus	Bachelor of Music.
B S	Bachelor in Surgery
B Sc.	Bachelor of Science.
B.Sc.Agr.	Bachelor of Agricultural Science.
C	Chairman.
C.A.	Chartered Accountant.
C.B.	Companion of the Bath.
C.B.E.	Commander, Order of the British Empire.
C.E	Civil Engineer.
C H.	Companion of Honour.
Ch B.	Bachelor of Surgery.
Ch.D.	Doctor of Chemistry.
C.I.E.	Companion of the Order of the Indian Empire.
C.M.	(*Chirurgiae Magister*), Master in Surgery.
C.M.G.	Companion of St. Michael and St. George.
C.O.	Commanding Officer.
C.S.I.	Companion of the Star of India
C.V.O.	Companion of the Royal Victorian Order.
D.B.E.	Dame Commander of the British Empire.
D.Ch.	Doctor of Surgery.
D.C.L.	Doctor of Civil Law.
D.C.M.	Distinguished Conduct Medal. District Court Martial.
D.D.	Doctor of Divinity.
D.F.C.	Distinguished Flying Cross.
D.Lit.	Doctor of Literature; Doctor of Letters.
D.Mus.	Doctor of Music.
D S C.	Distinguished Service Cross.
D Sc.	Doctor of Science.
D S M.	Distinguished Service Medal.
D.S O.	Distinguished Service Order.
D Th	Doctor of Theology.
D V.S.	Doctor of Veterinary Science.
Ebor	(*Eboracensis*) of York[1].
F B A	Fellow of the British Academy.
F C S	Fellow of the Chemical Society
F.D	(*Fidei Defensor*), Defender of the Faith
F F P S	Fellow of the Faculty of Physicians and Surgeons (Glasgow).
F G S.	Fellow of the Geological Society.
F.I C.	Fellow of the Institute of Chemistry.
F K Q C P I.	Fellow of King and Queen's College of Physicians in Ireland.
F L S.	Fellow of the Linnean Society.
F M	Field Marshal.
F P S.	Fellow of the Philological Society.
F R A I.	Fellow of the Royal Anthropological Institute
F R A S.	Fellow of the Royal Astronomical Society
F R C P.	Fellow of the Royal College of Physicians.
F R C P. E.	Fellow of the Royal College of Physicians of Edinburgh.
F R C S.	Fellow of the Royal College of Surgeons.
F R C V S.	Fellow of the Royal College of Veterinary Surgeons
F R G S	Fellow of the Royal Geographical Society.
F.R.Hist. S.	Fellow of the Royal Historical Society
F.R H S	Fellow of the Royal Horticultural Society.
F R I B.A	Fellow of the Royal Institution of British Architects.
F R Met. S.	Fellow of the Royal Meteorological Society.
F R S	Fellow of the Royal Society.
F.R S E.	Fellow of the Royal Society of Edinburgh.
F R.S L.	Fellow of the Royal Society of Literature.
F S.A.	Fellow of the Society of Antiquaries.
F S.S	Fellow of the Statistical Society
F Z S.	Fellow of the Zoological Society.
G.B E	Knight or Dame Grand Cross, Order of the British Empire.
G C B.	Knight Grand Cross of the Bath.
G C I E.	Knight Grand Commander of the Order of the Indian Empire.
G C M G.	Knight Grand Cross of St. Michael and St George.
G C S I.	Knight Grand Commander of the Star of India.
G C V O.	Knight Grand Cross of the Victorian Order
G O C.	General Officer Commanding.
G.W R.	Great Western Railway.
H H	His or Her Highness.
H I H.	His or Her Imperial Highness.
H I M	His or Her Imperial Majesty.
H M	His or Her Majesty.
H R H	His or Her Royal Highness.
H S H	His or Her Serene Highness.
I S O	Imperial Service Order.
J	Judge.
J C D	(*Juris Canonici Doctor*, or *Juris Civilis Doctor*), Doctor of Canon or Civil Law.
J P	Justice of the Peace.
J U D.	(*Juris utriusque Doctor*), Doctor of Civil and Canon Law.
K B E	Knight Commander, Order of the British Empire.
K C	King's Counsel.
K C B	Knight Commander of the Bath.
K C I E	Knight Commander of the Order of the Indian Empire.
K C M G	Knight Commander of St Michael and St George.
K C S I	Knight Commander of the Star of India.
K C V O	Knight Commander of the Victorian Order.
K G	Knight of the Garter.
K P.	Knight of St. Patrick.
K T	Knight of the Thistle
L A.H.	Licentiate of the Apothecaries' Hall
L C C	London County Council, or Councillor.
L C J	Lord Chief Justice.
L H D.	Doctor of Literature (U.S A.).
Litt D	Doctor of Letters.
L J	Lord Justice.
L L A	Lady Literate in Arts.
LL.B.	(*Legum Baccalaureus*), Bachelor of Laws.
LL D.	(*Legum Doctor*), Doctor of Laws.
LL M.	(*Legum Magister*), Master of Laws.
L.M S R.	London, Midland and Scottish Railway.
L N E.R.	London and North-eastern Railway.
L.R.A.M.	Licentiate of the Royal Academy of Music.
L.R C P	Licentiate of the Royal College of Physicians

[1] An archbishop or bishop, in writing his signature, substitutes for his surname the name of his see; thus the prelates of Canterbury, York, Oxford, London, etc., subscribe themselves with their initials (Christian names only) followed by Cantuar., Ebor., Oxon., Londin. (sometimes London), etc.

L.R C.P. E.	Licentiate of the Royal College of Physicians, Edinburgh.
L R.C S.	Licentiate of the Royal College of Surgeons.
L S A.	Licentiate of the Apothecaries' Society.
M.A	Master of Arts.
M B.	(*Medicinae Baccalaureus*), Bachelor of Medicine
M.B.E.	Member, Order of the British Empire.
M C	Member of Congress (U S.A.), Military Cross.
M Ch. *or* Chir.	Master of Surgery.
M Com.	Master of Commerce.
M D.	(*Medicinae Doctor*), Doctor of Medicine.
M I E E	Member of the Institute of Electrical Engineers
M I M E	Member of the Institute of Mining Engineers.
M I Mech E.	Member of the Institute of Mechanical Engineers
M Inst C. E.	Member of the Institute of Civil Engineers
M Litt.	Master of Literature.
M O	Medical Officer
M P	Member of Parliament
M R	Master of the Rolls
M R A S.	Member of the Royal Asiatic Society.
M R C P.	Member of the Royal College of Physicians
M.R C S.	Member of the Royal College of Surgeons.
M R C.V. S.	Member of the Royal College of Veterinary Surgeons
M.R I A.	Member of the Royal Irish Academy.
Mus B.	Bachelor of Music.
Mus D	Doctor of Music.
Mus M.	Master of Music.
M Sc	Master of Science.
M.V O.	Member of the Victorian Order.
N P	Notary Public
O B E.	Order of the British Empire.
O C.	Officer Commanding
O M.	Order of Merit.
P C.	Privy Councillor
Ph D.	(*Philosophiae Doctor*), Doctor of Philosophy.
P.P.	Parish Priest
P.R A.	President of the Royal Academy.
Q M G	Quarter-master General
R	(*Rex, Regina*), King, Queen
R.& I.	(*Rex et Imperator*), King and Emperor
R A.	Royal Academician, Royal Artillery
R A.F	Royal Air Force.
R A.M	Royal Academy of Music
R A.M C.	Royal Army Medical Corps
R A S C	Royal Army Service Corps
R.B A.	Royal Society of British Artists.
R E.	Royal Engineers.
Reg Prof	Regius Professor
R.I.B A.	Royal Institution of British Architects.
R.M.	Royal Marines, Resident Magistrate.
R.N.	Royal Navy.
R.N.V R	Royal Navy Volunteer Reserve.
S. *or* St.	Saint.
Sc D.	Doctor of Science.
S R	Southern Railway.
S.S.C.	Solicitor before the Supreme Courts (of Scotland).
S.T.P.	(*Sacrosanctae Theologiae Professor*), Professor of Sacred Theology.
T.M.	Their Majesties.
T.R H.	Their Royal Highnesses.
V C.	Vice-Chancellor, Victoria Cross.
V.G.	Vicar-General.
V S.	Veterinary Surgeon.
W S.	Writer to the Signet (in Scotland). [Equivalent to Attorney.]

2. ABBREVIATIONS DENOTING MONEYS, WEIGHTS AND MEASURES, ETC.

Characters, not properly abbreviations, are used in the same way, *e.g.*, ° ′ ″ for "degrees, minutes, seconds" (circular measure), ℥, ʒ, ℈ for "ounces, drachms, scruples." ℥ is probably to be traced to the written form of the *z* in "*oz.*"

ac	acre.
bar., bbl.	barrel.
bu.	bushel
c.	cent
cal	calorie
cu (*or* cub) ft.	cubic foot.
cwt.	hundredweight.
d.	(denarius) penny.
deg	degree
dr.	drachm or dram.
dwt.	pennyweight.
f	franc
fl	florin.
ft.	foot
fur.	furlong.
gal	gallon.
gr.	grain
hhd	hogshead.
h *or* hr	hour.
in	inch.
km	kilometre.
k *or* kilo	kilogram
L[1], £[1], or *l.*	(*libra*), pound (money).
lb. *or* lb.	(*libra*), pound (weight)
m. *or* mi.	mile, minute.
m.	minim
mo.	month
oz	ounce.
pk	peck
po	pole.
pt.	pint
q	(*quadrans*), farthing.
qr.	quarter.
qt.	quart.
ro	rood
Rs.[1]	rupees
sc *or* scr.	scruple.
s *or* sec.	second
s *or* /	(*solidus*), shilling.
sq ft, etc.	square foot, etc
st.	stone.
$[1]	(U S) dollar
yd	yard.

3. MISCELLANEOUS ABBREVIATIONS

A.	Accepted.
A.C.	(*Ante Christum*), before Christ.
acc, a/c. *or* acct.	Account
A D	(*Anno Domini*), in the year of our Lord.
Aet *or* Aetat.	(*Aetatis* [*anno*]), in the year of his age.
A H.	(*Anno Hegirae*), in the year of the Hegira (the Mohammedan era).
A.M	(*Anno Mundi*), in the year of the world.
a m.	(*Ante meridiem*), forenoon
A.M D.G	(*Ad majorem Dei gloriam*), to the greater glory of God.
Anon	Anonymous.
A.U.C.	(*Anno urbis conditae*), in the year from the building of the city (*i.e.*, Rome).
A.V.	Authorized version of the Bible.
b.	born.
B C	Before Christ
B V.M	The Blessed Virgin Mary.
C. *or* Cap.	(*Caput*), Chapter.
C.	Centigrade (*or* Celsius's) Thermometer.
c.	*circa*, about.
cent.	(*Centum*), a hundred; frequently £100. "Per cent." is often signified by %, a form traceable to "100."
Cf *or* cp	(*Confer*), compare.
Ch *or* Chap.	Chapter.
c i f	cost, insurance, freight.
C M S.	Church Missionary Society.
Co	Company, County.
C O.D.	Cash on Delivery.
Cr.	Creditor.
curt.	current; the present month.
d	died.
D C	District of Columbia
D G	(*Dei gratia*), by the grace of God.
Do	Ditto, the same.
D O.M	(*Deo Optimo Maximo*), to God the Best and Greatest.
Dr	Debtor.
D V	(*Deo volente*), God willing.
E & O E	Errors and omissions excepted.
e.g	(*Exempli gratia*), for example
etc. *or* &c	(*Et caetera*), and the rest, and so forth
Ex.	Example.
F *or* Fahr.	Fahrenheit's Thermometer.
Fec.	(*Fecit*), He made (*or* did) it.
fl	flourished.
Fo *or* Fol.	Folio.
f o b	free on board.
G P O.	General Post Office.
H M S.	His Majesty's Ship, or Service.
Ib. *or* Ibid.	(*Ibidem*), in the same place.
Id.	(*Idem*), the same.
i e	(*Id est*), that is.
I H.S.	A symbol for "Jesus," from first three Greek letters (Ι Η Σ), the correct origin forgotten, the Romanized letters were misinterpreted *Iesus, Hominum Salvator*, Latin "h" and Greek long "e" being confused.
inf	(*infra*), below.
I N R.I	Iesus Nazarenus Rex Judaeorum, Jesus of Nazareth King of the Jews.
inst	instant, the present month.
I O U.	I owe you.
i q.	(*Idem quod*), the same as.
κτλ.	καὶ τὰ λοιπά, *et caetera*, and the rest.
L. or Lib	(*Liber*), book.
Lat	Latitude.
l c *or* loc. cit	(*Loco citato*), in the place cited.
Long	Longitude
L S	(*Locus sigilli*), the place of the seal
m.	married.
Mem.	(*Memento*), remember; memorandum
ms	Manuscript, mss., manuscripts.
N.B.	New Brunswick.
N.B.	(*Nota bene*), mark well, take notice.
n d	No date.
N E.D	New English Dictionary.
nem. con.	(*Nemine contradicente*), no one contradicting
No.	(*Numero*), number.
N S.	New Style.
N.T.	New Testament.
ob.	(*Obiit*), died.
Obs.	Obsolete.
O.H M.S.	On His Majesty's Service.
O.K.	Correct, or approved.
okeh	correct, or approve (U. S.)
O.S.	Old Style.
O.S.B.	*Ordo Sancti Benedicti* (Benedictines).
O.T.	Old Testament.
p.	page; pp., pages.
Pinx.	(*Pinxit*), he painted it.
p.m.	(*Post Meridiem*), afternoon.
P.O.	Post Office, Postal Order.

[1] These forms are placed before their amounts.

P.O.O. Post Office Order.
P.P.C. (*Pour prendre congé*), to take leave.
P.R. Prize-ring.
prox. (*Proximo* [*mense*]), next month.
P.S. Postscript.
Pt. Part.
p.t or pro tem (*pro tempore*), for the time.
P.T.O. Please turn over.
Q., Qu, *or* Qy. Query; Question.
q.d (*Quasi dicat*), as if he should say; as much as to say.
Q E D (*Quod erat demonstrandum*), which was to be demonstrated
Q E F. (*Quod erat faciendum*), which was to be done.
q s. or quant. suff. (*Quantum sufficit*), as much as is sufficient

q v. (*Quod vide*), which see.
qq.v. (*Quae vide*), which see [plural].
℞. (*Recipe*), take.
√( ) (*or* = *r* for *radix*), sign of square root.
R.C. Roman Catholic
Ré Réaumur's thermometrical scale.
R I.P. (*Requiescat in pace*), may he rest in peace.
R.S.V.P. (*Répondez s'il vous plaît*), please reply
sc. (*Scilicet*), namely, that is to say.
S.C. South Carolina
Sc. *or* Sculp. (*Sculpsit*), he engraved it.
S.D.U K. Society for the Diffusion of Useful Knowledge
seq. *or* sq, seqq *or* sqq. (*Sequens, sequentia*), the following

S J. Society of Jesus.
s p. (*Sine prole*), without offspring.
S.P C K. Society for the Promotion of Christian Knowledge
S.P.G. Society for the Propagation of the Gospel
S.S R. Socialist Soviet Republic.
sup. (*supra*), above.
s v. (*Sub voce*), under the word (or heading).
s vv. (*sub vocibus*)
T C D. Trinity College, Dublin.
ult. (*Ultimo* [*mense*]), last month
U S. United States.
U S A. United States of America.
v (*versus*), against.
v *or* vid. (*Vide*), see
viz (*Videlicet*), namely.
Xmas. Christmas. This X is a Greek letter, corresponding to Ch.

II. MEDIAEVAL ABBREVIATIONS

A M. Ave Maria.
B P. Beatus Paulus; Beatus Petrus
CC. Carissimus (*also plur.* Carissimi); Clarissimus, Circum
D Deus, Dominicus, Dux
D N.PP. Dominus noster Papa.
FF. Felicissimus; Fratres; Pandectae (*prob. for Gr.* II).

I C *or* I X Iesus Christus.
I D N In Dei nomine.
KK. Karissimus (*or* -mi).
MM. Magistri, Martyres, Matrimonium; Meritissimus
O S B. Ordinis Sancti Benedicti
PP Papa, Patres, Piissimus.
R F. Rex Francorum.

R P.D. Reverendissimus Pater Dominus.
S C.M. Sacra Caesarea Maiestas
S M E. Sancta Mater Ecclesia.
S M M. Sancta Mater Maria
S R I Sanctum Romanum Imperium.
S V Sanctitas Vestra, Sancta Virgo
V Venerabilis; Venerandus
V R P. Vestra Reverendissima Paternitas.

III. CLASSICAL ABBREVIATIONS

A. Absolvo, Aedilis, Aes, Ager, Ago, Aio, Amicus, Annus, Antiquo, Auctor, Auditor, Augustus, Aulus, Aurum, Aut
A.A. Aes alienum, Ante audita, Apud agrum, Aurum argentum.
AA. Augusti
AAA Augusti tres.
A A A F F. Auro argento aere flando feriundo (of the III viri monetales).
A A.V. Alter ambove.
A C. Acta causa, Alius civis.
A.D Ante diem; *e g*, A D.V.: Ante diem quintum.
A D A Ad dandos agros.
AED Aedes, Aedilis, Aedilitas.
AEM *and* AIM Aemilius, Aemilia.
AER Aerarium.
AER P. Aere publico.
A F. Actum fide, Auli filius.
AG Ager, Ago, Agrippa.
A.G Animo grato, Aulus Gellius.
A L AE. *and* A L E Arbitrium litis aestimandae.
A.M *and* A MILL Ad milliarium.
AN. Aniensis, Annus, Ante.
ANN. Annales, Anni, Annona.
ANT. Ante, Antonius.
A.O. Alii omnes, Amico optimo.
AP. Appius, Apud.
A P Ad pedes, Aedilitia potestate.
A.P.F. Auro (*or* argento) publico feriundo
A P.M. Amico posuit monumentum, Annorum plus minus.
A.P.R C. Anno post Romam conditam.
ARG. Argentum.
AR V V. D.D. Aram votam volens dedicavit, Arma votiva dono dedit.
A.T. A tergo.
Also A TE. *and* A TER.
A.T.M.D. O. Aio te mihi dare oportere.
A.V. Augur, Augustus, Aurelius.
A V. Annos vixit.
A V.C. Ab urbe condita.
AVG. Augur, Augustus.
AVGG Augusti (*generally of two*).
AVGGG. Augusti tres.

AVT.PR. R. Auctoritas provinciae Romanorum.
B. Balbius, Balbus, Beatus, Bene, Beneficiarius, Beneficium, Bonus, Brutus, Bustum.
B. *for* V. Berna, Bivus, Bixit
B A Bonis augurus, Bonus amabilis
BB *or* B.B. Bene bene; *i e.*, optime, Optimus.
B D Bonae deae, Bonum datum
B DD Bonis deabus
B D S M. Bene de se merenti.
B F. Bona femina, Bona fides, Bona fortuna, Bonum factum
B F. Bona femina, Bona filia.
B H. Bona hereditatia, Bonorum heres.
B I Bonum iudicium.
B I I Boni iudices iudicium.
B M Beatae memoriae, Bene merenti
B N Bona nostra, Bonum nomen
BN.H I. Bona hic invenies
B P. Bona paterna, Bonorum potestas, Bonum publicum.
B Q. Bene quiescat, Bona quaesita.
B RP N. Bono reipublicae natus.
BRT. Britannicus
B T. Bonorum tutor, Brevi tempore
B V Bene vale, Bene vixit, Bonus vir
B V.V. Balnea vina venus.
BX. Bixit, *for* vixit.
C. Caesar, Gaius, Caput, Causa, Censor, Civis, Cohors, Colonia, Comitialis, (dies) Condemno, Consul, Cum, Curo, Custos
C. Gaia, Centuria, Cum, *the praenomen* Con.
C.B. Civis bonus, Commune bonum, Coniugi benemerenti, Cui bono.
C.C. Calumniae causa, Causa cognita, Coniugi carissimae, Consilium cepit, Curiae consulto.
C.C.C. Calumniae cavendae causa.
C.C.F. Caesar (*or* Gaius) cuiavit faciendum, Gaius Gaii filius.
CC.VV. Clarissimi viri.
C.D. Caesaris decreto, Gaius Decius, Comitialibus diebus.
CES. Censor, Censores.
CESS. Censores.
C.F. Causa fiduciae, Coniugi fecit, Curavit faciendum.
C.H. Custos heredum, Custos hortorum.

C I. Gaius Iulius, Consul iussit, Curavit iudex
CL. Clarissimus, Claudius, Clodius, Colonia
CL V Clarissimus vir, Clypeum vovit.
C M Gaius Marius, Causa mortis.
CN. Gnaeus.
COH. Coheres, Cohors.
COL Collega, Collegium, Colonia, Columna
COLL. Collega, Coloni, Coloniae.
COM. Comes, Comitium, Comparatum.
CON. Conius, Consensus, Consiliarius, Consul, Consularis
COR. Cornelia (tribus), Cornelius, Corona, Corpus.
COS Consiliarius, Consul, Consulares.
COSS. Consules
C P. Carissimus *or* Clarissimus puer, Civis publicus, Curavit ponendum
C R Gaius Rufus, Civis Romanus, Curavit reficiendum.
CS Caesar, Communis, Consul
C V Clarissimus *or* Consularis vir.
CVR. Cura, Curator, Curavit, Curia.
D. Dat, Dedit, etc.; De, Decimus, Decius, Decretum, Decurio, Deus, Dicit, etc., Dies, Divus, Dominus, Domus, Donum.
D C. Decurio coloniae, Diebus comitialibus, Divus Caesar.
D D. Dea Dia, Decurionum decreto, Dedicavit, Deo dedit, Dono dedit.
D D.D. Datum decreto decurionum, Dono dedit dedicavit.
D E R. De ea re
DES. Designatus.
D.I. Dedit imperator, Diis immortalibus, Diis inferis.
D I M. Deo invicto Mithrae, Diis inferis Manibus.
D.M. Deo Magno, Dignus memoria, Diis Manibus, Dolo malo.
D.O.M. Deo Optimo Maximo.
D P.S. Dedit proprio sumptu, Deo perpetuo sacrum, De pecunia sua.
E. Ejus, Eques, Erexit, Ergo, Est, Et, Etiam, Ex.
EG. Aeger, Egit, Egregius
E.M. Egregiae memoriae, Eius modi, Erexit monumentum.

EQ M.	Equitum magister.
E.R.A.	Ea res agitur.
F.	Fabius, Facere, Fecit, etc.; Familia, Fastus (dies), Felix, Femina, Fides, Filius, Flamen, Fortuna, Frater, Fuit, Functus
F.C.	Faciendum curavit, Fidei commissum, Fiduciae causa
F D.	Fidem dedit, Flamen Dialis, Fraude donavit.
F F F.	Ferro flamma fame, Fortior fortuna fato
FL.	Filius, Flamen, Flaminius, Flavius
F L	Favete linguis, Fecit libens, Felix liber
FR.	Forum, Fronte, Frumentarius.
F.R.	Forum Romanum
G.	Gaius, Gallia, Gaudium, Gellius, Gemina, Gens, Gesta, Gratia
G F.	Gemina fidelis (*applied to a legion*). *So* G P F Gemina pia fidelis.
GL.	Gloria
GN.	Genius, Gens, Genus, Gnaeus
G.P.R.	Genio populi Romani
H.	Habet, Heres, Hic, Homo, Honor, Hora
HER.	Heres, Herennius
HER *and* HERC.	Hercules.
H.L.	Hac lege, Hoc loco, Honesto loco.
H M.	Hoc monumentum, Honesta mulier, Hora mala
H S.E.	Hic sepultus est, Hic situs est.
H V.	Haec urbs, Hic vivit, Honeste vixit, Honestus vir.
I.	Immortalis, Imperator, In, Infra, Inter, Invictus, Ipse, Isis, Iudex, Iulius, Iunius, Iuppiter, Iustus.
IA.	Iam, Intra.
I.C.	Iulius Caesar, Iuris Consultum, Ius civile.
ID.	Idem, Idus, Interdum
I.D.	Inferis dus, Iovi dedicatum, Ius dicendum, Iussu Dei
I.D.M.	Iovi deo magno
I.F.	In foro, In fronte.
I.H.	Iacet hic, In honestatem, Iustus homo.
IM.	Imago, Immortalis, Immunis, Impensa.
IMP.	Imperator, Imperium.
I.O.M.	Iovi optimo maximo.
I.P.	In publico, Intra provinciam, Iusta persona.
I.S.V.P.	Impensa sua vivus posuit
K.	Kaeso, Gaia, Calumnia, Caput, Carus, Castra.
K., KAL. *and* KL.	Kalendae.
L.	Laelius, Legio, Lex, Libens, Liber, Libra, Locus, Lollius, Lucius, Ludus
LB	Libens, Liberi, Libertus
L.D.D D	Locus datus decreto decurionum.
LEG.	Legatus, Legio
LIB.	Liber, Liberalitas, Libertas, Libertus, Librarius.
LL.	Leges, Libentissime, Liberti
L.M.	Libens merito, Locus monumenti.
L.S.	Laribus sacrum, Libens solvit, Locus sacer.
LVD.	Ludus.
LV.P.F	Ludos publicos fecit.
M.	Magister, Magistratus, Magnus, Manes, Marcus, Marius, Marti, Mater, Memoria Mensis, Miles, Monumentum, Mortuus, Mucius, Mulier.
M'.	Manius
M.D.	Magno Deo, Manibus diis, Matri deum, Merenti dedit.
MES.	Mensis.
MESS.	Menses.
M F.	Mala fides, Marci filius, Monumentum fecit
M I.	Matri Idaeae, Matri Isidi, Maximo Iovi.
MNT. *and* MON	Moneta.
M P.	Male positus, Monumentum posuit.
M S.	Manibus sacrum, Memoriae sacrum, Manu scriptum
MVN.	Municeps, *or* municipium, *so also* MN, MV and MVNIC.
M V S	Marti ultori sacrum, Merito votum solvit
N.	Natio, Natus, Nefastus (dies), Nepos, Neptunus, Nero, Nomen, Non, Nonae, Noster, Novus, Numen, Numerius, Numerus, Nummus.
NEP	Nepos, Neptunus
N F C	Nostrae fidei commissum
N L	Non licet, Non liquet, Non longe.
N M V.	Nobilis memoriae vir.
NN	Nostri
NN, NNO *and* NNR	Nostrorum.
NOB.	Nobilis.
NOB, NOBR. *and* NOV.	Novembris.
N.P.	Nefastus primo (*i.e.*, priore parte dici), Non potest
O.	Ob, Officium, Omnis, Oportet, Optimus, Opus, Ossa.
OB	Obiit, Obiter, Orbis
O C S	Ob cives servatos.
O H F.	Omnibus honoribus functus.
O H S S	Ossa hic sita sunt.
OR	Hora, Ordo, Ornamentum.
O.T.B Q	Ossa tua bene quiescant
P.	Pars, Passus, Pater, Patronus, Pax, Perpetuus, Pes, Pius, Plebs, Pondo, Populus, Post, Posuit, Praeses, Praetor, Primus, Pro, Provincia, Publicus, Publius, Puer.
P.C.	Pactum conventum, Patres conscripti, Pecunia constituta, Ponendum curavit, Post consulatum, Potestate censoria.
P.F.	Pia fidelis, Pius felix, Promissa fides, Publii filius.
P.M.	Piae memoriae, Plus minus, Pontifex maximus.
P.P.	Pater patratus, Pater patriae, Pecunia publica, Praepositus, Primipilus, Propraetor.
PR.	Praeses, Praetor, Pridie, Princeps.
P.R.	Permissu reipublicae, Populus Romanus.
P.R C.	Post Romam conditam.
PR.PR.	Praefectus praetorii, Propraetor.
P.S.	Pecunia sua, Plebiscitum, Proprio sumptu, Publicae saluti.
P.V.	Pia victrix, Praefectus urbi, Praestantissimus vir.
Q.	Quaestor, Quando, Quantus, Que, Qui, Quinquennalis, Quintus, Quirites.
Q D R.	Qua de re.
Q I S S.	Quae infra scripta sunt, *so* Q.S. S S Quae supra, etc.
QQ	Quaecunque, Quinquennalis, Quoque.
Q R	Quaestor reipublicae
R	Recte, Res, Respublica, Retro, Rex, Ripa, Roma, Romanus, Rufus, Rursus
R C.	Romana civitas, Romanus civis
RESP. *and* RP	Respublica.
RET P. *and* RP.	Retro pedes.
S	Sacrum, Scriptus, Semis, Senatus, Sepultus, Servius, Servus, Sextus, Sibi, Sine, Situs, Solus, Solvit, Sub, Suus.
SAC	Sacerdos, Sacrificium, Sacrum.
S.C.	Senatus consultum
S D.	Sacrum dus, Salutem dicit, Senatus decreto, Sententiam dedit
S D M	Sacrum dus Manibus, Sine dolo malo
SER	Servius, Servus.
S E T L.	Sit ei terra levis.
SN.	Senatus, Sententia, Sine.
S.P.	Sacerdos perpetua, Sine pecunia, Sua pecunia.
S P Q R.	Senatus populusque Romanus.
S S.	Sanctissimus senatus, Supra scriptum
S.V B.E. = E Q V.	Si vales bene est, ego quidem valeo
T.	Terminus, Testamentum, Titus, Tribunus, Tu, Turma, Tutor.
TB., TI *and* TIB	Tiberius.
TB, TR *and* TRB.	Tribunus.
T.F.	Testamentum fecit, Titi filius, Titulum fecit, Titus Flavius
TM.	Terminus, Testamentum, Thermae.
T.P.	Terminum posuit, Tribunicia potestate, Tribunus plebis.
TVL.	Tullius, Tullus.
V.	Urbs, Usus, Uxor, Vale, Verba, Vestalis, Vester, Vir, Vivus, Vixit, Volo, Votum.
V.A.	Veterano assignatus, Vixit annos.
V.C.	Vale conjux, Vir clarissimus, Vir consularis.
V.E.	Verum etiam, Vir egregius, Visum est.
V F.	Usus fructus, Verba fecit, Vivus fecit.
V.P.	Urbis praefectus, Vir perfectissimus, Vivus posuit.
V.R.	Urbs Roma, Uti rogas. Votum reddidit.

In musical notation abbreviations of many kinds are regularly employed. A familiar example is the substitution of a single note with one or more strokes through it for a group of notes which has to be repeated

ABBREVIATORS, officials in the papal chancery, whose business was to draft the pope's bulls, briefs and consistorial decrees before these were written out *in extenso* by the *scriptores*. They are first mentioned in *Extravagantes* of John XXII. Pius II fixed their number at 70, and formed them into a college of prelates, classing them as *de Parco majori* and *de Parco minori*. The abbreviators *de Parco majori* were among the most important officers of the apostolic chancery. By Martin V. their signature was made essential to the validity of the acts of the chancery; and they obtained in course of time many important privileges. The present college consists of 17 prelates, six substitutes, and one sub-substitute. (*See* CURIA ROMANA.)

A.B.C. POWERS, a designation which came into use shortly before the World War for the three leading South American powers—Argentina, Brazil and Chile. For many years previously a current of opinion had prevailed in several republics of South America favouring an alliance to counteract certain political tendencies of the United States and particularly the Monroe Doctrine. Recalling unsettled boundaries and other political problems, statesmen of certain Latin American republics had, from

time to time, provided for arbitration agreements or other means of mutual assistance in case of emergencies. Among such was the treaty between Brazil and Chile in 1899; between Argentina and Chile in 1902; and between Argentina and Brazil in 1905. These pacts have been regarded as the forerunners of the three-power *entente cordiale* that gradually developed and was discussed at the first Pan-American Scientific Congress, held at Santiago, Chile, in 1908–09. In 1915 Argentina, Brazil and Chile concluded among themselves a group of treaties of peace and arbitration.

On April 25, 1914, when war between the United States and Mexico appeared imminent, the Governments of Argentina, Brazil and Chile, through their diplomatic representatives at Washington, Dr. Rómulo S. Naón, Sr. Domicio da Gama, and Don Eduardo Suárez, respectively, addressed the secretary of State of the United States tendering their services as mediators. This mediation was accepted by President Woodrow Wilson, who appointed as United States delegates Justice Joseph R. Lamar and Frederick W. Lehmann, while Mexico chose as her representatives Sres. Emilio Rabasa, Augustin Rodriguez and Luis Elguero. These A B.C. mediators, together with the Americans and the Mexicans, met in a series of sessions at Niagara Falls, Canada. The deliberations began on May 18, 1914, and were continued until August of the same year. The result of the conference was thus summarized by the Brazilian delegate, Senhór da Gama, as follows: "We have established, through agreement between the parties most directly interested, and in complete harmony with the sentiments of the Government of the United States, that it is a principle of American policy to have our national problems always given a fair examination and settled without foreign interference." (W. A. R.)

ABDALLATIF or ABD-UL-LATIF (1162–1231), physician and traveller, was born and died in Baghdad. A memoir of Abdallatif, written by himself, has been preserved with additions by Ibn-Abu-Osaiba (Ibn abī Usaibia), a contemporary. He visited Mosul, Damascus and Egypt and then joined the circle of learned men whom Saladin gathered around him at Jerusalem. He taught medicine and philosophy at Cairo and at Damascus for a number of years, and afterwards, for a shorter period, at Aleppo.

Of the numerous works—mostly on medicine—which Osaiba ascribes to him, one only, his graphic and detailed *Account of Egypt*, appears to be known in Europe. The manuscript, discovered by Edward Pococke, the Orientalist, and preserved in the Bodleian Library, contains a vivid description of a famine caused by the Nile failing to overflow its banks. It was translated into Latin by Professor White of Oxford in 1800 and into French, with valuable notes, by De Sacy in 1810.

'ABD-AR-RAHMAN, the name borne by five princes of the Omayyad dynasty, amirs and caliphs of Cordova.

'ABD-AR-RAHMAN I. (756–788) founded the branch of the family which ruled for nearly three centuries in Mohammedan Spain. When the Omayyads were overthrown in the East by the Abbasids, 'Abd-ar-Rahman ibn Moawya, grandson of the caliph Histrām, was a young man of about 20 years of age. Together with his brother Yahya, he took refuge with Bedouin tribes in the desert. The Abbasids hunted their enemies down without mercy. Yahya was slain, and 'Abd-ar-Rahman saved himself by fleeing first to Syria and thence to northern Africa which had fallen into the hands of local rulers, formerly amirs or lieutenants of the Omayyad caliphs, but now aiming at independence. In the midst of all his perils, which read like stories from the *Arabian Nights*, 'Abd-ar-Rahman had been encouraged by a prophecy of his great-uncle Maslama that he would restore the fortunes of the family. He was followed in all his wanderings by a few faithful clients of the Omayyads. In 755 he was in hiding near Ceuta, and he sent an agent over to Spain to ask for the support of other clients of the family, descendants of the conquerors of Spain, who were numerous, in the province of Elvira, the modern Granada. On the invitation of his partisans he landed at Almuñecar, to the east of Malaga, on Aug. 14, 755. In the course of 756 a campaign was fought in the valley of the Guadalquivir, which ended, on May 16, in the defeat of the emir Yūsuf outside Cordova. 'Abd-ar-Rahman's army was so ill provided that he mounted almost the only good war-horse in it; he had no banner, and one was improvised by unwinding a green turban and binding it round the head of a spear. The turban and the spear became the banner of the Spanish Omayyads. Yūsuf recognized 'Abd-ar-Rahman as emir of Spain in July 756. (*See* SPAIN.)

'ABD-AR-RAHMAN II. (822–852), son of the emir Hakam, was one of the weaker of the Spanish Omayyads. He was a prince with a taste for music and literature.

'ABD-AR-RAHMAN III. (912–961) was the greatest and the most successful of the princes of his dynasty in Spain (for the general history of his reign *see* SPAIN: *History*). He succeeded his grandfather 'Abdallāh when he was barely 22 and reigned for half a century. 'Abd-ar-Rahman III came to the throne when the country was exhausted by more than a generation of tribal conflict among the Arabs, and of strife between them and the Mohammedans of native Spanish descent. Spaniards who were openly or secretly Christians had acted with the renegades. These elements were not averse from supporting a strong ruler who would protect them against the Arab aristocracy. These restless nobles were the most serious of 'Abd-ar-Rahman's enemies. Next to them came the Fatimites of Egypt and northern Africa, who claimed the caliphate, and who aimed at extending their rule over the Mohammedan world, at least in the west. 'Abd-ar-Rahman subdued the nobles by means of a mercenary army, which included Christians. He repelled the Fatimites, partly by supporting their enemies in Africa and partly by claiming the caliphate for himself. His ancestors in Spain had been content with the title of sultan. The caliphate was thought only to belong to the prince who ruled over the sacred cities of Mecca and Medina. But the force of this tradition had been so far weakened that 'Abd-ar-Rahman could proclaim himself caliph on Jan. 16, 929. His worst enemies were always his fellow Mohammedans. After he was defeated by the Christians at Alhandega in 939 through the treason of the Arab nobles in his army (*see* SPAIN: *History*) he never again took the field.

In the agony of the Omayyad dynasty in Spain, two princes of the house were proclaimed caliphs for a very short time, 'Abd-ar-Rahman IV. Mortada (1017), and 'Abd-ar-Rahman V. Mostadir (1023–24). Both were the mere puppets of factions, who deserted them at once. 'Abd-ar-Rahman IV was murdered in the year in which he was proclaimed, at Guadiz, when fleeing from a battle in which he had been deserted by his supporters. 'Abd-ar-Rahman V. was proclaimed caliph in Dec. 1023 at Cordova, and murdered in Jan. 1024 by a mob of unemployed workmen, headed by one of his own cousins.

The history of the Omayyads in Spain is the subject of the *Histoire des Musulmans d'Espagne* by R. Dozy (Leyden, 1861).

ABD-EL-AZIZ IV. (1880–), sultan of Morocco, son of Sultan Mulai el Hasan III. by a Circassian wife. He was 14 years of age on his father's death in 1894. By the wise action of Si Ahmad bin Musa, the chamberlain of el Hasan, Abd-el-Aziz's accession to the sultanate was ensured with but little fighting. Si Ahmad became regent and for six years showed himself a capable ruler. On his death in 1900 the regency ended, and Abd-el-Aziz took the reins of government into his own hands, with an Arab from the south, el Menebhi, for his chief adviser. Urged by his Circassian mother, the sultan sought advice and counsel from Europe and endeavoured to act up to it. But disinterested advice was difficult to obtain, and in spite of the unquestionable desire of the young ruler to do the best for the country, wild extravagance both in action and expenditure resulted, leaving the sultan with depleted exchequer and the confidence of his people impaired. His intimacy with foreigners and his imitation of their ways were sufficient to rouse fanaticism and create dissatisfaction. Europeans were accused of having spoiled the sultan and of being desirous of spoiling the country. When British engineers were employed to survey the route for a railway between Mequinez and Fez this was reported as indicating an absolute sale of the country. The fanaticism of the people was aroused and a revolt broke out near the Algerian frontier. Such was the condition of things when the news of the Anglo-French Agreement of 1904 came as a blow to Abd-el-Aziz, who had relied

on England for support and protection against the inroads of France. On the advice of Germany he proposed the assembly of an international conference at Algeciras in 1906 to consult upon methods of reform, the sultan's desire being to ensure a condition of affairs which would leave foreigners with no excuse for interference in the control of the country. The sultan gave his adherence to the Act of the Algeciras Conference, but the state of anarchy into which Morocco fell during the latter half of 1906 and the beginning of 1907 exposed the weakness of his government. In May 1907 the southern tribes invited Mulai Hafid, an elder brother of Abd-el-Aziz, and viceroy at Marrakesh, to become sultan, and in the following August Hafid was proclaimed sovereign. In the meantime the murder of Europeans at Casablanca had led to the occupation of that port by France. In September Abd-el-Aziz arrived at Rabat from Fez to seek the support of the European powers against his brother. From France he was later enabled to negotiate a loan. His leaning to Christians aroused further opposition and in January 1908 he was declared deposed by the ulema of Fez, who offered the throne to Hafid After months of inactivity Abd-el-Aziz made an effort to restore his authority, and quitting Rabat in July he marched on Marrakesh. His force was completely overthrown (Aug. 19) when near that city, and Abd-el-Aziz fled to Settat within the French lines round Casablanca. In November he came to terms with his brother, and thereafter took up his residence in Tangier as a pensioner of the new sultan. (*See* MOROCCO: *History*)

ABD-EL-KADER (1807?–1883), amir of Mascara, the great opponent of the conquest of Algeria by France, was born near Mascara in 1807 or 1808. His family were *sherifs* or descendants of Mohammed, and his father, Mahi-ed-Din, was celebrated throughout north Africa for his piety and charity. Abd-el-Kader received an excellent education in theology and philosophy, in horsemanship and in other manly exercises. A pilgrimage to Mecca and Medina and to the tomb of Sidi Abd-el-Kader El Jalili at Baghdad stimulated his religious enthusiasm While in Egypt in 1827, Abd-el-Kader was impressed by the reforms then being carried out by Mohammed Ali, and the knowledge he then gained affected his career Mahi-ed-Din and his son returned to Mascara shortly before the French occupation of Algiers destroyed the government of the Dey (July 1830). Coming forward as the champion of Islam against the infidels, Abd-el-Kader was proclaimed amir at Mascara in 1832. In a short time he had rallied to his standard all the tribes of western Algeria The story of his 15 years' struggle against the French is given under ALGERIA. Up to the beginning of 1842 the contest went in favour of the amir; thereafter he found in Marshal Bugeaud an opponent who proved, in the end, his master. Throughout this period Abd-el-Kader showed himself a born leader of men, a great soldier, a capable administrator, a persuasive orator, a chivalrous opponent. His ultimate failure was due in considerable measure to the refusal of the Kabyles, Berber mountain tribes whose Mohammedanism was somewhat loosely held, to make common cause with the Arabs against the French. On Dec 21, 1847 Abd-el-Kader surrendered to General Lamoricière at Sidi Brahim. On the 23rd, his submission was formally made to the duc d'Aumale, then governor of Algeria. In violation of the promise that he would be allowed to go to Alexandria or St. Jean d'Acre, Abd-el-Kader and his family were detained in France, where he remained until Oct. 1852, when he was released by Napoleon III on taking an oath never again to disturb Algeria. The amir then lived in Brusa, removing in 1855 to Damascus In July 1860, when the Muslims attacked the Christian quarters of Damascus, Abd-el-Kader saved large numbers of Christians.

When the Algerians revolted, Abd-el-Kader, in 1871, counselled submission to France. After 1847 he composed a philosophical treatise, of which a French translation was published in 1858 under the title of *Rappel à l'intelligent, Avis à l'indifférent.* He also wrote a book about the Arab horse. He died at Damascus on May 26, 1883.

See Commdt. J Pichon, *Abd el Kader, 1807–83* (1899); Alex. Bellemare, *Abd-el-Kader: sa vie politique et militaire* (1863); Col. C. H. Churchill, *The Life of Abdel Kader* (1867).

ABDEL KRIM, Mohammed ben Abdel Krim el-Khatabe, a Moroccan chieftain, was the son of a caid of the Beni Uriaghel tribe inhabiting the mountainous country that extends inland from Alhucemas bay on the Rif coast of Morocco. His father was a person of no particular importance or family, but, being a man of progressive ideas and in contact with the Spaniards at Melilla, he gave his two sons an education to which few of the Riffian tribesmen aspire. While Mohammed, the future Riffian leader, was taught Spanish and a smattering of European knowledge, his brother, Mohammed, was sent to Spain and educated as a mining engineer. (It is customary among the peoples of northern Africa and Egypt to give brothers the same name if it is an illustrious one) Abdel Krim was employed in the office of native affairs at Melilla, while his brother worked in the interests of certain mining groups.

In 1919 a quarrel between Abdel Krim and General Silvestre, of the Spanish army, led to the former's flight from Melilla. He took to the mountains of his tribe, where his brother joined him. Both swore revenge, and instituted a fierce resistance to the occupation of the Rif by the Spaniards. In 1921 Abdel Krim avenged himself of the slight he had received from Silvestre. With only a few hundred tribesmen, he attacked the Spanish advanced post of Anual and captured it. Silvestre was killed, or committed suicide. The fall of Anual spread panic through the Spanish army of 19,000 men The Spanish posts were deserted, and the troops fled in disorderly retreat. Before the fighting was ended 16,000 of the 19,000 men had been massacred. The remainder mostly crossed into the French zone. The Riffian tribesmen were guilty of every kind of treachery and atrocity, their revenge for acts of which they accused the Spaniards, more especially that of forcible interference with their women, an unpardonable offence in their eyes. The Rifi reached the walls of Melilla, and, had they chosen, they could have captured the town and massacred its population of 50,000 civilians. But glutted with bloodshed and loaded with loot, they desisted.

This signal defeat of the Spaniards vastly increased Abdel Krim's reputation amongst the tribes. The Jabala, inhabiting the western portion of the Spanish zone, joined his cause and in 1924 the Spaniards were obliged to abandon all their inland positions and retreat on Tetuan and the sea, suffering heavy losses in the retirement. By the end of that year Abdel Krim, having rid himself by capture of his only rival, Raisuli, was master of the situation, and set to work to prepare a fresh campaign against the Spaniards. But a new danger threatened him from the south. The French, gradually occupying the zone to which they laid claim under existing treaties, were advancing northward, and Abdel Krim was forced to go to the aid of the threatened tribes. His army and the revolted tribesmen invaded the French protectorate, and by June 1925 threatened Fez.

French reinforcements were hurriedly dispatched from France and Algeria, and by October the French protectorate territory was clear of the enemy, and a French army of 160,000 men, under Marshal Pétain, was on the borders of the Rif. In September the Spaniards had successfully disembarked a force in Alhucemas bay and Ajdir had been taken. By Nov. 1, 1925 the French and Spanish armies had been obliged by the weather to abandon an active campaign, and were digging themselves into winter quarters, but Abdel Krim, though weakened and threatened, was by no means beaten. This man of great ability and astounding energy fortified his mountain fastnesses and collected new forces to continue his campaign against two European armies, but in vain. He surrendered to France in May 1926, and was exiled to the island of Réunion. *See* MOROCCO, CAMPAIGNS IN.

See Walter Harris, *France, Spain and the Rif* (1927).

(W. B. H.)

ABDERA, ancient town, coast of Thrace, near the mouth of the Nestos, almost opposite Thasos. Its mythical foundation was attributed to Heracles; historically it was a colony from Clazomenae in the 7th century B.C. But its prosperity dates from 544 B.C., when the majority of the people of Teos migrated to Abdera to escape Persian oppression (Herod. i. 168). The town seems to have declined in importance after the middle of the 4th

century. The air of Abdera was proverbial as causing stupidity; but among its citizens was the philosopher Democritus. The ruins on Cape Balastra cover seven small hills, and extend from an east to a west harbour; on the south-west hills are remains of the mediaeval settlement of Polystylon.

See *Mittheil. d. deutsch. Inst Athens,* xii. (1887), p. 161 (Regel); *Mém de l'Acad des Inscriptions,* xxxix. 211; K F. Hermann, *Ges. Abh.* 90–111, 370 ff , S. Casson, *Macedon, Thrace and Illyria* (1926); Pauly-Wissowa, *s.v.*

ABDERA, an ancient seaport on the south coast of Spain, between Malaga and New Carthage, in the district inhabited by the Bastuli. Founded by the Carthaginians, it became an important town in the Roman province of Hispania Baetica. It was on a hill above the modern Adra (*q.v.*). Its most ancient coins bear the Phoenician inscription, *abdrt,* with the head of Heracles (Melkarth) and a tunny-fish; those of Tiberius (who seems to have made the place a colony) show the chief temple of the town with two tunny-fish erect in the form of columns. For inscriptions relating to the Roman municipality *see* Corpus Inscriptionum Latinarum, ii 267.

ABDICATION, the act whereby a person in office renounces the same before the expiry of the time for which it is held (Lat *abdicatio,* from *ab,* from, and *dicare,* to proclaim as not belonging to one) In Roman law, the term is especially applied to the disowning of a member of a family, as the disinheriting of a son, but the word is seldom used except in the sense of surrendering the supreme power in a State. Despotic sovereigns are at liberty to divest themselves of their powers at any time, but it is otherwise with a limited monarchy. The throne of Great Britain cannot be lawfully abdicated unless with the consent of the two Houses of Parliament When James II., after throwing the great seal into the Thames, fled to France in 1688, he did not formally resign the Crown, and the question was discussed in parliament whether he had forfeited the throne or had abdicated.

Recent abdications include Pu-yi (China) Feb. 12, 1912, Nicholas II (Russia) Mar. 15, 1917; Ferdinand I. (Bulgaria) Oct. 3, 1918; William II. (Germany) Nov 9, 1918; Frederick Augustus III. (Saxony) Nov. 9, 1918; Charles I (Austria-Hungary) Nov 12, 1918; Louis III (Bavaria) Nov 13, 1918, Frederick II. (Baden) Nov. 22, 1918; William II (Wurttemberg) Dec. 2, 1918; George II (Greece) Dec. 18, 1923.

ABDOMEN, the belly, the region of the body containing most of the digestive organs. (*See* ANATOMY AND ALIMENTARY CANAL)

ABDOMEN, SURGERY OF. The diseases of this region are dealt with generally in the article DIGESTIVE ORGANS, and under their own names (*e g ,* APPENDICITIS) Under the appropriate headings the surgery of each abdominal organ is dealt with (*see* STOMACH, KIDNEY, LIVER, etc.); here the general principles of abdominal surgery are discussed.

Exploratory Laparotomy.—In many cases of intra-abdominal disease the surgeon cannot say what is wrong without making an incision and examining by sight or touch. Under conditions of strict asepsis this is not a perilous or serious procedure. When an opening is made in such circumstances—provided only it is done soon enough—the successful treatment of the case often becomes a simple matter.

A great impetus was given to the surgery of wounded, mortified, or diseased pieces of intestine by the introduction from Chicago of a contrivance named, after the inventor, *Murphy's button* This consists of a short nickel-plated tube in two pieces, which are secured in the divided ends of the bowel so that when the pieces are subsequently "married" the adjusted ends of the bowel are securely fixed together and the canal rendered practicable. In the course of time the button loosens itself into the interior of the bowel and comes away with the motions. In many other types of case the button has proved convenient and successful, but sometimes ulceration occurs around the rim of the metal button, or the loosened metal causes trouble in its passage along the alimentary canal. Some surgeons therefore prefer a bobbin of decalcified bone or similar soft material, while others rely upon direct suturing of the parts. The last-named method has increased in favour. The cause of death in intestinal obstruction is usually absorption of poisonous substances formed in the bowel above the obstruction. Usually, therefore, the surgeon completes his operation for the relief of obstruction by drawing out a loop of the distended bowel, incising and evacuating it, and then carefully suturing and returning it.

Rectal or subcutaneous injections of saline or other fluid and early adoption of a sitting position for the patient are other measures often adopted.

Wounds of the Abdomen.—The treatment of gunshot wounds of the abdomen differs according to circumstances. If the wound be caused by a rifle bullet travelling at high speed, the intra-abdominal pressure is usually sufficient to prevent escape of intestinal contents; complete rest and avoidance of surgery is the procedure of choice, and the chance of recovery is great though several coils of intestine may have been pierced But if the wound be caused by a fragment of high explosive shell, or a revolver shot or a stab this is not the case. To avoid the onset of peritonitis, early operation, suture of the wounded gut and washing out of the peritoneal cavity afford the only chance for the patient. The "expectant" treatment which proved best in the South African War (1899–1902) was at first followed in the World War, but soon was abandoned in favour of laparotomy.

Intussusception.—This is a terribly fatal disease of infants and children, in which a piece of bowel slips into, and is gripped by, the piece next below it. Formerly attempts were made to reduce the invagination by passing air or water up the rectum under pressure, but now early recourse is had to abdominal surgery with far better results.

Cancer of the Intestine.—With the introduction of aseptic surgery the bowel can be reached through the peritoneum easily and safely. If the cancerous mass is fairly movable the affected piece of bowel is excised, the cut ends are united and the continuity of the alimentary canal is re-established When the lowest part of the bowel was found to be cancerous, the surgeon used formerly to secure an escape for the contents of the bowel by making an opening into the colon in the left loin But in recent years this operation of *lumbar colotomy* has been almost entirely replaced by opening the colon in the left groin.

ABDUCTION, a law term denoting the forcible or unlawful removal of a person. The Offences against the Person Act 1861, by s. 53, makes it felony for any one from motives of lucre to take away or detain against her will, with intent to marry or carnally know her, etc , any woman of any age who has any interest in any real or personal estate, or is an heiress presumptive, or co-heiress, or presumptive next of kin to any one having such an interest; or for any one to cause such a woman to be married or carnally known by any other person; or for any one with such intent to allure, take away, or detain any such woman under the age of 21, out of the possession and against the will of her parents or guardians By s 54, forcible taking away or detention against her will of any woman of any age with like intent is felony The same act, by s. 55, makes abduction without even any such intent a misdemeanour, where an unmarried girl under the age of 16 is unlawfully taken out of the possession and against the will of her parents or guardians. The girl's consent is immaterial, nor is it a defence that the person charged reasonably believed that the girl was 16 or over. By s 56, stealing a child under the age of 14 with intent to deprive parents or guardian of such child is also a felony The Criminal Law Amendment Act 1885 made still more stringent provisions with reference to abduction by making the procuration or attempted procuration of any virtuous female under the age of *twenty-one years* a misdemeanour, as well as the abduction of any girl under *eighteen years* of age with the intent that she shall be carnally known, or the detaining of *any female* against her will on any premises, with intent to have, or that another person may have, carnal knowledge of her.

In the United States, in some of the States, mere unchastity is no defence The burden of proof is on the defendant that the woman abducted was unchaste, the presumption of her chastity standing unless otherwise proved

ABDUL AZIZ (ahbd-o͝ol ah-zēz) (1830–1876), Sultan of Turkey, second son of Sultan Mahmud II., was born Feb. 9, 1830, and succeeded his brother Abdul Mejid as sultan 1861. He took advantage of the constant issue of State loans to acquire wealth which was squandered extravagantly, and received large sums from Ismail Pasha, the khedive of Egypt, for signing the firman of 1866, which made succession to the khedivate hereditary from father to son in direct line, as well as subsequent firmans of 1867, 1869 and 1872, extending the khedive's prerogatives. In 1870 Abdul Aziz signed the firman creating the Bulgarian exarchate, thus separating the Bulgarian church from the Greek church at Constantinople. The insurrection of 1875 in Bosnia and Hercegovina and the abortive revolts in Bulgaria (Sept. 1875 and May 1876) together with the Sultan's incapacity and extravagance in Turkey itself caused an outbreak of Muslim discontent and fanaticism culminating in the Bulgarian atrocities, and in the murder of two consuls at Salonika. Abdul Aziz was deposed May 29, 1876 by a group of prominent politicians, and his death, four days later, is attributed to suicide. Abdul Aziz was the first Ottoman sultan to visit western Europe (1867).

'ABDUL'AZIZ IBN SA'UD: *see* IBN SA'UD

ABDUL-HAMID I. (1725–1789), sultan of Turkey, son of Ahmed III, succeeded his brother Mustafa III. in 1773, and died on April 7, 1789. For the disastrous wars with Russia which marked his reign *see* TURKEY.

ABDUL-HAMID II. (1842–1918), sultan of Turkey, son of Sultan Abdul-Mejid, was born on Sept. 21, 1842, and succeeded to the throne on the deposition of his brother Murad V., on Aug. 31, 1876. He accompanied his uncle Sultan Abdul-Aziz on his visit to England and France in 1867. At the time of his accession he was supposed to be of liberal principles, and conservative Turks were for some years inclined to regard him with suspicion as a too ardent reformer. But the circumstances of the country at his accession were ill-adapted for liberal developments. An empty treasury, the revolts in Serbia and Montenegro, the feeling aroused throughout Europe by the savage methods adopted in stamping out the Bulgarian rebellion, all combined to prove to the new sultan that he could expect little aid from the Powers. But he obstinately opposed the pressing requests of the Powers that the necessary reforms should be instituted During the international conference which met at Constantinople towards the end of 1876, a constitution was indeed promulgated, but the demands of the conference were rejected in spite of solemn warnings. Midhat Pasha, the author of the constitution, was exiled, and his work was suspended.

Early in 1877 the disastrous war with Russia followed The hard terms, embodied in the treaty of San Stefano, to which Abdul-Hamid was forced to consent, were to some extent amended at Berlin, thanks in the main to British diplomacy (*see* EUROPE: *History*); but by this time the sultan had lost all confidence in England, and thought that he discerned in Germany the future friend of Turkey. He employed Germans to reorganize his finances and army, and determined to resist foreign encroachments and gradually to take the reins of absolute power into his own hands. Financial embarrassments forced him to consent to a foreign control over the debt, and to issue the decree of Dec. 1881, under which many of the revenues of the empire were handed over to the Public Debt Administration for the benefit of the bondholders. Trouble in Egypt, where a discredited khedive had to be deposed, trouble on the Greek frontier and in Montenegro, where the Powers were determined that the decisions of the Berlin Congress should be carried into effect, were more or less satisfactorily got over. In his attitude towards Arabi, the would-be saviour of Egypt, Abdul-Hamid, showed less than his usual astuteness, and the resulting consolidation of England's hold over the country contributed still further to his estrangement from Turkey's old ally. The union in 1885 of Bulgaria with Eastern Rumelia was another blow. Few people south of the Balkans dreamed that Bulgaria could be anything but a Russian province, and apprehension was entertained of the results of the union until it was seen that Russia really and entirely disapproved of it. For some years the sultan preserved towards Bulgaria an attitude skilfully calculated to avoid running counter either to Russian or to German wishes. Germany's friendship was not entirely disinterested, and had to be fostered with a railway or loan concession from time to time, until in 1899 the Baghdad railway was conceded.

Meanwhile the sultan had succeeded in reducing his ministers to the position of secretaries, and in concentrating the whole administration of the country into his own hands at Yildiz. But internal dissension was not thereby lessened. Crete was constantly in turmoil, the Greeks were dissatisfied, and from about 1890 the Armenians began a violent agitation with a view to obtaining the reforms promised them at Berlin. Minor troubles had occurred in 1892 and 1893 at Marsovan and Tokat. In 1894 a more serious rebellion in the mountainous region of Sassun was ruthlessly stamped out; the Powers insistently demanded reforms, the eventual grant of which in the autumn of 1895 was the signal for a series of massacres in the Armenian provinces and in Constantinople itself. The reforms became more or less a dead letter. Crete indeed profited by the grant of extended privileges, but these did not satisfy its turbulent population, and early in 1897 a Greek expedition sailed to unite the island to Greece. War followed, in which Turkey was easily successful and gained a small rectification of frontier; then a few months later Crete was taken over *en dépôt* by the Four Powers (Germany and Austria not participating) and Prince George of Greece was appointed their mandatory. In the next year the sultan received the visit of the German emperor and empress

Abdul-Hamid had always resisted the pressure of the European Powers to the last moment, in order to seem to yield only to overwhelming force, while posing as the champion of Islam against aggressive Christendom. Pan-Islamic propaganda was encouraged; the privileges of foreigners in the Ottoman Empire (often an obstacle to government) were curtailed; the new railway to the Holy Places was pressed on, and emissaries were sent to distant countries preaching Islam and the caliph's supremacy This appeal to Muslim sentiment was, however, powerless against the disaffection due to perennial misgovernment. In Mesopotamia and Yemen disturbance was endemic; nearer home, a semblance of loyalty was maintained in the army and among the Muslim population by a system of delation and espionage, and by wholesale arrests; while, obsessed by terror of assassination, the sultan withdrew himself into fortified seclusion in the palace of Yildiz.

Macedonian Crisis.—The humiliation of the situation in Macedonia (*q.v.*), together with the resentment in the army against the palace spies brought matters to a crisis. The remarkable revolution associated with the names of Niazi Bey and Enver Bey, the young Turk leaders, and the Committee of Union and Progress is described elsewhere (*see* TURKEY: *History*); here it must suffice to say that Abdul-Hamid, on learning of the threat of the Salonika troops to march on Constantinople (July 23), at once capitulated On the 24th an *iradé* announced the restoration of the suspended constitution of 1875; next day, further *iradés* abolished espionage and the censorship, and ordered the release of political prisoners. On Dec. 10 the sultan opened the Turkish parliament with a speech from the throne in which he said that the first parliament had been "temporarily dissolved until the education of the people had been brought to a sufficiently high level by the extension of instruction throughout the empire."

The correct attitude of the sultan did not save him from the suspicion of intriguing with the powerful reactionary elements in the State, a suspicion confirmed by his attitude towards the counter-revolution of April 13, when an insurrection of the soldiers and the Muslim populace of the capital overthrew the committee and the ministry. The committee, restored by the Salonika troops, now decided on Abdul-Hamid's deposition, and on April 27 his brother Reshid Effendi was proclaimed sultan as Mohammed V. The ex-sultan was confined at Salonika. When Salonika capitulated to the Greeks in the Balkan War (1912) Abdul-Hamid was brought back to Constantinople. In 1915 he was removed to Magnesia, in Asia Minor, where he died on Feb. 10, 1918.

See Sir E. Pears, *Life of Abdul-Hamid* (1917); C. Hacquard, *La Turquie sous Abdul-Hamid II.* (Brussels, 1901).

ABDULINO, town in Samara province of R.S.F.S.R. Pop. (1926), 13,690. It is situated on the boundary between Samara and Bashkiria on the Uk river, north of the railway from Samara to Ufa and is a market for local products.

ABDUL MEJID (ahbd-ōōl mĕ-jēd′) (1823–1861), sultan of Turkey, was born April 23, 1823, and succeeded his father, Mahmud II., on July 2, 1839. Mahmud appears to have been unable to effect the reforms he desired in the mode of educating his children, so that his son received no better education than that usually given to Turkish princes in the harem. Abdul Mejid succeeded to the throne at a moment of crisis. The news was on its way to Constantinople that the Turkish army had been defeated at Nezib by that of the rebel Egyptian viceroy, Mohammed Ali; and the Turkish fleet was on its way to Alexandria, where it was handed over by its commander, Ahmed Pasha, to the enemy, on the pretext that the young sultan's advisers were sold to Russia. Through the intervention of the European Powers Mohammed Ali was obliged to come to terms, and the Ottoman Empire was saved. *See* MOHAMMED ALI.

Abdul Mejid set at once about carrying out the reforms to which Mahmud had devoted himself. In Nov. 1839 was proclaimed an edict, known as the Tanzimāt, or Hatt-i-sherif of Gulhané, consolidating and enforcing these reforms, this was supplemented at the close of the Crimean War by a similar statute issued in Feb. 1856. These enactments provided that all classes of the sultan's subjects should have security for their lives and property; that taxes should be fairly imposed and justice impartially administered; and that all should have full religious liberty and equal civil rights. The scheme was opposed by the governing classes and the *ulema*, or privileged religious teachers, and was but partially put in force, especially in the remoter parts of the empire; and more than one conspiracy was formed against the sultan's life on account of it

Of the other measures of reform promoted by Abdul Mejid the more important were. the institution of a council of public instruction (1838), the reorganization of the army (1843–44), and of a ministry of public instruction (1857), the abolition of an odious and unfairly imposed capitation tax, the repression of slave trading, and various provisions for the better administration of the public service and for the advancement of commerce, including the establishment of a mixed commercial court at Constantinople. For the general history of his times—the disturbances and insurrections in different parts of his dominions throughout his reign, and the great war successfully carried on against Russia by Turkey, and by Britain, France and Sardinia, in the interest of Turkey (1853–56)—*see* TURKEY and CRIMEAN WAR. When Kossuth and others sought refuge in Turkey, after the failure of the Hungarian rising in 1849, the sultan refused to surrender them. It is to his credit, too, that he would not allow the conspirators against his own life to be put to death. He was described as a kind and honourable man, if somewhat weak and easily led.

His extravagance, especially towards the end of his life, was excessive. He died on June 25, 1861, and was succeeded by his brother, Abdul Aziz (*q.v.*), as the oldest survivor of the family of Osman. He left several sons, of whom two, Murad V and Abdul Hamid II., eventually succeeded to the throne.

ABDUR RAHMAN KHAN (*c.* 1844–1901), amir of Afghanistan, was the son of Afzul Khan, who was the eldest son of Dost Mohammed Khan, the famous amir, by whose success in war the Barakzai family established their dynasty in the rulership of Afghanistan. Before his death at Herat, June 9, 1863, Dost Mohammed had nominated as his successor Shere Ali, his third son, passing over the two elder brothers, Afzul Khan and Azim Khan; and at first the new amir was quietly recognized. But after a few months Afzul Khan raised an insurrection in the northern province, between the Hindu Kush mountains and the Oxus, where he had been governing when his father died; and then began a fierce contest for power among the sons of Dost Mohammed which lasted for nearly five years. In this war Abdur Rahman soon became distinguished for ability and daring energy. Although his father, Afzul Khan, who had none of these qualities, came to terms with the Amir Shere Ali, the son's behaviour in the northern province soon excited the amir's suspicion, and Abdur Rahman, when he was summoned to Kabul, fled across the Oxus into Bukhārā. Shere Ali threw Afzul Khan into prison, and a serious revolt followed in south Afghanistan; but the amir had scarcely suppressed it when Abdur Rahman's reappearance in the north was a signal for a mutiny of the troops stationed in those parts and a gathering of armed bands to his standard. After some delay and desultory fighting, he and his uncle, Azim Khan, occupied Kabul (March 1866). The amir Shere Ali marched up against them from Kandahar; but in the battle that ensued at Sheikhabad on May 10, he was deserted by a large body of his troops, and was defeated. Abdur Rahman then released his father, Afzul Khan, from prison in Ghazni and installed him as amir of Afghanistan. Notwithstanding the new amir's incapacity and some jealousy between the real leaders, Abdur Rahman and his uncle, they again routed Shere Ali's forces and occupied Kandahar in 1867; and when at the end of that year Afzul Khan died Azim Khan succeeded to the rulership, with Abdur Rahman as his governor in the northern province. But towards the end of 1868 Shere Ali's return and a general rising in his favour, resulting in their defeat at Tinah Khan on Jan. 3, 1869, forced them both to seek refuge in Persia, whence Abdur Rahman proceeded afterwards to place himself under Russian protection at Samarkand. Azim died in Persia in Oct. 1869.

In 1893 the amir showed his usual ability in the settlement of the frontier question with Sir Henry Durand's mission. Abdur Rahman died on Oct 1, 1901, being succeeded by his son Habibullah. (*See* AFGHANISTAN. *History*)

See also S. Wheeler, F R G S, *The Amir Abdur Rahman* (1895); J A Grey, *At the Court of the Amir* (1895); *The Life of Abdur Rahman, Amir of Afghanistan, G C B, G C S I*, edited by Mir Munshi, Sultan Mohammed Khan (1900).

ABECEDARIANS, a nickname given to certain extreme Anabaptists (*q v*), who regarded the teaching of the Holy Spirit as all that was necessary, and so despised all human learning and even the power of reading the written word (from "A, B, C, D").

À BECKETT, GILBERT ABBOTT (1811–1856), English humorous writer, was born in north London on Jan. 9, 1811. He belonged to a family claiming descent from the father of St. Thomas Becket. His elder brother, Sir William à Beckett (1806–1869), became chief justice of Victoria (Australia). Gilbert Abbott à Beckett was educated at Westminster School, was called to the bar at Gray's Inn in 1841, and in 1849 became a metropolitan police magistrate. He edited *Figaro in London*, and was one of the original staff of *Punch* and a contributor all his life. He produced some 50 or 60 plays, among them dramatized versions of Dickens's shorter stories in collaboration with Mark Lemon. He died at Boulogne Aug 30, 1856

His eldest son, GILBERT ARTHUR À BECKETT (1837–1891) was born at Hammersmith on April 7, 1837. On leaving Christ Church, Oxford, he was entered at Lincoln's Inn, but gave his attention chiefly to the drama, producing *Diamonds and Hearts* at the Haymarket in 1867, which was followed by other light comedies His pieces include numerous burlesques and pantomimes, the libretti of *Savonarola* (Hamburg, 1884) and of *The Canterbury Pilgrims* (Drury Lane, 1884) for the music of Dr. (afterwards Sir) C V. Stanford. *The Happy Land* (Court Theatre, 1873), a political burlesque of W. S Gilbert's *Wicked World*, was written in collaboration with F L. Tomline. For the last ten years of his life he was on the regular staff of *Punch*. He died on Oct. 15, 1891.

A younger son, ARTHUR WILLIAM À BECKETT (1844–1909), a well-known journalist and a man of letters, was also on the staff of *Punch* from 1874–1902, and gave an account of his father and his own reminiscences in *The À Becketts of Punch* (1903). He died in London on Jan. 14, 1909.

See also M. H. Spielmann, *The History of Punch* (1895).

ABEDNEGO, the name given in Babylon to Azariah, one of the companions of Daniel (Dan. i. 7, etc.). Probably a corruption of Abednebo, "servant of Nebo," or perhaps of Abednergo for Abednergal, "servant of the god Nergal"

ABEKEN, HEINRICH (1809–1872), German theologian and Prussian official, was born at Berlin on Aug. 8, 1809. In 1848

he entered the Prussian ministry for foreign affairs, and in 1853 was promoted to be privy councillor of legation (Geheimer Legationsrath). He was employed by Bismarck in the writing of official despatches, and often accompanied King William on his journeys as representative of the foreign office and was with him during the campaigns of 1866 and 1870–71.

See *Heinrich Abeken, ein schlichtes Leben in bewegter Zeit* (1898), by his widow. English translation by Mrs C. E Barrett-Lennard and M. W. Hofer (with portraits 1911). This is valuable by reason of the letters written from the Prussian headquarters.

ABEL, a city in Maacah, one of the genuinely "Israelite" cities (*see* 2 Sam xx 18) The question of the Aramaean and Edomite composition of Israel involves a consideration of the territories occupied in early times by the tribes and their progenitor (Deut. xxvi. 5). Abel and Dan were considered as definitely Israelite cities (see *The Cambridge Ancient History,* 1926, vol. ii., pp. 368–69)

ABEL (Hebrew Hebel, *breath*), second son of Adam, slain by Cain, his elder brother (Gen iv. 1–15) The narrative in Genesis is supplemented in the New Testament ("By faith Abel offered unto God a more excellent sacrifice than Cain," Heb. xi 4; Cain slew Abel "because his own works were evil, and his brother's righteous," 1 John iii. 12) The name probably means "herdsman" (*cf* Jabal), as distinguished from the agriculturist Cain. Possibly Abel was originally a South Judaean demigod or hero; *see* Winckler, *Gesch Israels,* ii p 189; E Meyer, *Israeliten,* p 395. Augustine (*De Haeresibus,* lxxxvii.) mentions a sect of *Abelitae,* in northern Africa.

ABEL, SIR FREDERICK AUGUSTUS, Bart. (1827–1902), English chemist, was born in London on July 17, 1827 After studying chemistry for six years under A. W. von Hofmann at the Royal College of Chemistry (established in London in 1845), he became professor of chemistry at the Royal Military academy in 1851, and three years later was appointed chemist to the War Department and chemical referee to the government During his tenure of this office, which lasted until 1888, he carried out a large amount of work in connection with the chemistry of explosives He developed an improved and safer process for the manufacture of gun-cotton, and prepared the way for the "smokeless powders" which came into general use towards the end of the 19th century; cordite, the particular form adopted by the British government in 1891, was invented jointly by him and Professor James Dewar. In conjunction with Sir Andrew Noble he carried out one of the most complete enquiries on record into the behaviour of ordinary black powder when fired The invention of the apparatus, legalized in 1879, for the determination of the flash-point of petroleum, was also his work. His first instrument, the open-test apparatus, was prescribed by the Act of 1868, but was superseded in 1879 by the Abel close-test instrument. In electricity Abel studied the construction of electrical fuses and other applications of electricity for war purposes, and his work on problems of steel manufacture won him in 1897 the Bessemer medal of the Iron and Steel institute, of which from 1891 to 1893 he was president He took an important part in the work of the Inventions Exhibition (London) in 1885, and in 1887 became organizing secretary and first director of the Imperial institute, a position which he held till his death, which took place in London, Sept. 6, 1902. He was knighted in 1891, and was created a baronet in 1893.

Among his books were *Handbook of Chemistry* (with C. L. Bloxam), *Modern History of Gunpowder* (1866), *Gun-cotton* (1866), *On Explosive Agents* (1872), *Researches in Explosives* (1875), and *Electricity applied to Explosive Purposes* (1884). He also wrote several important articles in the 9th ed. of the *Encyclopædia Britannica.*

ABEL, JOHN JACOB (1857–), American pharmacologist and physiological chemist, was born in Cleveland, O., on May 19, 1857. He began life as a teacher and in 1879–82 was a principal and superintendent of schools in Indiana. In 1883 he graduated from the University of Michigan and, after a year at Johns Hopkins university, he devoted six years (1884–90) to the study of chemistry and medicine at Berlin, Strasbourg, Vienna and other European universities. He was lecturer on materia medica in the University of Michigan in 1890–91 and then entered the faculty of Johns Hopkins university in which in 1883 he became professor of pharmacology and physiological chemistry. He made extensive investigations of the chemical composition of animal tissues and fluids, and also of the function and isolation of special chemical principles of the animal organism. A noteworthy example of the latter was his isolation of the blood-pressure-raising constituent of the suprarenal glands (epinephrine) in the form of a benzoyl derivative. He made researches also on carbamic acid, the action of phthaleins, the poisons of mushrooms, albumoses in the tissues, hydrolytic products of proteins, histamin, insulin and various related subjects, in connection with which he has published many important papers. In recognition of his contributions to science he was awarded the Willard Gibbs medal in 1927.

ABEL, KARL FRIEDRICH (1725–87), German musician, was born in Cothen and died in London, where he lived during the greater part of his career. He was a great player on the viola da gamba, composed much music for that instrument and was one of the most prominent figures in the London musical life of his day He studied under Johann Sebastian Bach at the Leipzig Thomasschule; played for ten years (1748–58) under A. Hasse in the band formed at Dresden by the elector of Saxony; and then, going to England, became (in 1759) chamber-musician to Queen Charlotte The friendship between Johann Christian Bach, 11th son of Sebastian, who had also settled in London, and Abel led, in 1764 or 1765, to the establishment, at first under the auspices of the notorious Mrs Cornelys, of the famous concerts subsequently known as the Bach and Abel concerts. The Hanover Square Rooms were opened, on Feb 1, 1775, by one of these concerts, at which, too, Haydn's symphonies were first performed in England He was a man of striking presence, as several fine portraits, including two by Gainsborough, attest.

ABEL, NIELS HENRIK (1802–29), Norwegian mathematician, was born at Findöe, Aug 25, 1802, and educated at Christiania. His first notable work was a proof of the impossibility of solving the quintic equation by radicals State aid enabled him to visit Germany and France in 1825. He spent six months in Berlin, where he became intimate with August Leopold Crelle, who was then about to publish his mathematical journal From Berlin he passed to Freiburg, where he made his brilliant researches in the theory of elliptical functions In 1826 he moved to Paris Want of money finally compelled him to abandon his tour, and on his return to Norway he taught for some time at Christiania. In 1829 Crelle obtained a post for him at Berlin, but the offer did not reach Norway until after his death near Arendal, April 6.

The early death of this talented mathematician, of whom Legendre said *"quelle tête celle du jeune Norvegien!"* cut short a career of extraordinary brilliance and promise. Under Abel's guidance, the prevailing obscurities of analysis began to be cleared, new fields were entered upon and the study of functions advanced. His works, the greater part of which originally appeared in *Crelle's Journal,* were edited by Holmboë and published in 1839 by the Swedish Government, and a more complete edition by L Sylow and S. Lie was published in 1881.

See C. A. Bjerknes, *Niels Henrik Abel: Tableau de sa vie et son action scientifique* (1885); Lucas de Peslouán, *Niels Henrik Abel* (1906).

ABEL, THOMAS (better Abell) (d. 1540), an English priest who was martyred during the reign of Henry VIII., and beatified by Pope Leo XIII. In 1533, he published his *Invicta Veritas* (with the fictitious pressmark of Luneberge to avoid suspicion) in answer to the tracts supporting Henry's ecclesiastical claims. After an imprisonment of more than six years, Abel was sentenced to death for denying the royal supremacy in the church, and was executed at Smithfield on July 30, 1540.

See J. Gillow's *Bibl. Dictionary of Eng. Catholics,* vol. i.; *Calendar of State Papers of Henry VIII.,* vol. iv.-vii. *passim.*

ABÉLARD, PETER (1079–1142), scholastic philosopher, was born in Pallet (Palais), not far from Nantes, in 1079. He was the eldest son of a noble Breton house. He studied first under

Roscelin, the extreme nominalist, and then went to the cathedral school of Notre-Dame, whose master was William of Champeaux, the disciple of St. Anselm, and most advanced of realists. After a short time he overcame the master in discussion, and thus began a long duel that issued in the downfall of the philosophic theory of realism, till then dominant in the early middle ages.

When William procured his expulsion from Paris, he set up a school of his own at Melun, whence he removed to Corbeil, nearer Paris, finally becoming master of the school of St. Geneviève. He next turned to theology and attended the lectures of Anselm at Laon. His triumph over the theologian was complete; the pupil was able to give lectures, without previous training or special study, which were more popular than those of the master. Abélard was now at the height of his fame. In 1115 he was made canon and master of Notre Dame, whither the fame of his learning and his personal charm drew students from all countries (Fulk of Deuil, *Ep. ad Abaelardum*)

Few teachers ever held such sway as Abélard now did for a time; but a change in his fortunes was at hand. He fell in love with the beautiful and learned Héloise, niece of Canon Fulbert, and seduced her. After the birth of their son, they were secretly married, though Héloise appealed to Abélard not to sacrifice his independence and chances of advancement. When the marriage became known, Héloise returned to the convent of Argenteuil. Fulbert, believing that Abélard planned to be rid of her, took a barbarous revenge, breaking into his chamber by night and perpetrating upon him the most brutal mutilation. Abélard, in despair, became a monk at St. Denys and Héloise took the veil

After a year Abélard opened a school of theology at the priory of Maisoncelle (1120). His lectures were heard again by crowds of students, and all his old influence seemed to have returned; but old enmities were revived also. His adversaries fell foul of his rationalistic interpretation of the Trinitarian dogma Charging him with the heresy of Sabellius in a provincial synod held at Soissons in 1121, they procured a condemnation of his teaching, made him burn his book, and shut him up in the convent of St. Médard at Soissons When he returned to St Denys, another dispute arose. He cited Bede to prove that Dionysius the Areopagite had been bishop of Corinth, and not, as the monks held, bishop of Athens When this historical heresy led to the inevitable persecution, Abélard withdrew to a desert place near Nogent-sur-Seine and turned hermit. His retreat becoming known, students flocked to him from Paris, and in gratitude for the consolation they brought him, he consecrated the new oratory they built for him by the name of the Paraclete.

Upon the return of new dangers, or at least of fears, Abélard accepted an invitation to preside over the abbey of St. Gildas de Rhuys, in Lower Brittany. The abbey was poor, disorderly and depraved; yet for nearly ten years he endured it, and it was only under peril of violent death that he fled from his charge. Meanwhile he had been able, on the breaking up of Héloïse's convent at Argenteuil, to establish her as head of a new religious house at the deserted Paraclete. After his flight from St. Gildas, he wrote, among other things, his famous *Historia Calamitatum*, and thus moved Héloise to pen her three *Letters*, which have kept their place among the great love letters of the world In 1136 he was lecturing on Mount St. Geneviève (when he was heard by John of Salisbury), but it was only for a brief space. As far back as the Paraclete days he had been the opponent of Bernard of Clairvaux, who upheld the principle of fervent and unhesitating faith, from which rational inquiry like his was sheer revolt, and Abélard now came into conflict with this uncompromising spirit. In 1141 a council met at Sens, before which Abélard, formally arraigned upon a number of heretical charges, was prepared to plead his cause; but when Bernard had opened the case, suddenly Abélard appealed to Rome. The stroke availed him nothing; for Bernard, who had power, notwithstanding, to get a condemnation passed at the council, did not rest till a second condemnation was procured at Rome in the following year. Meanwhile, on his way thither to urge his plea in person, Abélard had broken down at the abbey of Cluny, and there, an utterly fallen man, only not bereft of his intellectual force, he lingered but a few months. Removed for the relief of his sufferings to the priory of St. Marcel, near Chalon-sur-Saone, he died April 21, 1142. Héloise died in 1164, and the two now lie in the well-known tomb in the cemetery of Père Lachaise in Paris

Great as was the influence exerted by Abélard on the minds of his contemporaries and the course of mediaeval thought, he has been little known in modern times but for his relations with Héloïse. Indeed, it was not till 1836, when Cousin issued the collection entitled *Ouvrages inédits d'Abélard*, that his philosophical performance could be judged at first hand; of his strictly philosophical works only one, the ethical treatise *Scito te ipsum*, having been published earlier (1721). Cousin's collection, besides giving extracts from the theological work *Sic et Non* (an assemblage of opposite opinions on doctrinal points, culled from the Fathers as a basis for discussion, the main interest in which lies in the fact that there is no attempt to reconcile the different opinions), includes the *Dialectica*, commentaries on logical works of Aristotle, Porphyry and Boethius, and a fragment, *De Generibus et Speciebus*, which, with the psychological treatise *De Intellectibus* (published apart by Cousin in *Fragmens Philosophiques*, vol. ii) is now considered upon internal evidence not to be by Abélard himself. A genuine work, the *Glossulae super Porphyrium*, from which Charles de Rémusat, in his classical monograph *Abélard* (1845), has given extracts, remains in manuscript.

The general importance of Abélard lies in his having fixed more decisively than anyone before him the scholastic manner of philosophizing, with its object of giving a formally rational expression to the received ecclesiastical doctrine. However his own particular interpretations may have been condemned, they were conceived in essentially the same spirit as the general scheme of thought afterwards elaborated in the 13th century with approval from the heads of the church. Through him was prepared the ascendancy of the philosophical authority of Aristotle, which became firmly established in the half-century after his death, when first the completed *Organon*, and gradually all the other works of the Greek thinker, came to be known in the schools; before his time it was rather upon the authority of Plato that the prevailing realism sought to lean As regards his so-called conceptualism and his attitude to the question of universals, *see* SCHOLASTICISM

Outside of his dialectic, it was in ethics that Abélard showed greatest activity of philosophical thought, laying very particular stress upon the subjective intention as determining, if not the moral character, at least the moral value, of human action. His thought in this direction, wherein he anticipated something of modern speculation, is the more remarkable because his scholastic successors hardly ventured to bring the principles and rules of conduct under pure philosophical discussion, even after the ethical inquiries of Aristotle became known to them

BIBLIOGRAPHY —Abélard's own works remain the best sources for his life, especially his *Historia Calamitatum*, an autobiography, and the correspondence with Héloise. Charles de Remusat's *Abélard* (1845) remains an authority, it must be distinguished from his drama *Abélard* (1877). McCabe's life of Abélard is written closely from the sources. *See* also U. Chevalier, *Répertoire des sources hist du moyen âge*, "Abailard," (bibl), and H Rashdall, *Universities of Europe in the Middle Ages* (Oxford, 1895) A new translation of the famous *Letters* of Héloise, by George Moore, appeared in 1926.

ABELIN, JOHANN PHILIPP, (d. *c.* 1635) German chronicler. He wrote numerous histories over the pseudonyms of Philipp Arlanibäus, Abeleus and Johann Ludwig Gottfried or Gotofredus. His best known work is the *Theatrum Europaeum*, a series of chronicles of the chief events in the history of the world down to 1619. He compiled the first two volumes. It was continued by various writers and grew to 21 volumes (Frankf. 1633–1738). The chief interest of the work is its illustration by the beautiful copperplate engravings of Matthäus Merian (1593–1650).

See G. Droysen, *Arlanibaeus, Godofredus, Abelinus* (1864); and notice in *Allgemeine Deutsche Biographie.*

ABELL, SIR WESTCOTT STILE (1877–), naval engineer, chief ship surveyor at Lloyds Register of Shipping. From 1910–14 he was professor of naval architecture at the Uni-

versity of Liverpool. A member of various boards, including two committees of the Board of Trade, on the Internationalization of the Load Line of Ships in 1913, and on Shipping and Shipbuilding in 1916, he became technical adviser to the Controller of Shipping in 1917, and was president of the Institute of Marine Engineers 1924–25. He was given a K.B.E. in 1920. His writings include *The Ship and her Work* and contributions to the *Transactions* of the Naval Institute of Architects, etc.

ABEL TEST, the close-test process of determining the flash-point of petroleum, invented by Sir Frederick Abel and embodied in the British Petroleum Act of 1879. The test is employed to ascertain whether a sample of petroleum may be safely used at a given temperature.

The Abel apparatus simply raises the temperature of the sample under test until the resultant combination of oil vapour and air forms an explosive mixture and causes a flash. The minimum limit of flash-point under British law is 73°, and most civilized countries have provided a similar test of inflammability. (*See* PETROLEUM.)

ABENCERRAGES, a family or faction that is said to have held a prominent position in the Moorish kingdom of Granada in the 15th century. The name appears to have been derived from Yussuf-ben-Serragh, the head of the tribe in the time of Mohámmed VII. It is familiar from the interesting romance of Ginés Perez de Hita, *Guerras civiles de Granada,* which celebrates the feuds of the Abencerrages and the rival family of the Zegris. The hall of the Abencerrages in the Alhambra takes its name from being the reputed scene of the massacre of the family.

ABENDANA, the name of two Jewish theologians. (1) JACOB (1630–95), rabbi (Hakham) of the Spanish Jews in London from 1680. (2) ISAAC (*c.* 1650–1710), his brother, teacher of Hebrew at Cambridge and afterwards at Oxford. He compiled a Jewish Calendar and wrote *Discourses on the Ecclesiastical and Civil Policy of the Jews* (1706).

ABENEZRA (Ibn Ezra), whose full name was Abraham ben Meir Ibn Ezra (1092 or 1093–1167), Jewish poet and scholar, was a native of Toledo He had already gained a reputation as a thinker and poet before he left Spain, some time before 1140, and began the travels in northern Africa, in England, France and Italy which extended over a quarter of a century. He translated the writings of Hayyūj, the father of modern Hebrew grammar, from Arabic into Hebrew, and himself wrote treatises on the subject, the most important of which are *Moznayim* ("the Scales"), written in 1140, and *Zahot* ("Correctness"), written in 1141. His writings include works on philosophy, astronomy and mathematics, but his fame is derived chiefly from his commentaries on the Scriptures. Ibn Ezra sought to establish the simple sense of the text, basing his interpretation on solid grammatical principles. The commentary on the Pentateuch was first printed at Naples in 1488; in this edition a second commentary on Exodus takes the place of the original one The great editions of the Hebrew Bible contain other commentaries by Ibn Ezra on Isaiah, the Minor Prophets, Job and Daniel, and his name was attached to commentaries on Proverbs, Ezra and Nehemiah, which were really the work of Moses Kimhi. The *Yōsōd Mēra* (1158), the best known of his writings on the philosophy of religion, explains the reasons for the biblical commandments

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ABENSBERG, a town and spa of Germany, in Bavaria, on the Abens, a tributary of the Danube, 18m. S W. of Regensburg. Pop. (1925) 2,256. Some Roman remains exist in the neighbourhood of the town, which was known to the Romans as Castra Abusina. Here Napoleon defeated the Austrians under the Archduke Louis and Gen. Hiller on April 20, 1809.

ABEOKUTA, a town of British West Africa, the capital of the Egba division of the Yoruba people and of the province of Abeokuta, southern Nigeria. It is situated in 7° 8′ N., 3° 25′ E, on the Ogun river, 64m. north of Lagos by railway, or 81m. by water. Population (1921 census) 38,034. Abeokuta is surrounded by mud walls 18m. in extent and lies in a beautiful and fertile country, the surface of which is broken by masses of grey granite. Besides the usual mud built houses there are several buildings (including public offices) of modern design. Palm-oil, timber, yams and shea-butter are the chief articles of trade.

Abeokuta (a word meaning "under the rocks"), dating from 1825, owes its origin to incessant inroads of slave-hunters from Dahomey and Ibadan, which compelled the village populations to take refuge in this rocky stronghold, which became the capital of the Egba State, the ruling chief being styled *Alake* (Ake is the principal quarter of Abeokuta and is the name of the ancient Egba capital) The Egba carried on a long war with Ibadan, and claimed the right to close the trade routes to Lagos. This brought them from 1865 onward into collision with the British, but in 1893 a treaty was signed which, while preserving Egba independence in internal affairs, brought the State under direct British influence. Christian missions had been in Abeokuta since 1843 and gained many converts; in 1867 the Christians were expelled. They returned some years later and now form an influential part of the population. The town is the headquarters of the Yoruba branch of the Church Missionary Society.

After 1899 when the railway from Lagos reached Abeokuta there was a large increase in trade. Meanwhile the Egbas had set up a government based on European models, and in 1904 the *Alake* created some interest in his country by a visit to England. But side by side with an administration on modern lines (including fiscal barriers) "there existed," to quote Sir F. D. Lugard, "the ancient *régime* with all its abuses—extortionate demands from the peasantry, corruption and bribery in the courts, arbitrary imprisonment and forced labour " These conditions could not be tolerated and in 1914 by a new agreement the Egbas renounced "independence," and their country, with Jebu and other districts, was constituted the province of Abeokuta. Since then the *Alake* and his council have carried on the native administration under the supervision of a British resident. In 1917 a somewhat serious rising occurred in the province; it was the only instance of the peace being disturbed in Nigeria during the World War.

See Sir F. D. Lugard's *Report on Nigeria* (pub. in 1920) as a White Paper (cmd. 468); an article on Abeokuta by Sir Wm Macgregor, *African Society's Journal* No. xii. (July, 1904), and Sir W. N. Geary, *Nigeria under British Rule* (1927).

ABERAVON: *see* PORT TALBOT.

ABERCARN, urban district, Monmouthshire, England. Pop. (1921) 20,122. It is situated in the middle portion of the Ebbw valley and like the other towns of the north and east of the coalfield had an early association with iron smelting, and then relied more and more on the export of coal, but tin plates are manufactured in large quantities. Like the other towns of the coalfield, it is mainly a long street along the valley. It has shared the deep industrial depression in the neighbourhood since 1918. Abercarn has a station on the Great Western railway branch line from Newport and is in the Abertillery parliamentary division.

ABERCORN, JAMES HAMILTON, 1ST EARL OF (*c.* 1575–1618), was the eldest son of Claud Hamilton, Lord Paisley (4th son of James, 2nd Earl of Arran, and Duke of Chatelherault), and of Margaret, daughter of George, 6th Lord Seton. He was made sheriff of Linlithgow in 1600, received large grants of lands in Scotland and Ireland, was created in 1603 Baron of Abercorn, and on July 10, 1606 was rewarded for his services in the matter of the union by being made Earl of Abercorn, and Baron Hamilton, Mount Castle and Kilpatrick. He married Marion, daughter of Thomas, 5th Lord Boyd, and left five sons, of whom the eldest, Baron of Strabane, succeeded him as 2nd Earl of Abercorn. He died on March 23, 1618. The title of Abercorn, held by the head of the Hamilton family, became a marquisate in 1790, and a dukedom in 1868.

ABERCORN, JAMES HAMILTON, 2ND DUKE OF (1838–1913), British politician, born on Aug. 24, 1838, succeeded his father, the 1st Duke, in 1885. His sister, the Duchess of Buccleuch, was for many years mistress of the robes to Queen Victoria and to Queen Alexandra. The duke became a member of the household of the Prince of Wales (afterwards Edward VII). He was a strong supporter of the Unionist Party in the House of Lords, and was chairman of the British South Africa Company. He died in London on Jan. 3, 1913.

ABERCORN, JAMES ALBERT EDWARD HAMILTON, 3RD DUKE OF (1869–), British politician, son of the preceding, was born on Nov. 1, 1869, and was educated at Eton. Lord James Hamilton was M P. for Londonderry, 1900–13, a leader of the Unionist Party in Ulster, and treasurer of H M. Household in 1903–05. After the passage of the Government of Ireland Act, he became a senator of Northern Ireland, and in 1922 was appointed governor.

ABERCROMBIE, LASCELLES (1881–), English poet, was born at Ashton-upon-Mersey, Cheshire, Jan. 9, 1881, and educated at Malvern and Victoria university, Manchester, where he studied science. His first work, *Interludes and Poems,* appeared in 1908. Other works are: *Mary and the Bramble* (1910); *The Sale of St. Thomas* (1911); *Emblems of Love* (1912); *Deborah* (1912); *Speculative Dialogues* (1913). He was appointed lecturer in poetry at the University of Liverpool (1919) and in English literature at Leeds (1922).

Professor Abercrombie was more concerned with bringing his students to the study of the essential greatness of the writers with whom he dealt than with the details which are apt to encumber overmuch the study of literature. His critical study of *Thomas Hardy* (1912), the *Theory of Poetry* (1924), and his volume of collected lectures, *The Idea of Great Poetry* (1925), are important contributions to modern critical literature His works include some plays in blank verse, among them *Phoenix* (1923).

ABERCROMBY, DAVID, a 17th century Scottish physician His *Nova medicinae praxis* was reprinted after his death in Paris (1740). His *Tuta ac efficax luis venereae saepe absque mercurio ac semper absque salivatione mercuriali curando methodus* (1684) was translated into French, Dutch and German. In his *Discourse on Wit* (1685) he expounds the Scottish philosophy of common sense. The exact date of his death is unknown, but according to Haller he was alive early in the 18th century.

ABERCROMBY, PATRICK (1656–*c.* 1716), Scottish physician and author, was born at Forfar, and educated at St. Andrews. He is best known as the author of the *Martial Atchievements of the Scots Nation* (fol 1711–16), in which he had the assistance of many learned contemporaries. As a pamphleteer on behalf of the Union he crossed swords with Daniel Defoe.

ABERCROMBY, SIR RALPH (1734–1801), British soldier, eldest son of George Abercromby, of Tullibody, Clackmannanshire, was born Oct 7, 1734. Educated at Rugby and at Edinburgh University, he was sent in 1754 to Leipzig to study civil law, with a view to his proceeding to the Scottish bar. But he received a commission in the 3rd Dragoon Guards in March 1756. He served with his regiment in the Seven Years' War, and study of the methods of the great Frederick moulded his military character and formed his tactical ideas. In 1781 he became colonel of the King's Irish infantry. When that regiment was disbanded in 1783, he retired upon half pay. Hitherto he had scarcely been engaged in active service, mainly because of his disapproval of the policy of the Government, and especially because of his sympathies with the American colonists in their struggles for independence; and his retirement was no doubt the result of similar feelings. But on the declaration of war by France against England in 1793, he returned to the Army, and was appointed to the command of a brigade under the Duke of York, for service in Holland. He commanded the advanced guard in the action at Le Cateau, and was wounded at Nijmwegen. The duty fell to him of protecting the British Army in its disastrous retreat out of Holland in the winter of 1794–95. In 1795 he received a knighthood of the Bath, and in the same year he was appointed to succeed Sir Charles Grey as commander-in-chief of the British forces in the West Indies. In 1796 he seized Grenada, and then took the settlements of Demerara and Essequibo, and the islands of St. Lucia, St. Vincent and Trinidad. He held, in 1797–98, the chief command of the forces in Ireland. He sought to restore the discipline of the army, and declined to allow the military to be called out, except when it was indispensable for the maintenance of order. Finding that all his efforts were thwarted by the Government in Ireland, he resigned the command. After acting as commander-in-chief in Scotland, Sir Ralph was second-in-command to the Duke of York in the second disastrous expedition to Holland in 1797. In 1801 he was sent with an Army to turn the French out of Egypt. The disembarkation on March 2 of the troops at Aboukir Bay, in the face of strenuous opposition, is justly ranked among the most daring and brilliant exploits of the British Army. The French made a surprise attack on the British camp near Alexandria (March 21, 1801), and Abercromby fell in the moment of victory. He was struck by a spent ball, which could not be extracted, and died on board the flagship seven days after the battle. By a vote of the House of Commons, a monument was erected in his honour in St. Paul's Cathedral. His widow was created Baroness Abercromby of Tullibody and Aboukir Bay, and a pension of £2,000 a year was settled on her and her two successors in the title.

A memoir of the later years of his life (1793–1801) by his third son, James (who was Speaker of the House of Commons, 1835–39, and became Lord Dunfermline), was published in 1861. For a shorter account of Sir Ralph Abercromby *see* Wilkinson, *Twelve British Soldiers* (London, 1899).

ABERDARE, HENRY AUSTIN BRUCE, 1ST BARON (1815–95), English statesman, was born at Duffryn, Aberdare, Glamorganshire, on April 16, 1815. He was called to the bar in 1837, and was stipendiary magistrate for Merthyr Tydvil and Aberdare, 1847–52. The discovery of coal in the Duffryn and Aberdare estates of the family made him a rich man. He sat in the House of Commons for Merthyr Tydvil from 1852–68 and for Renfrewshire from 1869–73, when he became a peer. He was under-secretary at the Home Office (1862–64), vice-president of the board of education (1864–66), home secretary (1868–73), and lord president of the council (1873–74) After the defeat of the Liberal Government in 1874 Lord Aberdare turned to social and economic questions. From 1882, when he became chairman of the National African Company incorporated under charter in 1886 as the Royal Niger Company, he was closely associated with West African affairs He presided over several royal commissions, and promoted university education in Wales. He died in London on Feb. 25, 1895.

ABERDARE, industrial town of north Glamorganshire, Wales, situated, as its name implies, at the confluence of the Dar and Cynon (the latter being a tributary of the Taff). Population (1921) 55,007. The neighbouring moorlands show evidences of occupation in pre-Roman times, and a site about 4m. to the northwest of the town is reputed to be the scene of a Norman victory over the native forces under Rhys ap Tewdwr in the 11th century. Aberdare remained but a small nucleus among the scattered farms of the moorlands until the beginning of the 19th century when the place grew rapidly owing to the abundance of its coal and iron ore, and the population of the whole parish (which was only 1,486 in 1801) increased tenfold during the first half of the century. Ironworks were established at Llwydcoed and Abernant in 1799 and 1800 respectively, followed by others at Gadlys and Aberaman in 1827 and 1847. The building of the Glamorgan canal in 1811 connected these ironworks with the coast, but the rapid development of the railways superseded the canals and at the same time gave an impetus to the iron trade between 1820 and 1870 and a consequent rapid growth of the town. These ironworks have not been worked since 1875, and the only supplementary industry remaining in the town is a small tinplate works at Gadlys (established in 1868). Previous to 1836, most of the coal worked in the parish was consumed locally, chiefly in the ironworks, but in that year the working of steam coal for export was begun, pits were sunk in rapid succession, and the coal trade, which at

least since 1875 has been the chief support of the town, soon reached huge dimensions. There are also several brickworks and breweries.

Until 1918 Aberdare was included for parliamentary representation with the borough of Merthyr Tydfil, but since that date it returns a member to parliament jointly with the urban district of Mountain Ash.

ABERDEEN, GEORGE GORDON, 1ST EARL OF (1637–1720), lord chancellor of Scotland, was the son of Sir George Gordon of Haddo, who had been executed by the Presbyterians in 1664. He was born Oct. 3, 1637, and studied at Aberdeen and abroad He was called to the bar in 1668 and gained a great reputation as a lawyer. He was president of the court of session in 1681 and lord chancellor of Scotland from 1682 to 1684. He was created earl of Aberdeen in 1682.

Burnet reflects unfavourably upon him, calls him "a proud and covetous man," and declares "the new chancellor exceeded all that had gone before him." He executed the laws enforcing religious conformity with severity, and filled the parish churches, but resisted the excessive measures of tyranny prescribed by the English government; and in consequence of an intrigue of the Duke of Queensberry and Lord Perth, who gained the duchess of Portsmouth with a present of £27,000, he was dismissed in 1684. He remained a non-juror during the whole of William's reign, and took the oaths for the first time after Anne's accession, on May 11, 1703 In the affair of the Union in 1707, he protested against the completion of the treaty till the act declaring the Scots aliens should be repealed, but refused to support the opposition to the measure itself He died on April 20, 1720.

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ABERDEEN, GEORGE GORDON, 4TH EARL OF (1784–1860), British statesman, was born in Edinburgh on Jan. 28, 1784, the son of George Gordon, Lord Haddo At the age of 11, when he was left an orphan, he went to reside with Henry Dundas, afterwards Lord Melville; and three years later he was permitted by Scots law to select William Pitt and Dundas as his curators, or guardians. At Harrow and at St. John's college, Cambridge, he proved himself a gifted classical scholar, though modern history shared his interest; and his education was completed by an extended tour of Europe which took him to the Far East. On the death of his grandfather in 1801 he succeeded to the peerage, and four years later he married Catherine Hamilton, daughter of Lord Abercorn.

His connection with Pitt and Dundas, and his native ability, favoured him for a political career, and in 1812 he travelled as ambassador extraordinary to Austria, where he signed the Treaty of Töplitz in 1813. He remained on the Continent as one of the most active British representatives throughout the negotiations which led to the Treaty of Paris, then he returned to England, and for some years lived in comparative retirement. The year 1815 saw his marriage to Harriet, Lady Hamilton, his first wife having died three years before.

In Jan. 1828 he joined the cabinet of the duke of Wellington, and in the following June he became secretary of state for foreign affairs. Resigning in 1830 with Wellington, he did not again take office until the short administration of 1834 and 1835, when he was colonial secretary to Sir Robert Peel, but in 1841 he joined the latter's cabinet as foreign secretary and commenced the most fruitful and successful period of his public life. He now acquired more power than he had ever possessed with Wellington, to whom he had felt himself subordinate; and this new authority he devoted first to establishing friendly relations with France. Public opinion in both countries exhibited hostility, so that the marriage of Isabella II. of Spain and the imprisonment of Pritchard in Tahiti might have led to a quarrel; but Aberdeen was fortunate in having the confidence of Guizot, and it was largely through their efforts that a satisfactory understanding was maintained. He was equally successful in avoiding a rupture with the United States, which might easily have resulted from the question involving the boundary between that country and Canada. The north-east frontier was first settled amicably by the Webster-Ashburton Treaty of 1842, but in 1844 the new democratic administration in the States claimed from Britain the whole of the Pacific coast as far as Russian Alaska To this demand Peel's Government refused to yield, and Aberdeen crowned his successful term at the Foreign Office with the Oregon Treaty of 1846, which fixed the boundary along the forty-ninth degree of latitude.

In 1845 he supported Peel in a proposal to suspend the duty on foreign corn, and left office with him in July 1846 After Peel's death in 1850, Aberdeen was recognized as leader of the Peelites, and in 1852, at the head of a coalition ministry of his own party and the Whigs, he became first lord of the Treasury. Although united on free trade and on questions of domestic reform generally, a cabinet including Lord Palmerston and Lord John Russell, in addition to Aberdeen, was certain to differ on foreign policy; and contemporaries realized that the task of the prime minister was one of unusual difficulty. "In the present cabinet," wrote Charles Greville, in his *Memoirs,* "are five or six men of equal or nearly equal, pretensions every one of these five or six considering himself abler and more important than their premier" Nevertheless, the first year of this administration was successful, and it was due to Aberdeen's steady support that Gladstone's great budget of 1853 was accepted by the cabinet; but the weakness of Aberdeen and of the cabinet soon became apparent in the negotiations which preceded the Crimean War. That the prime minister wished to maintain the peace is unquestionable, but whether he acted wisely to this end is more obscure. His foreign policy was essentially one of peace and non-intervention, but his character is perhaps best described by a writer who says "his strength was not equal to his goodness."

The Vienna note, by which the four powers sought to find terms which were agreeable to both Russia and Turkey, was largely the result of Aberdeen's endeavours; and when Turkey refused to accept the proposed agreement, Aberdeen would not have offered her British support had not the publication of a secret Russian document in Berlin thrown doubt upon the Tsar's intentions. Even then he sought to preserve the peace by presenting a new note early in Dec. 1853 to the two countries; but when he wished to insist upon Turkey's acceptance of these terms, Lord John Russell refused to support him. Rather than risk a break up of the cabinet, Aberdeen consented to a compromise of which advantage was taken by those who desired war; and Turkey was thus enabled to force England with her into the disastrous struggle. The stories of misery and mismanagement from the seat of war deprived the Government of public favour. Russell resigned; and in Jan. 1855, he was followed by Aberdeen, who interpreted a motion by J. A. Roebuck as one of no confidence He died in London, on Dec. 14th, 1860, and was buried in the family vault at Stanmore. He left four children by his second wife, who died in Aug. 1833; the eldest son, George John James, succeeded as 5th earl; his youngest son, Arthur Hamilton, was created Baron Stanmore in 1893. Aberdeen wrote *An Inquiry into the Principles of Beauty in Grecian Architecture,* which was published in London, 1822. A bust of him by Matthew Noble is in Westminster Abbey, and his portrait was painted by Sir T. Lawrence.

See Sir T. Martin, *Life of the Prince Consort* (1875–80); A. W. Kinglake, *Invasion of the Crimea* (1877–88); Spencer Walpole, *History of England* (1878–86), C. C. F. Greville, *Memoirs,* edited by H. Reeve (1888); Spencer Walpole, *Life of Lord John Russell* (1889); Lord Stanmore, *The Earl of Aberdeen* (1893); J. Morley, *Life of Gladstone* (1903).

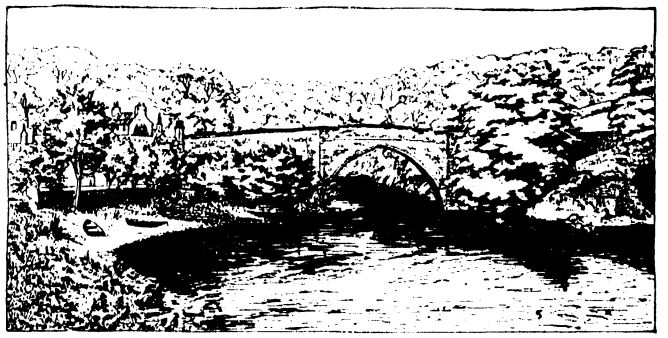
ABERDEEN, a royal burgh, city and county of a city, the capital of Aberdeenshire and chief seaport in the north of Scotland. Population (1921) 158,963. It is the fourth Scottish town in population, industry and wealth, and stands on a bay of the North Sea between the mouths of Don and Dee, 130½m. N.E. of Edinburgh by the L.N.E.R. Though the residential suburb of Old Aberdeen, extending from the city suburbs to the southern banks of the Don, has a separate charter, history and privileges,

there is no distinction between it and New Aberdeen for parliamentary, municipal or other purposes. Aberdeen derives its popular name of the "Granite City" from its building stone, which under sunshine after rain gleams white and justifies the town's more poetical designation of the "Silver City by the Sea." The area of the city is 6,319 acres, the burghs of Old Aberdeen and Woodside, and the district of Torry (in the parliamentary constituency of Kincardineshire) to the south of the Dee, having been incorporated in 1895. The city comprises 11 wards and 18 ecclesiastical parishes, and is under the jurisdiction of a council with lord provost, bailies, treasurer and dean of guild. The corporation owns the water supply (derived from the Dee at a spot 21m. W.S.W. of the city), as well as gas, electric lighting and tramways.

Streets and Buildings.—Roughly, the extended city runs north and south. From the new bridge of Don to the "auld brig" of Dee there is tramway communication via King street, Union street and Holburn road—a distance of over five miles. The name of the ancient castle of Aberdeen, long since demolished, is preserved in Castle street, Castlegate and Castlehill. From Castle street the imposing Union street 70 ft. wide runs west-south-west for nearly a mile, and contains the principal shops and most of the modern public buildings, all of granite. Part of the street crosses the Denburn ravine by a fine granite arch of 132ft. span; portions of the older town fringe the gorge, 50ft. below the level of Union street. The Trinity Hall of the incorporated trades, originating between 1398 and 1527, and having charitable funds, contains some fine portraits by George Jamesone (*q.v.*), who was a native of Aberdeen and one of the earlier British portrait painters. Castle street continues Union street eastwards, and has the fine structures of the municipal and county buildings in Franco-Scottish Gothic (1867–78), the sheriff court house and the town hall, with excellent portraits; from the south-west corner a tower commands a fine view. At the upper end of Castle street stands the Salvation Army Citadel, reputed to be the most imposing "barracks" possessed by this organization. In front of it is the beautiful Market Cross, one of the most notable of its kind in Scotland, an open-arched, hexagonal structure, 21ft. in diameter and 18ft. high, dating originally from 1682, when it replaced an earlier cross, and rebuilt on its present site in 1842. On an eminence east of Castle street are the military barracks, Aberdeen being the depot of the Gordon Highlanders. In Market street is the Mechanics' Institution, founded in 1824, with a good library. The fish market on the Albert Basin is an important centre of activity. The art gallery and museum is at Schoolhill, the Macdonald Hall containing portraits of contemporary artists by themselves being unique of its kind in Great Britain. In Sept. 1925 King George opened the city's war memorial; it consists of a domed court, or hall of remembrance, attached to the art gallery and museum. Other extensions opened at the same time include Cowdray Hall, used for lectures, with the Cowdray Museum of Applied Arts beneath it. New rooms were also provided for the pictures. The public library is magnificently housed.

The see of Aberdeen is represented by the Old Cathedral of St. Machar, the only granite cathedral in the British Isles, the beginnings of the present structure date from the 14th century and were completed by Bishops Elphinstone (1484–1511) and Gavin Dunbar (1518). On the flat panelled ceiling are the heraldic shields of princes, noblemen and bishops who shared in its erection. The name of St. Machar (or Mochonna) is referred by tradition to a disciple of St. Columba who founded a chapel here for the conversion of the Picts. The bishopric, which had been founded at Mortlach (Banffshire) by King Malcolm II. in 1004, in honour of a victory over the Danes, was transferred to Aberdeen by King David I. about the year 1137, a bull of Pope Adrian IV. dated 1157 "confirming all grants made by the kings of the Scots." "The church of Aberdeen" which is mentioned in the same bull, together with the church of St. Machar, is held to refer to the old church of St. Nicholas, of which the only remains are the Drum and Collison aisles which now link the east and west churches. The John Knox parish church was rebuilt in 1911; the Roman Catholic cathedral (Gothic, 1859) is in Huntly street.

The Dee is crossed by four bridges, including the railway bridge. Till 1832 the old bridge of Dee built by Bishops Elphinstone and Dunbar (and rebuilt in 1718–23 and 1842) formed the only entry to the city from the south. The bridge of Don, consisting of five granite arches, was built in 1827–32. The Auld Brig o' Balgownie, said to have been built by King Robert I. in the 13th century, and celebrated by Byron in the tenth canto of *Don Juan*, is one of the oldest historical bridges still in use. The parks and open spaces



BY COURTESY OF LONDON, MIDLAND AND SCOTTISH RAILWAY

THE "AULD BRIG O' BALGOWNIE" AT ABERDEEN, SUPPOSEDLY BUILT BY KING ROBERT I. (1274–1329), AND CELEBRATED IN BYRON'S POEM, "DON JUAN"

include Duthie Park (50 acres), the gift of Miss Elizabeth Crombie Duthie of Ruthrieston; Victoria Park (13 acres) and its extension Westburn Park (13 acres); Stewart Park (11 acres), after Sir D. Stewart, lord provost in 1893. Capacious golf links and a bathing beach border the sea.

Education.—Aberdeen university consists of King's college in Old Aberdeen, founded by Bishop Elphinstone (*q.v.*) in 1494, and Marischal college, in Broad street, founded in 1593 by George Keith, 5th earl Marischal, the two colleges being incorporated together, 1860. Ten chairs and 11 lectureships have been founded. Handsome new buildings have been erected, and an important addition to the resources of the university was the foundation, in 1913, of the Rowett Institute for Research in animal nutrition. Donations have been received for scholarships and bursaries, and the Carnegie Trust has made generous grants for building purposes. The number of students is about 1,400.

King's forms a quadrangle with interior court; the Crown Tower and the Chapel, the oldest parts, date from 1500. The choir of the chapel contains the original oak canopied stalls, miserere seats and lofty open screens in French flamboyant style. The principal at the time of the Reformation armed his folk to save the building from the barons of the Mearns (the modern Kincardineshire) after they had robbed St. Machar's of its bells and lead. The present building of Marischal college was erected in 1836–41 and has been greatly extended since. Dr. Charles Mitchell gave the great graduation hall and the Mitchell tower, opened in 1895, on the 400th anniversary of the university's foundation. A lintel stone from the old buildings of Marischal college is preserved at the foot of the Mitchell tower, bearing the famous inscription: THAY HAIF SAID · QUHAT SAY THAY · LAT THAME SAY, the circumstances giving rise to which are believed to embody the founder's retort to criticisms passed against him for his appropriation (by gift from the Crown) of lands and revenues belonging to the suppressed Cistercian abbey of Deer. A botanic garden was presented to the university in 1899.

Aberdeen, St. Andrews, Edinburgh and Glasgow universities combine to return three members to Parliament. The United Free Church Divinity Hall is in Tudor Gothic (1850). The Grammar school, founded in 1263, was removed in 1861–63 from Schoolhill to new buildings off Skene street. Robert Gordon founded (1729) and Alexander Simpson further endowed (1816) Gordon's Hospital for instruction and maintenance of sons of poor burgesses of gild and trade; since 1881 it is Robert Gordon's college for secondary and technical education.

Harbour.—A formerly defective harbour with a bar has been greatly deepened under various Acts since 1773. The north pier, built partly by Smeaton in 1775–81, and partly by Telford in

1810–15, extends nearly 2,000ft. into the North sea It increases the depth of water on the bar from a few feet to 32ft. at high water, and 19ft. at low water, spring tides. The wet Victoria dock of 29 acres, and with 6,000ft. of quay, was completed in 1848. Adjoining it is the Upper Dock. By the Harbour Act of 1868, 90 acres of new ground (in addition to 25 acres formerly made up) were provided on the north side of the Dee for the Albert Basin (with a graving dock), quays and warehouses. A breakwater of concrete, 1,050ft. long was constructed on the south side of the stream, and a third floating dock was built in 1911.

Industry.—Grey granite has been quarried for more than 300 years, and blocked and dressed paving "setts," kerb and building stones and monumental work have long been exported Aberdeen is an important centre of the Scottish fisheries, the antiquity of which is shown by the mention of the provision of "dried fish from Aberdeen" in the royal wardrobe accounts of the 13th century. Other industries include woollens, linen, jute, cotton, paper (1694), engineering, chemical works, soap and candles, combs, jams, pickles, potted meat, distilling, brewing. In the days of wooden ships ship-building flourished, the town being noted for its fast clippers, many of which established records in the "tea races." The introduction of trawling revived this to some extent, and there is a fair yearly output of iron vessels.

History.—Aberdeen was important as far back as the 12th century. The corporate rights which were granted by David I. on account of Aberdeen to the clerics of the abbey of Deer, mentioned in the *Book of Deer,* were confirmed by a royal charter of King William the Lion (1179), from whose times down to the 14th century the Scottish kings maintained a royal residence in Aberdeen. The city received other royal charters later. After it was burned by the English king, Edward III. in 1336, the new town which was built was called New Aberdeen to distinguish it from Old Aberdeen. The burgh records are the oldest in Scotland, being complete with one brief break from 1398 to the present day. During the struggles between the Royalists and the Covenanters the city was plundered by both. In the Scottish wars of independence led by William Wallace and Robert Bruce, Aberdeen gave its aid to both, and the motto on the city arms of "Bon Accord" commemorates the watchword used by the Aberdonians aiding Robert Bruce. In 1715 the Earl Marischal proclaimed the Old Pretender at Aberdeen

Once strongly fortified, the gates of the city were all removed by 1770. The importance of Aberdeen as a royal burgh and trading port placed it from the earliest times in the first rank of Scottish towns, a position which its great cathedral and, later, the fame of its university both served to maintain Among the eminent men in a long line connected with Aberdeen, John of Fordun and John Barbour (*qq v.*) were both attached to the cathedral, while Hector Boece (*q.v*) was the first principal of King's college; in modern times the Scottish historians, J. H. Burton and W. F. Skene were Aberdonians.

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ABERDEEN, a city of north-eastern Mississippi, U S A., at the head of navigation on the Tombigbee river; the county seat of Monroe county. It is on Federal highway 45, and is served by the Frisco, the Illinois Central and the Mobile and Ohio railways. The population in 1920 was 4,071 (52% negroes), and was estimated locally at 5,000 in 1928. Aberdeen has a large trade in cotton, cotton seed and its products, cattle, feed, pelts, hides, wool, lumber, hardware and machinery. The dairy industry and truck-farming are developing rapidly. Two gas wells were "brought in" near by in 1927. The city was founded about 1834 and incorporated in 1837.

ABERDEEN, the second largest city of South Dakota, U.S.A., the county-seat of Brown county. It is in the north-eastern part of the State, on the Yellowstone Trail, about 270m. W. by N. of Minneapolis, and is served by nine lines altogether of the Chicago, Milwaukee and St. Paul, the Great Northern, the Chicago and North Western, and the Minneapolis and St. Louis railways. The population (90% native whites) was 4,087 in 1900 and 15,036 in 1925 (State census).

Aberdeen is the financial and trading centre of the northern part of the State, a fine agricultural region, producing grain, potatoes, hay and flax. In 1925 it had 35 manufacturing establishments, including packing houses, machine shops, and a flour-mill, which had an aggregate output valued at $4,639,377. The Northern State Teachers college was established in 1901. An open-air theatre, with a seating capacity of 5,000, was added to the campus equipment in 1923 The college has an annual enrolment of about 2,000. It maintains a summer biological station at Lake Enemy Swim, near Waubay Aberdeen was settled in 1880 and was chartered as a city in 1883.

ABERDEEN, a port of entry, the largest city of Grays Harbor county, Washington, U.S A , on the north shore of Grays Harbor, about 50 m. W. of Olympia It has an area of 10 5 sq m.; is built on both sides of the Chehalis and the Wishkah rivers; and adjoins the city of Hoquiam (*q v*) on the west, and the town of Cosmopolis (population 1920, 1,512) on the east. The population of Aberdeen increased from 3,747 in 1900 to 15,337 in 1920, of whom 4,221 were foreign-born whites (nearly half Scandinavians) and was estimated locally at over 24,000 in 1927. The three municipalities form one community, with a population (1927) of over 30,000, served by the Northern Pacific, the Union Pacific, and the Chicago, Milwaukee and St. Paul railways, by auto-stages to Puget sound, and by 39 steamship lines under seven flags.

Grays Harbor was discovered in 1792 by Capt. Robert Gray of Boston, on a trading voyage around the world. Aberdeen was founded in 1867 by Samuel Benn, who in 1873 established a cannery, and in 1883 planned the town site. It was incorporated in 1890.

ABERDEEN AND TEMAIR, JOHN CAMPBELL GORDON, 1st Marquess of, P.C., K.T., second son of the fifth earl of Aberdeen, was born in Edinburgh in 1847. He was educated at St. Andrews and University college, Oxford; he succeeded his brother as sixth earl of Aberdeen in 1870, taking his seat in the House of Lords early in 1873 and at once plunging into committee work. After being lord high commissioner to the general assembly of the Church of Scotland from 1881 to 1885—an office he again filled in 1915—Mr. Gladstone appointed him lord lieutenant of Ireland in his short administration (Feb.–July) of 1886. Soon after the Liberals' next accession to power he became governor general of Canada (1893) and after his return to England in 1898 took little part in politics. In Dec. 1905 he was again appointed lord lieutenant of Ireland, he held this office till May 1915, and in the following January received the title of Marquess of Aberdeen and Temair (Tara). Both in Canada and in Ireland Lord Aberdeen's terms of office were distinguished by the cordial relationship which he, as representative of his sovereign, maintained with the very different nations over whom he presided.

In 1877 Lord Aberdeen married the Hon. Ishbel Maria Majoribanks, a daughter of Lord Tweedmouth

See *We Twa: Reminiscences of Lord and Lady Aberdeen* (1925).

ABERDEENSHIRE, a north-eastern county of Scotland, bounded north and east by the North sea, south by Kincardine, Angus and Perth, and west by Inverness and Banff. It has a

coast-line of 65m., and is the sixth Scottish county in area, occupying 1,261,521ac. or 1,970 square miles. The county is generally hilly, since from the south-west, near the centre of Scotland, the Grampians send out various branches in a general north-easterly direction. The county is watered by the rivers Dee, Don, Ythan, Ugie and Deveron—names, especially the two first, associated with some of the finest valley scenery on the eastward slope of Scotland. The upper valley of the Dee, about Braemar, penetrates the central mass of crystalline schists belonging to the metamorphic rocks of the eastern highlands, with extensive intrusions of later granites, which, on the border with Banffshire, rise in the fine mass of Ben Macdhui (4,296ft.) to a height second only to that of Ben Nevis among the mountains of the British Isles. This mountain commands views of one of the most beautiful parts of the central highlands, with the summits of Braeriach (4,248ft.), Cairntoul (4,241ft.) and Cairngorm (Banffshire) near by, the columnar cliffs of Corrie Etchachan, and Loch Avon in its deep gully, 2,500ft. above sea-level. Among many other heights, "dark" Lochnagar, south-east of Braemar, is famed through a well-known song of Byron; and Benwachie, on the Banffshire border, through John Imlah's verse "O gin I were where Gadie rins." The shire is popularly divided into five districts. Of these the first is Mar, mostly between Dee and Don, the southern half of the county with the city of Aberdeen The soil on the Dee is sandy, and on the Don loamy. The second district, Formartine, between the lower Don and Ythan, has a sandy coast, succeeded inland by a clayey, fertile, cultivated tract, and then by low hills, moors, mosses and tilled land. Buchan, the third district, lies north of the Ythan, and comprises the north-east part of the county. The surface is bare, low, flat or gently undulating and in places peaty. The coast is in parts bold and rocky, and at the Bullers of Buchan, 6m. south of Peterhead, the sea enters a basin by a natural arch and boils up violently in stormy weather. Buchan Ness is the most easterly point of Scotland. The fourth district, Garioch, in the centre of the shire, is beautiful, undulating, loamy and fertile. Strathbogie, the fifth district south of the Deveron, mostly consists of hills, moors and mosses.

Geology.—The schists extend east from the central mass to Formartine and Peterhead. East down Dee and Don and north across the plain of Buchan towards Rattray head and Fraserburgh there is a development of biotite gneiss, partly of sedimentary and perhaps partly of igneous origin. A belt of slate quarried for roofing purposes runs along the west border of the county from Turriff by Auchterless and the Foudland hills towards the Tap o'Noth near Gartly. The metamorphic rocks have been invaded in almost every part of the county by igneous materials, some before, and by far the larger series after the folding of the strata. There are chalybeate springs at Peterhead and Pannanich near Ballater. The later granites subsequent to the plication of the schists have a wide distribution on the Ben Macdhui and Ben Avon range, and on Lochnagar; they stretch east from Ballater by Tarland to Aberdeen and north to Bennachie. Isolated masses appear at Peterhead and at Strichen. The Aberdeen granites have been widely used for building and paving, and extensively quarried at Rubislaw, Peterhead, Kemnay and elsewhere. The glacial deposits in the county indicate an eastward movement off the high ground at the head of Dee and Don, while the mass spreading outwards from the Moray Firth invaded the low plateau of Buchan; but at a certain stage there was a marked defection northwards parallel with the coast, as proved by the deposit of red clay north of Aberdeen. At a later date the local glaciers laid down materials on top of the red clay. The rivers abound with salmon and trout. Loch Muick, the largest of the few lakes in the county, 1,310ft. above the sea, 2½m. long and ¼ to ½m. broad, lies some 8½m. south-west of Ballater, and has Altnagiuthasach, a royal shooting-box, near its south-west end. Red deer (in Braemar), grouse, and partridges are plentiful.

The climate of the upper Dee and Don valleys has a reputation as the driest and most bracing in the British isles, and grain is cultivable up to 1,600ft. above sea-level—considerably higher than elsewhere in the north of Great Britain. At Loch Muick vegetables, currants, laurels and roses flourish; the larch grows well, and elsewhere in Braemar natural timber, especially Scots fir in addition to larch, is particularly fine. Ash-trees, 5ft. in girth, are found at 1,300ft. elevation.

History.—The country now forming the shires of Aberdeen and Banff was originally peopled by northern Picts, whom Ptolemy called Taixali. Evidence of effective Roman occupation is lacking, though so-called Roman camps have been discovered on the upper Ythan and Deveron. Traces of the native inhabitants, however, are numerous Weems or earth-houses are fairly common in the west. Relics of crannogs or lake-dwellings exist at Loch Ceander, or Kinnord, 5m. N.E. of Ballater, at Loch Goul in the parish of New Machar, and elsewhere. Duns or forts occur on hills at Dunecht, where the dun encloses an area of two acres, Barra near Old Meldrum, Tap o'Noth, Dunnideer near Insch and other places. Monoliths, standing stones and stone circles abound, and there are many early Christian sculptured stones. Efforts to convert the Picts were begun by Ternan in the 5th century and continued by Columba (who founded a monastery at Old Deer), Drostan, Maluog and Machar, but dissensions within the Columban Church and the expulsion of the clergy from Pictland by the Pictish king Nectan in the 8th century, undid most of the progress that had been made. The Vikings and Danes periodically raided the coast, but when (1040) Macbeth ascended the throne of Scotland the Northmen, under the guidance of Thorfinn, refrained from further trouble in the north-east. Macbeth was afterwards slain at Lumphanan (1057), a cairn on Perkhill marking the spot Along with numerous Anglo-Saxon exiles after the Norman conquest of England there also came to Aberdeenshire Flemings who introduced various industries, Saxons who brought farming, and Scandinavians who taught nautical skill. The Celts revolted more than once, but Malcolm Canmore and his successors crushed them and confiscated their lands In the 12th and 13th centuries some of the great Aberdeenshire families arose, including the earl of Mar (*c.* 1122), the Leslies, Freskins (ancestors of the dukes of Sutherland), Durwards, Bysets, Comyns and Cheynes, and in most cases their founders were immigrants The Celtic thanes and their retainers slowly fused with the settlers. They declined to take advantage of the disturbed condition of the country during the wars of the Scots independence, and made common cause with the bulk of the nation. Though John Comyn (d. 1300?), one of the competitors for the throne, had considerable interests in the shire, his claim received locally little support. In 1296 Edward I. made a triumphal march to the north to terrorize the more turbulent nobles. Next year William Wallace surprised the English garrison in Aberdeen, but failed to capture the castle. In 1303 Edward again visited the county, halting at the castle of Kildrummy, then in the possession of Robert Bruce, and made Aberdeen his headquarters during several months After Robert Bruce's death (1329) there was intermittent anarchy in the shire. Aberdeen itself was burned by the English in 1336, and the resettlement of the districts of Buchan and Strathbogie occasioned constant quarrels on the part of the dispossessed Moreover, the Crown embroiled itself by trying to subdue some of the Highland chieftains. This policy culminated in the invasion of Aberdeenshire by Donald, lord of the Isles, who was, however, defeated at Harlaw, near Inverurie, by the earl of Mar in 1411. In the 15th century Sir Alexander Forbes was created Lord Forbes (*c.* 1442), and Sir Alexander Seton Lord Gordon in 1437 and earl of Huntly in 1445. Bitter feuds raged between these families but the Gordons' domains, already vast, were enhanced by the acquisition, through marriage, of the earldom of Sutherland (1514). Meanwhile commerce with the Low Countries, Poland and the Baltic had grown apace, Campvere, near Flushing in Holland, becoming the emporium of the Scottish traders, while education was fostered by the foundation of King's college at Aberdeen in 1494 (Marischal college followed a century later). At the Reformation so little intuition had the clergy of the drift of opinion that at the very time that religious structures were being despoiled in the south, the building

and decoration of churches went on in the shire The change was acquiesced in without much tumult, though rioting took place in Aberdeen and St. Machar's cathedral in the city suffered damage. The 4th earl of Huntly offered some resistance, on behalf of the Catholics, to the influence of Lord James Stuart, afterwards the regent, Moray, but was defeated and killed at Corrichie on the Hill of Fare in 1562 As years passed it was apparent that Presbyterianism was less generally acceptable than episcopacy, of which system Aberdeenshire remained for generations the stronghold in Scotland. In 1638 the National Covenant was ordered to be subscribed, a demand so grudgingly responded to that the earl of Montrose visited the shire in the following year to enforce acceptance. The Cavaliers, not being disposed to



VIEW OF THE CENTRE OF ABERDEEN, SCOTLAND, SOMETIMES CALLED "THE GRANITE CITY," THE CHIEF CITY OF ABERDEENSHIRE

yield, dispersed an armed gathering of Covenanters in the affair called the Trot of Turriff (1639), in which the first blood of the Civil War was shed. The Covenanters obtained the upper hand in a few weeks, when Montrose appeared at the bridge of Dee and compelled the surrender of Aberdeen, which had no choice but to cast in its lot with the victors. Montrose, however, soon changed sides, and defeated the Covenanters under Lord Balfour of Burleigh (1644), and again after a stiff fight on July 2, 1645, at Alford Peace was temporarily restored on the "engagement" of the Scots commissioners to assist Charles I On his return from Holland in 1650 Charles II was welcomed in Aberdeen, but in little more than a year General Monk entered the city at the head of the Cromwellian regiments. The English garrison remained till 1650, and next year the Restoration was effusively hailed, and prelacy was again in the ascendant. After the Revolution (1688) episcopacy passed under a cloud, and as George I was antipathetic to the clergy, it happened that Jacobitism and episcopalianism came to be regarded in the shire as identical The earl of Mar raised the standard of revolt in Braemar (Sept 6, 1715); a fortnight later James was proclaimed at Aberdeen cross; the Pretender landed at Peterhead on Dec. 22, and in Feb 1716 he was back again in France The collapse of the first rising ruined many of the lairds, and when the second rebellion occurred 30 years afterwards the county in the main was apathetic, though the insurgents held Aberdeen for five months, and Lord Lewis Gordon won a trifling victory for Prince Charles Edward at Inverurie (Dec 23, 1745).

Population and Government.—In 1911 the population numbered 312,177, and in 1921, 300,980 (159,987 females) In 1921, only 874 spoke Gaelic as well as English, and one person Gaelic only, although as late as 1830 Gaelic was the common tongue almost throughout Braemar at least The chief towns, with populations in 1921, are Aberdeen (158,967), Peterhead (13,126), Fraserburgh (10,514), Huntly (4,455), Inverurie (3,752), Turriff (2,152). The Supreme Court of Justiciary sits in Aberdeen to try cases from the counties of Aberdeen, Banff and Kincardine. The three counties are under a sheriff, and there are three sheriffs-substitute resident in Aberdeen, who sit also at Fraserburgh, Huntly and Peterhead. The county, with Kincardineshire, sends one member to parliament. The county town, Aberdeen, returns two members

Occupations.—Except in favoured tracts, as in Formartine and Garioch, the glacial drift soils are generally poor, gravelly or peaty; but in no part of Scotland has careful cultivation more successfully increased productivity About two-thirds of the population depend on agriculture. Farms are small compared with those in the south-eastern counties Oats are the predominant crop, wheat has practically gone out of cultivation, but turnips and barley are grown Great numbers of the home-bred crosses of cattle are fattened for London and local markets, and Irish animals are imported on an extensive scale for the same purpose

Fisheries.—The white and herring fishery is the next most important industry to agriculture, its development having been due almost exclusively to the introduction of steam trawlers. Aberdeen is the chief Scottish centre for trawling and great line fishing, and the chief port for white fish Fraserburgh is one of the largest centres of the North sea herring fishing Haddocks are salted and rock-dried (speldings) or smoked (finnans) The ports and creeks are divided between the fishery districts of Peterhead, Fraserburgh and Aberdeen, the last of which includes also three Kincardineshire ports The herring season for Aberdeen, Peterhead and Fraserburgh is from June to September, at which time the ports are crowded with boats from other Scottish districts There are valuable salmon-fishings—rod, net and stake-net—on Dee, Don, Ythan and Ugie

Communications.—From the south Aberdeen city is approached by the L M S R (via Perth, Forfar and Stonehaven), and the L N E R (via Dundee, Montrose and Stonehaven) A line of the latter company runs via Kintore and Huntly to Keith and Elgin Branch lines from Aberdeen to Ballater by Deeside, from Aberdeen to Fraserburgh (with a branch at Maud for Peterhead and at Ellon for Cruden bay and Boddam), from Kintore to Alford, and from Inverurie to Old Meldrum and also to Macduff By sea there is regular communication with London, Leith, Newcastle and Hull, Inverness, Wick and other ports, the Orkneys and Shetlands, and the Continent The highest macadamized road crossing the East Grampians rises to a point 2,200ft. above sea-level.

ABERDOUR, village and parish, Fifeshire, Scotland Pop. (1921), 3,063 On the shore of the Firth of Forth, 17½m N W. of Edinburgh by the L N E R, 7m N W of Leith by steamer, it is a favoured bathing resort. There are ruins of a castle and a church with fine Norman work About 3m S W is Donibristle House, the seat of the earl of Murray (Moray). The island of Inchcolm, or Island of Columba, ½m from shore, is in the parish. The primitive stone-roofed oratory is supposed to have been a hermit's cell Remains of 13th-century fresco have been found. Of an Augustinian monastery, founded (1123) by Alexander I, there remain a low square tower, church cloisters, refectory and small chapter-house

ABERDOVEY (ăb-ur-dŭv'ĭ) (ABERDYFI), a village on the north side of the Dyfi Estuary, Merionethshire, Wales Population (1921) 1,466 Its site has associations in Welsh folk-lore with coastal submergence (*see* CARDIGANSHIRE) During the 17th, 18th and 19th centuries it had a considerable coasting and fishing trade, the export of slates from Corris and Aberllefenni being considerable. Aberdovey also exported lead ore from the mines of the Dyfi region. With the development of private motor traffic on a large scale since 1918 Aberdovey has become increasingly a resort for visitors from the large towns of England.

ABERFOYLE, village and parish, Perthshire, Scotland, 34¼m. N by W. of Glasgow by the L N E R. Population of parish (1921) 1,170 The village is at the base of Craigmore (1,271ft. high) and on the Laggan, a headwater of the Forth. In 1885 the duke of Montrose built a road over the east shoulder of Craigmore to the Trossachs but this does not take motor traffic. The Laggan drains the small lochs Ard and Chon, the first of which is the scene of incidents in Scott's *Rob Roy*. There are slate quarries on Craigmore.

ABERGAVENNY (ăb-ur-gĕn'ĭ or ăb-ur-gă-vĕn'ĭ), municipal borough, Monmouthshire, England, at the converge of roads from Crickhowell, Ross, Hereford, Newport and Merthyr, at the confluence of the Gavenny with the Usk. Population (1921) 9,010 There are evidences of the early occupation of the area on the hills around and the focus which became Abergavenny was the Roman Gobannium, a small fort guarding the road up the Usk The town grew under the protection of the Norman lords of Abergavenny and there are remains of a castle built by Hamelyn de Baalun in the 11th century The mediaeval walled town contained a Benedictine monastery which later became the church of St Mary. Owing to its situation, the town was frequently embroiled in the border warfare of the 12th and 13th centuries and was burnt by Owain Glyndwr (Owen Glendower, *q v*) in 1404. At the dissolution of the priory part of its endowment went towards a free grammar school In 1639 Abergavenny received a charter of incorporation with bailiff and burgesses Like most towns of similar history it showed strong conservative tendencies during the Civil Wars when the town suffered badly at the hands of Fairfax (1646), and again in 1688 when it lost its charter for its strong Jacobean demonstrations. The market was important as early as 1200 and further reference is made to it in 1657, but with the better roads and greater movement of the 18th and 19th centuries cattle and horse fairs become more important In the 18th and early 19th centuries Abergavenny prospered as a market and social centre It was also famous for its Welsh flannel Abergavenny was incorporated in 1899 and is governed by a mayor and corporation. It is in the parliamentary division of Monmouth.

ABERIGH-MACKAY, GEORGE ROBERT (1848–1881), Anglo-Indian writer, is known by his famous *Twenty-one Days in India* (1878–79), a satire upon Anglo-Indian society and ways of thinking

ABERNETHY, JOHN (1680–1740), Irish Presbyterian divine, was born at Coleraine, county Londonderry, on Oct. 19 1680. He was educated at Glasgow, Edinburgh and Dublin, and was pastor of a church at Antrim for 14 years In 1717 he was assigned by the synod to Usher's Quay, Dublin He declined to obey, and remained at Antrim This refusal became a test case of the authority of the ecclesiastical courts, and Irish Presbyterianism was split into two camps of "subscribers" and "non-subscribers" Out-and-out evangelical as John Abernethy was, there can be no question that he and his associates sowed the seeds of that after-struggle (1821–40) in which, under the leadership of Dr Henry Cooke, the Arian and Socinian elements of the Irish Presbyterian Church were thrown out In 1726 the "non-subscribers," in spite of pleading against separation by Abernethy, were cut off from the Irish Presbyterian Church In 1730, although a "non-subscriber," he was invited to Wood Street, Dublin, whither he removed In 1731 Abernethy made a stand against the Test Act, "against all laws that, upon account of mere differences of religious opinions and forms of worship, excluded men of integrity and ability from serving their country" He was nearly a century in advance of his age in his repudiation of tests and disabilities He had to reason with those who denied that a Roman Catholic or Dissenter could be a "man of integrity and ability." His *Tracts*—afterwards collected—did fresh service, generations later, and his name is honoured by all who love freedom of conscience and opinion

See Dr Duchal's *Life*, prefixed to *Sermons* (1762); *Diary* in ms., 6 vols. 4to; Reid's *Presbyterian Church in Ireland*, iii. 234.

ABERNETHY, JOHN (1764–1831), British surgeon, was born in London on April 3 1764. He was apprenticed in 1779 to Sir Charles Blicke, then assistant surgeon to St. Bartholomew's Hospital, and studied under Sir William Buzard at the London Hospital and under John Hunter. When Blicke became surgeon to the hospital, Abernethy became assistant surgeon. He began to lecture to students in his house The lectures were so crowded that the governors of the hospital decided to build a regular lecture theatre. Abernethy's best known work is *Surgical observations on the constitutional Origin and Treatment of Local Diseases* (1809). He had enjoyed great celebrity in private practice, enhanced, it is said, by his rough manners He was surgeon to the hospital 1815–27, and died at Enfield April 20 1831.

A collected edition of his works was published in 1830 A biography, *Memoirs of John Abernethy*, by George Macilwain, appeared in 1853.

ABERRATION IN OPTICAL SYSTEMS, the deviation of light rays from certain points through which they should pass in order to satisfy the conditions necessary for distinct focus. *Spherical* aberration results in distortion of the image, and *chromatic* aberration produces coloured fringes around an otherwise white image. (*See* OPTICS; PHOTOGRAPHY *Apparatus*)

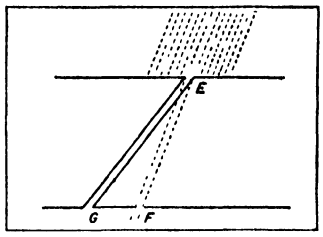
ABERRATION OF LIGHT. This is an astronomical phenomenon depending on the fact that light is not propagated instantaneously Our observations of the heavenly bodies are taken from the earth, a planet whose speed of motion is not incomparably smaller than that of the light; the result is that the apparent position of a star in the sky does not correspond to its true direction from the earth. We are accustomed to assume intuitively that a body is "where we see it to be"; or, since the distance cannot always be judged, that at any rate it is in the direction in which we see it But actually vision gives only an indirect acquaintance with its position That which affects our eyes is the light which has travelled to us from the object; we have, therefore, to take into consideration the circumstances of propagation of the light It is well known that a light-ray changes direction in passing from one transparent medium to another, *e g*, water to air, and that its course is curved in a medium of varying density such as our atmosphere; an object seen by these dislocated or curved rays is displaced from its correct position, and the corresponding correction for *refraction* by the earth's atmosphere is highly important in determining the positions of stars. The correction for *aberration* is also concerned with the propagation of light; it arises from the fact that our actual judgment of the direction of a ray involves a combination of the earth's motion and the motion of the light

The most elementary explanation can be given in terms of the old corpuscular theory of light—which was the theory accepted at the time aberration was discovered If we think of the ray of light as a stream of missiles proceeding from the star with a speed of 186,000m a second, it is clear that the apparent direction from which the missiles come will be affected by our own velocity if that is not too insignificant in comparison A common illustration is that of a man walking through a rain-storm with the drops falling vertically, the faster he walks, the more inclined is the position in which he must hold his umbrella to shield off the "missiles" The argument can be re-stated in terms of the wave theory of light without essential alteration, but reference should be made to an account of that theory for an explanation of the signification of "rays of light"

A rough way of aiming the direction of a star is to point a long narrow tube so that we can see the star through it. The alinement is given by the two apertures at the ends of the tube, which must be such that the small pencil of rays admitted through one can make an exit through the other and thus reach the observer's eye The upper part of the diagram shows the rays of light coming from a star, the upper aperture E admits a narrow beam which continues in the original direction, so that F is the position in which the exit aperture has to be placed Suppose that whilst the light travels the distance E F the earth moves through a distance G F; then the required direction of our tube is G E It will then admit the light at E, and, by the time the light has travelled down the tube, the lower aperture will have reached the position F and the light will pass out It will be seen that the tube G E does not point in the true direction of the star F E. The same principle applies when the tube is furnished with lenses, as in a telescope

The alinement is the same whether the tube is long or short, and we can conveniently appreciate the relative proportions if we take E F to be 186,000 miles The light then takes 1 second to pass from E to F; and in 1 second the earth travels in its orbit 18½m, represented by G F. Thus G F is $\frac{1}{10,000}$ of E F. The greatest possible angle between the observed direction and the true direction is $\frac{1}{10,000}$ of a radian, or more accurately 20·47″;

this is called the *constant of aberration.* For comparison the apparent radius of Jupiter is about 20″; so that (when the aberration is a maximum) we see the centre of Jupiter when we are actually looking towards the edge of disc. As the direction of the earth's motion changes throughout the year so the direction of the aberration displacement of the star changes; the star is always displaced towards the "apex of the earth's way," *i.e.,* the point of the sky towards which the earth's motion is directed. The star apparently moves in an ellipse around its true position as centre, making a circuit once a year. For a star at the pole of the ecliptic this ellipse is a circle of radius 20·47″; for other parts of the sky the path may be regarded as a parallel circle which is projected into an ellipse by foreshortening. The major axis of the ellipse is always 20·47″, but the minor axis depends on the latitude (*i.e*, distance from ecliptic) of the star.



Discovery of Aberration.—The discovery of the aberration of light in 1725, due to James Bradley (1693–1762) is one of the most important in the whole domain of astronomy; and in pure physics it has provoked a succession of investigations culminating in the theory of relativity. It was entirely unexpected, and it was only by extraordinary perseverance and perspicuity that Bradley was able to explain it in 1729. The discovery arose in the course of an attempt to discover whether the stars had appreciable parallaxes. We now know that stellar parallaxes are less than a second of arc, and the first authentic parallax was not measured until a century later. Many observers had, however, claimed to have discovered such parallaxes. In 1680 Jean Picard in his *Voyage d'Uranuborg* stated, as the result of ten years' observations, that the Pole Star exhibited variations of position amounting to 40″ annually; some astronomers endeavoured to explain this by parallax, but the motion was at variance with that which parallax would occasion. J. Flamsteed, from measurements in 1689 and succeeding years with his mural quadrant, concluded that the declination of the Pole Star was 40″ less in July than September. R. Hooke in 1674 concluded from his observations that γ Draconis was 23″ more northerly in July than October

When James Bradley and Samuel Molyneux entered this sphere of astronomical research in 1725 there was much uncertainty as to whether genuine stellar parallaxes had been detected or not; and it was with the intention of answering this question definitely that they erected a large telescope in the house of the latter at Kew. They determined to re-investigate γ Draconis, a star selected because it passed almost through the zenith in the latitude of London; its position would therefore not be affected by troublesome and uncertain corrections for refraction. The telescope constructed by George Graham (1675–1751), a celebrated instrument-maker, was affixed to a vertical chimney-stack; the eye-piece could be moved a little laterally so as to measure deviation from the vertical by means of a screw, the vertical being fixed by a plumb-line. The first observations were made on the 3rd, 5th, 11th, 12th Dec, 1725. On the 17th Bradley found the star to be moving southwards, and confirmed this on the 20th. (The change of position by aberration at this time of the year is rapid, and amounts to about 3·2″ in ten days) The star was found to continue its southerly course until March when it was about 20″ south of the December position By the middle of April it was apparent that it was returning north again. In September it reached its northerly limit, the extreme range between March and September being 40″.

Although the observers were seeking an apparent shift of the star, they immediately realized that what they had found could not be attributed to parallax. The maximum range of parallactic shift for γ Draconis should be between June and December. Aberration and parallax are easily distinguished by this three months' difference of phase; the displacement of a star due to aberration is always at right angles to that due to parallax. Bradley and Molyneux discussed several hypotheses in the hope of arriving at an explanation. One hypothesis was that the direction of the earth's axis and therefore of the plumb-line varied, causing an apparent displacement of the star when its position was measured with respect to the plumb-line. Observations were therefore made of another star on the opposite side of the pole; from a comparison of the displacements with those of γ Draconis it was found that they could not be explained by a shift of the earth's axis. The precaution, however, was fruitful; for by long continued observation Bradley ultimately established that shifts due to a change of the earth's axis actually occurred; and he was led to his second famous discovery—*nutation.* Bradley realized that observations of many more stars were required in order to determine the laws governing this mysterious effect. For this purpose he set up a more convenient telescope at the Rectory, Wanstead, the residence of the widow of his uncle, James Pound, who had guided him in his early astronomical work. This telescope, erected in Aug. 1727 had a range of 6½° on each side of the zenith and thus covered a much larger area of the sky than the Kew instrument. Fifty stars were kept under close observation. Bradley disentangled from these observations the conclusion that a star had its extreme declinations at the times of the year when it passed through the zenith at 6 o'clock morning or evening.

The true theory of the phenomenon was discovered by an accident reminding us of the more apochryphal story of Newton and the apple-tree. Sailing on the Thames, Bradley noticed the shifting of the vane on the mast, as the boat altered her course; the shift was not due to unsteadiness of the wind, but to the combining of the changing motion of the boat with the steady velocity of the wind. This suggested that the changing direction of the ray from the star was the result of combining the changing motion of the earth with the steady velocity of the starlight. The finite velocity of light had been discovered by Roemer 60 years earlier.

Astronomical Effects.—In modern astronomy the aberration due to the earth's orbital motion is included along with precession and nutation as part of the "star correction" applied to reduce from Apparent to Mean Place. A small correction for diurnal aberration is also applied, arising from the motion of the observer caused by the diurnal rotation of the earth. For planets and comets a different procedure is adopted. It must be remembered that, even after allowing for the aberration, we see the body not where it is now but where it was when the light left it. Thus the corrected direction F E joins the position of the earth at the instant of observation to the position of the planet some minutes or hours before Using the previous diagram but with a new connotation, let E be the planet when the light left it, and let F be the position of the earth when the light arrives. Whilst the light travels from E to F the earth travels from G to F, so that the *apparent direction* of the planet G E is the actual direction joining the positions of the earth and planet *at the time when the light left the planet.* Accordingly we do not trouble about the hybrid direction F E. We accept G E uncorrected; but we apply a correction to the time of observation, antedating it by the light-time. This simple procedure is inapplicable to the stars whose light-time is many years, because it assumes that the earth's velocity has been constant throughout the interval. But it answers a question often raised—whether we ought not to apply a correction on account of the aberration due to the motion of the whole solar system through space towards a point in Hercules. This motion, being uniform, admits of the above treatment; and the answer is that no correction is required provided that it is understood that the observation relates to the state of things when the light left the star; the aberration rather helpfully "puts back the sun" to the earlier date which must in any case pertain to the star.

Since the velocity of light is known with great accuracy the observed value of the constant of aberration determines the earth's orbital velocity. This can also be calculated when we know the radius of the earth's orbit from observations of the solar parallax. There has long been a rivalry between the constant of aberration and the solar parallax as to which shall provide the more accurate determination; at present the degree of

accuracy seems to be about equal, and the two methods are in satisfactory accord.

Aberration and Aether.—In the explanation of aberration we pictured the light as travelling in a straight line from the star uninfluenced by the motion of the earth carrying the observer. On the wave theory this would not be true if the aether in our neighbourhood were carried along with the earth; for when the light reaches this moving region of the aether its course will be disturbed, the motion of the aether (if the phrase has any literal meaning) being superposed on the ordinary velocity of the light traversing it. According to the modern idea of the atom, introduced by Rutherford in 1911, the electrons and atomic nuclei are so minute that the aether can slip through the void interior of the atom as easily as through the solar system, and there is no longer any reason to anticipate a convection; but in the last century it seemed almost contrary to reason to imagine solid matter pushing its way through the aetherial medium without serious disturbance. Apart from this prejudice, experimental evidence in the last century suggested that the aether in the lower part of our atmosphere was travelling with the earth, and further that moving matter such as a stream of water partially dragged the aether with it. Thus in 1818 Arago pointed out that the refraction by a prism (depending on the ratio of the velocities of light in air and glass) ought to be altered by the motion of the prism through the aether; since no such alteration was observed he concluded that the surrounding aether shared the motion of the prism. Fresnel explained this effect by a "dragging co-efficient," his hypothesis being that the "condensed" aether carrying the light inside the prism did not have the full motion of the prism but was only partially dragged in the same direction This was apparently verified by Fizeau in 1851, who sent light in opposite directions round a circulating stream of water and thus studied its velocity with and against the current. In 1871 Airy performed his water-telescope experiment (originally suggested by Boscovitch) in which he measured the constant of aberration with a telescope that had its tube filled with water. Reasoning crudely, the aberration should have been increased, since the velocity of light in water is less than in air; but the normal value was obtained. Fresnel had already predicted that there would be a compensation when account was taken of the alteration of refraction at the surface of the moving liquid.

In the light of Fresnel's theory, it seemed to emerge from these results that the aether-drag was limited to the interior of the moving bodies, and that its effects were compensated by changes of refraction at the surface of the bodies, except when (as in Fizeau's experiment) differential motions were concerned. Thus the aether just outside the solid earth would be stagnant as the theory of aberration requires. But in 1887 Michelson and Morley made a much more delicate attempt to detect the difference of velocity of the earth and surrounding aether (*see* RELATIVITY); this seemed to decide that the aether was carried with the earth. Thus the conflict between stagnant and convected aether was brought to a head, the former being demanded by astronomical aberration and the latter by the Michelson-Morley experiment and certain later experiments involving similar principles

The astronomical observations prove that the ray as it reaches the telescope is travelling in the same direction as when it started from the star; this, however, does not entirely rule out possible motions of the aether near the earth. It was shown by Sir George Stokes (1845) that the necessary and sufficient condition was that the motion should be of the kind known as "irrotational" in hydrodynamics. This would allow the kind of disturbance which might be anticipated from the earth's pushing its way through a fluid aether, since there is a well-known irrotational solution of the problem of a sphere moving through a liquid; but it does little to help the present difficulty since it involves a sliding of the aether over the surface of the sphere, which is precisely the point denied by the Michelson-Morley experiment. If the aether is allowed to be compressible (the density having, however, no effect on the velocity of light) an irrotational solution can be found which does not involve any slip of the aether at the earth's surface. This was pointed out by Planck, but the condensation required is so extreme, that the loop-hole cannot be considered very seriously. The reconciliation was ultimately effected by the theoretical investigations of Lorentz and Larmor. Their work showed that the electrical structure of matter involves an alteration of length of all material objects in the direction of their velocity through the aether, which would compensate the effect looked for in the Michelson-Morley experiment—confirming a suggestion originally made by FitzGerald. When allowance is made for this contraction, none of the numerous experiments are capable of testing the relative motion of the earth and aether The position about 1900–05 can be summed up as follows:—The earth moves through the stagnant aether without disturbing it, as the original explanation of astronomical aberration demands. The objection that bodies carried on the earth show no effects of this relative motion falls to the ground because it turns out that in all the experiments the effects are precisely compensated. For the further developments originating from these ideas reference should be made to the article RELATIVITY

Astronomical aberration provides no means of determining a uniform motion through the aether; this will be apparent from what we have said as to the aberration from the motion of the solar system through space. But it provides a means of determining differences of velocity, such as the differences in the earth's orbital motion at different times of the year Equally it can test any possible difference of aether-drift at different levels, *e.g.*, at the top and bottom of a mountain Prof D C. Miller's recent attempt to test this by performing the Michelson-Morley experiment at the top of a mountain appears to us to have been misconceived; for even if (contrary to current theory) the experiment can reveal aether-drift, it is by no means comparable in accuracy with the test by astronomical observations, which assure us that the light of the stars is not deflected by any change of the aether current between a mountain observatory and the sea-level. All observable effects of aberration are due to relative velocity or change of velocity On absolute velocity it is silent; and there is reason to believe that all other experiments are silent also—a conclusion which has led to the principle of relativity.

BIBLIOGRAPHY.—For Bradley's work *see* S Rigaud, *Memoirs of Bradley* (1832) or H H. Turner, *Astronomical Discovery* (1904). The practical application in astronomy is treated in all text-books on spherical astronomy For the long controversy regarding stagnant and convected aether *see* J Larmor, *Aether and Matter* (1900) and E. T. Whittaker, *A History of the Theory of Aether and Electricity* (1910). (A. S. E.)

ABERSYCHAN (ăb-ur-zŭch'ăn), an urban district, Monmouthshire, England The population in 1921 was 27,087. It lies in the narrow valley of Afon Lwyd between Pontypool and Blaenavon. Its situation on the iron field accounts for its early development, and when coal-mining became more important than iron smelting, Abersychan's prosperity increased, as the veins in the vicinity of the town produced some of the best steam coal in the country. The rapid growth of population has taxed all available building sites in the narrow valley bottoms and consequently the town has had to expand along the floor of the main valley and those of its small tributaries. Trade depression, unemployment and depopulation (since 1918) have affected Abersychan with the rest of the coal-field. Abersychan has stations on the Great Western Railway and London, Midland and Southern branch lines, connecting it with Newport and Brynmawr respectively. It is in the Pontypool parliamentary division.

ABERTILLERY, urban district, Monmouthshire, England, 16m. N.W. of Newport, on the G W R. Pop. (1891) 10,846; (1921) 38,805. It lies in the mountainous mining district of Monmouthshire and Glamorganshire, in the valley of the Ebbw Fach, and the large industrial population is mainly employed in the numerous coal-mines, iron-works and tinplate works. The upper reaches of the valley were formerly important as iron smelting regions and coal was worked early at Abertillery. This region, like most of South Wales, has suffered badly in the trade depression following the World War.

ABERYSTWYTH (ab-ur-ŭst'with), watering-place and university town on the shores of Cardigan bay, Wales, at the mouth

of the artificially united Rheidol and Ystwyth rivers Population (1921) 11,211, but the census was taken during college session and while many visitors were in the town. There appears to be a long tradition of settlement in the neighbourhood, for on a prominent hill (Pendinas) overlooking the south of the town is one of the largest hill-top earthworks in central Wales. With the clearing of the lowland, Pendinas was superseded by Llanbadarn Fawr, a village situated on a dry bend above the flood plain of the Rheidol about 1½ m. E. of the town. The existence of three Norman motte and bailey castles in the neighbourhood suggests loose military tenure in early Plantagenet times. The most interesting of these sites is Castell Aberystwyth situated above the bend of the Ystwyth about 1½ m. S. of the town. It gave its name to the Edwardian stone castle erected near the fishing village that grew up at the river mouths. The history of the castle was a troublesome one, as was to be expected from its position in the heart of Wales, but future developments centred in the little community that gathered beneath it, and not in Llanbadarn Fawr. Traces of the mediaeval town wall are still to be seen

Aberystwyth shared in the mining (lead), agricultural and sea trade movements of the early 19th century and seems to have become at this time the social centre for the surrounding area. It has since extended northwards and eastwards over the newly drained marshy ground that surrounded the mediaeval settlement, and has gained favour as a summer health resort, especially since the development of the railway. The latter, however, killed the coastal trade and much of the seafaring habit (*see* CARDIGANSHIRE). In spite of this loss of old activities, Aberystwyth did not become a mere watering-place. As a link between the northern and southern parts of Welsh Wales, it became the site of the first University college of Wales, opened in 1872 and incorporated by charter in 1889, and of the National Library of Wales, opened in 1911. In 1906 the Welsh Calvinistic Methodist Theological college was moved here from Trevecca Aberystwyth was a contributory parliamentary borough until 1885, when its representation was merged in that of the county.

ABETTI, ANTONIO (1846–1928), Italian astronomer, was born on June 19, 1846, at Gorizia, Italy He was educated at Pisa. After working in the observatories at Pisa and Padua, Abetti became director of the Arcetri observatory, Florence, in 1894; he remained there until he retired in 1921. He made a special study of the minor planets and wrote a number of papers on this subject. Abetti was a member of the Academie dei Lincei; he died on Feb. 20, 1928.

Abetti wrote *Construction of a Sundial in a Vertical Plane* (1876); *Differences in Longitude between Rome, Padua and Arcetri* (1891), and *Annals of Arcetri Observatory* (1896–1911).

ABETTOR, a law term implying one who is present, actually or constructively, and aids and abets another to commit an offence. An abettor differs from an accessory (*q v.*) in that he must be present at the commission of the crime; all abettors (with certain exceptions) are principals in the second degree, and, in the absence of specific statutory provision to the contrary, are punishable to the same extent as the actual perpetrator of the offence

ABEYANCE, a state of expectancy in respect of property, titles or office, when the right to them is not vested in any ascertained one person, but awaits the appearance or determination of the true owner. In law, the term abeyance can only be applied to such future estates as have not yet vested or possibly may not vest. The freehold of a benefice, on the death of the incumbent, is said to be in abeyance until the next incumbent takes possession. A common use of the term is in the case of peerage dignities. If a peerage which passes to heirs-general, like the ancient baronies by writ, is held by a man whose heir-at-law is neither a male, nor a woman who is an only child, it goes into abeyance on his death between two or more sisters or their heirs, and is held by no one till the abeyance is terminated; if eventually only one person represents the claims of all the sisters, he or she can claim the termination of the abeyance as a matter of right. The Crown can also call the peerage out of abeyance at any moment, on petition, in favour of any one of the sisters or their heirs between whom it is in abeyance. It is common, but incorrect, to speak of peerage dignities which are dormant (*i.e.*, unclaimed) as being in abeyance. (*See* PEERAGE.)

ABGAR, a name borne by a line of Mesopotamian kings, 29 in number, who reigned in Osrhoene and had their capital at Edessa in the last century before and the first century after the birth of Christ. According to an old tradition, one of these princes, perhaps Abgar V. (Ukkāmā or Uchomo, "the black"), being afflicted with leprosy, sent a letter to Jesus, acknowledging his divinity, craving his help and offering him an asylum in his own residence, but Jesus wrote a letter declining to go, promising, however, that after his ascension he would send one of his disciples. Eusebius states that in due course Judas, son of Thaddaeus, was sent (A D 29) The letters are given by Eusebius (*Eccl. Hist* i. 13), who declares that the Syriac document from which he translates them had been preserved in the archives at Edessa from the time of Abgar.

This legend has survived in various forms, and has given rise to much discussion. The correspondence was rejected as apocryphal by Pope Gelasius and a Roman synod (*c.* 495), though, it is true, this view has not been shared universally by the Roman Church. Among Protestants the spuriousness of the letters is almost universally admitted Lipsius (*Die Edessenische Abgarsage*, 1880) has pointed out anachronisms which seem to indicate that the story is quite unhistorical. The first king of Edessa of whom we have any trustworthy information is Abgar VIII. bar Ma'nu (A D. 176–213) It is suggested that the legend arose from a desire to trace the Christianizing of his kingdom to an apostolic source

See Lipsius, *Die Edessenische Abgarsage kritisch untersucht* (1880); Tixeront, *Les Origines de l'église d'Edesse et la légende d'A.* (1888); for the Epistles *see* APOCRYPHAL LITERATURE, sect. "New Testament."

ABGESANG: *see* AUFGESANG

ABHIDHAMMA, the name of one of the three divisions into which the Buddhist scriptures are divided (*see* BUDDHISM) It consists in the Pali Canon of seven works: 1. *Dhammasangani* (enumeration of mental states) 2 *Vibhanga* (analysis). 3. *Kathā-vatthu* (subjects of discussion) 4. *Puggala-paññatti* (on classes of individuals). 5 *Dhātu-kathā* (on mental elements). 6 *Yamaka* (pairs of ethical states). 7 *Paṭṭhāna* (relations of ethical states). These have been published by the Pali Text Society, and the first, third, and fourth have been translated (*see* below) Most of the works consist of the analysis and classification of psychical states from an ethical standpoint, but the *Kathā-vatthu* gives a list of dogmas disputed between the eighteen sects. The Ceylon Chronicles say that it was spoken or promulgated (not composed) by Tissa Moggaliputta at the third council in 247 B C. As Mrs Rhys Davids has shown, it must have been compiled gradually It is probably one of the latest of the works, but none of them are primitive, and some schools, according to Tāranātha, denied that Abhidhamma was the word of Buddha. The oldest name for this literature is *mātikā*, "lists," *i.e* of the questions discussed, and it is mentioned under this name in several parts of the canon, but from this nothing can be inferred as to the age of the extant works. The Sarvāstivāda school had a similar set of seven works, which exist now only in a Chinese version They have been analysed by Prof. Takakusu in the article mentioned below. The subject was first examined by Burnouf, who relied on the Mahāyāna canon as found in Tibetan, in which Abhidharma (Pāli, Abhidhamma) is represented by the *Prajñāpāramitā* and such works. These teach a doctrine of negativism, or as Prof. Stcherbatsky terms it, relativity, and hence Abhidharma was translated "metaphysics." But this is quite absent from the earlier schools, in which the term means "higher dharma."

See *Buddhist Psychology*, translation of *Dhamma-sangani*, and *Points of Controversy*, translation of *Kathā-vatthu*, by Mrs. Rhys Davids (1900 and 1915), E. Burnouf, *Introduction à l'histoire du bouddhisme indien* (1845); Tāranātha, *Geschichte des Buddhismus*, translated by A. Schiefner, St. Petersburg, 1869; "On the Abhidhamma books of the Sarvāstivādins," by Prof. Takakusu, in *Journal of the Pāli Text Society*, 1905; *Designation of human types*, translation of *Puggala-paññatti*, by B C. Law (1924). (E. J. T.)

ABHORRERS, the name given in 1679 to the persons who expressed their "abhorrence" at the action of those who had signed petitions urging King Charles II. to assemble parliament. To prevent the Exclusion Bill directed against James, the Roman Catholic Duke of York, from passing into law, Charles had dissolved parliament in July 1679, and in the following October had prorogued its successor without allowing it to meet. He was then deluged with petitions urging him to call it together; but Sir George Jeffreys (*q v*) and Francis Wythens presented addresses expressing "abhorrence" of the "Petitioners." Similar addresses reached the King from all parts of the country, and formed a counterblast to those of the Petitioners. *See* WHIG and TORY.

ABIATHAR, in the Old Testament, son of Ahimelech, priest of Nob. He alone escaped from the massacre carried out by Doeg Fleeing to David, he remained with him throughout his wanderings and his reign He was loyal through the rebellion of Absalom, but supported Adonijah against Solomon, and was banished to Anathoth He probably represents an early rival house to that of Zadok, the official priestly family of Jerusalem down to the exile. (*See* especially I Sam xxii. *seq*, II Sam xv. xx, I Ki. i ii iv)

ABICH, OTTO WILHELM HERMANN VON (1806–1886), German mineralogist, geologist and traveller, was born in Berlin on Dec. 11, 1806, and died in Vienna on July 1, 1886 His earliest scientific work related to spinels and other minerals, and later he made special studies of fumaroles, of the mineral deposits around volcanic vents and of the structure of volcanoes. The mineral Abichite was named after him.

His works include. *Vues illustratives de quelques phénomènes géologiques, prises sur le Vésuve et l'Etna, pendant les années 1833 et 1834* (Berlin, 1836), *Ueber die Natur und den Zusammenhang der vulcanischen Bildungen* (Brunswick, 1841); *Geologische Forschungen in den Kaukasischen Landern* (1878, 1882 and 1887).

ABIGAIL, one of David's earlier wives, formerly the wife of Nabal of Carmel in southern Judah For the story of her relations with David, *see* I Sam xxv. The use of the word in 16th and 17th century English is due to the fact that in I Sam xxv. 25 Abigail calls herself a "handmaid"

ABIJAH, a name borne by nine different persons mentioned in the Old Testament, of whom the most noteworthy are (1) the son and successor of Rehoboam, king of Judah (*c* 918–915 B C). The accounts of him in the books of Kings and Chronicles are very conflicting (*cf.* I Kings xv 2 and II Chron xi. 20 with II Chron xiii 2); (2) the second son of Samuel. He and his brother Joel judged at Beersheba, and their misconduct was made a pretext for demanding a king (I Sam viii 4).

ABILA, (1) generally called Abila of Pausanias to distinguish it from (2) below It was the capital of the tetrarchy of Abilene in ancient Syria and an important town on the road between Damascus and Baalbek (Heliopolis) Ruins and inscriptions at modern village of Sūq Wādī Baradā mark its site which, though the names have no connection, is one of the traditional burial places of Abel. Early Arab geographers called it Ābil Al Sūq According to Josephus, Abilene was a separate Iturean kingdom till A D. 37, when Caligula granted it to Agrippa I, in 52 Claudius granted it to Agrippa II (*See* also LYSANIAS) (2) A city of Perea (modern North Trans-Jordan) represented by ruins of Ābil Al Zait.

ABILDGAARD, NIKOLAJ ABRAHAM (1744–1809), Danish painter, was born at Copenhagen. He was known as the "Father of Danish Painting," had a great reputation in his own country, and was the master of Thorwaldsen and Eckersberg.

ABILENE, a city of Kansas, U S A., on the Smoky Hill river, about 95m. W. of Topeka; the county seat of Dickinson county It is on Federal highway 40S, and is served by the Union Pacific, the Rock Island and the Santa Fé railways. The population was 3,507 in 1900, and 5,116 in 1925 (State census). In the '60s Abilene, at the end of the trail from the south-west, was one of the important centres for shipping cattle. It has a large trade in cattle, grain and poultry, and is headquarters of the public utility companies serving central and western Kansas. Its creamery has an annual output valued at $2,000,000. Flour-mills and bottling works for medicinal mineral water are also important. It is a pleasant residential city, with well-designed public buildings Abilene was settled about 1860; incorporated in 1869; and adopted the commission form of government in 1911.

ABILENE, a city of Texas, U.S A, about 150m. W. by S. of Fort Worth, at an altitude of 1,800ft, almost at the geographical centre of the State; the county seat of Taylor county. It is on the Bankhead highway, and is served by the Texas and Pacific, the Abilene and Southern and the Wichita Valley railways, and by seven motor-stage lines. Between 1900 and 1920 the population increased threefold, from 3,411 to 10,274; in 1927 it was estimated locally at 30,000.

Abilene is the distributing centre for a fine farming and stock-raising district Around it are many producing petroleum pools. It has 75 jobbing houses, and is headquarters for a score of oil companies. Natural gas is abundant Cotton-seed and peanut products, poultry and stock feeds, poultry remedies, pressed brick and artificial limbs are manufactured There are railway shops and two creameries The assessed valuation of property in 1926 was $20,505,865. The West Texas State fair is held here. Abilene is the seat of the West Texas Baptist hospital, which conducts a training-school for nurses, and of a State colony for epileptics The city has a commission form of government. Its site was determined by the route of the Texas and Pacific railway. When it was extended through this region new towns sprang up as sections were completed, and at mile-post 407, on March 16, 1881, the first sale of building lots was held for the city of Abilene.

ABILITIES, GENERAL AND SPECIAL. The now common term "general ability" in its current signification is of recent origin Previously it appears to have had only occasional usage in ordinary writing and conversation, being there taken to characterize excellence in performances of several different kinds, especially when these were not all readily subsumable under the name of "intelligence" As for the professedly psychological treatises, they took little notice of individual differences of ability at all, and when they referred to such they commonly did so in terms of the orthodox faculties, such as acuteness of sense, profundity of intellect, tenaciousness of memory, liveliness of imagination, and so forth

But in the year 1904 the observation was made by C Spearman that the correlations between different abilities tended to bear a special and regular relation to each other They showed such comparative magnitudes that, when set out in the usual square table, they could be arranged in a "hierarchical" manner, so that the values proportionately diminished from left to right and from top to bottom And from this hierarchy mathematical reasoning led to the theorem that the measure of any individual in any ability could be divided into two factors, the one was common to all the abilities concerned, whereas the other was specific to that ability alone. These two factors, "general ability" and "specific ability," were designated by the letters *g* and *s* Further, the important corollary was drawn that, by averaging together many dissimilar mental performances, the influence of the *s*'s involved would—since they were mutually independent—tend to cancel out; in the long run the influence of *g*, being constant, would become paramount, or, in other words, the average would become an accurate measure of the pure "general ability" itself

A year later, such a hotchpot of diversified mental performances was actually tried out, viz, by A. Binet, his purpose being to compare the mental powers of exceptionally dull children with those of normal ones. But he avoided using the theory by which such a hotchpot had been suggested; for this theory was incompatible with the doctrine of "faculties" which up to that time had been advocated by him and almost everybody else. Instead, he said that he was measuring what he called the child's "level of intelligence." This he expressed in terms of age If a dull child of *x* years could pass the test-performances about as well on the whole as a normal child of *y* years, this *y* was taken to represent the "mental age" of the dull child; *x* minus *y* was called his "retardation"

The success of these tests of "intelligence"—constructed, as they were, with extreme ingenuity—proved to be quick and great. School teachers took them up not only for the dull chil-

dren but for all others, however bright. Each child had his "mental age" determined. So used and interpreted these tests found widespread favour. Other sets of tests were devised, and these proved to be no less successful, although possessing little, if anything, in common with the original set, except that they were miscellaneous.

The next landmark in the movement was a surprising exploit. Several different tests of "intelligence" were applied to the American army, that is to say, nearly two million men. The results were declared to be highly satisfactory by the secretary of State for war, himself. Even this application of the tests, unsurpassable in size as a single event, was soon overtopped by their cumulative further employment elsewhere. Putting together all the individuals tested in various countries—school children, university students, industrial employees, and others—the sum total could hardly have been less than some twenty millions. Still the results were usually reported to be very successful. Teachers and other persons using them declared that they derived valuable information from so doing.

Criticism.—Nevertheless, all was not quite so harmonious as it seemed. From the very beginning there had been an opposition party, and this continually waxed in strength. Many of the objections raised, indeed, were of but little importance. But one of them became increasingly obvious and menacing. It was that the testers did not really know what they were testing, nor even whether they were all testing one and the same thing. They were calling it "intelligence," but their usage of this term was highly equivocal. Few had troubled themselves to define what they meant, and those doing so had disclosed the most discrepant views. Equally discrepant, too, had been the test-making in actual practice. Consider, for instance—the objectors urged—that large part of mental activity which is commonly entitled memory. Some of the test-makers had brought this within the pale of what they were naming intelligence, whereas others had as carefully kept it all outside. Even the same psychologist would on one occasion construct his set of tests so as to involve much memory and even formal memorization, but on another occasion would reject any such thing. As for Binet himself, he began by declaring memory to be not intelligence but only a mimicry of this, and yet he straightway proceeded to make his tests depend on memory in a very high degree. Just as unfortunate had been the state of affairs with respect to the faculty of imagination, for this also was included by some testers within the purview of intelligence as conceived by them, whereas by others it was explicitly excluded. But the climax was reached when several declared that under intelligence must be comprehended even "sensation." Thus Binet himself wrote, "A sensation, a perception, are intellectual manifestations as much as reasoning is." Whereas other testers declared that if ever, from Plato onwards, there has been any one characteristic to form the very core—the *raison d'être*—of the concept of intelligence, it has been that of being something to be distinguished from and opposed to mere sensation. Small wonder, then, if the critics proceeded to assert, as J. Wallin did, that these widely-employed sets of tests of the so-called intelligence really "measure qualities which are so different as to be practically incommensurable."

There was a further and even graver objection raised against these measurements of intelligence or general ability, or whatever we like to call it. It demands evidence that any such mental power is susceptible of measurement at all. It points out that Binet had written as follows: "The mental faculties of each subject are independent and unequal; with a little memory there may be associated much judgment. . . . Our mental tests, always special in their scope, are each appropriate to the analysis of a single faculty." If thus, it is urged, the faculties are not one but many, how can one single measure possibly suffice? On such grounds, G. Whipple and S. Colvin had protested that a high total score in any such set of tests "fails to get anywhere in our real enquiry as to just which ones of the various mental functions are possessed by the extraordinarily-heightened efficiency. Is it memory span, or capacity for concentrated attention, or ability to handle symbols, or apprehension of abstract relations, or acute perceptive capacity, or lively imagination, or originality, or breadth of associative tendencies, or speed of learning, or what, that demarcates such a child from other children?"

The inference from all this might seem to be that each of these faculties or functions ought to be measured separately. But thereupon just the same objections are raised over again, only on a smaller scale. For how, it is asked, can anyone measure memory in general when the individual may be excellently endowed with it for some classes of objects but very badly for others? As much may be said for all the rest of the faculties, "judgment," "imagination," "attention," etc. There would appear to be no rallying place along this line until we reach the last elements of knowledge and agree with the Herbartians that every idea has its own imagination, its own memory, its own judgment, and so forth. In like strain Thorndike wrote that "the mind is a host of highly-particularized and independent faculties."

Since the preceding objections seem to necessitate renouncing all claim that the tests measure general ability in the sense of anything that functions in a unitary manner, the natural step has been to take them as measuring some "average" or "sample" of many independent abilities. But here a crop of new difficulties has arisen. For it is objected that the operation of averaging, widespread and indispensable as it is both in psychology and elsewhere, still only becomes feasible when certain fundamental conditions are fulfilled. Certainly, any number of tests can be averaged. But can a person's abilities be so? One of the conditions evidently is that the domain should be settled within which the averaging is intended to run. No genuine averaging of a person's abilities can be effected until there has first been some agreement as to whether memory, imagination, sensation, motor skill, etc., are to be counted in or not. No such agreement, as we have seen, appears to have been reached, or even to be possible. Another needful condition in order to obtain any genuine average is to settle on some definite unit. In the case of abilities no such unit would seem to be ever discoverable. A further condition is that every unit should be given an equal weight, none being omitted and none counted more than once. This also cannot ever be satisfied by any set of tests, it would seem; by no method can they be so constructed that all the existing elements of ability are introduced and equally weighted. So much for averaging. If we turn to sampling, all the same difficulties recur, and indeed with some new ones added. For here again there is need of definite limits and definite units that are nowhere realizable. Again, there is the apparently hopeless task of giving to every unit an equal weight, in the sense that the sampling should be so carried out as to afford every possible cognitive element an equal chance of being introduced into the tests.

Such, then, are the formidable difficulties against which the vogue of testing general ability has run its head. By these—in spite of its vast dimensions and its claims of actual success—it has been compelled to pause and look around for some more secure foundation.

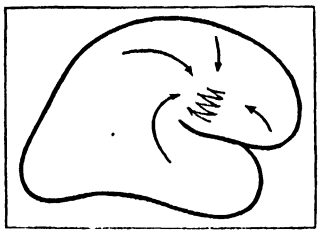
Re-interpretation.—All the time, however, that these obstacles were becoming more and more stubbornly resistant to the efforts at relying solely on practical success in testing, other investigators more theoretically inclined were busily discovering means whereby such obstacles could be safely surmounted. Indeed, the key to the solution had been supplied from the very beginning, namely, in taking general ability to be represented, not by any such psychological concept as "intelligence," but instead by the statistical concept of *g*. That the latter is measurable was definitely demonstrated. Since it recurs throughout all the cognitive powers of each individual, the general ability was unequivocally designated as that—whatever it might be—which was measured by this individual constant.

But to put this standpoint upon a secure foundation, much further research was indispensable. One branch of progress was purely mathematical. The criterion of the divisibility into the two factors *g* and *s* had to be established more rigorously than was done at first. What was much more difficult, means had to be devised for counteracting the disturbances of this criterion by the so-called errors of sampling. The other great branch of ad-

vance besides the mathematical one was by way of broadening the scope of observation. Originally, the relevant work had been limited to a single experimenter dealing with little over a hundred individuals, all of whom were young boys. But already in 1912 the range had been extended to 14 experimenters treating 1,463 boys and girls, men and women, sane and insane. At the present day this number of experimenters has certainly been quadrupled, whilst the number of individuals has been further multiplied at least twentyfold. All this progress, it must be added, has not been done without extensive and at times very acute controversy. This, however, has now mostly died down. The foregoing view is almost everywhere at any rate adopted in substance, if not always explicitly acknowledged.

So far we have only been considering the *main* theory, where the *g* is not credited with being anything more than a measured value which constantly recurs and therefore must have some constant basis in fact. By adopting this statistical standpoint, however, the psychological analysis is by no means rendered unnecessary; it is only, for convenience, postponed. Instead of having to be made prematurely in order to supply a definition to work with, it is accomplished gradually and provisionally in accordance with all such facts as may from time to time be elicited The various psychological interpretations suggested for *g* constitute so many sub-theories of this. In respect of these, controversy not only still remains keen but probably will never be completely silenced. A fate may be expected for it analogous to that of the enquiry into the nature of electricity; for more than a century the latter has been susceptible of accurate measurement, and yet to this day expert opinion as to its real nature is always changing and developing.

At the present moment, the interpretation of *g* which has been found to account best for all the known facts is to conceive it as measuring some general psychic or psycho-physical "energy" responsible for all the activities of which the mind is capable. The *s*'s on this view become the various "engines" into any of which the energy may alternatively be directed, much as a current of electricity received from a single power station may at one moment be directed to the turning of a wheel, at another to the raising of a lift, and then, say, to the heating of a furnace. This interpretation can be symbolized in the following diagram. The whole area represents the cerebral cortex; the shaded patch is any special group of neurons; and the arrowheads stand for the lines of force from the entire cortex



FROM SPEARMAN, "NATURE OF INTELLIGENCE AND THE PRINCIPLES OF COGNITION," BY COURTESY OF MACMILLAN & CO LTD

Among the most important of the engines has been found to be what is commonly called "mechanical aptitude," and what on psychological analysis is shown to consist of the power to educe spatial relations and correlates. Another engine (or system of engines) of cardinal importance is that which specifically subserves linguistic ability. Further vital engines are those connected with the several sensory and motor abilities. Of the many facts discovered concerning all these engines, perhaps the most interesting and significant is that they alone appear to be susceptible of improvement by practice; they alone, then, supply the material upon which education can work effectively. The amount of a person's "energy" would seem to be, under normal conditions, irrevocably fixed

Still more important developments claimed for the theory of general and specific abilities have yet to be mentioned. For up to now we have only considered these in and by themselves. Whereas their investigation has led on to discovering some very important further mental characteristics. In addition to the *g* which measures the quantity of the energy of the mind, there has also been determined a value *p* which measures the degree of the "inertia" of this energy, and, furthermore, an *o* which measures the degree that the supply of the energy tends to oscillate. These three measures conjointly are said to furnish the chief features distinguishing the abilities of one individual from those of another.

The evolution of the theory has gone further still, carrying it far beyond that whole sphere of psychology which appertains to individual differences. For during the time that the facts belonging to this sphere have been investigated with the success described, those belonging to "general" psychology have been treated from a fundamentally novel standpoint, that of the doctrine of "neogenesis." The unexpected result has been that these two spheres, hitherto kept by psychology in disastrous divorce from one another, would now seem to fit as hand and glove

Finally, both these spheres of cognition—that of individual differences and that of general psychology—have in the continued development of the theory of *g* and *s* become organically united with that other great domain of the mind which is not cognitive but conative; it does not deal with knowing, but with desiring and striving To the *g* and the *s*'s of the energy and the engines there has been added a *w* which brings all these into action, playing thus the part of the "engineer"

BIBLIOGRAPHY —For a general account of the whole topic, see *The Abilities of Man* (1927), by C Spearman, in which will also be found a comprehensive bibliography; also the work of A Binet, *Année Psychologique* (1905); whilst the most notable contribution on the mathematical side has been that of Maxwell Garnett, *Brit. Journ. Psych.* (1920). Among other works which on no account should be overlooked are those of P. Ballard on the age at which *g* reaches its full growth, *Brit. Journ Psych.* (1921); C Burt on the development of reasoning power, *Journ. Educ. Psych.* (1923); W. Stern in his *Differential Psychology* (1911); L Thorndike on *The Measurement of Intelligence* (1927); and of Webb on "Character and Intelligence," *Brit. Journ. Psych.*, Monthly Supplement (1915). (C S)

ABIMELECH, the name of two well-known characters in the Old Testament. (1) A king of Gerar in South Palestine with whom Isaac had relations. The patriarch, during his sojourn there, alleged that his wife Rebekah was his sister, but the king doubting this remonstrated with him and pointed out how easily adultery might have been unintentionally committed (Gen. xxvi). Abimelech is called "king of the Philistines," but the title is clearly an anachronism. A very similar story is told of Abraham and Sarah (ch. xx), but here Abimelech takes Sarah to wife, although he is warned by a divine vision before the crime is actually committed. The incident is fuller and shows a great advance in ideas of morality. Further incidents in Isaac's life at Gerar are narrated in Gen. xxvi. (*cf.* xxi. 22–34, time of Abraham), notably a covenant with Abimelech at Beer-sheba (whence the name is explained "well of the oath").

(2) A son of Jerubbaal or Gideon (*q v*), by his Shechemite concubine (Judges viii. 31, ix). On the death of Gideon, Abimelech set himself to assert the authority which his father had earned, and through the influence of his mother's clan won over the citizens of Shechem. Furnished with money from the treasury of the temple of Baal-berith, he hired a band of followers and slew 70 (*cf.* 2 Kings x. 7) of his brethren at Ophrah, his father's home. Abimelech thus became king, and extended his authority over central Palestine. But his success was short-lived, and the subsequent discord between Abimelech and the Shechemites was regarded as a just reward for his atrocious massacre.

ABINGDON, municipal borough, Berkshire, lying in the flat Thames valley on the Oxford border, where the small river Ock, draining the Vale of White Horse, joins the Thames. Pop. (1921) 7,165. Abingdon (Abbedun, Abendun) was famous for its abbey, which was of great wealth and importance, and is believed to have been founded in A.D. 675 by Cissa, one of the *subreguli* of Centwin. Abundant charters from early Saxon monarchs are extant confirming various laws and privileges to the abbey, and the earliest of these, from King Ceadwalla, was granted before A.D. 688. In the reign of Alfred the abbey was destroyed by the Danes, but it was restored by Edred, and an imposing list of possessions in the Domesday survey evidences recovered prosperity. William the Conqueror in 1084 celebrated Easter at Abingdon, and left his son, afterwards Henry I., to be educated at the abbey. After the dissolution in 1538 the town sank into decay, and in 1555, on a representation of its pitiable condition, Queen Mary granted a charter establishing it as a free borough corporate with a common council. The council was

empowered to elect one burgess to parliament, and this right continued until the Redistribution of Seats Act of 1885. The abbot seems to have held a market from very early times, and charters for the holding of markets and fairs were granted by various sovereigns from Edward I. to George II. In the 13th and 14th centuries Abingdon was a flourishing agricultural centre with an extensive trade in wool, and a famous weaving and clothing manufacture The latter industry declined before the reign of Queen Mary, but has since been revived.

Remains of the Benedictine Abbey include a beautiful Perpendicular gateway, ruins of buildings called the prior's house, and the guest house. The narrow arched bridge over the Thames dates from 1416, and was doubtless an important feature in the town's growth. Near the bridge is St. Helen's church, the fine Early English tower and Perpendicular spire of which are the principal objects in the views of the town from the river. There may be mentioned further the old buildings of the grammar school, founded in 1563, and of the charity called Christ's Hospital (1583); while the town hall in the market-place is attributed to Inigo Jones.

Abingdon has manufactures of clothing and carpets and a large agricultural trade. The borough is under a mayor, four aldermen and 12 councillors Area, 730 acres. For purposes of parliamentary representation it is included in the Abingdon county division.

ABINGER, JAMES SCARLETT, 1st Baron (1769–1844), English judge, was born on Dec 13, 1769 in Jamaica, where his father, Robert Scarlett, had property He was educated at Trinity college, Cambridge, and the Inner Temple From 1816 when he became a K C, to 1834 he was the most successful lawyer at the bar. He entered parliament in 1819 as member for Peterborough and was attorney-general under Canning in 1827; and though he resigned when the Duke of Wellington came into power in 1828, he resumed office in 1829 and went out with the Duke of Wellington in 1830. His opposition to the Reform bill caused his severance from the Whig leaders. He was appointed lord chief baron of the exchequer in 1834, and presided in that court for nine years He died at Bury St Edmunds on April 7, 1844. The qualities which brought him success at the bar were not equally in place on the bench; he was partial, dictatorial and vain; and complaint was made of his domineering attitude towards juries

See P. C. Scarlett *Memoir of James, 1st Lord Abinger* (1877); Foss, *Lives of the Judges*, E. Manson, *Builders of our Law* (1904).

ABINGTON, FRANCES (1737–1815), English actress, was the daughter of a private soldier named Barton, and was, at first, a flower girl and a street singer. She appeared at the Haymarket in 1755 as Miranda in Mrs Centlivre's *Busybody* In 1756, on the recommendation of Samuel Foote, she joined the Drury Lane company In 1759, after an unhappy marriage with her music-master, one of the royal trumpeters, she is mentioned in the bills as Mrs Abington.

Her first remarkable success was in Ireland as Lady Townley, and it was only after five years, on the pressing invitation of Garrick, that she returned to Drury Lane. There she remained for 18 years, and created more than 30 important characters, notably Lady Teazle (1777). Her Beatrice, Portia, Desdemona and Ophelia were no less liked than her Miss Hoyden, Biddy Tipkin, Lucy Lockit and Miss Prue It was in the last character in *Love for Love* that Reynolds painted his best portrait of her.

In 1782 she left Drury Lane for Covent Garden, where she played until 1790. She reappeared on the stage for two years (1797–99), and then retired. Her ambition, wit and cleverness, won for her a position in society. She died March 4, 1815.

ABINGTON, a town of Plymouth county, Mass, U.S.A., 19m. S. by E. of Boston. It is served by the New York, New Haven and Hartford railroad, and by trolley and bus lines. The population was 5,882 in 1925 (State census). Farming, fruit growing (especially strawberries), and dairying are carried on. The principal manufactures are boots and shoes, lasts, cement blocks, window-shades and machinery. The town was settled about 1680 and incorporated in 1712.

ABIOGENESIS, in biology, the term, equivalent to the older terms "spontaneous generation," *Generatio aequivoca, Generatio primaria,* and more recent terms such as archegenesis and archebiosis, for the theory according to which fully formed living organisms sometimes arise from non-living matter. Aristotle explicitly taught abiogenesis, and laid it down as an observed fact that some animals spring from putrid matter, that plant-lice arise from the dew falling on plants, etc, and most of the earlier biologists accepted his views. The first step in the scientific refutation of the theory of abiogenesis was taken by the Italian Redi, who, in 1668, proved that no maggots were "bred" in meat on which flies were prevented by wire screens from laying their eggs. From the 17th century onwards it was gradually shown that, at least in the case of all the higher and readily visible organisms, abiogenesis did not occur, but that *omne vivum e vivo,* every living thing came from a pre-existing living thing.

The discovery of the microscope carried the refutation further. In 1683 A. van Leeuwenhoek discovered bacteria, and it was soon found that however carefully organic matter might be protected by screens, or by being placed in stoppered receptacles, putrefaction set in, and was invariably accompanied by the appearance of myriads of bacteria and other low organisms. As knowledge of microscopic forms of life increased, so the apparent possibilities of abiogenesis increased, and it became a tempting hypothesis that whilst the higher forms of life arose only by generation from their kind, there was a perpetual abiogenetic fount by which the first steps in the evolution of living organisms continued to arise, under suitable conditions, from inorganic matter. It was due chiefly to L. Pasteur that the occurrence of abiogenesis in the microscopic world was disproved. If organic matter were first sterilized and then prevented from contamination from without, putrefaction did not occur, and the matter remained free from microbes The nature of sterilization, and the difficulties in securing it, as well as the extreme delicacy of the manipulations necessary, made it possible for a very long time to be doubtful as to the application of the phrase *omne vivum e vivo* to the microscopic world, and there still remain a few belated supporters of abiogenesis It may now be stated definitely that all known living organisms arise only from pre-existing living organisms. It must be noted, however, that this statement relates only to known existing organisms It may be that in the progress of science it may yet become possible to construct living protoplasm from non-living material The refutation of abiogenesis has no further bearing on this possibility than to make it probable that if protoplasm ultimately be formed in the laboratory, it will be by a series of stages, the earlier steps being the formation of some substance, or substances, now unknown, which are not protoplasm Such intermediate stages may have existed in the past, and the modern refutation of abiogenesis has no application to the possibility of these having been formed from inorganic matters at some past time. Perhaps the words archebiosis, or archegenesis, should be reserved for the theory that protoplasm in the remote past has developed from non-living matter by a series of steps, and many of those, notably T. H. Huxley, who took a large share in the process of refuting contemporary abiogenesis, have stated their belief in a primordial archebiosis. (*See* Biogenesis and Life.)

ABIPONES, a tribe of South American Indians belonging to the Guaycuruan (*q.v*) linguistic stock. The Abipones were a warlike, nomad hunting people, living in the Argentine Chaco, between the Vermejo and Salado rivers. Although once numerous, they are now believed to be quite extinct. Both men and women wore mantles of coarse textiles, belted at the waist; the women were abundantly tattooed, the men but slightly. The latter wore long, pendant labrets. Their dwellings were tents of mats. Spears, bows, clubs, slings and bolas were their weapons. They had no shield, but used a poncho of heavy hide for protection. They made no use of canoes, having only "bull-boats" of hide stretched over a bowl-shaped frame, for crossing broad streams. Pottery was made. The people were divided into local social units, over which a semi-hereditary chief presided, although he had little power. The bodies of the dead were buried, unless death occurred far from home, when the flesh was stripped from the bones, and

these placed in a leather sack. This was carried with the roving group, until they reached their home, where it was buried The property and tent of the deceased were burned. Little is known of their religious beliefs and ceremonial. They possessed, however, some sort of secret societies, membership in which was attained by valour, and which celebrated ceremonials of importance.

The Abipones became widely known from the account of them written by the missionary Dobrizhoffer, at the end of the 18th century, after they had become horse Indians

See M. Dobrizhoffer, *An Account of the Abipones*, etc. (1822).

ABITIBBI, lake and river, Ontario, Canada The lake, 49° N 80° W., 60m. long, is shallow and studded with islands; the shores are covered with small timber. The Hudson's Bay Co used it on a canoe route to the northern fur lands The Grand Trunk Pacific (now the Canadian National) Railway passes through this district. Its outlet is the rapid Abitibbi river, which after 200m joins the Moose river

ABJURATION, a solemn repudiation or renunciation on oath At common law, it signified the oath of a person who had taken sanctuary to leave the realm for ever; this was abolished in the reign of James I. The *Oath of Abjuration,* in English history, was a solemn disclaimer, taken by members of parliament, clergy and laymen against the right of the Stuarts to the Crown, imposed by laws of William III , George I. and George III ; but its place has since been taken by the Oath of Allegiance

ABKHASIA, a Socialist Soviet Republic under the protection of the Georgian S S R. (*q v*), comprising six districts of the former Sukhum province Area 8,172sq km. Pop. (1926) 199,175; urban 30,617, rural 168,558. Its boundaries are, on the north, the north Caucasian area and Karachaev autonomous area, on the south and east, the Georgian S S R , on the west, the Black sea. It is divided into the following districts for administrative purposes, 1926 population given in parentheses. Gagrinsk (9,950; urban 3,659, rural 6,291), Galsk (50,071; entirely rural), Gydaytsk (30,740; urban 3,536, rural 27,204), Kodorsk (33,043; urban 3,390, rural 29,653) and Sukhum (75,371; urban 20,032, rural 55,339) The area is mainly mountainous and densely forested (especially oak and walnut). The Black sea coastal belt from Sukhum-Kaleh southwards is an evergreen vegetation area, with citrus fruits (oranges, mandarins, lemons), camellias and even palms It has hot, sunny summers and winter rains of the western coast Mediterranean type, but in winter low pressure systems form on the Black sea, with south and south-east winds bringing rain Average temperature at Sukhum-Kaleh is in January 48°·8 F., August 76°·1 F. Oranges ripen in December and spring begins in February. The area is never frozen, and snow rarely falls and never lies; malaria is a perpetual scourge The chief products are tobacco and maize, with wheat, grapes, figs, pomegranates, citrus fruits and wine (vines hang from walnut trees) Tea and mulberries (for silk) are produced On higher land, cattle and horses are bred and bees kept The chief town is Sukhum-Kaleh on the Black sea coast (site of ancient Greek Dioskurias). Pop (1926) 17,426 The town is noted for manufacture of saddlery Other coastal towns are Pitsunda and Ochemchiri A coastal railway is being constructed. There are extensive coal deposits, practically unworked at present

Abkhasia became Christian under Justinian (*c* 550), later Mohammedan (after its conquest by the Turks in the 15th century) and definitely Russian after 1864 It includes part of the former Mingrelia, the Colchis of antiquity The people are of Circassian stock, related to Cherkesses and Kabardians, and speaking, like them, a distinct non-Aryan dialect; there are apparently both tall and fair groups, and short, dark groups, with Tatar intermixture. In the Kodor district small groups of negroes have settled and intermarried.

ABLATION, the process of removing anything; a term used technically in geology of the wearing away of a rock or glacier by weathering agents, and in surgery for operative removal

ABLATIVE, in grammar, a case of the noun, the fundamental sense of which is direction from; in Latin extended to the instrument or agent of an act, and the place or time at, and manner in, which a thing is done; also found in Sanskrit, Zend, Oscan, Umbrian and other languages (Lat. *ablativus,* sc. *casus,* from *ablatum,* taken away) The "ablative absolute," in Latin, consists of a noun in the ablative case, with a participle or qualifying word agreeing with it, not depending on any other part of the sentence, to express the time, occasion or circumstance of a fact.

ABLUTION, a ritual washing destined to secure that ceremonial purity which must not be confused with the physical cleanliness obtained by the use of soap and water. (Lat. *ablutio,* from *abluere,* "to wash off.") Indeed the two states may conflict, as with the 4th century pilgrim who boasted that she had not washed her face for 18 years for fear of removing the baptismal chrism In the Catholic Church the *ablution* is the ritual washing of the chalice and of the priest's fingers after celebrating mass; or the wine and water used for this purpose. The purport of ablutions is to remove the supposed stains contracted by contact with the dead, with childbirth, menstruous women, murder, almost any form of bloodshed, persons of inferior caste, dead animal refuse, leprosy, madness and disease. In general, water, cows' urine and blood of swine are the materials used in ablutions Of these water is the commonest, and its efficacy is enhanced if it be running, and still more if a magical or sacramental virtue has been imparted to it by ritual blessing or consecration. In the *Atharva-Veda,* vii. 116, a remedy for fever is to tie to the foot of the bed a frog, bound with red and black thread, and wash down the patient so that the water of ablution falls on the frog, the magician praying that the fever may pass into the frog, which is forthwith released In the old Athenian Anthesteria the blood of victims was poured over the unclean. A bath of bulls' blood was used as a baptism in the mysteries of Attis The water must in ritual washings run off in order to carry away the miasma or unseen demon of disease; so the early Christians used living or running water, which the baptizer must pour over the head of the baptized person so that it runs down his body Similarly the Brahman takes care to wipe the cathartic water off from head to feet downwards, that the malign influence may pass out through the feet The same care is shown in ritual ablutions in the Bukovina and elsewhere

Water, fire, spices and sulphur are used in ritual cleansings (Iamblichus on Mysteries, v. 23), as being specially full of the divine nature But in all religions the cathartic virtue of water is enhanced by means of suitable prayers and incantations Ablutions are usually cathartic, that is, intended to purge away evil influences (*καθαίρειν,* to make *καθαρός,* pure) But things and persons may become taboo, that is, so holy as to be dangerous and useless for daily life, through the mere infection of holiness Thus in Syria one who touched a dove became taboo for one whole day, and if a drop of blood of the Hebrew sin-offering fell on a garment it had to be ritually washed off It was as necessary for the Hebrew priest to wash his hands *after* handling the sacred volume as before Christians might not enter a church to pray without first washing their hands Tertullian (*c.* 200) condemned this as a heathen custom; but it was insisted on in later ages (Sozomen, vi 6) and is a survival of the pagan lustrations or *περιρραντήρια.* The same custom prevails among Mohammedans. Porphyry (*de Abst.* ii. 44) relates that one who touched a sacrifice meant to avert divine anger must bathe and wash his clothes in running water before returning to his city and home, and similar scruples in regard to holy objects and persons have been observed among the natives of Polynesia, New Zealand and ancient Egypt

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ABNAKI, a group of closely related and confederate Algonkin Indian tribes originally centring in Maine, now mainly in Quebec and New Brunswick. The name means "east land" They included the Etchimin, Malecite, Passamaquoddy and Penobscot, often reckoned as distinct tribes. They fought the English colo-

nists, were friendly with the French, and in the 18th century most of the bands withdrew to French Canadian soil. They grew maize, hunted and fished, lived in conical houses of bark or mats, palisaded their villages, were divided into patrilineal totemic clans, and were typical northern woodland tribes. Their speech is close to the Algonkin dialects of the Great Lakes. About 2,000 survive.

ABNER. In the Old Testament, Saul's cousin and commander-in-chief, comes into prominence only after the crushing defeat of Israel at Mt. Gilboa. This battle placed the Philistines in control of the whole of central Palestine, and the weakness of Israel was enhanced by the division into two parties, that of the south, which followed David, and that of Transjordania, which remained faithful to Ishbaal, the son who succeeded Saul. The king himself, however, was a weak character, and the whole strength of the party was concentrated in Abner. The struggle between the two parties was continuous, and in the battle of Gibeon Abner killed Asahel, brother of Joab, thus exposing himself to the blood-vengeance of the dead man's whole family. It seems that Abner aspired to become the sole leader of his party, and, as a step in the achievement of his aim, married Rizpah, one of the concubines of Saul. For this he was reproved by Ishbaal, and thereupon deserted to the opposite party. An agreement was made between David and Abner, by which David had restored to him Michal, daughter of Saul, thus establishing a claim on Saul's throne, and Abner was received into favour. Joab, however, in obedience to the binding law of blood-revenge, took an opportunity of putting Abner to death, and his disappearance practically brought to an end the resistance of the eastern party. David, of course, was not implicated in Abner's death, though he had no right to punish the assassin, and his short dirge over the body, like that over Saul and Jonathan, is an exquisite specimen of the early poetry of Israel. (*See* II. Sam. ii. 8; iii 39)

ABNEY, SIR WILLIAM DE WIVELESLIE (1843–1920), English chemist, was born at Derby July 24 1843 and died at Folkestone on Dec. 3 1920. Abney held high appointments at the board of education and was president at different times of the Royal Astronomical Society and the Physical Society. His contribution to science was mainly in the furtherance of photographic chemistry and especially of colour photography and colour printing. His publications on these subjects include *Instruction in Photography* (1870); *Colour Vision, Colour Measurement and Mixture* (1893); and *Trichromatic Theory of Colour* (1914). He also wrote *Thebes and its Five Great Temples* (1876), and, with C. D. Cunningham, *The Pioneers of the Alps* (1888).

ABNORMALITIES AND DEFORMITIES: *see* MONSTERS.

ABNORMAL PSYCHOLOGY. By abnormal psychology is meant the study of mental processes that deviate from an imagined norm. When the deviation is unmistakable the term "psychopathology" is more commonly employed. Otherwise the terms "medical psychology" or "clinical psychology" are the usual ones, "abnormal psychology" being used only by one psychopathologist of note—Morton Prince. The term "clinical psychology" connotes a special approach and attitude towards the problems concerned, one identical with that indicated by the word "clinical" in medicine, namely, that the problem is envisaged as related to the whole of a living organism and not isolated as is often done in academic psychology. It is essential to realize from the outset that this subject is not, as might have been expected, simply the extension of the psychology of the normal to the study of the abnormal. For reasons that will become apparent later, what should have been the applied branch has had to create its own discipline, its own methods and its own general outlook. The case, indeed, has been reversed, for it is becoming plainer that it is only by means of studying the phenomena which for the sake of convenience we call "abnormal"—though they do not possess the attributes commonly associated with this word—that the deeper problems of the mind are at all possible of approach. This holds good for the so-called "normal" as for the so-called "abnormal," so that it is by no means impossible that the uncertainty in nomenclature just alluded to may ultimately be solved by our simply adopting the word "psychology" for the whole field.

The branch of science here considered has been almost entirely the construction of the past 40 or 50 years. In this time a huge mass of knowledge, little known outside the specialist field, has accumulated. Much of it has been of an unexpected and, indeed, revolutionary nature which requires considerable assimilation to the generally existing outlook on life and particularly to man's previous view of himself The difficulties encountered in the earlier advances of science, repeated time and again in the past 400 years, here reach their maximum. They are both external, in the form of intense opposition to the unwelcome new, and internal, in the form of the subjectivity which is the bane of all science. The presence of the latter difficulty is evident, but an interesting discovery has been made in regard to the former: it appears likely that man's opposition to the new, which is one of his most characteristic qualities, is a radiation into all fields of thought, from the most concrete to the most abstract, of the effects of a deep-seated opposition against self-knowledge.

Unconscious.—The key to the understanding of this new science lies in the concept of the *unconscious*, one which we owe essentially to the work of one man, Freud. Converging evidence from many sources had shown the necessity of assuming the existence of mental processes remote from consciousness and even inaccessible to it. By devising a special method of investigation Freud made it possible actually to penetrate into these deeper layers of the mind and to ascertain much about the structure and significance of their content. The mind can therefore no longer be regarded as a homogeneous unity, however much that part of it may which gives us the feeling of self, and the importance of the various conflicts and incompatibilities subsisting among the different portions of the mind is increasingly recognized.

Significance of Neuroses.—Since so much of this new knowledge has been gained from study of the states known as functional nervous disorders or *neuroses*, something must be said about the general signification of these states. The main point is that the words "abnormal" and "disease" are singularly out of place in connection with them. Apart from the superficial considerations that the distinction between normal and abnormal is even more arbitrary here than elsewhere and that neurotic reactions are easily to be demonstrated with everyone, investigation of the origin and nature of such reactions convinces one that they represent little more than one particular way of responding to difficult stages in mental development which are of universal occurrence. They really constitute varieties of social adjustment rather than any disease in the ordinary sense. Neuroses are not things that happen to a person as an infection or an accident may; they are integral and dynamic expressions of the personality. They cannot be described without importing the idea of purpose, the idea of their being designed to meet certain mental situations, to cope with certain difficulties, to achieve certain aims. A great part of modern psychology is built on these pseudo-teleological conceptions, though opinions differ widely whether the most adequate formulations will prove to be truly teleological and finalistic or strictly deterministic and even mechanistic in the widest sense.

HISTORY: A. HYPNOTIC STAGE

The *history* of abnormal psychology can easily and definitely be divided into three stages: the hypnotic, the experimental and the analytical. The first two derived their inspiration from Paris, the third from Vienna. The beginnings of medical psychology are less than a century old. It is true that the material on which it was based, that of hypnotic experiences, is considerably older, but there was no psychological theory of it to begin with. In the 17th century Maxwell, and in the 18th Mesmer, made such extensive observations in this field that relatively little has been added to them since. They accounted for them by postulating the presence of a mysterious fluid of a magnetic nature which could be transmitted from one person to another. Early in the 19th century mental conceptions, such as imagination, were invoked and a struggle ensued between what were called the fluidists and the animists. First to present the latter point of view comprehensively was Bertrand, in the early 'twenties, and it was independently developed by Braid of Manchester some 20 years later. It was Braid

who first used the terms "suggestion" and "hypnotism"; his work put an end to the idea of magnetic fluid. In the eighties of the last century, however, the discussion was renewed in other terms. Charcot, the distinguished neurologist, revived the study of hypnotism, which had almost fallen into disrepute, and again attempted to account for the phenomena by physiological explanations. This was countered by Bernheim of Nancy, a pupil of a local doctor, Liébault, who practised hypnotism, and once more the animist school, which ascribed everything in the process to mental suggestion, triumphed.

The most striking feature of the observations made by employing hypnotism was that in the peculiar mental condition thus induced, hypnosis, a large number of phenomena occurred which, though evidently of mental origin, were of such a kind that cannot be normally produced by the deliberate action of the conscious will, in short, of the mind as previously conceived. For instance, changes could be produced in the functioning of various bodily organs which have no connection with consciousness and sometimes even changes in the physical state of the body. A hyperacuity beyond the normal could be induced in the sense organs for ordinary stimuli, hallucinations of non-existent stimuli brought about and "negative hallucinations" that prevented the perception of existent stimuli. Of special interest in later developments was the extension of memory in hypnosis; long forgotten and otherwise inaccessible memories could be recovered, so that one was led to suspect that perhaps no memory traces are ever obliterated. These memories could be retained or not in the subject's subsequent waking state at the hypnotist's will, so that from these and many similar observations the conclusion was forced on psychologists that consciousness was by no means an essential attribute of mental processes. It could also be proved by post-hypnotic suggestion that mental processes of which the subject was in no way conscious could lead to definite effects in conduct, so that it would not be true to regard them as merely latent.

It was at that time observed, notably by Charcot, that many of the phenomena that could be brought about in hypnosis, *e.g.*, paralyses, contractures, anaesthesias, blindness, etc , were identical with spontaneous symptoms of a particular disorder, hysteria. He inferred that hypnosis was an artificially created hysteria, a conclusion which, though subsequently abandoned by psychopathologists, may yet contain a germ of truth. It was only much later that the relationship between the two conditions was elucidated through the discovery that hysterical symptoms, including the bodily ones, are directly produced by unconscious mental processes and, further, that they are related to post-hypnotic suggestions in being closely connected with "delayed" obedience to parental influence that has been incorporated—largely unconsciously—into the personality.

The theory of all these phenomena was slow in developing. For half a century no perceptible progress was made on the idea thrown out by Durand (1855, 1860) that a clear distinction should be effected between the "ideoplastic" and "hypotaxic" phenomena. By the former he meant all those results of implanted ideas briefly indicated above, by the latter the peculiar mental state of the subject that made them possible. The essence of this state had long been recognized to be the existence of a peculiar *rapport* between the subject and the hypnotist. This is an emotional relationship of intense concentration which may at times reach the pitch of rendering the subject oblivious to the presence and deaf to the voice of any other human being. In 1905 Freud's investigations led to the conclusion, subsequently amplified by Ferenczi and Ernest Jones, that the nature of the hypnotic *rapport* was a particular kind of erotic relationship of which the subject was quite unaware and, further, that its peculiar potency was due to a reanimation in the subject's unconscious mind of an infantile dependence on the parents.

B. EXPERIMENTAL STAGE

The second stage in the development of medical psychology was the experimental work undertaken in the eighties of the last century by Binet, Féré, and, above all, Janet. By a series of beautifully devised experiments Janet was able to demonstrate convincingly the presence of mental processes, which he called "subconscious," of which the subject was quite unaware. It could be shown, for example, that this subconscious part of the mind was able to register and reproduce impressions on an anaesthetic limb when no stimuli applied to it could be detected by consciousness. The subject could feel and could not feel with the same limb, a paradox only to be described in terms of mental dissociation. The same conclusion was reached from study of more complicated mental manifestations, extensive amnesias, (gaps in memory), alternating personality, fugues (flights) and so on. Janet was able to describe a large number of hysterical symptoms in terms of mental dissociation and the problem was thus shifted to the nature and origin of this The only explanation he was able to throw out was the assumption of a congenital tendency to dissociation, a constitutional defect in mental integration to be correlated with what he termed a fall in psychical tension, a condition favoured by such factors as fatigue, shock, distress, grief, harmful suggestions, etc.

The various forms of what are grouped together as cases of dissociated personality, which have been most exhaustively studied by Morton Prince, introduce another problem They include alternating personality, double or multiple personality, hysterical fugues with amnesia, hypnotic somnambulism and the like The actual problem of personality in this connection will be dealt with later, but it is necessary here to consider a feature of certain cases for the light it throws on the limitations of the conceptions just mentioned. In many of the cases it is found that of the total store of available memories one "personality" has access to all, whereas another has access to only a portion. The dissociation in question, therefore, cannot be a complete break, for it is traversable in one direction though not in the other It is what Bernard Hart has termed an out-of-gear relationship. The noteworthy point is that all the memories concerned are accessible to one form or another of consciousness. Further they are all of a kind familiar to ordinary waking life. When a subject realizes that a part of him has been feeling sensations in an anaesthetic hand, or when a patient who has lost his memory for the past month is told that during this time he performed such and such actions, he may be astonished but he does not find it incredible The mental processes not available to the main stream of consciousness are for this reason termed "subconscious," and it is essential to appreciate the all-important distinction between this conception and that of the "unconscious," for the processes comprising the latter are alien to any form of consciousness the subject may possess and contemplation of them is repudiated with incredulity.

C. ANALYTICAL STAGE

The third stage in the development of medical psychology was inaugurated in 1893 by the first publication of Freud's investigations. The original and fruitful work he has since done, and is still doing, has not only so deepened medical psychology as to effect a revolutionary transformation in it, but has vastly extended it beyond its early confines. We stand perhaps too near to this work to attempt a final appreciation of its true value and a storm of controversy still rages about it. At present it dominates the field of medical psychology with no serious rival to the methods, modes of approach and theories it embodies, all of which are included under the name of "psycho-analysis"

We have seen that before Freud's work it was known that in certain circumstances mental processes of a kind familiar to consciousness could be separated from the main stream of the latter. A few philosophers, notably Hartmann and Schopenhauer, had surmised that there was a still deeper mental layer, the unconscious proper, but there was at that time no means of investigating it. The importance of a curious mental state called suggestibility was also known, but no explanation of it was forthcoming The mysterious congeries of phenomena called neurotic symptoms was popularly "explained" as due to morbid imagination, and by neurologists as being accidental disease processes with no specific meaning; incidentally, the popular view, as sometimes happens, was nearer the truth All these topics underwent a remarkable illumination as the result of Freud's investigations.

The origin of these was the communication, in 1884, by an older colleague, Breuer, of an observation the latter had made with a patient some three years previously. It was to the effect that if the memories connected with the beginning of an hysterical symptom could be recovered in hypnosis the symptom in question would vanish, in other words, that there was an inherent connection between the presence of such symptoms and the forgetting of certain significant mental processes. After spending a few years at other work Freud pursued the train of investigation thus suggested and soon confirmed Breuer's observation He was imbued with a deep faith in scientific determinism as applied to mental phenomena, and did not disdain to act on it even in regard to apparently trivial and meaningless phenomena which would usually be explained as being due to "chance." The object of the investigation was essentially a genetic one, and this feature has characterized all his later work, being, indeed, identical with the one just mentioned Being forced to recognize the limitations of hypnotism as a method of investigation, Freud was led to devise one without its deficiencies, and in so doing made the most far-reaching of all his discoveries. This was what is known as the free association method, which opened the way to the exploration of the deeper layers of the mind. The essence of it is that the more the conscious guiding of a train of thought is abrogated, the more extensively is it guided by processes of which the subject is unaware. The material thus produced provided either open or disguised indications of these unconscious processes. They have to be extracted from it by an interpretative procedure and the criticism naturally arises of the necessarily subjective nature of this It is claimed that sufficient safeguards are provided in the technique of the procedure, which is a very complicated one, to check any tendency to subjectivity. In particular the observer has first to become aware, through self-analysis, of his own unconscious processes so as to obviate the automatic temptation to bias on the one hand and to blindness on the other.

An essential part of the technique consists of the correct handling of two groups of reactions which Freud terms "transference" and "resistance" respectively. By the former is meant the tendency of the subject to allow his unconscious trends to emerge only in the form of personal references to the analyst. Various ideas, attitudes, phantasies and emotions appear in this form, but prove on investigation to have been transferred temporarily to the analyst from some other person of importance in the subject's previous life. The discovery of these earlier attitudes is thus regularly made via the person of the analyst. By resistance Freud refers to the innumerable forms of opposition that are automatically manifested whenever the subject is nearing some important unconscious material The interpretation of the material in connection with these reactions is usually easier than might perhaps seem and it is constantly confirmed by the memories subsequently recovered and by the general piecing together of the material in the later course of the analysis. It is maintained that the converging nature of this admits of no alternative conclusions to the ones reached in the course of the interpretative procedure and that any errors in the latter are soon disclosed by the subsequent material

PSYCHO-ANALYTICAL THEORY

Application of the free association method and accompanying technique led Freud to his three most important conclusions

1. **The Unconscious.**—The first was the demonstration not only that many mental processes are unconscious, *i.e.*, both unconscious in themselves and completely unknown to consciousness, but also that they could be rendered accessible. The absolute inaccessibility of these processes to consciousness, apart from the use of the psycho-analytic method, differentiates the unconscious proper from the subconscious processes mentioned earlier. Two other features of it also emerged immediately. One was the dynamic nature of unconscious processes; that is, they are not merely dormant material but are constantly exercising pressure which actively influences conscious thinking and behaviour The other was concerned with the genetic point of view, for it was shown that a number of mental acts of various kinds which had been thought to originate in consciousness are really derivatives of deeper, unconscious processes. This, indeed, appears to hold good for all conscious processes except possibly simple responses to external stimuli (perception). The unconscious processes themselves were seen to be essentially expressions of the instinctual life, so that, as might have been expected biologically, the instincts proved to be the foundation of all mental life, the latter being an extraordinarily elaborate manifestation of impulses derived from these and interactions between one set and another.

These discoveries have an important bearing on the doctrine of *free will,* for they greatly extend the field of scientific determinism. Indeed, the whole work is based on the assumption that causeless phenomena do not exist and this assumption is amply confirmed by demonstrating in detail the actual causes of phenomena that were supposed to be due either to "chance" or to "free will," *i e* , to be causeless. The conception of free will, however, receives a fresh signification While it is believed that all thought and conduct are determined by pre-existing factors, there is nevertheless an important difference between that which is automatically determined by unconscious ones and that where consciousness plays a larger part. The practical difference is that in the former case the possible responses to a given situation are much fewer, whereas in the latter they are both more varied and more likely to be adjusted to the actual possibilities in the outer world It is the difference between the fixed and unvarying response of an insect and the freer adaptation of a higher animal, it is the latter that, when highly developed, gives rise to the conscious feeling of free choice

It is found that the mental processes of the unconscious proper differ from those we are familiar with in many respects besides the obvious one of not being accompanied by consciousness To begin with, they are regulated throughout by what is called the pleasure-pain principle; the only consideration that matters is the diminution of pain (in its widest sense, including all forms of discomfort) and the pleasurable gratification of various impulses. As we know, this simple rule is often subordinated in consciousness to more complex considerations; an immediate gratification is often postponed or abandoned in favour of a distant interest of the individual or of some one he cares for This is expressed by saying that in the more conscious layers of the mind the primitive pleasure-pain principle has been evolved into the reality principle. In the unconscious the freedom of association is far greater than in consciousness; ideas that have only a slight resemblance are brought together or even fused into one, the feeling or significance attaching to one readily passes over to the other, and so on. This ease with which "displacement," as it is termed, occurs results in one idea often serving as a representative of another and is at the basis of the extraordinary part played by symbolism in connection with unconscious processes. The idea of time does not exist in the unconscious; similar events or ideas that may logically be separated from one another by many years are simply telescoped together as though they happened at the same moment.

2. **Repression and Conflict.**—By the concept of repression Freud solved the great riddle of mental dissociation which had baffled previous investigators. He came to it quite empirically. Observing that his efforts to penetrate into the deeper layers of the mind—for example, to recover lost memories—regularly met with an opposition which cost an active effort to overcome, and that this opposition or "resistance," as he called it, was always strongest just as an important part of the unconscious was being approached, he conceived the idea that the force thus exercised must be the very same force that had previously kept the unconscious thoughts from becoming conscious. There must therefore be some agency within the mind that automatically acts as an active barrier, fulfilling the functions of a censorship, and both prevents any spontaneous tendency on the part of the unconscious processes to become conscious and obstructs any effort from without to reach them.

Resistance is a phenomenon that can be observed, repression is an inference. But this inference has been extensively confirmed by careful unravelling of the relations between conscious and

unconscious processes, and in addition much has been learned about the nature and functions of the mental agency in question Repression may be defined as a striving of a given group of agencies in the mind to keep certain mental processes from consciousness; the processes in question may once have been conscious or, which is true of the most important ones, may never have been. Conversely, unconscious processes may be defined as those which are incapable of becoming conscious All those which are so capable, however, do not necessarily become conscious; their capacity is a potential one. Only a relatively small number are conscious at a given moment; the others are called "preconscious" and there is also a slight barrier, which, however, can be overcome in many ways, between the preconscious and consciousness. The preconscious roughly corresponds with what we considered earlier under the name of subconscious.

What has been indicated here is a doctrine of *conflict* within the mind, a conflict the very existence of which is unknown to the subject It is between two sides of the total personality, between what is called the ego on one side and various repressed impulses on the other. The ego, which of course includes the conscious personality with its sense of "self," is a relatively consistent unity, but it is essential to realize that part of it also is unconscious, for its roots, so to speak, extend below the threshold of consciousness This unconscious ego has to be distinguished carefully from what we have hitherto been referring to as the unconscious proper, but which should more correctly be termed the repressed unconscious. It is thus more accurate to say that the conflict is between the ego and the repressed than between consciousness and the unconscious, though the two statements overlap to a considerable extent. The nature of the conflict is essentially a moral one. The ego, from which the repressions emanate, condemns and repudiates various internal impulses on moral or aesthetic grounds This is not an act of judgment, as might be supposed from this statement, but an automatic avoidance which is more in the nature of "flight from" and which indeed probably originated in the instinct of fear. Incompatibility is thus the secret of dissociation To defend itself against the demands for gratification on the part of various primitive impulses the ego resorts to the flight mechanism of repression. It is the innumerable forms of failure in this mechanism that provide the only way whereby the unconscious can be investigated, hence the enormous importance attaching to abnormal psychology.

3 **Infantile Sexuality.**—Among the anti-moral or, more strictly speaking, non-moral, impulses that constitute the repressed unconscious, *e g.*, selfish and cruel impulses, it was inevitable that sexual ones should play a considerable part, but only actual investigation revealed how very large this part is. The fact itself appears to contradict the former statements that such impulses emanate from the inborn instincts and that the super-ego is formed in opposition to them in the first years of life, but no part of psycho-analysis is more unequivocal than its conclusion that the popular belief of sexuality originating only with the reproductive functions at puberty is entirely fallacious Not only does this instinct have a complex evolutionary history before it finally emerges in its generally recognized form, but the astonishing fact has come to light that, unlike its course in other animals, it undergoes in man two distinct developments at different ages.

The circumstance that sexuality in childhood has been so extensively overlooked and even denied is to be ascribed to the powerful repressions that occur early in life in connection with it Freud interestingly correlates with this occurrence the mysterious loss of childhood memories that is so general. As the same factors operate throughout life, adults are prone to ignore or discount the numerous sexual manifestations to be observed during childhood. When these cannot be quite ignored they are automatically treated as sexual misdemeanours, but they are simply called "naughty habits," and the sexual nature of them is not consciously recognized. This is assisted by the fact, inevitable in the nature of the case before the reproductive function is properly established, that the manifestations are mostly of what would in an adult be termed a perverse kind, *i e*, they are acts that deviate from the final goal of the instinct. The puzzling perversions of the instinct met with in adults can be shown to be little more than the persistence, often in a somewhat altered guise, of the normal manifestations of childhood

The periods at which the two developments in question take place are the first four or five years of life and the four or five years following puberty respectively. In the former period the development runs through a prescribed course, naturally with infinite individual variations, and the interesting point is that the same course is then repeated, on a correspondingly modified plane, when the time comes for the second period of development. This means that any particular feature in the first period, an arrest of development at one stage or a peculiar variation at another, will inevitably be repeated in the second period and will, of course, leave its trace for life Between the two lies the so-called "latency period" during which sexual manifestations play a subordinate part and in any event do not undergo any development.

Genetic investigation of the sexual instinct traces its roots back to infancy itself It is here characterized by leading at first no independent existence, being parasitic on the great life-preserving instincts. Thus its first manifestations are to be seen in connection with sucking activities prolonged far beyond the actual need for nourishment and occurring in respect of objects quite unconnected with nourishment. The sexual nature of these accessory acts, with their later manifestations of kissing, thumb-sucking and nail-biting, is not simply inferred from observation of them, but can be amply demonstrated by the unravelling of their numerous derivatives The interests aroused in connection with the mouth, the so-called "oral" stage of development, extend later to other bodily functions, notably those of excretion. This alimentary or pre-genital stage thus precedes that in which concentration takes place in the genital organs proper, though some degree of genital activity, *e g*, what is known as infantile masturbation, occurs from a very early age.

The first period of development may also be regarded, not only from the point of view of the bodily areas concerned, but from that of the goal or object of the impulse. It is evident that to begin with this is purely concerned with the child's own body and sensations, the "auto-erotic" stage In the next, or "narcissistic" stage, the child becomes conscious of itself as distinct from the outer world and takes itself as its first love object Soon, however, its interests, curiosities and needs are aroused in connection with the environment, and here the other members of the family play a preponderating part. It is then that is generated the infantile conflict over incest on the solution of which will depend so much of the later character and capacities The condemnation, and consequent repression, of sexuality at this age is almost absolute and appears to arise from internal as well as external sources. All the unconscious conflicts to be observed at various ages and in various spheres are radiations from the central conflict over infantile sexuality and the kernel of this is its incestuous nature. Endless reactions, tendencies and traits of character in later life can be shown to have originated in repudiation of incest, and there is much reason for supposing that this was the historical origin of morality and religion in the individual and the race.

The sexual instinct is not altogether set from the first in the direction of the opposite sex. On the contrary, the evidence would make it seem necessary to assume a congenital bisexuality. This complicates the original situation in regard to the parents. In addition to the normal attitude of attraction towards the parent of the opposite sex with jealousy of the other parent, the classical "Oedipus complex," there would appear to be always present more or less active indications of the opposite, the inverted Oedipus complex The latter may become abnormally developed as a result of flight from what was originally the normal.

There is always intense repression of the early incestuous trends. Indeed, this repression is the centre and prototype of all later ones The exact factors bringing it about are somewhat obscure, especially the relative importance of internal (inherited) and external ones. It is at all events certain that the process is connected with intense fear and guilt The fear would seem to be essentially that of damage to the genital organs, but whether this arises purely in terms of punishment is not yet clear. The

guilt, which is in large part an elaborated product of fear, becomes later what we described above as the super-ego, the critical faculty which gives rise to, among other things, the normal conscience. The super-ego, which embodies the image of the parents, may thus be termed the heir of the Oedipus complex. The sexual and hostile attitudes towards the parents are renounced to a greater or lesser extent, the child identifies itself with its conception of the parents and so incorporates into itself their images.

A small part of these happenings is sometimes conscious and the careful observer may discover indications of this in the child's conduct, but the essential part is certainly throughout unconscious. The work done in the latter respect even at the ages of two and three years old, gives unequivocal proof that the inferences drawn from studies of adults were correct. Melanie Klein has evolved a special technique for the analysis of young children It is thought that these early unconscious conflicts, or rather the way in which the child deals with them are of vast importance for its whole future life. Psychoanalysis makes it likely that the fundamentals of character are permanently set by the age of four or five. The possible outcomes of the conflicts, which are, of course, infinite in number, may be grouped under four headings.

OUTCOMES OF CONFLICT

1. **Sublimation.**—This term is applied to a process whereby the energy pertaining to a given sexual impulse can lose its specifically sexual exciting character and the impulse in its search for gratification be directed towards a non-sexual, and usually social, goal. The process is entirely an unconscious one and can neither be initiated nor guided by any deliberate effort. It occurs most characteristically in respect of the infantile elements ("component impulses") out of which the sexual instinct as a whole is developed. It is a reversible process, that is to say, the change is not brought about once and for all. Sublimations are of varying stability, and in certain circumstances the energy attaching to them can "regress" to its primitive form The function of sublimation is evidently to achieve at the same time a permissible gratification for impulses which in their unaltered state would be condemned and checked and to make use of the energy thus set free for the various needs and interests of life.

2. **Reaction-formation.**—This is a barrier set up to dam back the particular repressed impulse. For instance, modesty is developed to check any tendency to self-display; cleanliness to check the infantile fondness for playing with dirt. The energy of a reaction-formation is aimed in the opposite direction to the original impulse, whereas that of sublimations flows in the same direction. Another difference is that with sublimation it is derived from the original impulse, being merely a transformation of it, but with reaction-formations it is derived from the ego or non-sexual part of the mind, opposed to the repressed impulses.

3. **Character-formation.**—Many durable character traits, such as ambitiousness, parsimony, timidity, and so on, have been traced to certain mental attitudes which became fixed in connection with the early unconscious conflicts A very great part of the whole character originates in this way. A given trait may partake of the nature of a sublimation or of that of a reaction-formation, but more often it is a complex product The transformation of the unconscious material (in connection with the primary conflicts) into these character traits may be incomplete, in which case we speak of a neurotic character. They are then intermediate between normal character traits and neurotic symptoms, the neurosis being built into the very structure of the character instead of appearing, as it usually does, in the form of something alien imposed from without. Such cases are harder to modify therapeutically than the commoner neurotic ones.

4. **Neurosis.**—This is the last, but by no means the least frequent, outcome of unconscious conflicts. Its appearance in this series illustrates the very important consideration, which was dealt with at some length earlier, to the effect that neurotic manifestations represent nothing more than one particular mode of responding to general mental situations; their interest is rather sociological than pathological. The importance of them to psychology as a science lies in the fact that only by the avenue of neurotic manifestations, or borderline phenomena closely allied to them, is it possible to investigate the deeper strata of the mind, *i.e.*, the foundation on which the rest is built.

PSYCHONEUROSES

At this point we may cast back to pre-analytical days and consider, in as condensed a way as possible, the vast problem of the neuroses as a whole. Two contrasting views have always obtained on this matter, the popular and the medical respectively. According to the former, neurotic ailments are purposive; they are more or less deliberately produced by the patient's imagination for various motives, *e g*, securing sympathy, self-indulgence, etc. Medical practice has always been strongly influenced by the same attitude, and the corresponding treatment meted out has often been extremely drastic. Officially, however, the medical view has been that such disorders are proper diseases, for which the victims were, of course, in no way responsible. In practice a compromise was generally reached, typified by the attitude called "kind but firm." The difficulty was to ascertain the nature of the "disease," which was so plainly out of ordinary medical experience. The fiction was desperately invented that there must be some such disease but that unfortunately its traces in the brain were invisible, and so the term "functional disease of the brain" was coined. Janet's researches lent colour to the medical view by demonstrating that in many hysterical manifestations the patient was really unaware of the dissociated mental processes, so that he could hardly be held responsible for them. On the aetiological side, however, he contributed little beyond confirming Charcot's opinion that shock, both physical and mental, could play a part in addition to an hereditary disposition. Janet's work was mostly carried out in respect of the signs of hysteria rather than the symptoms. He proved, for instance, that a patient suffering from blindness or numbness could really see or feel, though with a part of the mind dissociated from consciousness. But, strictly speaking, this had little to do with the question of whether *causative* mental processes lay concealed behind the symptoms.

It was Freud who first demonstrated that hysterical and other neurotic symptoms have a meaning and in so doing he was also able to reconcile what we have called the popular and the medical views on the subject. On the one hand there turned out to be this much truth in the popular view, that neurotic symptoms are purposely brought about and that their function is to serve some quite personal interest of the patient; but this purpose is entirely unknown to the patient, for what had been regarded as a conscious process proved to be an unconscious one. On the other hand, the medical view was true in so far as such events can be regarded as something happening to the patient without his knowing why, or, therefore, being responsible for it; but it was nevertheless something purposely brought about by a part of his personality and not a disease in the sense of an external accident.

One further point in this connection. After the symptom has been in this way created it can be put to further secondary uses in the interest of the patient (to secure sympathy, escape disagreeable tasks, etc), but only the smaller part of even these secondary uses is as a rule conscious.

The unravelling of the genesis of neurotic symptoms is an extremely complicated affair and has taught us much about the finer mechanisms of unconscious mental processes in general. In regard to the problem of the neuroses themselves, the outstanding conclusions that have emerged are that they result from unconscious conflict and represent a compromise between the two components of this conflict, and that the essential source of them invariably lies in the sexual sphere, though other adjuvant factors may also be present. The symptoms represent a disguised form of sexual gratification, but this statement has to be supplemented by two others to give it its proper meaning. In the first place, the symptoms also represent an expression of the forces opposed to the forbidden sexual impulses; it is from this that the suffering of the neuroses proceeds, the suffering, whatever form it may assume, thus signifying fear and guilt. In the second place, the impulses that obtain gratification are not sexual in the ordinary adult sense, but only the infantile compo-

nents which, as was described earlier, are destined to build up the adult instinct. What actually happens is that the subject of the future neuroses meets with some situation in life which, for reasons connected with errors in his early development, is difficult to cope with; the situation may be a really difficult one or one that would present no difficulty whatever to other people who did not possess the particular disposition. He then withdraws into phantasy in which the external difficulties are overcome in his imagination; the phantasies become more and more "introverted," more and more connected with older unconscious ones which they revive, and they ultimately re-animate the oldest, most unconscious, *i.e.*, most repressed of all, those concerning infantile sexuality. The imagined and consoling gratification of these is opposed by the ego, the energy accompanying them displaced on to associated ideas, and a compromise formation built up in which both of the opposing factors in the conflict come to expression. The structure of any neurotic symptom is thus very elaborate and the genesis of it more complex than might have been supposed The essential point is the flight into consoling phantasy as an ostrich-like means of dealing with the real exigencies of life.

The famous psycho-analytic treatment with which the conclusions just indicated are bound up, is designed to remedy the state of affairs by introducing the unconscious part of the mind into consciousness. It recognizes that the natural method of dealing with forbidden impulses has failed; it has proved to be beyond the patient's power to repress them satisfactorily, *i e.*, in a way that their energy can find adequate expression through various sublimations and the socially permissible amount of direct gratification. It has proved impossible to find a solution automatically and unconsciously, so the analyst decides to call in the assistance of consciousness The process of revising the ancient infantile conflicts in the light of adult knowledge, and with the help of an ego that no longer has reason to fear the temptations of childhood, holds out every prospect of the patient finding more harmonious solutions than he previously could The essence of it is the transferring of the decisions, judgments, condemnations, and so on, from the old irrational unconscious super-ego, with its out-of-date nursery outlook, to the conscious self, fortified as it is with all the strength of the conscious personality and the knowledge of reason. The patient is thus freed from the old tyranny and acquires a control over his full self never before possible.

When the super-ego has been built up in childhood through the imprint of disharmonious influences, there is always the latent possibility of the remarkable occurrence known as *multiple personality*. This condition may take various forms. The simplest is a mere loss of memory for a section of past life, occasionally for the whole past life and personal identity; such cases are common in the police reports More complicated is the condition when the consciousness remaining develops attributes at variance with what was known to characterize the previous personality If such cases are investigated by means of hypnotism, but probably not otherwise, two or more definite personalities may be developed. The relation they have to consciousness varies. They may become conscious in turns, one at a time, or there may be two consciousnesses, one being aware of the second, but not the second of the first The splitting takes place typically in the region of the preconscious mind, and probably in the super-ego

Adler and Jung.—Before leaving the subject of the neuroses, mention should be made of two alternative views to those of Freud put forward by Adler and Jung respectively, workers who were for a short time colleagues of his. There is much in common between their two views, especially in their negative aspects of denying the conclusions Freud reached about the deeper strata of the mind. Adler put forward the suggestion that in the neurotic mind all attributes and feeling of inferiority tend to become identified with the idea of femininity, so that the motive of the neurotic trends is to secure in an infinite number of ways a "masculine position." It can be shown that, though this view corresponds with a certain number of observations in neurotic symptomatology, it is descriptive rather than explanatory, since the formula in question is a composite product which can be analysed into a number of constituent elements. Jung's view is harder to present, for it avowedly passes beyond the canons of science and enters the realms of both philosophy and mysticism. Essentially it consists in the reinterpretations of psycho-analytic findings into extremely abstract terms for which there is very doubtful warrant in the evidence to hand.

Insanity.—This is not the place for consideration of the very complex problems of insanity, but it must be pointed out that medical psychology, and especially psycho-analysis, has been able to throw a great deal of light on many aspects of them The psychology of certain forms of insanity, notably paranoia (delusional insanity), manic-depressive insanity (mania and melancholia), and to some extent dementia praecox, has been elucidated in a very satisfactory degree, and even with those forms of insanity, *e g.*, general paralysis, that depend on structural changes in the brain, the purely mental manifestations can be brought into line with our other knowledge of unconscious mental processes.

Borderline of the Normal.—To pass to the other extreme, to the borderline of normal mental functioning. There is a large class of phenomena which indubitably indicate erroneous mental functioning and therefore come under the heading of abnormal psychology, but which nevertheless are, by what might be called a general conspiracy, regarded as well within the realm of the normal. This latter feat is accomplished by removing the phenomena from the sphere of psychological determinism and agreeing to ascribe them to vague processes such as "chance," "inattention," "accident," and so on. We refer to the everyday occurrence of such errors as slips of the tongue and pen, forgetting of familiar facts (names, etc), mislaying of objects, forgetfully omitting to carry out quite definite intentions, and a large number of similar phenomena. Freud has shown by a detailed analysis of numerous examples that these phenomena have a certain amount in common with neurotic mechanisms. It is true that their origin is not sexual (though of course it may on occasion be so), and that the source is only at times to be sought in the unconscious proper, but it can be demonstrated that they nearly all have a definite meaning and they arise from conflicts between opposing intentions which are not both clearly present in consciousness

Dreams.—Similar remarks apply to dreams, for many of these are situate on the same borderline. The older views about dreams have been entirely superseded by the penetrating study Freud has made of them by application of his psycho-analytic method The latent meaning behind dreams has been laid bare, the mechanisms whereby this becomes distorted into the fantastic imagery of most dreams have been elucidated, the reasons for this distortion are known, and the function itself of dreaming has been ascertained. Dreams are devices, which may or may not be successful, for allaying stimuli that would disturb sleep. They achieve this by a special mechanism which shows much in common with that of the neuroses Thus there is an introverting regression towards unconscious, and usually infantile, material, the forging of associations with a repressed wish in this sphere, and the disguise of the imaginary fulfilment of this wish, which has, so to speak, in a consoling fashion replaced the disturbing stimulus The detailed investigation of dream life affords one of the readiest means of access to the unconscious.

Phantasy Life.—Other products of the life of phantasy have also been extensively investigated by the methods mentioned above. We can here only enumerate a few of the fields where this work has proved fruitful; the mechanisms and functions of wit, the meaning of humour, the explanation of such opposite phenomena as uncanniness (sense of awesome strangeness in a familiar situation) and what is known by the name of *déjà vu* (sense of familiarity in a new situation), the sources of the imagination employed in such activities as art and literature, the signification of superstitions, folk-lore and mythological beliefs, and last but not least—the significance of religious emotions, beliefs and ritual

Super-normal Phenomena.—Finally a word must be said about the vexed question of so-called super-normal phenomena, including telepathy and spiritism In the eighties of the last century many interesting investigations of these phenomena were carried out on the lines of medical psychology by various English observers, notably Gurney and Myers They made a number of

discoveries in the field of automatic writing, etc, which were in close agreement with the work then being done by Janet and others on subconscious processes in a state of dissociation. Unfortunately the researches soon left these lines and they have not been seriously resumed since then by medical psychologists The chief reason for this is, obviously, lack of opportunity, for interest in psychology and in super-normal possibilities respectively has not yet proved mutually compatible; in other words, mediums appear to guard themselves solicitously against the chance of submitting to a psycho-analysis The matter therefore remains in an atmosphere of general scepticism It is evident that a knowledge of the unconscious must inevitably be capable of throwing much light on many of the happenings recorded in this sphere, but how much ground the conclusions thus reached would cover it is impossible to say without actual experience

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ÅBO: *see* TURKU

ABO-BJORNEBORG: *see* TURKI-PORI

ABODE. In English law this term has a more restricted meaning than domicile, being used to indicate the place of a man's residence or business, whether that be either temporary or permanent The law may regard for certain purposes, as a man's abode, the place where he carries on business, though he may reside elsewhere; so that the term has come to have a looser significance than residence, which has been defined as "where a man lives with his family and sleeps at night" (*R* v. *Hammond*, 1852, 17 Q B 772).

In serving a notice of action, a solicitor's place of business may be given as his abode (*Roberts* v *Williams*, 1835, 5 L J M C 23), and in more recent decisions it has been similarly held that where a notice was required to be served under the Public Health Act 1875, either personally or to some inmate of the owner's or occupier's "place of abode," a place of business was sufficient. (*See* DOMICIL)

ABOLITIONIST, an advocate of the abolition of slavery. The term as used in the United States referred specifically to those persons who, during the years 1830–61, made it their mission to advocate the immediate abolition of negro slavery In spite of riots, assaults and persecutions of every kind, they carried on their task by means of the press, tracts, lectures and petitions to Congress Among the outstanding leaders of the abolitionist movement were William Lloyd Garrison, Wendell Phillips, Lucretia Mott and John Brown. (*See* SLAVERY)

ABOMASUM, the fourth or rennet stomach of ruminants. It is that part of the digestive apparatus which corresponds to the single stomach of other mammals. (*See* PECORA.)

ABOMEY, capital of the ancient kingdom of Dahomey, West Africa, now included in the French colony of the same name. It is 70m north by rail of the seaport of Kotonu, and has a population of about 15,000 Abomey is built on a plain, 800ft above sea level The town was surrounded by a mud wall, 6m in circumference, with a ditch 5ft deep, filled with a dense growth of prickly acacia, the usual defence of West African strongholds There were six gates Within the walls were villages separated by fields, several royal palaces, a market-place and a large square containing the barracks In November 1892, Behanzin, the king of Dahomey, being defeated by the French, set fire to Abomey and fled northward Under French administration the town has been rebuilt, placed (1905) in railway communication with the coast, and given an ample water supply.

ABOMINATION, anything regarded with aversion as were things contrary to omen (Lat. *ab*, from, and *ominor* forbode) Evil doctrines and impure ceremonial practices are so-called in the Bible Hebrew authorities hold that the expression "abomination of desolation" (Matt. xxiv. 15; Mark xiii. 14) refers to the desecration of the Sacred Temple of Jerusalem by the erection of heathen statues (see *s v Jewish Encyclopedia*)

ABOR (*A-bari-* untamed), an Assam tribe inhabiting hills north of the Brahmaputra, subdivided into Minyong, Galong, Padam and other groups. They fall into patrilineal exogamous septs with traces of dual organization A cross division exists into Mishing and Mipak—"pure" and "impure," the latter condition being hereditary, and contagious as a result of sexual intercourse, though exogamy is not affected by it The dead are buried, monogamy prevails, but the Galongs practise the levirate and polyandry within the family circle; slavery, tattooing and segregation of the unmarried obtain, but there is no head-hunting Public affairs are managed by elders and offenders are fined by the random confiscation of property; the property owner must execute the order of the court in order to recover from the culprit in his turn. Weapons used include long swords, crossbows, bows, poisoned arrows and spears Men wear bark loincloths with tails, women a string of small circular metal plates, often the only garment

See Duff-Sutherland-Dunbar, *Abors and Galongs* (Mem Asiatic Society of Bengal, 1916), Cumming, *The Abors* (Assam Census Report, 1921, I, Appendix B, III).

ABOR HILLS, a tract of country on the north-east frontier of India, occupied by an independent tribe—the Abors, who are divided into clans They live north of Lakhimpur, between the Miri and Mishmi hills in the extreme north of Assam, where the Brahmaputra (Dihang) debouches on to the plain The country is exceedingly difficult and entirely mountainous and forest clad, with great rivers running for miles in rocky gorges, and unnavigable beyond Pasighat Communication is only by the roughest tracks from village to village The rainfall is very heavy The term Abor is Assamese signifying "barbarous" and is applied by the Assamese to many frontier tribes, but is restricted especially to the above tract The Abors frequently raided the plains of Assam They were first visited by the English in 1826 From 1848 they carried out numerous raids and outrages on the neighbouring territory and several expeditions were sent against them, while a blockade was instituted from 1894–1900 From 1911 onwards parties under military escort surveyed the border.

ABORIGINAL LANGUAGES, languages spoken by the native inhabitants of certain countries The term is generally applied to tongues called non-literary languages, "jargons," broken dialects, etc, but is more correctly used of languages which, whatever their state of development, have left their individuality unimpaired upon the territory where they originated Aboriginal languages of Africa, for example, are the Bushman (*q v*), dialects; of China, the Lolo (*q v*), Man-tse (*q.v*), No-su, Mo-so, etc

ABORIGINES, a mythical people of central Italy, supposed to have descended from near Reate (an ancient Sabine town) upon Latium, whence they expelled the Siceli and settled down as Latini under a King Latinus (Dion Halic. i 9. 60) The etymology of the name (*ab origine*), makes them the original inhabitants (=Gr. *αὐτόχθονες*) of the country, but is inconsistent with the fact that the oldest authorities (*e g*, Cato in his *Origines*) regarded them as Hellenic immigrants, not as a native Italian people. Other explanations suggested are *arborigines*, "tree-born," and *aberrigines*, "nomads"

The term "Aborigines" indicates the inhabitants found in a country at its first discovery The Aborigines' Protection Society was founded in 1838 in England as the result of a royal commission appointed at the instance of Sir T. Fowell Buxton to enquire into the treatment of the indigenous populations of the various British colonies.

ABORTION, the premature separation and expulsion of the contents of the pregnant uterus. It is usual to call premature labour of an accident type a "miscarriage," in order to distinguish "abortion" as a deliberately induced act, whether as a medical necessity by the accoucheur, or as a criminal proceeding (*see* MEDICAL JURISPRUDENCE); otherwise the term "abortion" would ordinarily be used when occurring before the eighth month of gestation, and "premature labour" subsequently. As an accident of pregnancy, it is not uncommon, although its relative frequency, compared with that of completed gestation, has been very differently estimated by accoucheurs. It is more liable to occur in the earlier than in the later months of pregnancy, and probably occurs more readily at times corresponding to those of the menstrual discharge. It may be induced by numerous causes, both of a local and general nature. Malformations of the pelvis, accidental injuries and the diseases and displacements to which the uterus is liable, on the one hand; and, on the other, various morbid conditions of the ovum or placenta leading to the death of the foetus, are among the direct local causes. The general causes embrace certain states of the system which are apt to exercise a more or less direct influence upon the progress of utero-gestation The tendency to recurrence in persons who have previously miscarried is well known, and should be borne in mind with the view of avoiding any cause likely to lead to a repetition of the accident. Abortion resembles ordinary labour in its general phenomena, excepting that in the former haemorrhage, often to a large extent, forms one of the leading symptoms Treatment consists in rest, astringents and sedatives, to prevent the occurrence when it merely threatens, when abortion is inevitable, it is directed towards speedy and complete removal of the entire contents of the uterus

Among primitive savage races abortion is practised to a far less extent than infanticide (*q v*), which offers a simpler way of getting rid of inconvenient progeny. But it is common among the American Indians, as well as in China, Cambodia and India, although throughout Asia it is generally contrary both to law and religion How far it was considered a crime among the civilized nations of antiquity is uncertain.

The English law on the subject is now governed by the Offences against the Person Act, 1861, which makes the attempting to cause miscarriage by administering poison or other noxious thing, or unlawfully using any instrument, equally a felony, whether the woman be or be not with child. No distinction is now made as to whether the foetus is or is not alive, legislation appearing to make the offence statutory with the object of prohibiting any risk to the life of the mother If a woman administers to herself any poison or other noxious thing, or unlawfully uses any instrument or other means to procure her own miscarriage, she is guilty of felony The punishment for the offence is penal servitude for life or not less than three years, or ordinary imprisonment for not more than two years. If a child is born alive, but in consequence of its premature birth, or of the means employed, afterwards dies, the offence is murder; the general law as to accessories applies to the offence.

In all the countries of Europe the causing of abortion is now punishable with more or less lengthy terms of imprisonment Indeed, the tendency in continental Europe is to regard the abortion as a crime against the unborn child In the United States it is a statutory offence in all states of the Union, but the woman must be actually pregnant. In most states not only is the person who causes the abortion punishable, but also anyone who supplies any drug or instrument for the purpose

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ABORTION, CONTAGIOUS, an infective disease of cattle, horses and sheep which frequently causes premature birth in otherwise healthy pregnant females In Great Britain the condition is most frequent and of greatest economic importance in cattle

Cattle.—Most cases of abortion in cattle are due to the bacillus of contagious abortion, described by Bang and Stribolt in 1896, a few isolated cases, and outbreaks may arise from other causes.

The condition is widespread and is more prevalent where animal husbandry and dairy-farming are common. Although the disease is not usually fatal to the cow, temporary illness and loss of flesh occur; lactation is markedly interfered with; and many cows do not conceive again for prolonged periods, or may remain permanently sterile. At one time it was thought that the bull was the chief factor in the spread of the disease but this view is not now widely held, though it has been shown that the bull may contract the disease, and that lesions may exist in the seminal vesicles and testes, so that during coitus infection may be conveyed to the cow. The present-day belief is that the ingestion is the commonest method of contracting the disease, the principal source of the causal bacillus being discharges of an infected animal *per vaginam* These discharges may retain their infectivity for considerable periods In addition, the udder acts as a reservoir for the organism, which can remain located in this site without giving rise to alterations in the mammary gland; during lactation, the bacillus finds its way into the milk and may be present in the faecal matter of calves born from and reared on infected cows Once contaminated material becomes deposited on pastures where healthy cattle are grazed, or in yards where they feed off the ground, infection is certain to follow In non-infected herds the introduction of an infected animal is a fertile source whence the disease may spread rapidly Naturally occurring cases of the disease are mostly confined to cattle but outbreaks have been recorded in sheep and swine Experimentally, the disease may be transmitted to many species of animals both large and small

The Cause.—The causal organisms are aerobic, non-motile, non-sporing, Gram-negative, short thick rods, with rounded ends having a marked tendency towards aggregation into round or irregular clusters

Whether natural infection occurs by ingestion and entrance into the blood stream, or by way of the vagina, the bacillus reaches the uterus, which is a predilection site in the pregnant female Here a variable amount of exudate collects between the lining membrane of the uterus and the chorionic layer of the placenta ranging from yellowish to dark brown in colour, and from thin and pus-like to thick, tenacious and glutinous in consistence. The connective tissue underlying the chorion, and also the umbilical cord, undergo alterations and become infiltrated As a result of these changes the foetus dies in utero or is expelled If expulsion does not occur, mummification may supervene and retention may ensue over a prolonged period

In aborting cows, the placenta is infiltrated with a yellowish gelatinous material and whitish mucoid flakes are sometimes present, the foetal cotyledons are partly or entirely yellowish and macerated The tissues of the foetus may be abnormally moist and the great cavities may hold quantities of blood-stained serous fluid Infected pregnant cows may abort at any period of gestation but around the fifth to the sixth months is more common; occasionally, infected cows may undergo a normal pregnancy. Generally, in herds where the outbreak is of recent origin, abortion occurs earlier than when the affection is of longer duration

Incidence of the Disease.—When infection is introduced amongst animals, which have been free of the disease, the incidence may be noted with an increasing frequency until eventually few animals escape. If the aborting animals are again bred from, the infection gradually subsides, until only the newly introduced animals calve prematurely Although many cows lose their calves without premonitory symptoms, as a rule the act is preceded by a

mucoid, purulent or blood-stained discharge; in addition, normal parturition may be observed, but usually in a very modified form.

Secondary infection of the uterus may follow, especially if the foetal membranes are retained and a condition of sapraemia or septicaemia may be set up (*see* SEPSIS). Although putridity is not a character of contagious abortion, the secondary infections quickly lead to a very offensive condition of the retained placenta. As a consequence of these changes, animals become affected with a chronic endometritis with sterility as a sequel.

Some animals may become pregnant to abort a second time, but it is more usual for the animal to carry her calf to a normal parturition and to abort at the subsequent pregnancy. Statistics show that the majority of cows do not abort more than once. In the early months of pregnancy the calves are born dead; later, they may be living, and from the eighth month many are reared. Although the cow may only abort once, she may remain a carrier of the disease for a considerable time.

Diagnosis of the disease may be arrived at by the microscopical examination of the uncontaminated discharges and diseased placental membranes. Two blood tests are also available, the agglutination and the complement-fixation tests; the technique of the former has been clearly defined by M'Fadyean and Stockman and the method is now extensively used in diagnosis. Blood taken from the jugular vein of an animal may be sent to a veterinary pathological laboratory, and the result will show whether the animal is affected with contagious abortion. It is necessary to repeat the test after a few weeks as single tests are open to error when dealing with recently infected animals The method is of value in eliminating affected animals from herds, and in preventing the introduction of newly purchased, infected animals, into clean herds. As a means of preventing spread of the disease the agglutination test is of great value; the healthy animals are separated from the reactors and kept in strict isolation; their numbers are augmented out of their own progeny, or by purchased animals, which have not reacted positively to the agglutination test.

Where this method is not adopted animals showing signs of abortion should be strictly isolated. Very rigid disinfection should be carried out especially after abortion has occurred. The foetus and the placenta should be burnt and all discharges thoroughly disinfected. The uterus may be treated with medicated douches and the external genitalia kept as aseptic as possible. In such herds the preputial hairs of the bull should be clipped and the prepuce should be irrigated with a suitable disinfectant after each service.

Every case of abortion should be regarded as of the contagious variety unless proved to be otherwise by sero-diagnostic tests. In badly infected herds every effort should be made in order that aborted cows may conceive again, so that an immune herd may be acquired eventually.

Methods of vaccination have been introduced. Both dead and living abortion bacilli have been used in the endeavour to establish an immunity. In England, the use of the living vaccine has been advised by the Ministry of Agriculture and Fisheries. The method consists in the subcutaneous inoculation of a massive dose of living abortion bacilli into the virgin heifer, or the non-pregnant cow. Intercourse is not allowed for eight weeks. The object is to establish that degree of immunity which a natural attack confers, and to prevent the undesirable *sequelae* which occur in the pregnant animal; the process should be repeated annually until the disease is controlled Vaccination should not be resorted to in herds which are only very slightly affected, or in herds which are free of the condition.

In some countries attempts have been made to control the disease by legislative methods.

Mares.—The aetiology of this condition has been studied in various parts of the world and although several organisms have been described, the bacillus abortivo-equinus is now held to be the cause of the majority of outbreaks of mare abortion.

In Great Britain the subject has been studied by M'Fadyean and Edwards, and their observations indicate that the commonest cause of abortion in mares and joint-ill in foals is the B. abortivo-equinus.

The bacillus is small and pleomorphic; it may resemble a coccus, or occur in short, plump bacillary forms. It is motile, non-sporing and Gram-negative. It grows readily on artificial media and on agar its surface culture is characteristic. Experimentally, the disease can be transmitted to other farm animals and to small animals.

The agglutination and complement-fixation tests are applicable for diagnostic purposes.

The symptoms and lesions are in some respects similar to those observed in cattle but the placenta usually shows less alterations.

Mares are more liable to secondary complications such as laminitis, synovitis and pneumonia.

Sheep.—A vibrio has been described as the chief cause of outbreaks of abortion occurring in pregnant ewes (M'Fadyean and Stockman); these slightly curved organisms are motile and rarely exceed 3μ in length. They are Gram-negative and stain readily with the ordinary aniline dyes. They may be cultivated under somewhat similar conditions to the bacillus of contagious abortion of cattle and their distribution in naturally occurring cases follows somewhat the same lines. A similar vibrio has also been isolated from cows, which have aborted, but outbreaks of abortion in cattle are not usually regarded as being vibrionic in nature. Infection may take place *per os* or *per vaginam* and the act of abortion usually follows earlier in ewes than in cows.

(A. R. S.)

ABOUKIR, a village on the Mediterranean coast of Egypt, 14½m north-east of Alexandria by rail The meaning of the name is "Father Cyrus," who was a Coptic saint. Stretching eastward as far as the Rosetta mouth of the Nile is the spacious bay of Aboukir, where on Aug. 1, 1798, Nelson fought the battle of the Nile. Near Aboukir, on March 8, 1801, the British army, commanded by Sir R Abercromby, landed from its transports in the face of a strenuous opposition from a French force entrenched on the beach.

ABOUT, EDMOND FRANÇOIS VALENTIN (1828–1885), French novelist, publicist and journalist, was born Feb. 14 1828, at Dieuze, in Lorraine. Among his college contemporaries at the École Normale were Taine, Francisque, Sarcey, Challemel-Lacour and Prévost-Paradol. Of them all About was, according to Sarcey, the most highly vitalized, exuberant, brilliant and "undisciplined." After a brief period spent at the French school in Athens he returned to Paris, and became an industrious and lively journalist. About's attitude towards the Empire was that of a candid friend He greeted the liberal ministry of Émile Ollivier at the beginning of 1870 with delight, and welcomed the Franco-German War.

With the fall of the Empire he became a republican, and, always an inveterate anti-clerical, he fought against the conservative reaction which made head during the first years of the republic. From 1872 onwards for some five or six years his paper, the *XIXe Siècle,* of which he was the heart and soul, became a power in the land. On Jan. 23 1884, he was elected a member of the French Academy, but died Jan 16 1885, before taking his seat. About's best work is to be found, not in the once famous *Roman d'un brave homme* (1880), but in the books that are almost wholly farcical, *Le nez d'un notaire* (1862); *Le roi des montagnes* (1856); *L'homme à l'oreille cassée* (1862); *Trente et quarante* (1858); *Le cas de M. Guérin* (1862). Here his most genuine wit, his sprightliness, his vivacity, the fancy that was in him, have free play.

ABRABANEL, ISAAC, called also ABRAVANEL, ABARBANEL (1437–1508), Jewish statesman, philosopher, theologian and commentator, was born at Lisbon of an ancient family which claimed descent from the royal house of David. Like many of the Spanish Jews he united scholarly tastes with political ability. He was a favourite of King Alphonso V., who entrusted him with important state business, but after his death in 1481 Abrabanel was compelled to flee to Spain, where he held for eight years (1484–92) the post of a minister of state under Ferdinand and Isabella. After the expulsion of the Jews from Spain in 1492 Abrabanel resided at Naples, Corfu and Monopoli, and in 1503 removed to Venice, where he was a minister of state till his death

in 1508. Abrabanel was one of the first to see that for Biblical exegesis it was necessary to reconstruct the social environment of olden times, and he skilfully applied his practical knowledge of state-craft to the elucidation of the books of Samuel and Kings.

ABRACADABRA, a word analogous to Abraxas (*q.v.*) used as a magical formula by the Gnostics of the sect of Basilides in invoking the aid of beneficent spirits against disease and misfortune. It is found on Abraxas stones, which were worn as amulets. The Gnostic physician Serenus Sammonicus gave precise instructions as to its mystical use in averting or curing agues and fevers generally. Subsequently its use spread beyond the Gnostics, and in modern times it is applied contemptuously to complicated, unscientific hypotheses.

ABRAHAM or (Genesis xl. 26–xvii. 5) **ABRAM** is the progenitor of the chosen people, the "seed" of the "promised land." Canaan (Gen. xi. 7: xiii. 5: xv. 18. etc.). He was the first



ABRAHAM, THE FIRST OF THE GREAT BIBLICAL PATRIARCHS, BEING PREVENTED BY AN ANGEL FROM OFFERING UP HIS SON, ISAAC, AS A SACRIFICE. AFTER A RELIEF OF THE LIFE OF ABRAHAM ON THE DOORS OF THE BAPTISTERY, FLORENCE, BY GHIBERTI

of the three Patriarchs. He was extolled as "the Friend of God" (Isa. xii. 8; 2 Chron. xx. 7; *cf.* James ii. 23, and also the Mohammedan tradition), and as the "Father of the Faithful" (*cf.* Rom. iv. 11). To the present day the Jews trace their descent from him and from his progeny; who in accordance with the promise were to be as numerous as "the stars in the sky" (Gen. xv. 5) and "the sand on the sea shore" (Gen. xxii. 17). On the other hand in the New Testament it is declared that God can raise children unto Abraham from stones (Matt. iii. 9), possibly an allusion to the myth of Deucalion and Pyrrha or to an Aramaic play upon words (b'rīn "sons," abnīn "stones"). To rest in Abraham's bosom, the bosom of the progenitor of the race, was the summit of eternal peace (Luke xvi. 22 *seq.*).

The Different Accounts.—The stories in Gen. xi. 27–xxv. 11 belong to a larger whole. The basic conception upon which they are chosen and brought together is a single one. Despite all human opposition and despite all apparent despair and hopelessness, God holds forth his promise and brings to realization his scheme of salvation. Abraham, the bearer of this hope, is the pattern of peaceful and childlike faith, who stands firm against all dangers and disappointments. From the first his difficulties were overpoweringly great.

He had to leave his home and people and, following the course of the sun, go on into a foreign land, the very name of which has not been given him by God (Gen. xii. 1). The mighty Canaanites prevent his peaceful establishment (Gen. xii. 6), so he tarries in Sichem (xii. 6), Bethel (xii. 8), Hebron (xiii. 18), Gerar (xx. 1) and Beersheba (xxi. 33). At the very beginning he is compelled by a famine to leave Canaan and to go into Egypt, where his wife Sarai (Sara) is in danger through his untruth (Gen. xii. 10–20, *cf.* xx. 1–18, where the scene is told). Hardly has he again settled in Canaan when dissensions among the shepherds bring a new danger, and he has to part from his dear kinsman Lot. In calm trust in God, Abraham leaves the choice of locality to Lot (xiii. 9), who chooses the fruitful land on the hither side of the boundaries of the promised land. Further difficulties arise when Lot falls into captivity (ch. xiv.) and, finally, into extreme danger, at the destruction of Sodom (ch. xix.). Nevertheless here also Abraham's trustful confidence prevails, and he receives the promise of God in the form of a covenant (chs. xv. and xvii.). There was to be born a son to the aged and childless wife and Abraham *believed:* his calm, childlike trust represents the just relation between man and God. This is the real meaning of the famous verse (Gen. xv. 6) with which, in the New Testament, the profoundest thoughts of the Christian doctrine of justification are connected (Rom. iv. 3; Gal. iii. 6).

A new side-issue is Abraham's marriage with Hagar, for the offspring of that union, Ishmael, cannot be heir (Gen. xvi., *cf.* xxi. 8, *seq.*). Finally Isaac, "the son of promise," is born (xxi. 1, *seq.*), and Abraham by means of a covenant with the king of Gerar gets a foothold near the borders of the promised land (xxi. 22 *seq.*). Then comes the severest test of his faith: the son of the promise must be willingly sacrificed! Even this test Abraham stands and God renews the promise (ch. xxii.), and yet towards the end of his days all that he has acquired as his estate is a grave (ch. xxiii.). This grave of the Patriarch at Hebron is the sign that one day the whole territory shall belong to his descendants. Isaac, it is true, is still without an heir when Abraham dies in a good old age; and the old man's last thoughts concern themselves with the marriage of his son with a woman from his far-off home (ch. xxiv.). For Isaac is the heir, not Ishmael, or the child of Keturah; and Abraham has gained nought in the land of Canaan but a grave and his belief in the Promise.

Analysis of Sources.—These stories do not form a unity. The isolated stories whose concrete perspicuousness and brevity are unsurpassed are woven into a garland of sagas. They were collected in three or four larger works and finally put together in their present form, from the above-mentioned point of view. (*See* BIBLE, OLD TESTAMENT and GENESIS.) To the latest work, the so-called Priestly Codex (P.), are ascribed Gen. xi. 27, 31, 32; xii. 4*b*, 5; xiii. 6, 11*b*, 12; xvi. 1*a*, 3, 15, 16; ch. xvii.; xix. 29; xxi. 1*b*, 2*b*–5; ch. xxiii.; xxv. 7–11*a*. As part of the Elohists (E) are reckoned chs. xv. and xxiv. (?) in part, and nearly all chs. xx., xxi. and xxii. The rest belongs to the works of the two Jahwists (L, *i.e.*, the older "Lay-source" [so Eissfeldt] and J). The accuracy of this analysis is, however, in some details, doubtful. More important is the fact that the stories, despite many noticeable duplications (*cf.* ch. xii. 10 *seq.* and ch. xx., chs. xv. and xvii., chs. xvi. and xxi.), agree in all essentials. The etymological explanations of names and word-plays are of fundamental importance as stylistic criteria.

Historical Value.—The style and content of the stories deviate from strictly historical writing. The narrative does not concern itself with the political, social and economic events and conditions in the life of the peoples (with the sole exception of ch. xiv., on which see below, but with family idylls, delineated with an artist's love, the details of which, however, are beyond the reach of the historian. The question, therefore, of the real historical worth of the details is difficult to decide. On the other hand, scepticism as to the historicity of the patriarchs themselves goes too far. Some would suppose that the figure of Abraham owes its origin merely to the imagination of the poet; or that Abraham is merely a personification of a people who derived themselves from him, and the sagas and legends concerning him and other patriarchs are only a reflection of later tribal history. According to other scholars, the heroic figure Abraham is based on a Canaanite god who was worshipped in the holy arbours of Sichem and Hebron. In this case the Israelites are

supposed to have taken over the cult-centres and the rites; although, judging from their hatred of the earlier peoples, it is distinctly unlikely that they humanized their gods and heroes and regarded them as the progenitors of their own peoples. All these explanations, however, have an air of unreality about them. From beginning to end all that Abraham does and suffers is peculiar to individuals. Mythical outlines are wholly wanting, even miracles are not ascribed to him (in contrast, for example, to Moses). Even his human failings are not disguised (his untruth, xii. 13; xx. 2; his frailty, xvi. 6; his doubts, xvii 7). Were his shape devised with something of the idea of establishing Israel's right to Canaan, one would look for some other sort of figure According to the later sagas—some of which have been preserved—the Patriarchs were mighty heroes who conquered the land with signs and miracles, and held firmly to the later sacrificial and food laws. It is just the unfavourable traits in the characters of the Patriarchs and the undesirable traits in their lives, and the consciousness of a difference between the patriarchal and the Mosaic periods as regards the idea of God and the cults, that must rest on an historical foundation

The Two Names: Abram and Abraham.—The double name is peculiar, *Ab-ram* means "the father is exalted" or "the exalted father"; the word "Patriarch" is really nothing more than a Greek translation of this name. Lesser known bearers of the name were called *Abiram* (Num xvi, etc). *Ab-rāhām* is the new name which the patriarch received from God from the moment of the solemn covenant (Gen xvii 5). A newer name—mostly with a slight variation (*cf.* Sarai-Sara, Hosea-Joshua, Eliakim-Jehoiakim, Saul-Paul)—indicates a new period in the life of the bearer This name is explained in Gen xvii 5 as "Father of a Multitude," which in Hebrew would be *Ab-hamon;* but the second part of the compound is preferably compared with the Arabic word for "crowd" (rūhām) This explanation is however probably a popular etymology. it is most probable that the two names Abram and Abraham mean precisely the same thing *Abram* may be the Accadian (Babylonian) and *Abraham* the Amorite (Canaanite) form of the same name Certainly among the Amorite peoples in Babylonia during the first dynasty one finds names like *Abaram, Abam-rama,* and probably even *Aba-raham* (*cf.* for the last form Lutz, *Early Babylonian Letters from Larsa* [1917], No 15) Thus it seems that this name was in use even in Abraham's old Babylonian home, the regions of Ur and of Larsa.

Chronological Questions.—For determining the date of Abraham the 14th chapter of Genesis is the starting point In this noteworthy chapter are given the names of Kings and lands, and Abraham appears as a war-like hero The identification of these kings with the great Babylonian king Hammurabi and those of his time would seem to be erroneous. It is probable that the chapter deals with a primitive expedition undertaken by two princes of the middle Euphrates (*Amraphel;* i e, *Amur-apil* and *Arioch* or *Āriaka*) in the service of the allied kings of *Khatti* (*Tid'al* or *Tid'alia, Dudhalia*). They were beaten by the attack of a much smaller number of Hebrews under Abraham: it was the unforgettable first military exploit of this people on Canaan soil. Now, of these kings we know from the cuneiform inscriptions that Tid'al (I) was the founder of a dynasty of the kingdom of the Hittites (Hatti), and that he lived somewhere about 1550 B C. (or at the latest 1450 B C). It is therefore probable that we must place the time of Abraham about this date With this agrees the little that we know of the political life of the dark age after the downfall of the Hyksos kingdom. The biblical chronology does not actually contradict this late dating, for the dates in Gen. xxi. 5; xxv. 26; xlvii. 9; Exod xii, 40 and 1 Ki. vi. 1 belong to an artificial scheme, whereby precisely 12 centuries elapse from the birth of Abraham to the building of Solomon's temple. To make up these 12 centuries the length of a generation was reckoned first as 100 years, then as 40. But the older literary sources in the Old Testament give another picture; above all, the genealogical tables present good ancient evidence. On the basis of statements such as are found in Gen. xv. 16; xxxvi. 31–39 (*cf.* Num. xx. 14); Gen. i 23; Exod. vi 16–20; Ruth iv. 18–22, the period between Abraham and David must at the most be reckoned as 600 years, probably much shorter.

From the historical point of view Abraham's journey from Mesopotamia to Canaan is directly bound up with the wandering of the Moabites, Ammonites and Edomites to the south-west and southern Canaan, and with the wanderings of the Aramaeans to Syria An invasion by the non-Semitic tribes of the Mitanni and Kharri (about 1600 B C) expelled these Hebrews and Aramaeans from their old homes on the middle Euphrates, in a south-westerly direction. In the course of this migration individual Hebrew families (viz., Abraham and his kindred) came to Canaan; but there was no intention in the first instance of conquering this ancient land of culture.

The Religious Significance.—It has been shown that Abraham's journey from Ur (Gen. xi. 28) via Harran (xi 31) to Canaan was merely a part of a greater movement of peoples But, according to Biblical tradition, this journey had a precise objective and aim; God's direct command already contained a religious motive (Gen. xii 1 *seq*) Abraham is no leader of a Bedouin tribe seeking plunder and conquest; his significance lies rather in the field of religion He is not, in the first instance, the progenitor of peoples, but the founder and crusader of a religious movement Like Mohammed, some 2,000 years later, he stood at the head of a great movement among the Semitic peoples and tribes. Naturally, his adherents were bound to each other firmly by blood ties Abraham's religion was characterized by abstraction and was yet personal. The *one* great God, throned in Heaven, honoured without priests and Temple, the Almighty and all-comprehending One, to whom the faithful have personal access—this is Abraham's God so far as we can gather from our sources And that is more important for us than the question of the details of the tradition While Abraham's forefathers in Mesopotamia served other gods (Josh xxiv 2), "The God who redeemed Abraham" was the same as the God of Moses (*cf* Exod iii 6, 13 *seq.*) and of Elijah (1 Ki xviii 36) According to the Old Testament, Abraham was the founder of the Israelite faith, and Moses the founder of the Israelite people and the reformer of Cults

Bibliography.—*See* Genesis, and the article by S A Cook in the previous edition of this encyclopædia Kittel, *Geschichte des Volkes Israel,* vol. i, pp. 270–290, Wilke, *War Abraham eine geschichtliche Person?* 1907, Gressmann, *Sage und Geschichte in den Patriarchenerzahlungen* (*Zeitschrift d Alt Test Wissenschaft*), 1910, pp. 1–31; on the word-plays and the form of the stories *see* Bohl, *Journal of the Palestine Oriental Society,* 1926, pp. 196–212; on the Chronology, Albright, "The historical background of Genesis xiv" (*Journ. of the Society of Oriental Research,* 1926, pp 231–269 The present writer has discussed the views taken above, in the *Zeitschrift der Alten Testaments Wissenschaft,* 1916, pp 65–73, 1924, pp 148–153; also in a commentary on *Genesis* (in Dutch), 2 vols (1923–25), and in a work (Dutch), *The Period of the Patriarchs* (1925). (F. M. T. B.)

ABRAHAM A SANCTA CLARA (1644–1709), Austrian divine, was born at Kreenheinstetten, near Messkirch. His real name was Ulrich Megerle. In 1662 he joined the order of Barefooted Augustinians, became a popular preacher, and assumed the name by which he is known. In this order he rose step by step until he became *prior provincialis* and *definitor* of his province. He died at Vienna on Dec. 1, 1709. In his published writings he displayed the same force and homeliness as in the pulpit. Perhaps the most favourable specimen of his style is his didactic novel entitled *Judas der Erzschelm* (Salzburg, 1686–95).

Bibliography.—His works have been several times reproduced in whole or in part, though with many spurious interpolations. The best edition is that published in 21 vols at Passau and Lindau (1835–54). *See* Th. G. von Karajan, *Abraham a Sancta Clara* (Vienna, 1867); H. Mareta, *Über Judas d. Erzschelm* (Vienna, 1875); Schnell, *Pater A. a S.C.* (Munich, 1895); Sexto, *Abraham a S.C.* (Sigmaringen, 1896); Blanckenburg, *Studien über die Sprache Abrahams a S.C.* (Halle, 1897).

ABRAHAM, WILLIAM (1842–1922), British Labour politician of the old school, was born in the Afon valley and went to work in a coal mine at the age of nine. He was affectionately known by the name of Mabon, a name originally adopted by him in Eisteddfod competitions. President of the South Wales Miners' Federation, he was a power in South Wales, and he remained a respected figure to the end. He sat in the House of Commons for Rhondda from 1885 to 1920, and died on May 14, 1922.

ABRAHAM IBN DAUD (*c.* 1110–80), Jewish historiographer and philosopher of Toledo. His historical work was the *Book of Tradition* (*Sepher Haqabala*), a chronicle down to the year 1161. It was translated into Latin by Génébrad (1519). His philosophy was expounded in an Arabic work better known under its Hebrew title *'Emunah Ramah* (*Sublime Faith*). This was translated into German by Weil (1882). Ibn Daud was one of the first Jewish scholastics to adopt the Aristotelian system. Maimonides owed a good deal to him.

ABRAHAM, THE PLAINS OF, a plateau to the southwest of the city of Quebec, the scene of the historic battle between the French under Montcalm and the English under Wolfe on Sept. 13, 1759. (*See* QUEBEC.)

ABRAHAMITES, a sect of deists in Bohemia in the 18th century, who professed to be followers of the pre-circumcised Abraham, and declined to be classed either as Christians or Jews Believing in one God, they contented themselves with the Decalogue and the Paternoster. As a religious sect they disappeared by the end of the century

ABRAHAM-MEN, the nickname for vagrants who infested England in Tudor times The phrase is as old as 1561, and was due to these beggars pretending that they were patients discharged from the Abraham ward at Bedlam On his discharge the genuine Bedlamite, provided he wore a badge, was allowed to roam the country, soliciting alms. This humane privilege was grossly abused, and thus gave rise to the slang phrase "to sham Abraham"

ABRAMS, LEROY (1874–), American botanist, was born in Sheffield, Ia, Oct. 1, 1874 He graduated at Stanford university, Calif., in 1899, continued study there in 1900–04 and at Columbia university in 1904–05, receiving his Ph D degree in 1910 In 1906 he became assistant professor of botany in Stanford university; in 1912, associate professor, and in 1920 was made professor of botany and curator of the Dudley herbarium His researches have been connected chiefly with the flora of the Pacific coast region of the United States His published works include *Flora of Los Angeles and Vicinity* (1904, 1917), *A Phytogeographical and Taxonomic Study of the Southern California Trees and Shrubs* (1910) and *Illustrated Flora of the Pacific States* (1923).

ABRANTES, a town of central Portugal, in the district of Santarem, on the right bank of the river Tagus Pop (1920), 7,215. Abrantes is a fortified town, with trade in fruit, olive oil and grain. It is of military value as it commands the highway down the Tagus valley to Lisbon Founded about 300 B C as an Iberian settlement, it was called Aurantes by the Romans; perhaps owing to the alluvial gold (*aurum*) of the Tagus It was captured on Nov 24, 1807, by the French under General Junot, who for this achievement was created duke of Abrantes By the Convention of Cintra (Aug. 22, 1808) the town was restored to the British and Portuguese.

ABRASIVES. Abrasion is a scratching action and depends on the relative hardness of the two materials—the abrasive and the one abraded. The degree of hardness of a material, as determined by scratching, has long been used by mineralogists for distinguishing one mineral from another, and F. Mohs in 1820 devised a scale of hardness for minerals, which is still in use Mohs's scale is:—

1. Talc.	5. Apatite.	8. Topaz.
2. Gypsum.	6. Felspar.	9. Corundum.
3. Calcite.	7. Quartz.	10. Diamond
4. Fluorite.		

Diamond at No. 10 is the hardest of all minerals and indeed of all known substances. Steel (a knife-blade or file) will scratch felspar but not quartz, and it is itself scratched by quartz; it can therefore be set at 6½ on the scale. Window-glass at 5½ can be abraded and polished by felspar. The higher a material stands in the scale the more efficient is it as an abrasive, diamond being the most efficient of all.

Mohs's scale is arbitrary and merely comparative, and it gives no absolute measure of the degree of hardness of a material. Attempts have been made to arrive at this by various methods. such as by measuring under a microscope the depth of scratch produced by a diamond point under a certain load; or by determining the amount of work done in grinding away a certain weight or volume of material. From such experiments it is found that the gap between 10 and 9 on Mohs's scale is even greater than that between 9 and 1, emphasizing again the efficiency of diamond as an abrasive.

Brittleness or friability is another physical character to be considered in addition to hardness Carborundum although exceeding corundum in hardness is much more brittle, and it soon crushes and rubs down to a fine flour. Diamond with rough usage breaks along the directions of perfect cleavage in the crystal For this reason carbonado, a compact aggregate of minute diamond crystals, rather than a single crystal, is used in rock-drills.

The form in which abrasives are used varies for different purposes. The material may be crushed and sieved to different degrees of fineness. This may be used as a loose powder for grinding; or it may be glued on cloth or paper, or bonded with cements in the form of grinding wheels or hones Other abrasives are used in block form cut to a suitable shape, as grindstones, millstones, scythe-stones, whetstones, pumice blocks, etc. Besides being used for grinding and polishing metal, stone, wood, leather, etc, abrasives are also employed for cutting, drilling, and boring

In addition to natural minerals, certain artificial products are also used for abrasive purposes. For example, powdered glass as glass-paper, crushed steel for stone cutting, and the important carborundum Corundum is also produced artificially on a large scale Carbides of boron, tantalum, and tungsten are extremely hard, and these may in the future find technical applications.

In the following list the various abrasive agents are arranged according to their degree of hardness, *i e*, in the order of their efficiency. Further information respecting each of these materials will be found in the separate articles (*see* DIAMOND, etc).

Diamond (Hardness = 10). This is a crystallized form of carbon, and only the natural mineral is available Cloudy, spotted, and imperfectly crystallized stones, known as bort, and small fragments that cannot be cut as gems are crushed to powder for use as an abrasive Diamond powder is the only material with which diamond itself can be ground and polished

Carborundum (H = 9½) This artificial product is a crystallized carbide of silicon (CSi), and since its discovery in 1891 it has more and more replaced mineral abrasives It is produced in large quantities by heating coke and sand in electric furnaces at Niagara Falls It is used in the form of powder either loose or on cloth, or is made up with porcelain, shellac, or other bonding material in the form of grinding wheels, hones, etc This material is sold under a variety of trade-names—crystolon, carbolon, samite, etc

Corundum (H = 9) is the crystallized oxide of aluminium (Al_2O_3), a mineral which in its gem varieties is ruby and sapphire Rough corundum is found as large crystals in certain kinds of igneous rock in Canada, North Carolina, Ural Mountains, Madagascar, South Africa, the last being now the principal producer of material for abrasive purposes. *Emery* is an impure granular variety of corundum mixed with magnetite and other minerals, and it is not quite so hard as the purer crystal or rock corundum It is mined in Naxos, Asia Minor, and the State of New York Much corundum is now produced artificially by fusing bauxite in electric furnaces at Niagara Falls, the product being sold under the names alundum, adamite, aloxite, lionite, etc.

Garnet (H = 6½–7½) as mined in the eastern United States and in Spain for abrasives is mainly the almandine variety, a silicate of iron and aluminium It is largely used for making garnet-paper (often sold as "emery-paper").

Quartz (H = 7) is a crystallized form of silica (oxide of silicon, SiO_2) and is the commonest of all minerals, occurring in a bewildering variety of forms It finds extensive applications as an abrasive. Millstones, grindstones, and pulpstones (for grinding wood in the manufacture of paper) are made of quartz-rock, quartzite, burrstone, grit, or sandstone. Whetstones are made of hornstone, lydian-stone, Arkansas-stone, and other compact varieties of quartz. In the form of sand, quartz is used as a sand-blast, as sand-paper, in scouring-soap, and for cutting and grinding

marble. Pebbles and flints are used for grinding cement materials and clinker.

Steel (H. = 6½). Crushed crucible steel, crushed cast iron, and steel shot are used in stone cutting.

Felspar (H. = 6), the potash-felspar, orthoclase or microcline ($KAlSi_3O_8$), is used for polishing plate-glass and in scouring-soaps.

Glass (H. = 5½), powdered glass as glass-paper or "sand-paper"

Pumice (H. = 5½), a natural volcanic glass blown by included steam into a cellular mass. The best block pumice is from the Lipari Islands, and enormous quantities of pumice-dust are available in the United States.

Opal (H.=5), a hydrated glassy form of silica, found in a powdery form as large deposits of tripoli, diatomaceous or infusorial earth, and largely used for polishing and in scouring-soap.

Rotten-stone, chalk, rouge, putty-powder, and other softer grinding and polishing materials might also be mentioned.

Abrasives, in the household, are substances of an erosive nature used for polishing or cleaning purposes. Those best suited for this use are fine sand, emery, crushed pumice and chert, which consists of siliceous skeletons of sponges and marine shells. These materials are often mixed with a solution of soap, so that there is a cleansing action as well. In the cleaning of aluminium, steel wool, in combination with an abrasive powder or soap, has a wide usage. Abrasives are in very general use to-day and have done much to lighten the housewife's work. They may be purchased in paste, powder or cake form and used for cleaning and polishing all kinds of metals, as well as scouring paint and enamel ware.

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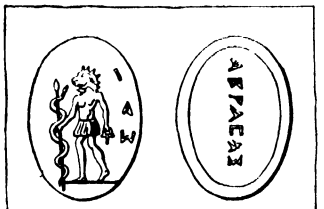
(L J S)

ABRAUM SALTS (from the German *Abraum-salze*, salts to be removed), the name given to a mixed deposit of salts, including chlorides and sulphates of sodium, potassium and magnesium, found in association with rock-salt at Stassfurt in Prussia

ABRAXAS or **ABRASAX,** a word probably first used by the Basilidians and engraved on certain antique stones, called on that account *Abraxas stones*. The letters of ἀβραξάς in the Greek notation make up the number 365, and the Basilidians gave the name to the 365 orders of spirits which emanated in succession from the Supreme Being. These orders were supposed to occupy 365 heavens, each fashioned like but inferior to that above it, the lowest being the abode of the spirits who formed the earth and its inhabitants, to whom was committed the administration of its affairs. In addition to the word Abraxas the stones often have cabalistic figures engraved on them.



OBVERSE AND REVERSE OF AN ABRAXAS STONE ATTRIBUTED TO THE BASILIDIANS, FOLLOWERS OF THE GNOSTIC, BASILIDES

ABROGATION, the annulling or repealing of a law by legislative action or by usage. Abrogation, which is the total annulling of a law, is to be distinguished from the term *derogation,* which is used where a law is only partially abrogated Abrogation may be either express or implied. It is express either when the new law pronounces the annulment in general terms, as when in a concluding section it announces that all laws contrary to the provisions of the new one are repealed, or when in particular terms it announces specifically the preceding laws which it repeals. It is implied when the new law contains provisions which are positively contrary to the former laws without expressly abrogating those laws. The abrogation of any statute revives the provisions of the common law which may have been abrogated by that statute. (*See* STATUTE; REPEAL)

ABRON, a longheaded tribe, physically akin to the Fanti, living on the Ivory Coast (Bondoukou region) and between Kintampo and Salaga, Gold Coast. The natives are husbandmen and traders, and they practise Animism. There are small kingdoms made up of several provinces. The family is constituted by several sub-groups which embrace a number of households. Marriage between cross-cousins is frequent. Descent is reckoned in the paternal lines. Inheritance passes to the maternal uncle, then to the nephew, the sister's son. Society consists of (*a*) nobles, (*b*) freemen, and (*c*) slaves and descendants of slaves. The judiciary organization is fairly well developed.

See Tauxier, *Le Noir de Bondoukou* (1921).

ABRUZZI E MOLISE, a group of provinces (*compartimento*) of Southern Italy. The total area is 5,951 sq m and the population (1921) 1,399,980. The interior is mountainous including the central portion of the Apennines and their culmination, the *Gran Sasso d'Italia.* The coastal hills consist mainly of somewhat unstable clay and sand; the zone of level ground along the coast is quite inconsiderable. The 100 miles of coastline have not a single harbour of importance. Climate varies with altitude, the highest peaks being covered with snow for most of the year, while the valleys running north-east towards the sea are fertile and well watered by several small rivers, the chief of which are the Tronto, Vomano, Pescara, Sangro, Trigno and Biferno. These are fed by minor streams, such as the Aterno and Gizio, with valleys between the main chains of the Apennines. They may be suddenly swollen by rains, and floods and landslips often cause damage. This danger has been increased, as elsewhere in Italy, by indiscriminate timber-felling without provision for reafforestation, though considerable oak, beech, elm and pine forests still exist and are the home of wolves, wild boars and even bears. The woods have large herds of swine, and the hams and sausages of the Abruzzi are famed. The rearing of cattle and sheep was at one time the chief occupation, and many flocks are still driven down to the Campagna di Roma for the winter and back again in the summer, but more cultivation is now done, especially in the valleys and in the now drained bed of Lago Fucino where beet sugar is produced. Industries are small but various: *e.g.,* arms and cutlery at Campobasso and Agnone and majolica at Castelli and elsewhere. Liqueurs are also made in several places The river Pescara and its tributary the Tirino form an important source of power for generating electricity. Communications are not easy. Railways are (1) the coast railway (a part of the Bologna-Brindisi line), with branches from Giulianova to Teramo and from Termoli to Campobasso; (2) a line diverging S.E. from this at Pescara and running via Sulmona (whence there are branches via Aquila and Rieti to Terni, and via Carpinone to (a) Isernia and Caianello, on the line from Rome to Naples, and (b) Campobasso and Benevento), and Avezzano (whence there is a branch to Roccasecca) to Rome, (3) a connecting line between the coastline (at Ortona and S Vito Lanciano) and the line from Solmona to Isernia (at Castel di Sangro). There are, consequently, no large towns. The district was, in Lombard times, part of the duchy of Spoleto, and, under the Normans, a part of that of Apulia; it was first formed into a single province in 1240 by Frederick II., who placed the *Justiciarius Aprutii* at Sulmona and founded the city of Aquila After the Hohenstaufens lost their Italian dominions, the Abruzzi became a province of the Angevin kingdom of Naples, to which it was of great strategic importance.

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ABRUZZI, DUKE OF THE (1873–), Italian vice-admiral and explorer, son of Amadeo, duke of Aosta, was born at Madrid Jan. 29, 1873, and named Luigi Amadeo. Although he had a distinguished naval career he achieved fame also as a traveller and mountaineer. He was the first to ascend Mt. St. Elias in Alaska (1897) and in 1899 he organized a North Pole expedition, part of which reached lat. 86° 3′ N, at that time the record of northern exploration, he himself being forced to remain behind owing to frostbite. In 1906 he was the first to ascend the Ruwenzori in East Africa, reaching the twin summits (16,800 ft.) which he named Margherita and Alexandra, and making the first detailed map of the Ruwenzori. In 1909 he explored the Central Karakoram in the Himalayas and by ascending peak K2 achieved the record for height. During the World War he commanded the naval

forces in the Adriatic, but he resigned in 1917 owing to disagreements with Admiral Thaon di Revel, his chief of staff, and retired from the service. Afterwards he undertook to carry out an important colonization scheme in Italian Somaliland.

English translations of his works are *The Ascent of Mount St. Elias* (1900); *Ruwenzori* (1909).

ABSALOM, the third son of David, and his father's favourite. The picture presented in II. Sam. xiii.–xix. (which deals mainly with his life) suggests that he was the Alcibiades of the Old Testament, alike in his personal attractiveness, his lawless insolence and his tragic fate. He is first mentioned as murdering his half-brother Amnon, David's eldest son, in revenge for the rape of his full sister Tamar. This deed drove him into banishment, but he was eventually restored to favour through the good offices of Joab. Later, when, some uncertainty seems to have arisen as to the succession, Absalom organized a revolt. For a time he seemed to be completely successful; David with a few followers and his personal guard fled across the Jordan, leaving to Absalom Jerusalem and the main portion of the kingdom. The usurper pursued the fugitives with his forces but was completely defeated in "the wood of Ephraim" (apparently *west* of Jordan, if the text be right), and killed by Joab, who found him caught by the hair in an oak-tree. To the affectionate chivalrous heart of David, the loss of his son, worthless and treacherous as he was, brought grief which more than outweighed his own safety and restoration.

ABSALON (*c.* 1128–1201), Danish archbishop and statesman, was born about 1128, the son of Asser Rig of Fjenneslev, at whose castle he and his brother Esbjorn were brought up with the young prince Valdemar, afterwards Valdemar I. He was sent later to the University of Paris. Absalon first appeared in Saxo's chronicle as a fellow-guest at Roskilde, at the banquet given in 1157 by King Sweyn to his rivals, Canute and Valdemar. Both Absalon and Valdemar narrowly escaped assassination at the hands of their treacherous host on this occasion, but at length escaped to Jutland, whither Sweyn followed them, to be defeated and slain at the battle of Grathe Heath

In the same year (1158) in which Valdemar ascended the Danish throne, Absalon was elected bishop of Roskilde. Henceforth Absalon was the chief counsellor of Valdemar, and the promoter of that imperial policy which, for three generations, was to give Denmark the dominion of the Baltic. Briefly, it was Absalon's intention to clear the northern sea of the Wendish pirates, who inhabited that portion of the Baltic littoral which we now call Pomerania, and ravaged the Danish coast so unmercifully that at the accession of Valdemar one-third of the realm of Denmark lay waste and depopulated. The very existence of Denmark demanded the suppression and conversion of these stiff-necked pagan freebooters, and to this double task Absalon devoted the best part of his life.

The first expedition against the Wends, conducted by Absalon in person, set out in 1160, but it was not till 1168 that the chief Wendish fortress, at Arkona in Rugen, containing the sanctuary of their god Svantevit, was surrendered, the Wends agreeing to accept Danish suzerainty and the Christian religion at the same time. From Arkona Absalon proceeded by sea to Garz, in South Rugen, the political capital of the Wends, and an all but impregnable stronghold. But the unexpected fall of Arkona had terrified the garrison, which surrendered unconditionally at the first appearance of the Danish ships. Absalon, with only Sweyn, bishop of Aarhus, and 12 "housecarls," thereupon disembarked, passed between a double row of Wendish warriors, 6,000 strong, along the narrow path winding among the morasses, to the gates of the fortress, and, proceeding to the temple of the seven-headed god Rügievit, caused the idol to be hewn down, dragged forth and burned. The whole population of Garz was then baptized, and Absalon laid the foundations of 12 churches in the isle of Rugen.

The destruction of this chief sally-port of the Wendish pirates enabled Absalon considerably to reduce the Danish fleet. But he continued to keep a watchful eye over the Baltic, and in 1170 destroyed another pirate stronghold, farther eastward, at Dievenow on the isle of Wollin. Absalon's last military exploit was the annihilation, off Strela (Stralsund), on Whit Sunday 1184, of a Pomeranian fleet which had attacked Denmark's vassal, Jaromir of Rügen.

He was now only 57, but his strenuous life had aged him, and he was content to resign the command of fleets and armies to younger men, like Duke Valdemar, afterwards Valdemar II, and to confine himself to the administration of the empire which his genius had created. The aim of his policy was to free Denmark from the German yoke. It was contrary to his advice and warnings that Valdemar I rendered fealty to the emperor Frederick Barbarossa at Dôle in 1162; and, when, on the accession of Canute V. in 1182, an imperial ambassador arrived at Roskilde to receive the homage of the new king, Absalon resolutely withstood him.

"Return to the emperor," cried he, "and tell him that the king of Denmark will in no wise show him obedience or do him homage."

As the arch-pastor of Denmark, Absalon also rendered his country inestimable services, building churches and monasteries, introducing the religious orders, founding schools and doing his utmost to promote civilization and enlightenment. It was he who held the first Danish Synod at Lund in 1167. In 1178 he became archbishop of Lund, but very unwillingly, only the threat of excommunication from the Holy See finally inducing him to accept the pallium Absalon died on March 21, 1201, at the family monastery of Soro, which he himself had richly embellished and endowed.

Absalon remains one of the most striking and picturesque figures of the middle ages, and was equally great as churchman, statesman and warrior There can be no doubt that he enjoyed warfare; and his splendid physique and early training had well fitted him for martial exercises He was the best rider in the army and the best swimmer in the fleet Yet he was not like the ordinary fighting bishops of the middle ages, whose sole concession to their sacred calling was to avoid the "shedding of blood" by using a mace in battle instead of a sword Absalon never neglected his ecclesiastical duties, and even his wars were of the nature of crusades Moreover, all his martial energy notwithstanding, his personality must have been singularly winning; for it is said of him that he left behind not a single enemy, all his opponents having long since been converted by him into friends.

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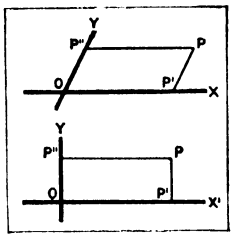
(R N B.)

ABSCESS, a collection of pus localized in solid tissues. When situated in a cavity special names are applied; *e g*, empyema (pleural cavities), hypopyon (aqueous chamber of eye), pyosalpinx (Fallopian tube). The usual method of formation is as follows When staphylococci or other pyogenic organisms have reached some spot, being carried thither by the blood stream or directly introduced, they begin to multiply and form their specific toxin This causes death of tissue cells in the neighbourhood and the resulting proteid material serves as nutriment for further multiplication of the organisms The irritant action of the toxins leads to local inflammatory changes in the tissues whereby extension of bacterial growth and effects are limited. The inflammatory fluid poured out by the congested blood vessels (*see* INFLAMMATION) coagulates (hence the early firmness to touch), but the coagulum and the dead tissue cells are soon liquefied by ferments produced by the bacteria (hence the fluidity of the contents of an abscess)

Throughout the whole process multitudes of leucocytes have left the blood vessels and collected at the seat of inflammation. These give to the abscess fluid its characteristic creamy appearance. Were it not for the zone of surrounding inflammation the irritant and destructive action of the micro-organisms would extend indefinitely, and something akin to this occurs if the bacteria be particularly virulent or the resisting powers of the individual unusually low. The fluid in an abscess "points" in the direction of least resistance. Frequently this is towards the surface, or the pus may track along the muscle. When an abscess

opens on the skin, the repair tissue in its walls usually brings about healing through the formation of scar tissue; when it opens into a serous cavity (*see* COELOM) it leads to a generalized suppuration probably fatal unless surgically treated with success (W. S. L.-B.)

ABSCISSA. In Cartesian co-ordinates (*see* CO-ORDINATES) the abscissa of a point (P) is the part (OP') of the x axis lying between the origin (O) and the point (P') where a line (PP') parallel to the y axis cuts the x axis. In each of the two figures, the line-segment PP'' is also called the abscissa of P. The axis of x (OX) is called the *axis of abscissas*. The term was used in its technical sense by Pietro Mengoli in 1659.



ABSCISSION, a tearing away, or cutting off; a term used sometimes in prosody for the elision of a vowel before another, and in surgery especially for abscission of the cornea, or the removal of that portion of the eyeball situated in front of the attachments of the recti muscles; in botany, the separation of spores by elimination of the connection.

ABSCOND, to depart in a secret manner; in law, to remove from the jurisdiction of the courts or so to conceal oneself as to avoid their jurisdiction. A person may "abscond" either for the purpose of avoiding arrest for a crime (*see* ARREST) or for a fraudulent purpose, such as the defrauding of his creditors (*see* BANKRUPTCY).

ABSENCE, the fact of being "away," either in body or mind. The special occasion roll-call at Eton College is called "Absence," which the boys attend in their tall hats. A soldier must get "leave of absence" before he can be away from his regiment. Seven years' absence with no sign of life either by letter or message is held, by English law, to be presumptive evidence of death.

ABSENTEEISM, a term used primarily of landed proprietors who absent themselves from their estates, and live and spend their incomes elsewhere; in its more extended meaning it includes all those (in addition to landlords) who live out of a country or locality but derive their income from some source within it. Absenteeism is a question which has been much debated, and from both the economic and moral point of view there is little doubt that it has a prejudicial effect. To it has been attributed in a great measure the unprosperous condition of the rural districts of France before the Revolution, when it was unusual for the great nobles to live on their estates unless compelled to do so by a sentence involving their "exile" from Paris. It has also been an especial evil in Ireland, and many attempts were made to combat it. As early as 1727 a tax of four shillings in the pound was imposed on all persons holding offices and employments in Ireland and residing in England. This tax was discontinued in 1753, but was re-imposed in 1769. In 1774 the tax was reduced to two shillings in the pound, but was dropped after some years. It was revived by the Independent Parliament in 1782 and for some ten years brought in a substantial amount of the revenue, yielding in 1790 as much as £63,089.

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ABSINTHE, a highly toxic liqueur or aromatized spirit, the characteristic flavouring matter of which is derived from various species of wormwood (*Artemisia absinthium*). Among the other substances generally employed in its manufacture are angelica root, sweet flag, dittany leaves, star-anise fruit, fennel and hyssop. The Swiss variety has a higher alcoholic strength than the French. The best absinthe contains 70 to 80% of alcohol. It quickly intoxicates, and its deleterious effects are more serious than those of other forms of alcohol. The wormwood acts powerfully upon the nerve-centres, and causes delirium and hallucinations, followed in some cases by idiocy. (*See* LIQUEURS.)

ABSOLUTE. The term *absolute* is frequently used in contrast with the terms *relative, comparative, conditioned,* etc.

(a) Absolute and Relative, Etc.—(1) Sometimes the contrast intended is that between what expresses a relationship and what does not. In Logic, for instance, a term is described as *relative* when its function is to indicate some definite relationship in which the object named stands to some other object denoted by the correlative term. Thus *teacher* is called a relative term because it indicates the relationship in which somebody, say Socrates, stands or stood to somebody else, for instance, Plato, who is consequently designated by the correlative term *disciple,* or pupil. But a term that indicates no relationship is called *absolute.* Thus the names Socrates and Plato are called absolute terms because they do not indicate any definite relationship in which Socrates and Plato stood to each other. (2) More commonly the contrast intended is that between what a thing is *relatively* to something else (or in comparison with certain other things) and what it is in itself (that is, apart from such comparisons), or *absolutely.* In this sense one sometimes contrasts what is *relatively* or *approximately* true with what is absolutely true, or what is *comparatively* beautiful, or large, or old, etc., with what is *absolutely* so. (3) Intimately connected with the preceding distinction between *absolute* and *relative,* etc., is yet another distinction, which is perhaps the commonest of all. This is the contrast between what is subject to certain reservations or conditions and what is not subject to conditions or reservations. Thus, for example, *relative* success may mean success under certain difficult circumstances, while *absolute* success would mean complete success, without any reservations. In this way *absolute* monarchy means monarchical government not subject to any conditions or reservations, whereas *constitutional* monarchy means monarchical government subject to certain reservations or restrictions formulated in the constitution of the country. Similarly a system of ethics conceived to be valid for all times under all conditions would be described (by H. Spencer, for instance) as *absolute,* whereas a system of ethics conceived to be valid only under certain conditions of time, place or circumstance, would be called *relative,* or local, or temporary, etc. (4) The foregoing distinction naturally leads to yet another distinction; namely, that between that which is conditioned by, or dependent on, something else and that which is independent of, or unconditioned by, anything else. In philosophy, *absolute* frequently means "independent" or "unconditioned." When certain philosophers speak of "absolute truth," or of "absolute value," they mean that there are truths, or values, as the case may be, that are objective, independent or self-dependent, and not relative to, or dependent upon, individual thinkers or seekers.

(b) The Absolute.—This term owes its great vogue in recent times mainly to the German Idealists (Fichte, Schelling, Hegel, etc.) and their followers. But the main idea which it expresses is already found in Plato; and both the idea and the term were familiar to Thomas Aquinas, Giordano Bruno, Benedict Spinoza, and many others, long before the period of German Idealism. The use of the term is intimately connected with the last of the above-mentioned applications of the term *absolute* (4). Spinoza describes substance (that is, Nature, God or the Universe) as *absolutely* infinite, in contrast with its ultimate attributes, which are infinite each *in its kind* only; and absolutely infinite substance is conceived by Spinoza as the self-existing, independent, unconditional ground of all that is. It is the ultimate ground of all reality that is always, or nearly always, meant by *the Absolute.* But different systems of philosophy hold out different views as regards both the reality and the nature of the absolute. In Vaihinger's *Philosophy of "As If,"* the *Absolute* is a fiction. For Hamilton, Mansel and Spencer the Absolute is the *Unknown;* for Kant the Absolute (or Noumenon) is even *Unknowable.* Theists identify the Absolute with God; pantheists, with the Universe;

Schopenhauer and Wundt, with Will; Bergson, with a Life-force characterized by creative evolution; Fechner and Lipps, with Consciousness; Bradley, with Experience; Joel, with the Potentiality of all that is real; Lotze and Royce, with self-conscious Personality; Alexander, presumably with the Space-time matrix of all reality. Hegel, whose philosophy is most intimately connected with the conception of the Absolute, identified it with the Universal Spirit, which by a process of logical or dialectical development takes on one predicate after another until it manifests itself as an objective world in perfect harmony with reason

BIBLIOGRAPHY.—Histories of Philosophy by Erchmann, Windelband, etc., the works of Hegel, Bradley and the other philosophers referred to in the text. (A. WO)

ABSOLUTE DIFFERENTIAL CALCULUS: *see* TENSOR ANALYSIS.

ABSOLUTE MUSIC, a term applied to music of a purely abstract type, devoid of any non-musical or extra-musical significance, as distinguished from that of the pictorial or descriptive kind known as "programme music" (*q v*)

ABSOLUTE TEMPERATURE SCALE, the scale of temperature based on thermodynamics (*q v*), also called the *Kelvin Scale* after Lord Kelvin (*q v*). The temperature scale derived from the law of expansion of a *perfect gas* (*q v*), is identical with this thermodynamical scale The usual abbreviations for absolute scale are abs., A, or K Comparing it (approximately) with the centigrade scale (*q v*), 0° C = 273° A, 100° C = 373° A, thus *absolute zero* is equivalent to −273° C. (*See* THERMODYNAMICS and THERMOMETRY)

ABSOLUTE UNITS, units of measurement of a physical quantity in terms of the fundamental units of length, mass and time, the British Association selected, as their fundamental units, the centimetre, the gramme, and the second of mean solar time, and thus formed the C G S system of units (*See* UNITS, DIMENSIONS OF, and UNITS, PHYSICAL)

ABSOLUTION (religious) denotes the setting of the penitent sinner free from the guilt of his sin, or from the ecclesiastical penalty (excommunication), or from both The authority of the church or its minister to pronounce or refuse forgiveness is implied in II Cor. ii 5–11, and Acts v. 1–9 (*cf* James v 15, 16), and was derived from the tradition of our Lord's teaching, *see* John xx 23 (in Matt xviii 18, binding and loosing probably mean forbidding and allowing) In primitive times, when confession of sins was made before the congregation, the absolution was deferred till the penance was completed, and there is no record of the use of any special formula The penitent was reconciled by imposition of hands by the bishop, with or without the clergy. Later the office was usually discharged by priests, and the outward action more and more disused It became the custom to give the absolution to penitents immediately after their confession and before the penance was performed Until the middle ages the form of absolution after private confession was of the nature of a prayer, such as "May the Lord absolve thee"; and this is still the practice of the Greek church But about the 13th century the Roman formula was altered, and the Council of Trent (1551) declared that the "form" and power of the absolution lay in the words *Ego te absolvo*, etc., and that the accompanying prayers are not essential to it Of the three forms of absolution in the Anglican Prayer Book, that in the Visitation of the Sick (disused in the church of Ireland and in the United States) runs "I absolve thee," tracing the authority so to act through the church up to Christ: the form in the Communion Service is precative, while that in Morning and Evening Prayer is indicative indeed, but so general as not to imply a decree of absolution. (W O. B)

In civil law absolution signifies the acquittal of an accused person on the ground that the evidence has either disproved or failed to prove the charge against him. The term is now little used, except in Scottish law in the forms *assoilzie* and *absolvitor*.

ABSOLUTISM. The term *absolutism* is generally applied to any view or theory that the object under consideration (whatever it may be) is not merely conventional, or subjective, or dependent, or limited in any way, but absolute, that is real or valid in itself, or objective, or independent, or unrestricted. (*See* ABSOLUTE) (1) In *ethics*, absolutism is the view that moral distinctions are not the result of mere arbitrary commands of God, or of human conventions variable according to circumstances, but that they are intrinsically valid, and the same for all human beings, at all times, and in all places. (2) In *aesthetics*, absolutism is the view that distinctions of beauty and ugliness are not entirely dependent on the subjective feelings of the percipient mind, but that they are objective differences in things themselves, like the primary qualities of material objects (*See* QUALITIES) Absolutism maintains accordingly that aesthetic appreciation should not be regarded as merely a matter of taste about which people must agree to differ (*de gustibus non disputandum*), but that there is an objective or absolute standard of beauty by which aesthetic judgment ought to be guided. The fact that even art specialists are frequently at variance is accounted for by absolutists by the suggestion that individuals vary in their powers of apprehending aesthetic qualities just as they vary in other capacities (3) In *political theory*, absolutism denotes a form of government in which the sovereign exercises almost complete power unrestrained by such laws and reservations as characterize what is commonly called constitutional government Hence absolutism is sometimes used as the equivalent of *despotism*.

ABSORPTION OF LIGHT: *see* LIGHT

ABSORPTION SPECTRUM, the dark lines and bands produced in another spectrum (*q v*) when the light responsible for the latter has passed through a substance at a lower temperature than its source (*See* SPECTROSCOPY)

ABSTEMII, a name formerly given to such persons as could not partake of the cup of the Eucharist on account of their aversion to wine (Lat *abs*, "away from"; *temetum*, "intoxicants"). In modern times many total abstainers, holding that the use of intoxicants is to be condemned absolutely, communicate in the unfermented "juice of the grape," sometimes also alleging that the wine used by Christ and his disciples at the Last Supper was unfermented

ABSTINENCE, the fact or habit of refraining from anything, usually from indulgence of the appetite. A "total abstainer" is one who takes the pledge to abstain from alcoholic liquor (*see* TEMPERANCE) Abstinence in the Christian Church, is a moderate form of fasting (*q v*).

"Abstinence" was also a term in economics, now fallen into disuse, applied to the postponement or sacrifice of present satisfaction for the sake of future gain It remains true that no person will save except for the purpose of securing some future advantage for himself or for others As Taussig puts it, "present resources will not be cancelled for future resources unless some inducement be offered" This is true equally of individual or of communal saving; thus, a Collectivist or Socialist Government could only provide capital for the prosecution of industry or for future social satisfactions by drafts upon current income, *i e*, by performing an act of national abstinence (*See* ECONOMICS)

ABSTRACT and **ABSTRACTION.** The term *abstract* is sometimes used as a noun to denote a summary or digest of a document Such an *abstract* is usually obtained by selecting what is essential and omitting the rest Speaking generally, the process of *abstraction* is usually a process of selection of some part or aspect of a complex whole, and of consequent neglect of the rest. The result of such a process of "withdrawal" (in the twofold sense of *selecting* a part and *neglecting* the rest) is commonly described as *abstract*

In logic, *e g*, abstract terms are distinguished from concrete terms, the latter denote objects consisting of a whole complex of attributes and standing in various relations, whereas the former designate some quality or relation isolated or abstracted from its concrete context For instance, "motor" and "relative" are concrete terms, whereas "motion" and "relationship" are abstract terms. But there are degrees of abstraction—the selection may be less or more restricted, and the consequent neglect more or less extensive. This may be readily seen if one passes in review such a series of terms as, say, "the horse that won the Derby in 1927," "race-horse," "horse," "quadruped," "animal," "life" Of these terms only the last would be called *abstract*, but really all the

terms in the series except the first are obtained by abstraction. In fact all general terms, or common nouns, are the result of abstraction. That is why some of the earlier logicians and psychologists applied the epithet *abstract* to what are now usually called general concrete terms. It is just a matter of convenience and convention that only the more abstract terms are now called *abstract*, the less abstract terms being called *general*.

In the past too much stress used to be laid on the negative side of abstraction, that is, on the mere neglect of certain parts or aspects of the concrete whole. It is now realized more fully that the process is mainly positive in character. It is a process of positive selection, not merely one of omission, though of course it involves omission. The relative stress on the positive and the negative sides of the process of abstraction really varies considerably. When the process is merely spontaneous, or not deliberate, the negative character of abstraction is probably more prominent; when it is deliberate, that is, a process of voluntary attention, the positive phase is the more marked.

Abstraction is of great importance for all real knowledge, especially for science and philosophy. The aim of all scientific knowledge is the discovery of laws expressing the relation or correlation between various aspects of reality, such as mass and gravitation, volume and pressure, or temperature and volume; and it is by processes of abstraction that these phases of reality are isolated and followed up. (A. Wo.)

ABSTRACT OF TITLE, in law, a digest or epitome of the various instruments and events under and in consequence of which the vendor or mortgagor of an estate derives his title thereto. The system of registration has much affected the necessity for this abstract being prepared or used. (*See* CONVEYANCING and REGISTRATION.)

ABT, FRANZ (1819–1885), German composer, was born at Eilenburg, Saxony, and died at Wiesbaden. His songs and part-songs enjoyed an extraordinary vogue throughout the world in the middle of the 19th century, and are still popular. Abt was kapellmeister at Bernburg in 1841, at Zurich in the same year and at Brunswick from 1852 to 1882, when he retired to Wiesbaden.

ABU, a mountain of central India, situated within the Rajputana State of Sirohi. It is an isolated peak of the Aravalli range, being completely detached from that chain by a narrow valley 7m. across, in which flows the western Banas. It rises from the surrounding plains of Marwar like a precipitous granite island, its various points ranging from 4,000 to 5,653 feet. The elevations and platforms of the mountain are covered with elaborately sculptured shrines, temples and tombs. On the top of the hill is a small round platform containing a cavern, with a block of granite, bearing the impression of the feet of Data-Bhrigu, an incarnation of Vishnu. The two principal temples, at Dilwarra, about the middle of the mountain, are built of white marble, and are pre-eminent alike for their beauty and as typical specimens of Jain architecture in India. The more modern of the two was built by two brothers, rich merchants, between the years 1197 and 1247, and for delicacy of carving and minute beauty of detail stands almost unrivalled, even in this land of patient and lavish labour. The other was built by Vimala, a local governor, apparently about A.D. 1032; simpler and bolder in style, it is one of the oldest as well as one of the most complete examples of Jain architecture known. The principal object within the temple is a cell lighted only from the door, containing a cross-legged seated figure of the god Parswanath. The portico is composed of 48 pillars, the whole enclosed in an oblong courtyard about 140ft. by 90ft., surrounded by a double colonnade of smaller pillars, forming porticos to a range of 52 cells, each of which is occupied by an image of Parswanath. The whole interior is magnificently ornamented.

Abu is now the summer residence of the governor-general's agent for Rajputana, and a place of resort for Europeans in the hot weather. The annual mean temperature is about 70°, rising to 90° in April; but the heat is never oppressive. The annual rainfall is about 68 inches.

ABU-BEKR (573–634), the name ("Father of the virgin") of the first of the Mohammedan caliphs (*see* CALIPH). He was originally called Abd-el-Ka'ba ("servant of the temple"), and received the name by which he is known historically in consequence of the marriage of his virgin daughter Ayesha to Mohammed. He was born at Mecca A.D. 573, a Koreishite of the tribe of Beni-Taim. Possessed of immense wealth, which he had himself acquired in commerce, and held in high esteem as a judge, an interpreter of dreams and a depositary of the traditions of his race, his early accession to Islamism was a fact of great importance. On his conversion he assumed the name of Abd-Alla ("servant of God"). His firm belief in Mohammed and his doctrines won for him the title El Siddik ("the faithful"). In his personal relationship to the prophet he showed the deepest veneration and the most unswerving devotion. When Mohammed fled from Mecca, Abu-Bekr was his sole companion, and shared both his hardships and his triumphs, remaining constantly with him until the day of his death. During his last illness the prophet indicated Abu-Bekr as his successor by desiring him to offer up prayer for the people. The choice was ratified by the chiefs of the army, and ultimately confirmed, though it was disputed by Ali, Mohammed's son-in-law. After a time Ali submitted, but the difference gave rise to the controversy which still divides Muslims, Sunnites and Shiites.

Abu-Bekr had scarcely assumed his new position (632), under the title Kalifat-Rasul-illah ("successor of the prophet of God"), when he was called to suppress the revolt of the tribes Hejäz and Nejd, of which the former rejected Islamism and the latter refused to pay tribute. He encountered formidable opposition from different quarters, but in every case he was successful, the severest struggle being that with the impostor Mosailima, who was finally defeated by Khalid at the battle of Akraba. When Arabia had been completely subdued, he turned to foreign conquests. The 'Iraq of Persia was overcome by Khalid in a single campaign, and there was also a successful expedition into Syria. After the hard-won victory over Mosailima, Omar, fearing that the sayings of the prophet would be entirely forgotten when those who had listened to them had all been removed by death, induced Abu-Bekr to see to their preservation in a written form. The record, when completed, was deposited with Hafsa, daughter of Omar, and one of the wives of Mohammed. It was held in great reverence by all Muslims, though it did not possess canonical authority, and furnished most of the materials out of which the Koran, as it now exists, was prepared. When the authoritative version was completed all copies of Hafsa's record were destroyed, in order to prevent possible disputes and divisions. Abu-Bekr died Aug. 23, 634. Shortly before his death, which one tradition ascribes to poison, another to natural causes, he indicated Omar as his successor, after the manner Mohammed had observed in his own case.

BIBLIOGRAPHY.—*See* CALIPHATE. W. Muir, *Annals of the early Caliphate from original sources* (1883), H. Lammens, *Le triumvirat d'Aboû Bekr, 'Omar et Aboû 'Obaida* (Beirut, 1910).

ABU HAMED, a town of the Anglo-Egyptian Sudan on the right bank of the Nile, 345m. by rail north of Khartum, and near the head of the fourth cataract. It stands at the centre of the great S-shaped bend of the Nile, and from it the railway to Wadi Halfa strikes straight across the Nubian desert, a little west of the old caravan route to Korosko. A branch railway, 138m. long from Abu Hamed, goes down the right bank of the Nile to Kareima in the Dongola *mudiria*. The town is named after a celebrated sheikh buried here, by whose tomb travellers crossing the desert used formerly to deposit all superfluous goods, the sanctity of the saint's tomb ensuring their safety. During the advance on Khartum in 1897, a sharp action was fought here, the troops under Gen. Hunter routing the Dervishes (Aug. 7, 1897).

ABŪ HANĪFA AN-NU'MAN IBN THABIT, Mohammedan canon lawyer, was born at Kufa in A.H. 80 (A.D. 699) of non-Arab and probably Persian parentage. Few events of his life are known to us with any certainty. He was a rich silk-dealer, lectured at Kufa upon canon law (*fiqh*) and was a consulting lawyer (*mufti*), but refused steadily to take any public post. When al-Mansūr, however, was building Baghdad (145–149) Abū Hanīfa was one of the four overseers whom he appointed over the crafts-

men. In A.H. 150 (A.D. 767) he died there. A persistent but apparently later tradition asserts that he died in prison after a severe beating, because he refused to obey al-Mansūr's command to act as a judge (cadi, *qādi*). This was to avoid a responsibility for which he felt unfit—a frequent attitude of more pious Muslims.

For many personal anecdotes *see* de Slane's transl. of Ibn Khallikan iii. 555 ff, iv. 272 ff. He was buried in eastern Baghdad, where his tomb still exists, one of the few surviving sites from the time of al-Mansūr, the founder.

See C. Brockelmann, *Geschichte*, i. 169 ff; Nawawi's *Biogr. Dict.* pp. 698–770, Ibn Hajar al-Haitami's *Biography*, publ. Cairo, A.H. 1304; legal bibliography under MOHAMMEDAN LAW.

ABU KLEA, a halting-place for caravans in the Bayuda desert, Anglo-Egyptian Sudan. It is on the road from Merawi to Metemma and 20m north of the Nile at the last-mentioned place. Near this spot, on Jan. 17, 1885, a British force marching to the relief of Gen Gordon at Khartum was attacked by a greatly superior force of Mahdists, who were repulsed. On the 19th, when the British force was nearer Metemma, the Mahdists renewed the attack, again unsuccessfully Sir Herbert Stewart, the commander of the British force, was mortally wounded on the 19th, and among the killed on the 17th was Col. F. G. Burnaby.

ABU-L-'ALA UL-MA'ARRI (973–1057), Arabian poet and letter-writer, belonged to the South Arabian tribe Tanukh, a part of which had migrated to Syria before the time of Islam. He was born in 973 at Ma'arrat un-Nu'mān in Syria In 1007 he visited Baghdad, where he was admitted to literary circles, recited in the academies and mosques, and made the acquaintance of men to whom he addressed some of his letters later. In 1009 he returned to Ma'arra, where he spent the rest of his life in teaching and writing.

Of his works the chief are two collections of his poetry and two of his letters. The earlier poems up to 1029 have been published in Bulaq (1869), Beirūt (1884) and Cairo (1886), under the title of *Saqt uz-Zand*. The poems of the second collection, known as the *Luzūm ma lam yalzam*, or the *Luzūmiyyāt*, are written with the difficult rhyme in two consonants instead of one, and contain the more original, mature, and somewhat pessimistic thoughts of the author on mutability, virtue, death, etc. They have been published in Bombay (1880) and Cairo (1889).

BIBLIOGRAPHY.—The letters on various literary and social subjects were published with commentary by Shain Effendi in Beirūt (1894), and with English translation, etc, by Prof. D S. Margoliouth in Oxford (1898) A second collection of letters, known as the *Risālat-ul-Ghufrān*, was summarized and partially translated by R. A. Nicholson in the *Journal of the Royal Asiatic Society* (1900, pp. 637 ff.; 1902, pp. 75 ff, 337 ff., 813 ff). C. Rieu, *De Abu-l-'Alae Poetae Arabici vita et carminibus* (Bonn, 1843); A. von Kremer, *Über die philosophischen Gedichte des Abu-l-'Ala* (Vienna, 1888); *cf* also the same writer's articles in the *Zeitschrift der deutschen morgenländischen Gesellschaft* (vols xxix., xxx, xxxi. and xxxviii). Some of his poems are translated by H. Baerlein in the *Diwan of Abu-l-'Ala* ("The Wisdom of the East" Series, 1908). For his life see the introduction to D. S Margoliouth's edition of the letters, supplemented by the same writer's articles "Abu-l-'Ala al-Ma'arri's Correspondence on Vegetarianism" in the *Journal of the Royal Asiatic Society* (1902, pp. 289 ff.).

ABU-L-'ATAHIYA (Abū Ishāq Ismā'īl ibn Qāsim al-'Anazī) (748–828), Arabian poet, was born at 'Ain ut-Tamar in the Hejāz near Medina. His ancestors were of the tribe of 'Anaza His life was spent in Kufa and in Baghdad, where he died in 828 in the reign of al-Ma'mūn. The poetry of Abū-l-'Atāhiya is notable for its avoidance of the artificiality almost universal in his days. The older poetry of the desert had been constantly imitated up to this time, although it was not natural to town life. Abū-l-'Atāhiya was one of the first to drop the old qasīda (elegy) form. He is one of the earliest philosophic poets of the Arabs. Much of his poetry is concerned with the observation of common life and morality, and at times is pessimistic. Naturally, in the circumstances, he was strongly suspected of heresy.

His poems (*Diwān*) with life from Arabian sources have been published at the Jesuit Press in Beirūt (1887, 2nd ed. 1888). On his position in Arabic literature *see* W. Ahlwardt, *Diwān des Abu Nowas* pp. 21 *et seq.* (Greifswald, 1861); A. von Kremer, *Culturgeschichte des Orients*, vol. ii. pp. 372 ff. (Wien, 1877).

ABULFARAJ (Abū-l-Faraj 'Alī ibn ul-Husain ul-Isfahani) (897–967), Arabian scholar, was a member of the tribe of the Quraish (Koreish) and a direct descendant of Marwān, the last of the Omayyad caliphs. He was thus connected with the Omayyad rulers in Spain, and seems to have kept up a correspondence with them and to have sent them some of his works. He was born in Isfahān, but spent his youth and made his early studies in Baghdad He became famous for his knowledge of early Arabian antiquities. His later life was spent in various parts of the Muslim world, in Aleppo with Saif-ud-Daula (to whom he dedicated the *Book of Songs*), in Rai with the Buyid vizier ibn 'Abbād and elsewhere. In his last years he lost his reason. In religion he was a Shiite. Although he wrote poetry, also an anthology of verses on the monasteries of Mesopotamia and Egypt, and a genealogical work, his fame rests upon his *Book of Songs* (*Kitāb-ul-Aghāni*), which gives an account of the chief Arabian songs, ancient and modern, with the stories of the composers and singers. It contains a mass of information as to the life and customs of the early Arabs, and is the most valuable authority we have for their pre-Islamic and early Muslim days A part of the *Book of Songs* was published by J. G. L. Kosegarten with Latin translation (Greifswald, 1840). The text was published in 20 vols at Bulaq in 1868 Vol. xxi. was edited by R. E. Brünnow (Leyden, 1888). A volume of elaborate indices was edited by I. Guidi (Leyden, 1900), and a missing fragment of the text was published by J. Wellhausen in the *Zeitschrift der deutschen morgenländischen Gesellschaft*, vol 50, pp. 146 ff. For his life *see* M'G de Slane's translation of Ibn Khallikan's *Biographical Dictionary*, vol ii. pp. 249 ff. (G. W. T.)

ABULFARAJ (13th century). *see* BAR-HEBRAEUS.

ABUL FAZL (ăb-ul fahzl) (1551–1602), vizier and historiographer of the Mogul emperor, Akbar, wrote the *Akbar Nameh* or "Book of Akbar" in Persian. It consists of two parts, and is a history of Akbar's reign and the *Ain-i-Akbari*, or "Institutes" of Akbar, giving an account of the constitution, religion and administration of the empire. Akbar was murdered at the instigation of Prince Selim, afterwards Jahangir, who was jealous of the vizier's influence.

A translation of the *Ain-i-Akbari* (Calcutta, 1783–86), by Francis Gladwin, is now exceedingly rare. There is a modern translation (Calcutta, 1873, 1891, 1894): vol. i. by H. Blockmann, vols. ii. and iii. by H. S. Jarrett.

ABULFEDA (Abū-l-Fidā' Ismā'īl ibn 'Ali 'Imād-ud-Dnī) (1273–1331), Arabian historian and geographer, was born at Damascus, whither his father Malik ul-Afdal, brother of the prince of Hamah, had fled from the Mongols. He was a descendant of Ayyūb, the father of Saladin In 1285 he was present at the assault of a stronghold of the knights of St. John, and he took part in the sieges of Tripoli, Acre and Qal'at ar-Rūm. In 1298 he entered the service of the Mameluke Sultan Malik al-Nāsir and in 1310 became governor of Hamah. In 1312 he became prince with the title Malik us-Sālih, and in 1320 received the hereditary rank of sultan with the title Malik ul-Mu'ayyad. For more than twenty years altogether he reigned in tranquillity and splendour, devoting himself to the duties of government and to the composition of the works to which he is chiefly indebted for his fame. He was a munificent patron of men of letters, who came in large numbers to his court. He died in 1331.

BIBLIOGRAPHY.—His chief historical work is *An Abridgment of the History of the Human Race*, annals extending from the creation to the year 1329 (Constantinople, 1869). Various translations of parts of it exist. His *Geography* is founded on the works of his predecessors, and so ultimately on the work of Ptolemy. Parts of the work were published and translated as early as 1650 (*cf.* Carl Brockelmann's *Geschichte der Arabischen Litteratur*, Berlin, 1902, vol. ii. pp. 44–46). The text of the whole was published by M'G. de Slane and M. Reinaud (Paris, 1840), and a French translation with introduction by M. Reinaud and Stanislas Guyard (Paris, 1848–83).

ABU'L KASIM MANSUR: *see* FIRDUSI.

ABŪ-L-QĀSIM [Khalaf ibn 'Abbās uz-Zahrāwi], Arabian physician and surgeon, generally known in Europe as ABULCASIS, flourished in the tenth century at Cordova as physician to the caliph 'Abdur-Rahmān III. (912–961).

A part of his compendium of medicine was published in Latin as *Liber theoricae nec non practicae Alsaharavii* (Augsburg, 1519). His manual of surgery was published at Venice in 1497, at Basle in 1541, and at Oxford *Abulcasis de Chirurgia arabice et latine cura Johannis Channing* (2 vols 1778)

For his other works *see* Carl Brockelmann, *Geschichte der arabischen Literatur* (Weimar, 1898), vol i pp. 239–240.

ABÛ 'L WAFÃ or **ALBUZDSCHANI** (940–998), Arab astronomer and mathematician, was born at Buzdschan in Khurãsãn, and was one of the most learned men of his day. A passage in his *Almagest* is held by some to indicate that he had noted inequalities in the moon's motion, later described as variation He translated and commented on the works of the Greek mathematicians, and made an exhaustive commentary on Diophantus; unfortunately these writings are lost The existing book in 12 chapters of geometrical constructions in a Persian translation is not his, but appears to be derived from an account of his lectures drawn up by one of his pupils Abû 'l Wafã introduced the trigonometrical functions and constructed tables of tangents and co-tangents

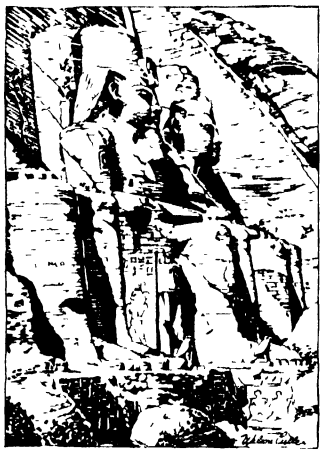
See Woepcke in *Journal Asiatique,* Feb. and March, 1855.

ABUNDANTIA, Roman goddess, the personification of prosperity and good fortune On the coins of the later Roman emperors she is frequently represented holding a horn of plenty and distributing grain and money She may be compared with Domina Abundia (O. Fr *Dame Habonde, Notre Dame d'Abondance*), a beneficent fairy, who brought plenty to those whom she visited (Grimm, *Teutonic Mythology,* i. 286–7).

ABU NUWAS (Abû 'Alî Hal-asan ibn Hãni'al-Hakamî) (*c.* 756–810), Arabian poet, was born in al-Ahwãz, probably about 756. His mother was a Persian, his father a soldier, a native of Damascus. He is said to have spent a year with the Arabs in the desert to gain purity of language Settling in Baghdad he enjoyed the favour of Harûn al-Rashîd and al-Amîn, and died there, probably about 810. Abû Nuwãs is recognized as the greatest Arab poet of his time Genial, cynical, immoral, he drew on all the varied life of his time for the material of his poems In his wine-songs especially the manners of the upper classes of Baghdad are revealed He was one of the first to ridicule the set form of the *qasîda* (elegy) as unnatural, and has satirized this form in several poems

See I. Goldziher, *Abhandlungen zur Arabischen Philologie* (Leyden, 1896), i. pp. 145 ff. His poems were collected by several Arabian editors. One such collection (the MS of which is now in Vienna) contains nearly 5,000 verses. His collected poems (*Diwãn*) have been published in Cairo (1860), in Beirût (1884) and an edition by Isma 'îl al-Nabhãnî (Cairo, 1904). The wine-songs were edited by W Ahlwardt under the title *Diwãn des Abu Nowas. i. Die Weinlieder* (Greifswald, 1861).

ABU SIMBEL or **IPSAMBUL,** the name of a group of temples of Rameses II (*c.* 1250 B.C.) in Nubia, on the left bank of the Nile, 56m by river south of Korosko They are hewn in the sandstone cliffs at the riverside, and are three in number. The principal temple, begun by Seti and completed by his son, is probably the greatest and most imposing of all rock-hewn monuments It was discovered by Burckhardt in 1812 and opened by Belzoni in 1817; the front has been cleared several times, but the sand is always pressing forward from the north end The hillside was recessed to form the façade, backed against which four immense seated colossi of the king, in pairs on either side of the entrance, rise from a platform or forecourt reached from the river by a flight of steps The colossi are 65ft in height, of nobly placid design, and are accompanied by smaller figures of Rameses' queen and their sons and daughters; behind and over them is the cornice, with the dedication below a long row of apes, standing in adoration of the rising sun The temple is dedicated primarily to the solar gods Amenra of Thebes and Raharakht of Heliopolis the true sun god; it is oriented to the east so that the rays of the sun in the early morning penetrate the whole length of two great halls to the innermost sanctuary and fall upon the central figures of Amenra and Rameses, which are there enthroned with Ptah of Memphis and Raharakht on either side The interior of the temple consists of a series of halls, penetrating for 185ft. into the solid rock and decorated with coloured sculpture of fine workmanship and in good preservation; some of the scenes are of religious import (amongst them Rameses as king making offerings to himself as god), others illustrate war in Syria, Libya and Ethiopia. another series depicts the events of the famous battle with the Hittites and their allies at Kadesh, in which Rameses saved the Egyptian camp and army by his personal valour Not the least important feature of the temple belongs to a later age when some Greek, Carian and Phoenician soldiers of one of the kings named Psammetichus (apparently Psammetichus II., 594–589 B.C.) inscribed their names upon the two southern colossi, doubtless the only ones then clear of sand. These graffiti are of the highest value for the early history of the alphabet, and as proving the presence of Greek mercenaries in the Egyptian armies of the period. The upper part of the second colossus (from the south) has fallen; the third was repaired by Sethos II not many years after the completion of the temple A small temple, immediately to the south of the first, is believed to have had a built antechamber: it is the earliest known example of a "birth chapel," such as was usually attached to Ptolemaic temples for the accommodation of the divine mother-consort and her son. The third and northernmost temple, separated from the others by a ravine, is on a large scale, the colossi of the façade are six in number and 33ft high, representing Rameses and his queen Nefrêre, who dedicated the temple to the goddess Hathôr



THE COLOSSAL STATUES OF RAMESES II AT ABU SIMBEL ARE 65FT. HIGH AND ARE ACCOMPANIED BY SMALLER STATUES OF THE MEMBERS OF HIS FAMILY

ABÛ TAMMÂM (Habîb ibn Aus) (807–846), Arabian poet, was born in Jâsim (Josem), a place to the north-east of the Sea of Tiberias or near Manbij (Hierapolis). He died in Mosul Abû Tammâm is best known as the compiler of the collection of early poems known as the *Hamâsa* (*q.v.*). Two other collections of a similar nature are ascribed to him His own poems have been somewhat neglected owing to the success of his compilations. His poems (*Diwân*) were published in Cairo (A.D. 1875).

See Life in Ibn Khallikan's *Biographical Dictionary,* trans by M'G. de Slane (Paris and London, 1842), vol i. pp 348 ff ; and in the *Kitâb ul-Aghâni* (Book of Songs) of Abulfaraj (Bulaq, 1869), vol xv pp. 100–108, also D S Margoliouth, "Indices to the Diwan of Abu Tammam" in the *Journal* of the Royal Asiatic Society (1905).

ABUTILON (from the Arabic *aubûtîlûn,* a name given by Avicenna to this or an allied genus), in botany, a genus of plants of the family Malvaceae (mallows), having about 120 species, and widely distributed in the tropics. They are free-growing shrubs with showy bell-shaped flowers, and are favourite greenhouse plants. They may be grown outside in England during the summer months, but a few degrees of frost is fatal to them They are readily propagated from cuttings taken in the spring or at the end of the summer. Many varieties have been developed by hybridization, some of which have a variegated foliage.

ABUTMENT, a construction in masonry designed to receive and resist the lateral pressure of an arch, vault or strut. When part of a wall it is termed a buttress (*q.v.*).

ABU UBAIDA (Ma'mar ibn ul-Muthannal) (728–825), Arabian scholar, was born a slave of Jewish-Persian parents in Basra. In 803 he was called to Baghdad by Harûn al-Rashid He died in Basra. He was one of the most learned and authoritative scholars of his time in the Arabic language, antiquities and stories The titles of 105 of his works are mentioned in the *Fihrist,* and his *Book of Days* is the basis of parts of the history of ibn al-Athîr and of the *Book of Songs* (*see* ABULFARAJ), but nothing of his (except a song) seems to exist now in an independent form.

BIBLIOGRAPHY —See *Life* in ibn Khallikān's *Biographical Dictionary*, trans. by M'G. de Slane (1842), vol iii, pp. 388–398, also I. Goldziher's *Muhammedanische Studien* (Halle, 1888), vol. i., pp 194–206.

ABYDOS, ancient town of Mysia, Asia Minor, on the Hellespont, here scarcely a mile broad Probably originally a Thracian town, it was afterwards colonized by Milesians Here Xerxes crossed the strait on his bridge of boats when he invaded Greece. Abydos is celebrated for its vigorous resistance to Philip V of Macedon (200 B C), and is famed in story for the loves of Hero and Leander. Until late Byzantine times the toll station of the Hellespont, its importance was transferred to the Dardanelles (*q v.*), after the building of the "Old Castles" by Sultan Mohammed II. (*c.* 1456).

ABYDOS, one of the most ancient cities of Upper Egypt, about 7m. west of the Nile in lat. 26°·10′ N. (railway station Al-Baliana). The Egyptian name was *Abdu*, "the hill of the symbol or reliquary" in which the sacred head of Osiris was preserved Thence the Greeks named it Abydos, like the city on the Hellespont; the modern Arabic name is *Arabet el Madfuneh* The history of the city begins in the late prehistoric age, it having been founded by the pre-Menite kings whose town, temple and tombs have been found there The kings of the 1st dynasty, and some of the 2nd dynasty, were also buried here, and the temple was renewed and enlarged by them Great forts were built on the desert behind the town by three kings of the 2nd dynasty. The temple and town continued to be rebuilt at intervals down to the times of the 30th dynasty, and the cemetery was used continuously. In the 12th dynasty a gigantic tomb was cut in the rock by Senwosri (or Senusert) III Seti I. in the 19th dynasty founded a great new temple to the south of the town in honour of the ancestral kings of the early dynasties, this was finished by Rameses II, who also built a lesser temple of his own Mineptah added a great Hypogeum of Osiris to the temple of Seti The latest building was a new temple of Nekhtnebf in the 30th dynasty.

The worship here was of the jackal god Upuaut (Ophois, Wepwoi), who "opened the way" to the realm of the dead, increasing from the 1st dynasty to the time of the 12th dynasty and then disappearing after the 18th Anher appears in the 11th dynasty, and Khentamenti, the god of the western Hades, rises to importance in the middle kingdom and then vanishes in the 18th The worship here of Osiris in his various forms begins in the 12th dynasty and becomes more important in later times, so that at last the whole place was considered as sacred to him

The temples successively built here on one site were nine or ten in number, from the 1st dynasty, to the 26th dynasty (500 B C). The first was an enclosure, about 30 x 50ft, surrounded by a thin wall of unbaked bricks Covering one wall of this came the second temple of about 40ft square in a wall about 10ft. thick An outer *temenos* (enclosure) wall surrounded the ground. This outer wall was thickened about the 2nd or 3rd dynasty. The old temple entirely vanished in the 4th dynasty, and a smaller building was erected behind it, enclosing a wide hearth of black ashes Pottery models of offerings are found in the ashes, and these were probably the substitutes for sacrifices decreed by Cheops (Khufu) in his temple reforms A great clearance of temple offerings was made now, or earlier, and a chamber full of them has yielded the fine ivory carvings and the glazed figures and tiles which show the splendid work of the 1st dynasty. A vase of Menes with purple inlaid hieroglyphs in green glaze and the tiles with relief figures are the most important pieces The noble statuette of Cheops in ivory, found in the stone chamber of the temple, gives the only portrait of this ruler The temple was rebuilt entirely on a larger scale by Pepi I. in the 6th dynasty. He placed a great stone gateway to the temenos, an outer temenos wall and gateway, with a colonnade between the gates His temple was about 40 x 50ft inside, with stone gateways front and back, showing that it was of the processional type. In the 11th dynasty Menthotp (Mentuhotep) III. added a colonnade and altars. Soon after, Sankhkerē entirely rebuilt the temple, laying a stone pavement over the area, about 45ft. square, besides subsidiary chambers. Soon after Senwosri (Senusert) I. in the 12th dynasty laid massive foundations of stone over the pavement of his predecessor. A great temenos was laid out enclosing a much larger area, and the temple itself was about three times the earlier size.

The 18th dynasty began with a large chapel of Amasis I., and then Thothmes III. built a far larger temple, about 130 x 200ft. He made also a processional way past the side of the temple to the cemetery beyond, with a great gateway of granite Rameses III added a large building; and Amasis II in the 26th dynasty rebuilt the temple again, and placed in it a large monolith shrine of red granite, finely wrought The foundations of the successive temples were comprised within about 18ft depth of ruins

The temple of Seti I was built on entirely new ground half a mile to the south of the long series of temples just described. This is the building best known as the Great Temple of Abydos, being nearly complete and an impressive sight The long list of the kings of the principal dynasties carved on a wall is known as the "Table of Abydos" There were also seven chapels for the worship of the king and principal gods The temple was originally 550ft long, but the forecourts are scarcely recognizable, and the part in good state is about 250ft long and 350ft wide, including the wing at the side Excepting the list of kings and a panegyric on Rameses II, the subjects are not historical but mythological The adjacent temple of Rameses II was much smaller and simpler in plan; but it had a fine historical series of scenes around the outside, of which the lower parts remain A list of kings, similar to that of Seti, formerly stood here; but the fragments were sold by the French consul to the British Museum

The royal tombs of the earliest dynasties were placed about a mile back on the great desert plain The earliest is about 10 x 20ft. inside, a pit lined with brick walls, and originally roofed with timber and matting Others also before Menes are 15 x 25ft The tomb probably of Menes is of the latter size After this the tombs increase in size and complexity The tomb-pit is surrounded by chambers to hold the offerings, the actual sepulchre being a great wooden chamber in the midst of the brick-lined pit. Rows of small tomb-pits for the servants of the king surround the royal chamber, many dozens of such burials being usual By the end of the 2nd dynasty the type changed to a long passage bordered with chambers on either hand, the royal burial being in the middle of the length The greatest of these tombs with its dependencies covered a space of over 3,000sq yards The contents of the tombs have been nearly destroyed by successive plunderers; enough remained to show that rich jewellery was placed on the mummies, a profusion of vases of hard and valuable stones from the royal table service stood about the body, the store-rooms were filled with great jars of wine, perfumed ointment and other supplies, and tablets of ivory and ebony were engraved with a record of the yearly annals of the reigns

The cemetery of private persons begins in the 1st dynasty with some pit tombs in the town It was extensive in the 12th and 13th dynasties and contained many rich tombs In the 18th–20th dynasties a large number of fine tombs were made, and later ages continued to bury here till Roman times

The forts lay behind the town That known as Shunet ez Zebib is about 450 x 250ft over all, and still stands 30ft high It was built by Khasekhemui, the last king of the 2nd dynasty. Another fort nearly as large adjoined it, and is probably rather older A third fort of a squarer form is now occupied by the Coptic convent; its age cannot be ascertained

Jean Capart, *Abydos Le Temple de Seti I.* (Bruxelles, 1912), *The Cemeteries of Abydos*, 3 vols. (Egypt Exploration Fund, 1913–14)

ABYSS, any deep place (Gr ἀ-, privative, *βυσσός*, bottom), a bottomless depth From the late popular *abyssimus* (superlative of Low Latin *abyssus*) through the French *abisme* (i e, *abime*) is derived the poetic form *abysm*, pronounced as late as 1616 to rhyme with *time* The adjective "abyssal" or "abysmal" has been used by zoologists to describe deep regions of the sea In heraldry the abyss is the middle of an escutcheon In the Greek version of the Old Testament the word represents (1) the original chaos (Gen i. 2), (2) the Hebrew *tehom*, which is used also in apocalyptic literature and in the New Testament for hell. In the Septuagint cosmography the word is applied (*a*) to the waters under the earth, and (*b*) to the waters of the firmament

which were regarded as closely connected with those below. Derivatively it acquired the meaning of the place of the dead. In *Revelation* it is the prison of evil spirits whence they may occasionally be let loose, and where Satan is doomed to spend 1,000 years. In rabbinical cosmography the abyss is a region of Gehenna situated below the ocean bed and divided into three or seven parts imposed one above the other. In the Kabbalah the abyss as the opening into the lower world is the abode of evil spirits, and corresponds to the opening of the abyss to the world above. In general, the abyss is regarded vaguely as a place of indefinite extent, the abode of mystery and sorrow.

ABYSSINIA (officially Ethiopia), an inland country and empire of North-east Africa lying, chiefly, between 5° and 15° N. and 35° and 42° E. It is bounded on the north by Eritrea (Italian), on the west by the Anglo-Egyptian Sudan, on the south-west and south by Uganda and Kenya, on the south-east and east by British, Italian and French Somaliland. The coast lands in European hands, which cut off Abyssinia from access to the sea, vary in width from 40 to 250 miles and are narrowest on the north-east border near the Red Sea. Abyssinia in the north is 230m. east to west, but is 900m. wide along latitude 9° N., and resembles a triangle with apex north. It is divided into Abyssinia proper (*i e*, the old Ethiopian empire consisting of Tigré, Amhara, Gojam and part of Shoa) with the south-west Galla highlands and the remainder of Shoa all forming a geographical unit—and cut off from it by the great Rift valley—and the Somaliland plateau with Harar: nearly all this country being surrounded by tracts of low-lying desert. The area of the whole State is about 350,000sq m., of which Abyssinian Somaliland covers almost a quarter.

PHYSICAL FEATURES

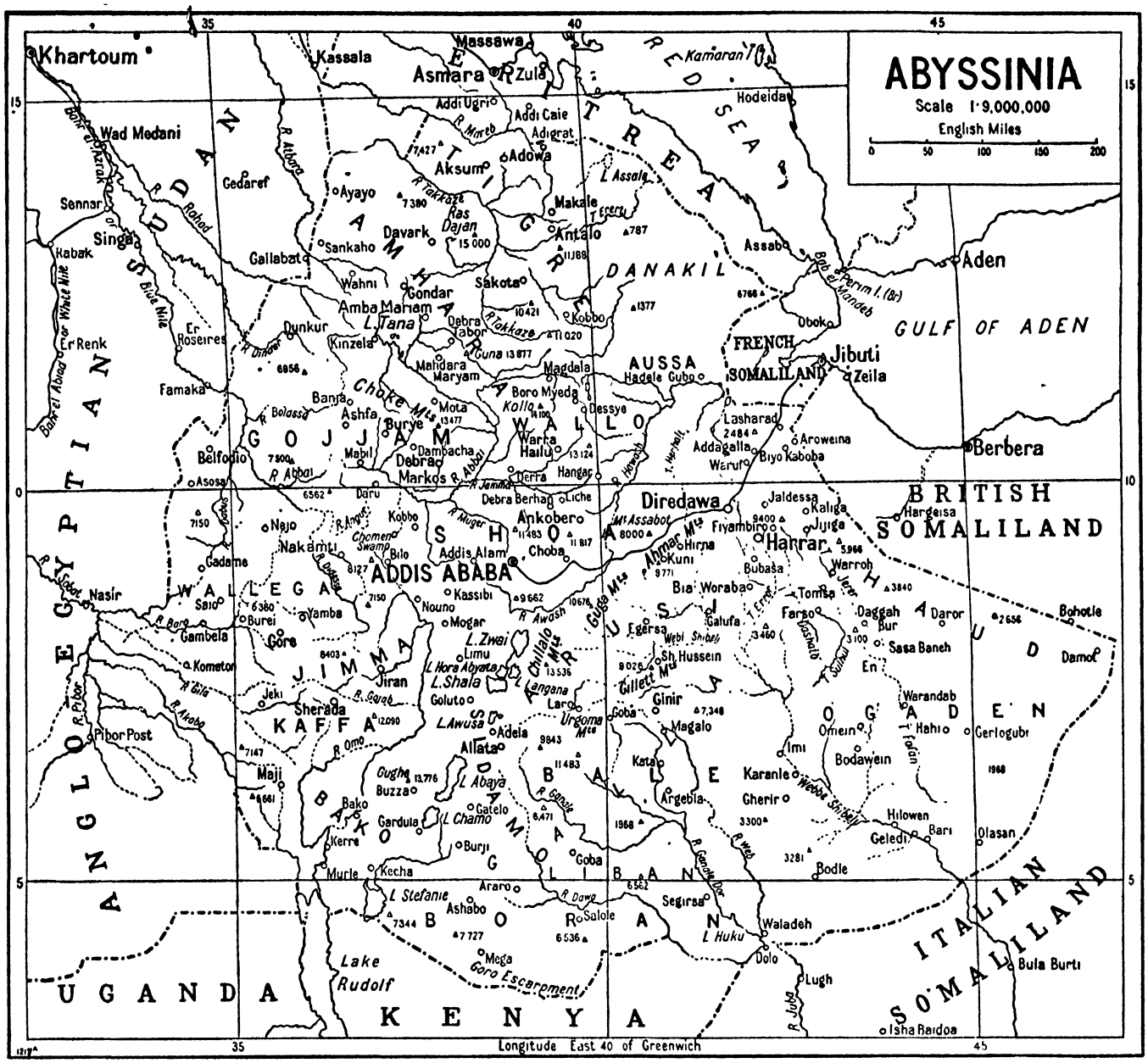
Between the Upper Nile and the low south-west shores of the Red Sea and the Gulf of Aden lie elevated plateaux with mountain ranges. The plateaux rise abruptly from the plains, constituting outer mountain chains. The Abyssinian highlands are thus a clearly marked orographic division. From Ras Kasar (18°N) to Annesley Bay (15°N.) the eastern wall of the plateau runs parallel to the Red Sea. It then turns due south and follows closely the line of 40°E. for some 400m. About 9°N. the River Hawash flows east through the opening of the Rift valley. The main range at this point trends south-west, while south of the Hawash valley, which is some 3,000ft. below the level of the mountains, another massif rises in a direct line south. The second range sends a chain (the Harar Hills) east to the Gulf of Aden. The two chief eastern ranges run parallel south by west on either side of the Rift valley—in which are a series of lakes—to about 3°N., the outer (eastern) spurs of the plateau still keeping along the line of 40°E. The southern escarpment of the plateau is highly irregular, but has a general direction north-west and south-east from 6°N. to 3°N. The western wall of the plateau, from 6°N. to 11°N., is precipitous. North of 11°N. the hills turn more to the east, and fall more gradually to the plains at their base. On its northern face also the plateau falls in terraces to the level of the eastern Sudan. The eastern escarpment has a mean height of 7,000 to 8,000ft., and is often precipitous. Torrents descend narrow deep clefts to lose themselves in the sandy coast land; they afford means of reaching the plateau, as alternatives to the easier route through the Hawash valley. On surmounting this rocky barrier the traveller finds that the encircling rampart rises little above the normal level of the plateau. The northern highlands, mainly 10° to 15°N., consist of Archaean rocks of mean height 7,000 to 7,500ft , and a deep central depression contains Lake Tana. Above the plateau mountain ranges rise to 12,000 and over 15,000ft., with fantastic forms, and cut by enormous fissures due to erosion; some are wider, others have the opposite walls but 200 or 300yd. apart, and fall almost vertically thousands of feet. Numerous isolated flat-topped hills or small plateaus known as *ambas,* are left. The highest peaks are in the Simen (or Semien) ranges, north-east of Lake Tana, which culminate in a snow-covered peak, Dajan (15,160ft.). Parallel with the eastern escarpment the heights rise to Mt. Kollo (14,100ft.) south-west of Magdala. The valley between these hills and the eastern escarpment is one of the largest and most profound chasms in Abyssinia. Between Lake Tana and the eastern hills are Mounts Guna (13,800ft.) and Uara Sahia (13,000ft.). The highlands south of latitude 10°N. have more open tableland than the northern portion and fewer lofty peaks, but the general character is still that of a much broken hilly plateau.

The uplands usually slope north-west and nearly all the large rivers flow to the Nile; the Takkaze in the north, the Abbai in the centre, and the Sobat in the south make up four-fifths of the entire drainage. The rest is carried off almost due north by the Khor Baraka, which occasionally reaches the Red Sea south of Suakin, by the Hawash, which runs out in the salt lake area near the head of Tajura Bay; by the Webi Shibeli and Juba, which flow south-east through Somaliland, though the Shibeli fails to reach the Indian ocean; and by the Omo, the main feeder of the closed basin of Lake Rudolf. The Takkaze, the true upper course of the Atbara, falls from about 7,000ft. in the central tableland to 2,500ft. in the tremendous crevasse through which it sweeps west, north, and west again, to the western terraces and the Sudan. During the rains the Takkaze (*i.e.*, the "Terrible") rises some 18ft. above its normal level, and at this time forms an impassable barrier between the northern and central provinces. Lower down, the river has the Arab name Setit. The Setit is joined (14° 10'N., 36°E.) by the Atbara, formed by several streams of the mountains west and north-west of Lake Tana. The Gash or Mareb is the most northerly Abyssinian river flowing towards the Nile. It rises on the landward side of the eastern escarpment within 50 miles of Annesley Bay on the Red Sea, and reaches the Sudan near Kassala to lose itself in the sandy plain. The Mareb is dry for a great part of the year, but like the Takkaze has sudden freshets during rains. Only the left bank of the upper course of the river is in Abyssinian territory, the Mareb here forming the boundary between Eritrea and Abyssinia.

The Abbai or Blue Nile has its source near Mt. Denguiza in the Gojam highlands (about 11°N. and 37°E) and first flows for 70m. nearly due north to the south side of Lake Tana (*q.v.*), through which it runs for some 20 miles and, escaping by a deep crevasse, bends in a great semicircle, east, south and north-west, the reverse of that of the Takkaze, down to the plains of Sennar. The Abbai has many perennial tributaries, of which the principal are the Bashilo, the Jamma, the Muger, the Gudiv, the Didessa, largest of all, and the Yabus. The right-hand tributaries, rising mostly on the western sides of the plateau, have steep slopes and are generally torrential; the Bolassa is perennial, and the Rahad and the Dinder are important in flood-time.

In the mountains and plateaux of Kaffa and Galla in south-west Abyssinia rise the chief affluents of the Sobat tributary of the Nile. The Akobo joins the Pibor, which unites with the Baro to form the Sobat. These rivers (which form for 250m. the west or south-west frontiers of Abyssinia) descend in great falls, and like other Abyssinian streams are unnavigable in their upper courses. The Baro on reaching the plain affords, however, an open waterway to the Nile (*see* NILE, SOBAT, and SUDAN)

The chief eastward river is the Hawash, rising in the Shoan uplands and bending first south-east and then north-east. It reaches the Afar (Danakil) lowlands through a broad breach in the eastern escarpment of the plateau, where it is nearly 200ft. wide and 4ft. deep, even in the dry season, and during the floods rises 50 or 60ft. above low-water mark, thus inundating the plains for many miles along both its banks. Yet it fails to reach the coast and after a winding course of about 500m. is lost near Lake Aussa, some 60 or 70m. from the head of Tajura Bay. From Shoa south-west to Lake Rudolf extends a chain of lovely upland lakes, some fresh, some brackish, some completely closed, others connected by short channels, the chief links in their order from north to south being:— Zwai, communicating southwards with Hora Abyata, which connects with Langana, all in the Arusi Galla territory; then Shala and Awusa; farther south Abaya (Margherita) with an outlet to a smaller tarn, Chamo, in the romantic Baroda and Gamo districts, skirted on the west by grassy slopes and wooded ranges (6,000 to nearly 9,000ft.);



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ABYSSINIA COVERS ABOUT 350,000 SQ M., OF WHICH ABYSSINIAN SOMALILAND MAKES FULLY A THIRD. MOST OF THE COUNTRY WEST OF 40° IS A PLATEAU FROM WHICH RISE VARIOUS MOUNTAIN RANGES. ON EVERY SIDE EXCEPT THE SOUTH THE WALLS OF THE PLATEAU RISE ABRUPTLY FROM THE PLAINS. IN A DAY'S JOURNEY THE TRAVELLER MAY PASS FROM TROPICAL TO ALMOST ALPINE CONDITIONS OF CLIMATE. EQUALLY GREAT IS THE RANGE OF THE FLORA AND FAUNA. THERE ARE FEW LARGE TOWNS

lastly, in the Asille country, Lake Stefanie, the Chuwaha of the natives, completely closed and about 1,800ft. above sea. To the same system obviously belongs the neighbouring Lake Rudolf (*q.v.*), larger than all the rest together. This lake receives at its northern end (1,800ft. above sea level) the waters of the Omo, a rapid and unnavigable perennial stream with many affluents, rising in the Shoa highlands and falling 6,000ft. in its course of 370m. The chief rivers of Somaliland (*q.v.*), Webi Shibeli and Juba (*q.v.*), rise on the south-eastern slopes of the Abyssinian escarpment and most of their course is through Abyssinian territory.

GEOLOGY

The East African tableland is continued into Abyssinia, the following formations being represented:—

Archaean.—Metamorphic rocks, the main mass of the tableland, are exposed in every deep valley in Tigré and along the Blue Nile. Mica schists are most prevalent. Hornblende schists also occur and a compact felspathic rock in the Suris defile. The foliae of the schists strike north and south.

Triassic (?).—In the region of Adigrat the metamorphic rocks are invariably overlain by white and brown sandstones, unfossiliferous, and attaining a maximum thickness of 1,000ft. They are overlain by the fossiliferous limestones of the Antalo group. Around Chilga and Adigrat coal-bearing beds occur, which Blanford suggests may be of the same age as the coal-bearing strata of India. The Adigrat sandstone possibly represents some portion of the Karoo formation of South Africa.

Jurassic.—The fossiliferous limestones of Antalo are generally horizontal, but much disturbed when interstratified with trap rocks. The fossils are all characteristic Oolite forms and include a species of *Hemicidaris, Pholadomya, Ceromya, Trigonia* and *Alaria.*

Igneous Rocks.—Above a height of 8,000ft. the country consists of bedded traps belonging to two distinct and unconformable groups. The lower (Ashangi group) consists of basalts and dolerites often amygdaloidal. Their relation to the Antalo limestones is uncertain, but Blanford considers them to be not later in age than the Oolite. The upper (Magdala group) contains

much thick trachytic rock lying perfectly horizontally, and giving rise to a series of terraced ridges characteristic of central Abyssinia. They are interbedded with unfossiliferous sandstones and shales. Of more recent date (probably Tertiary) are some igneous rocks, rich in alkalis, in parts of southern Abyssinia. Still more recent are the basalts and ashes west of Massawa and around Annesley Bay, and known as the Aden volcanic series. The older igneous rocks have suffered severe denudation, giving deep and narrow ravines, sometimes to a depth of 3,000 to 4,000ft.

Climate.—Somaliland and the Danakil lowlands are hot and dry with semi-desert conditions; the lower basin of the Sobat is hot, swampy and malarious. But over most of Abyssinia, as well as the Galla highlands, the climate is very healthy and temperate. The country lies wholly within the tropics, but its nearness to the equator is counterbalanced by the elevation of the land. In the deep valley of the Takazze and Abbai, and generally below 4,000ft., conditions are torrid and fevers prevalent. On the uplands, however, the air is bracing and the nights very bleak. The mean range of temperature is between 60° and 80°. On the higher mountains the climate is Alpine. The atmosphere on the plateaus is exceedingly clear. In addition to variation in climate with elevation, the year may be divided into two main seasons, the dry (*baga*) from Oct to mid-June, and the rainy (*karamt*), caused by the south-west monsoon, from mid-June to the end of September. There is also a period of so-called "little rains," generally about March.

The incidence of the rains varies slightly in different parts of the country, the rain moving from north to south; the average annual rainfall at Addis Ababa over a period of 25 years amounted to 1,200mm ; it is on the whole rather lighter in the north. The rainy season is of great importance not only to Abyssinia but to the countries of the Nile valley, as the prosperity of the eastern Sudan and Egypt is largely dependent upon the Abyssinian rainfall.

Flora and Fauna.—As in a day's journey the traveller may pass from torrid to almost Alpine conditions of climate, so great also is the range of flora and fauna. In the valleys and lowlands vegetation is dense, but the plateaux are comparatively bare, with thinly scattered trees and bushes The glens and ravines are often thickly wooded, and offer a delightful contrast to the open downs. These conditions are particularly characteristic in the north; in the south the upland vegetation is more luxuriant. The date palm, mimosa, wild olive, giant sycamores, junipers and laurels, the myrrh and other gum trees (gnarled and stunted, these flourish most on the eastern foothills), a magnificent pine (the Natal yellow pine, which resists the attacks of the white ant), the fig, orange, lime, pomegranate, peach, apricot, banana and other fruit trees; the grape vine (rare), blackberry and raspberry; the cotton and indigo plants, and occasionally the sugar cane, are all found. There are in the south large forests of valuable timber; and the coffee plant is indigenous in the Kaffa country, whence it takes its name. Many grasses and flowers abound. Large areas in the highlands are covered by the Kosso tree, which grows from 30 to 40ft. high and has abundant pendant red blossoms; the flowers and the leaves are prized for medicinal purposes. The fruit of the kurarina, found almost exclusively in Shoa, yields a black grain highly esteemed as a spice. On the tableland a great variety of grains and vegetables are cultivated. A fibrous plant, the sanseviera, grows wild in the semi-desert regions of the north and south-east.

Elephant and rhinoceros are found in low-lying districts, especially in the Sobat valley. The hippopotamus and crocodile inhabit many of the rivers and lakes, in some of which otters of large size are plentiful. Lions abound in the low countries and in Somaliland. Leopards, spotted and black, are numerous and often large; hyaenas are found everywhere and are hardy and fierce; lynx, wolf, wild dog and jackal are also common. Boars and badgers are more rarely seen. The giraffe is found in the west; the zebra and wild ass frequent the lower plateaux and the rocky hills of the north. Antelopes and gazelles of many varieties are numerous in most parts and include greater and lesser kudu (both rather rare), oryx, duiker, gemsbuck, hartebeest, gerenuk (the most common—it has long thin legs and a camel-like neck), klip-springer, found on the high plateaus as well as in the lower districts, and the dik-dik, the smallest of the antelopes, rarely over 10 lb., common in the low countries and the foothills. The rarest of all these is the nyala. The civet is found in many parts but chiefly in the Galla regions. Squirrels and hares, monkeys, notably the guereza, gelada, guenon and dog-faced baboon, range abundantly from the warm lowlands to heights of 10,000ft. Eagles, vultures, hawks, bustards and other birds of prey, partridges, duck, teal, guinea-fowl, sand-grouse, curlews, woodcock, snipe, pigeons, thrushes and swallows are very plentiful. A fine variety of ostrich is common. Among birds prized for plumage are the marabout, crane, heron, blackbird, parrot, jay, and many sun-birds of extraordinary brilliance. Serpents are not numerous but several are poisonous. The bee's honey is an important part of the people's food. The locust is a pest. There are thousands of varieties of butterflies and other insects.

ADMINISTRATION AND INDUSTRY

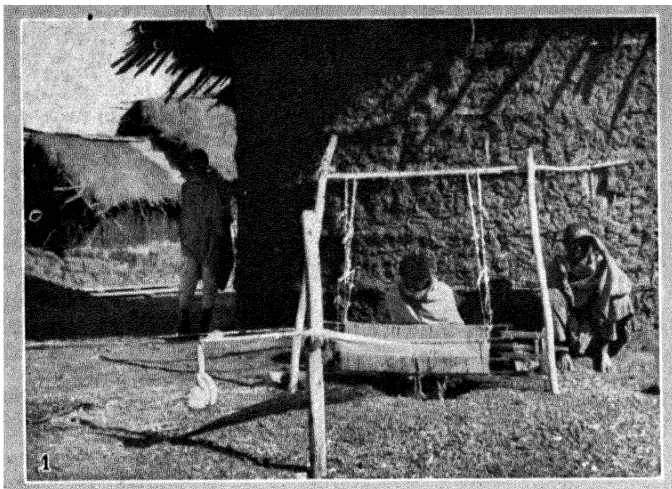
Provinces and Towns.—The ancient provincial divisions of Abyssinia (Amhara, Tigré, Gojam, Shoa, etc.) are for the most part now mere geographical expressions, having been broken up into smaller governorships with the exception of the ancient kingdom of Gojjam, enclosed by the great bend of the Abbai, which is still a single governorship. The more important provinces number about 20, of which may be mentioned: Gojam, North and South Tigré, Bagemdir, Harar, Salale, Waag and Lasta and Jimma. Each is divided into sub-districts and further subdivided into groups of villages With the exception of the capital, Addis Ababa (*q v.*), Harar, and Diredawa, there are no towns of any size in Abyssinia Centuries of almost continual warfare between the provinces help to account for the absence of large towns; also royal residences have changed frequently on exhaustion of fuel supplies. The earliest capital appears to have been Aksum (*q v*), in Tigré, where there are extensive ruins. Gondar in Amhara was the capital from the middle ages to the middle of the 19th century. Since 1892 the capital has been Addis Ababa in Shoa.

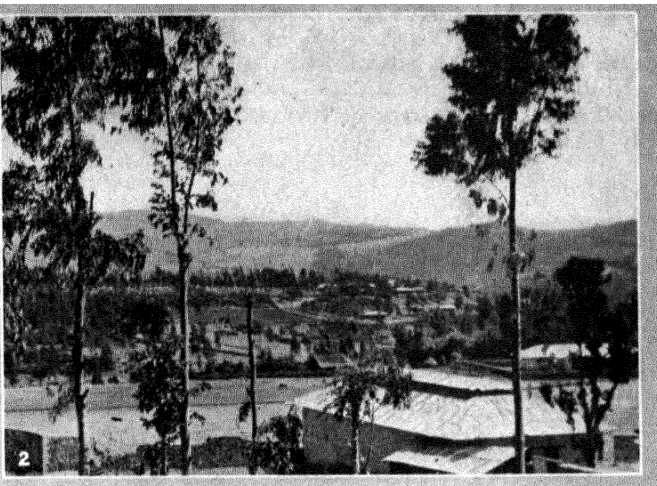
None of the other towns has a permanent population exceeding 6,000 to 10,000, but several have large periodic markets. In Tigré are Aduwa (17m E. by N. of Aksum), Aksum, Adigrat, Makale and Antalo. The three last are near the eastern escarpment of the high plateau on the direct road South from Massawa to Shoa. West of Adigrat is the monastery of Debra-Damo, a most celebrated sanctuary.

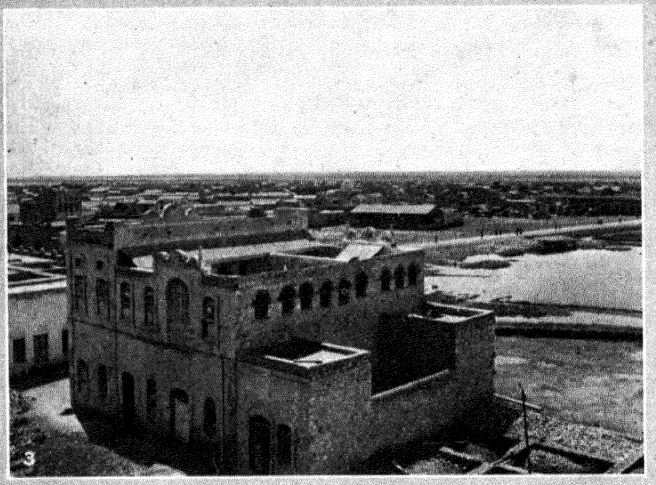
In Amhara are Magdala (*q.v*), formerly the residence of King Theodore, and the place of imprisonment of the British captives in 1866; Debra-Tabor ("Mount Tabor"), the chief royal residence under King John in a strong strategic position, overlooks the fertile plain east of Lake Tana about 8,620ft. above sea. Amba-Mariam, a fortified station midway between Gondar and Debra-Tabor near the north-east side of Lake Tana, with a population of 3,000, has the famous shrine and church dedicated to St. Mary, whence the name Mahdera-Mariam ("Mary's Rest"). It was a royal residence, and is an important market and place of pilgrimage, a few miles south-west of Debra-Tabor; Sokota, a great central market, capital of Waag, is at the convergence of several main routes. In Shoa are: Ankober, formerly the capital of the kingdom, Debra-Birhan ("Mountain of Light"), once a royal residence; Liché (Litché), one of the largest market towns in the south. Lfeka, the largest market in Gallaland, communicates direct with Gojam, Shoa and other parts of the empire. Anderacha, the commercial centre of Kaffa, and Jiren, capital of the neighbouring province of Jimma, attract traders from surrounding provinces.

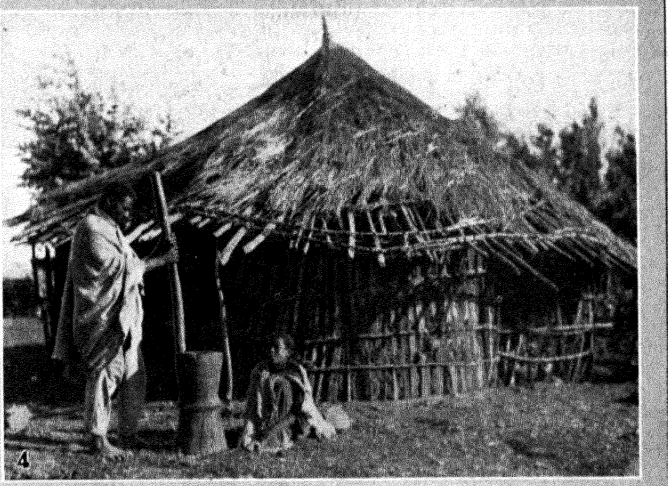
Communications.—There is a single line of railway from Jibuti to Addis Ababa (780m.) but, outside the capital, there are no roads for wheeled traffic. Transport is by mules, donkeys, pack-horses and (in the lower regions) camels. Telegraph lines connect Addis Ababa and several important towns of the North with Massawa, Harar and Jibuti. There is also a telephonic

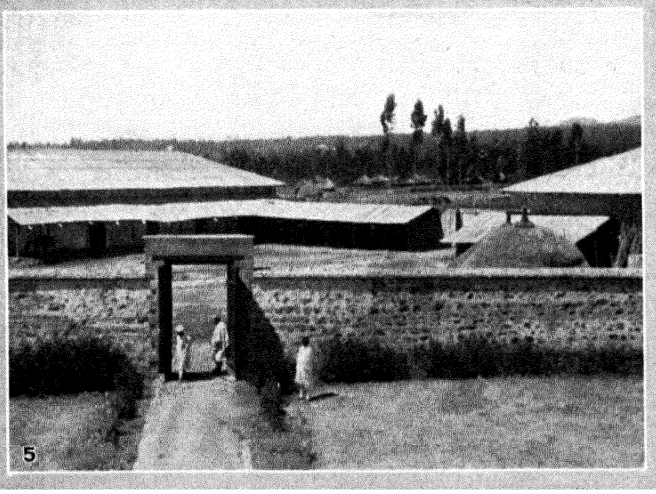
ABYSSINIA

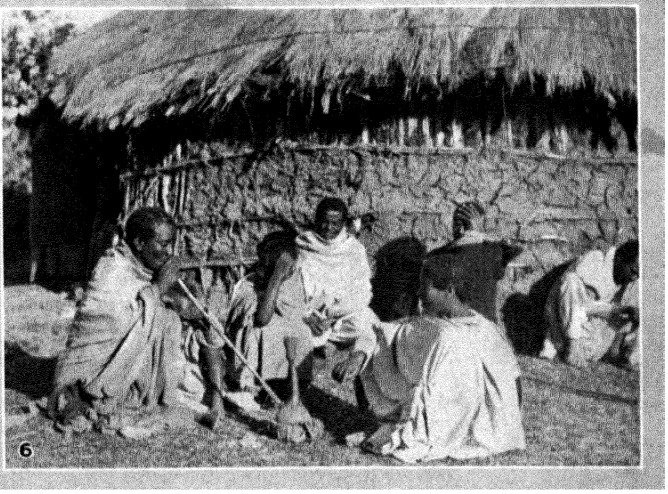










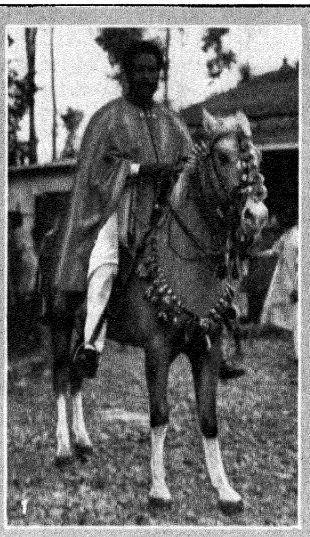


PHOTOGRAPHS (1, 2, 4, 5, 6) E. A SALISBURY FROM EWING GALLOWAY, (3) INTERNATIONAL NEWSREEL

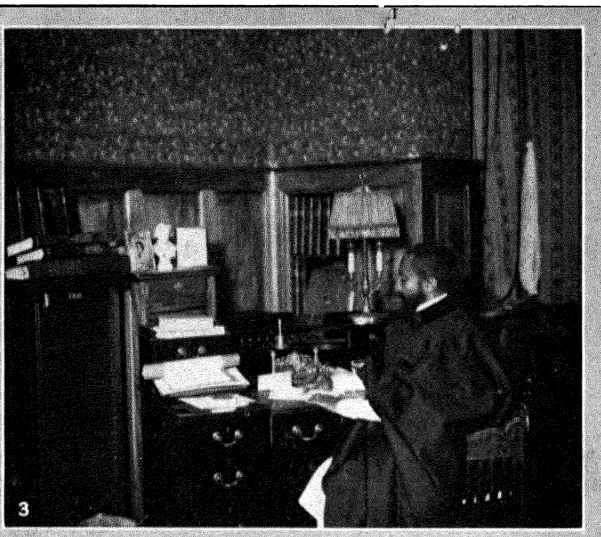
VILLAGE AND COUNTRY LIFE IN ABYSSINIA

1. A weaver at his loom in a village of Abyssinia, where practically all the manufacturing is primitive
2. Typical Abyssinian landscape showing farms on the level lands and mountains in the distance
3. General view of Djibouti, a French possession which is the principal port of French Somaliland
4. Crushing grain for bread in front of a country home in the hills of Abyssinia
5. View over the stables of one of the numerous local kings
6. A peaceful family scene taken in the evening in front of one of the huts on the plains

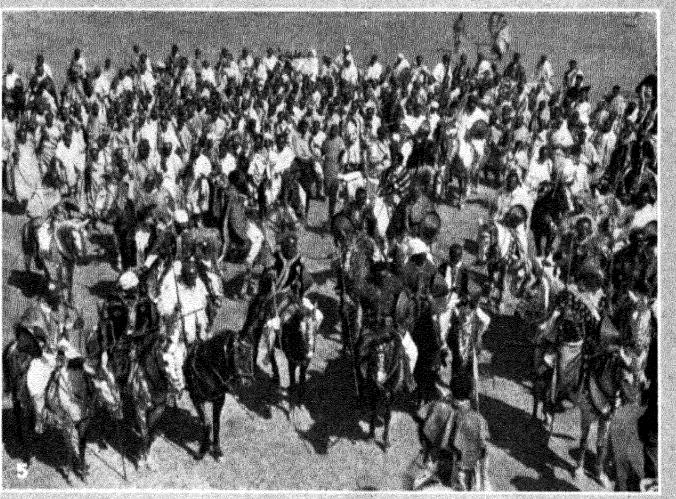
ABYSSINIA

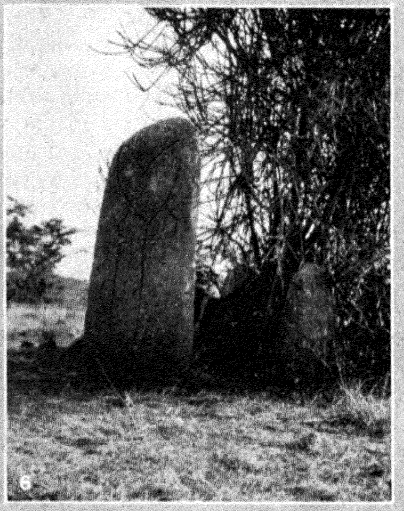


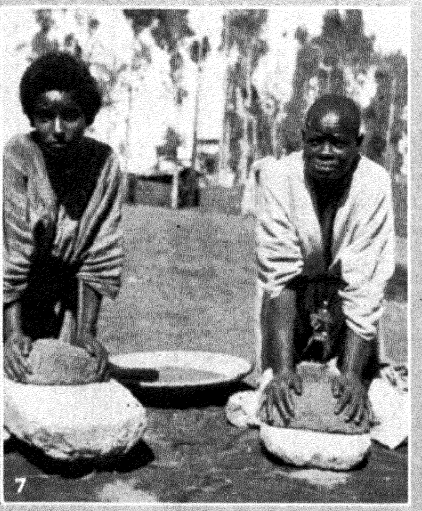


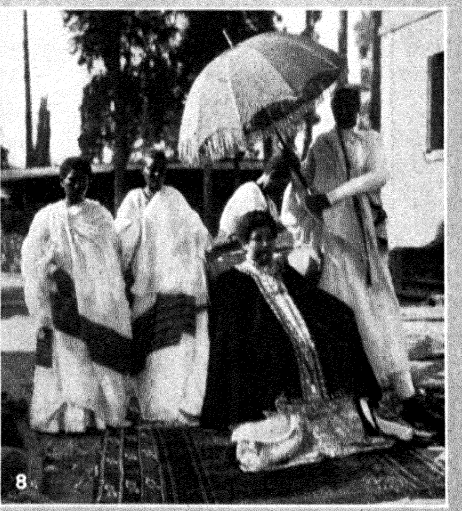












PHOTOGRAPHS: (1) EWING GALLOWAY, (4) INTERNATIONAL NEWSREEL, (5, 8) E. A. SALISBURY

LIFE AND CUSTOMS OF THE PEOPLE OF ABYSSINIA

1. Ras Taffari, who was appointed regent at the coronation of the Empress Zauditu, Feb. 11, 1917
2. Reproduction of a picture in an Abyssinian church in which the native artist has replaced the original face of the rider by that of the regent at that time
3. Ras Taffari signing the slavery decree in 1923. This decree made slave-trading punishable by death in Abyssinia
4. Wood-sellers at Addis Abeba, the capital of Abyssinia
5. Picture of the officers of the Abyssinian army on the parade grounds at Addis Abeba. They were commanded by Ras Taffari
6. An ancient Galla stone in the Arussi country, where recent archaeological research has resulted in the discovery of numbers of dolmens
7. An Abyssinian and a Shankalla woman (negroids) grinding grain on stones
8. An Abyssinian queen, wife of the actual ruler, posing for her picture in front of the palace in Addis Abeba

service; but outside Addis Ababa, the capital, it is subject to frequent interruption.

Agriculture.—The soil is exceedingly fertile and agriculture is extensively followed; in the lower regions maize, durra, wheat, barley, rye, *teff*, pease, cotton and sugar-cane are grown. *Teff*, a kind of millet with pinhead grains, is the common bread grain. The low grounds also produce a grain, *tocussa*, from which black bread is made. Certain oleaginous plants, the *suf*, *nuc* and *selite* (no European equivalents for the native names), and the groundnut, are largely grown. The castor bean grows wild, the green castor in the low, damp regions, the red castor at medium altitudes. The kat plant, a medicinal tonic, is largely grown in Harar province. On the higher plateaus the chief crops are wheat, barley, teff, peppers, vegetables of all kinds and coffee. Above 10,000ft. one finds barley, oats, beans and occasionally wheat. Of all cereals teff and barley are the most widely and generally grown. In the high plateaus sowing begins in May, in the lower plateaus and the plains in June, but where the summer is long and rain abundant sowing and reaping are going on at the same time. Most regions yield two, many three, crops a year.

Stock.—The land is admirably adapted for stock raising; enormous herds of cattle estimated at from 10 to 15 million head are found in Abyssinia, of which the most remarkable are the immensely long horned Sanga or Galla oxen. Most cattle are of the zebu or hump-backed variety, but there are also two breeds—one large, the other resembling the Jersey cattle—which are straight-backed. Sheep, of which there are also immense flocks, belong to the short and fat-tailed variety. The majority are not wool-bearing, but in one district a very small black sheep is raised for wool. The small mountain breed of sheep weigh no more than 20 to 30lb. apiece. Goats are of both the long and short-haired varieties, those from the Arusi Galla country having fine silky hair sometimes 16in. long. Large quantities of butter, generally rancid, are made from the milk of cows, goats and sheep. In the Leka province small black pigs are bred in considerable numbers The horses (very numerous) are strong and only about 14 hands high. The best breeds come from the Shoa uplands. The ass is also small and strong; and the mule, bred in large numbers, is of excellent quality, and, both as a transport animal and as a mount, is preferred to the horse. The mule, which averages 12 hands, thrives in every condition of climate, is fever-proof, travels over the most difficult mountain passes with absolute security and carries a load of from 150 to 200lb.

Minerals.—In the south and west provinces placer gold mines along the water-courses are worked by Gallas as an industry subsidiary to tending their flocks and fields In the Wallega district veins of gold-bearing quartz and finds of platinum have been reported. Iron, coal, potash and other minerals are found. Rock-salt is obtained from the province of Tigré.

Trade and Currency.—The small progress in the economic and commercial development may be attributed to disturbed political conditions (until quite recently), the lack of communications, bad methods of taxation, suspicion of foreign enterprise and currency difficulties. Some European commercial enterprises have been started and there are indications that the Government will be able to give more sympathetic attention in the future to this. A Belgian company has acquired the alcohol monopoly, but is meeting with great difficulties; a Franco-Belgian company has been formed for cotton cultivation, two Belgian companies are developing large coffee plantations in addition to a few smaller undertakings. Banking is a monopoly of the Bank of Abyssinia (a branch of the National Bank of Egypt) under charter of Emperor Menelek.

The total trade approximates £2,500,000 annually. The chief exports are coffee and hides, and the principal imports, salt, cotton fabrics and hardware. The main channel of trade is the Franco-Ethiopian railway, from Addis Ababa to the port of Jibuti in French Somaliland. The principal trade routes with the Sudan are via Gambela, Gallabat and Roseires. Other trade routes are through the Italian colony of Eritrea to Massawa, and through Harar to Berbera in British Somaliland. The currency is the Maria Theresa and Menelek dollars of a nominal value of about 2s., but in parts of the country bars of salt or even cartridges are used.

Government.—The political institutions are of a feudal character, and within their provinces the *rases* and other chiefs exercise large powers. The empress and regent have a number of ministers and a council of elders of the Crown. The legal system (*Feta Negast*) is a strange combination of various origins based on the Mosaic Code, the chief judicial officer being known as the *Afa Negus* (breath of the king). From all decisions there is an appeal to the throne. The powerful Church (*q.v.*) is presided over by the *Abuna*, always a Copt nominated from Egypt. The priests, an ignorant body, teach the scriptures in Giz, a tongue understood by very few. Apart from this and two schools in Addis Ababa, for which a few European teachers have been introduced, education is practically non-existent. The Abyssinian calendar divides the year into 12 months of 30 days each, followed by one month of five days (six in leap year). The year begins on 1st Maskaram, our Sept. 11 (12 in the European year preceding our leap year) and is then seven years behind the European year; from Jan. 1 to Sept. 10 it is eight years behind. The land is not held in fee simple but is subject to the control of the throne or the church. Revenue is derived from a 10% customs duty on imports, and from a levy on all forms of productions; but as the provincial governors receive no salaries the receipts of the central Government are subject consequently to fluctuations. (C. F. R)



BY COURTESY OF BARNUM BROWN

ABYSSINIAN NATIONAL COSTUME A CHIEF IN GALA DRESS WITH LION'S MANE COLLAR AND HEADDRESS AND AN INDIVIDUAL IN EVERY-DAY DRESS WITH WOOLLEN BURNOUS

Defence.—The early history of Abyssinia was marked by the struggles of an early Christian community against pagan and Mohammedan invaders. Early Portuguese records (1520–27) contain some entries of military interest King Theodore (b. 1818) first conceived the idea of organizing an Abyssinian army on European lines His power was broken in 1868 by an expedition under Lord Napier of Magdala, sent to the succour of Europeans whom he had made prisoner. (*See* also EGYPT AND SUDAN, CAMPAIGNS IN, 1882–1899). In March 1896 Theodore's successor Menelek successfully defended the country against an Italian invading force, 200,000 men having responded to his call to arms. In time of war every able-bodied Abyssinian is expected to serve. According to recent estimates, about 250,000–300,000 Abyssinians (including a small standing army) could be equipped with modern rifles; but lack of commissariat would prevent a large force from keeping the field long. From 1890 onwards various expedients have been adopted ineffectively by the European Powers to limit the import of arms. The co-operation of Abyssinia, which joined the League of Nations in 1923, is now being sought (1928).

Under the terms of a treaty concluded in May 1902 an area near Itang (Baro river) bordering the Sudan cannot be used for any military purpose (State Papers, vol. 95, p 467). (G. G A)

HISTORY

Early Records.—Abyssinia, or at least the northern portion of it, was included in the tract of country known to the ancients as Ethiopia, the northern limits of which reached at one time to about Syene. The connection between Egypt and Ethiopia was in early times very intimate, and occasionally the two countries were under the same ruler, so that the arts and civilization of the one naturally found their way into the other. In early times, too, the Hebrews had commercial intercourse with the Ethiopians; and according to Abyssinian tradition the queen of

Sheba who visited Solomon was a monarch of their country, and from their son Menelek the kings of Abyssinia claim descent. During the Captivity many of the Jews settled here and brought with them a knowledge of the Jewish religion. Under the Ptolemies, the arts as well as the enterprise of the Greeks entered Ethiopia, and led to the establishment of Greek colonies. Out of these Greek colonies appears to have arisen the kingdom of Auxume which flourished from the 1st to the 7th century A.D. and was at one time nearly coextensive with Abyssinia proper. The capital Auxume and the seaport Adulis were then the chief centres of the trade with the interior of Africa in gold dust, ivory, leather, aromatics, etc. At Axum, the site of the ancient capital, many vestiges of its former greatness still exist; and the ruins of Adulis, which was once a seaport on the bay of Annesley, are now about 4m. from the shore (*see* ETHIOPIA, *The Axumite Kingdom*).

Introduction of Christianity.—Christianity was introduced into the country by Frumentius (*q v.*), who was consecrated first bishop of Ethiopia by St. Athanasius of Alexandria about A D. 330. From the scanty evidence available it would appear that the new religion at first made little progress, and the Axumite kings seem to have been among the latest converts. Towards the close of the 5th century a great company of monks established themselves in the country, and since that time monachism has been a power among the people and not without its influence on the course of events. In the early part of the 6th century the king of the Homerites, on the opposite coast of the Red Sea, having persecuted the Christians, the emperor Justinian I. requested the king of Auxume, Caleb or El-Esbaha, to avenge their cause. He accordingly collected an army, crossed over into Arabia, and conquered Yemen (*c.* 525), which remained subject to Ethiopia for over 50 years. This was the most flourishing period in the annals of the country. The Ethiopians possessed the richest part of Arabia, carried on a large trade, which extended as far as India and Ceylon, and were in constant communication with the Greek empire. Their expulsion from Arabia, followed by the conquest of Egypt by the Mohammedans in the middle of the 7th century, changed this state of affairs, and the continued advances of the followers of the Prophet at length cut them off from almost every means of communication with the civilized world; so that, as Gibbon says, "encompassed by the enemies of their religion, the Ethiopians slept for near a thousand years, forgetful of the world by whom they were forgotten." About A D. 960, a Jewish princess, Judith, conceived the design of murdering all the members of the royal family, and of establishing herself in their stead. During the execution of this project, the infant king was carried off by some faithful adherents, and conveyed to Shoa, where his authority was acknowledged and the Solomonean dynasty ruled for about 300 years; while Judith reigned for 40 years over the rest of the kingdom after which a usurping dynasty of Lasta held the reins of power (except in Shoa) until in 1268 the kingdom was restored to the royal house in the person of Yekūnō Amlāk.



BY COURTESY OF B BROWN
ABYSSINIAN LADY WEARING WHITE SHAMMA (THE NATIONAL TOGA) WITH COLOURED STRIPES

Advent of the Portuguese.—Towards the close of the 15th century the Portuguese missions into Abyssinia began. A belief had long prevailed in Europe of the existence of a Christian kingdom in the far east, whose monarch was known as Prester John, and various expeditions had been sent in quest of it. Among others who had engaged in this search was Pedro de Covilham, who arrived in Abyssinia in 1490, and, believing that he had at length reached the far-famed kingdom, presented to the negūs, or emperor of the country, a letter from his master the king of Portugal, addressed to Prester John Covilham remained in the country, but in 1507 an Armenian named Matthew was sent by the negūs to the king of Portugal to request his aid against the Mohammedans. In 1520 a Portuguese fleet, with Matthew on board, entered the Red Sea in compliance with this request, and an embassy from the fleet visited the negūs, Lebna Dengel or Dawit (David) II., and remained in Abyssinia for about six years. One of this embassy was Father Francisco Alvarez, from whom we have the earliest and not the least interesting account of the country. Between 1528 and 1540 armies of Mohammedans, under the renowned general Mohammed Grañ (probably a Somali), entered Abyssinia from the low country to the south-east, and overran the kingdom, obliging the emperor to take refuge in the mountain fastnesses. In this extremity recourse was again had to the Portuguese, who sent a fleet, under the command of Stephen da Gama, from India, which arrived at Massawa in Feb. 1541. In the July following a force of 450 musqueteers, under the command of Christopher da Gama, younger brother of the admiral, left the fleet and marched into the interior, and being joined by native troops were at first successful against the enemy; but they were subsequently defeated, and their commander taken prisoner and put to death (Aug. 1542). On Feb. 21, 1543, however, Mohammed Grañ was shot in an engagement and his forces totally routed. After this, quarrels arose between the negūs and the Portuguese, who now wished the emperor publicly to profess himself a convert to Rome, which the negūs refused to do. The Jesuits who had accompanied or followed the da Gama expedition into Abyssinia, and fixed their headquarters at Fremona (near Adowa), were oppressed and neglected, but not actually expelled. In the beginning of the 17th century Father Pedro Paez arrived at Fremona, a man of great tact and judgment, who soon rose into high favour at court, and gained over the emperor to his faith. He directed the erection of churches, palaces and bridges in different parts of the country, and carried out many useful works. His successor Mendez was a man of much less conciliatory manners, and the feelings of the people became strongly excited against the intruders, till at length, on the death of the negūs, Socinius or Seged I., and the accession of his son Fasilidas in 1633, they were all sent out of the country, after having had a footing there for nearly a century and a half.

Penetration of European Travellers.—The French physician C. J. Poncet, who went there in 1698, via Sennar and the Blue Nile, was the only European that afterwards visited the country before Bruce in 1769. James Bruce's main object was to discover the sources of the Nile, which he was convinced lay in Abyssinia. Accordingly, leaving Massawa in Sept. 1769, he travelled via Axum (Aksum) to Gondar, and was well received by King Tekla Haimanot II. He accompanied the king on a warlike expedition round Lake Tana, crossing the genuine Blue Nile (Abbai) close to its point of issue from the lake. On a second expedition of his own he proved to his own satisfaction that the river originated some 40m. S W. of the lake at a place called Geesh (Nov. 4, 1770). He showed that this river flowed into the lake, and left it by its now well-known outlet. In 1805 the first British mission under Lord Valentia and Mr. Henry Salt was sent to conclude an alliance with Abyssinia and obtain a port on the Red Sea in case France secured Egypt by dividing up the Turkish Empire with Russia. This mission was succeeded by many travellers, missionaries and merchants of all countries. Prominent amongst them were Dr. C. T. Beke (*q.v.*) who did much to extend geographical knowledge of the country from 1840 to 1843, and Mr. Mansfield Parkyns (1843–46) who wrote the most interesting book on the country since Bruce.

In 1830 Protestant missionary enterprise was begun by Samuel Gobat and Christian Kugler, who were sent out by the Church Missionary Society and were well received by the Ras of Tigré, but in 1838 most of the missionaries were obliged to leave the country owing to the opposition of the native priests. Later on, however (1856), Bishop Gobat conceived the idea of sending lay missionaries who would engage in secular occupations as well as missionary work. Their secular work appears to have been the more appreciated, and King Theodore employed them as workmen and established them at Gaffat, near his capital

Position of the Negusa Nagast.—In order to obtain a clear view of native Abyssinian history, as distinct from the visits and

influence of Europeans, it must be borne in mind that during the last 300 years, and indeed for a longer period, for the old chroniclers may be trusted to have given a somewhat distorted view of the importance of the particular chieftains with whom they came in contact, the country has been merely a conglomeration of provinces and districts, ill defined, loosely connected and generally at war with each other. Of these the chief provinces have been Tigré (northern), Amhara (central), Gojam (north western) and Shoa (southern). The seat of government, or rather of overlordship, has usually been in Amhara, the ruler of which, calling himself negusa nagast (king of kings, or emperor), has exacted tribute, when he could, from the other provinces. The title of negusa nagast has been to a considerable extent based on the blood in the veins of the claimant. All the emperors have based their claims on their direct descent from Solomon and the queen of Sheba; but it is needless to say that in many, if not in most, cases their success has been due more to the force of their arms than to the purity of their lineage. Some of the rulers of the larger provinces have at times been given or have given themselves, the title of negūs or king, so that on occasion as many as three, or even more, negūses have been reigning at the same time; and this must be borne in mind by the student of Abyssinian history in order to avoid confusion of rulers. The whole history of the country is, in fact, with a few bright intervals due to the efforts of some of the more enlightened monarchs, one gloomy record of internecine wars, barbaric deeds and unstable governments, of adventurers usurping thrones, only to be themselves unseated, and of raids, rapine and pillage.

Thus, for example, though the Empire had been re-united under Yekūnō Amlāk of the Solomonean dynasty in 1268, the overlordship of the Negūs or Negusa Nagast (king of kings) had become purely nominal by the 18th century, and the rulers of Tigré and Amhara alternately held the real power. Between these two quasi-kingdoms there was perpetual hostility and much fighting, but without definite results until Kassa (later King Theodore of Magdala fame) appeared on the scene.

KING THEODORE

Origin and Rise.—Lij Kassa was born in Kwara, a small district of Western Amhara, in 1818. His father was a small local chief, and his uncle was governor of the districts of Dembea, Kwara and Chelga between Lake Tana and the undefined N W. frontier. He was educated in a monastery, but preferred a more active life, and by his talents and energy came rapidly to the front. On the death of his uncle he was made chief of Kwara, but in consequence of the arrest of his brother Bilawa by Ras Ali, he raised the standard of revolt against the latter, and, collecting a large force, repeatedly beat the troops that were sent against him by the ras (1841–47). On one occasion peace was restored by his receiving Tavavich, daughter of Ras Ali, in marriage; and this lady is said to have been a good and wise counsellor during her lifetime. He next turned his arms against the Turks, in the direction of Massawa, but was defeated; and the mother of Ras Ali having insulted him in his fallen condition, he proclaimed his independence. As his power was increasing, to the detriment of both Ras Ali and Ubié, these two princes combined against him, but were heavily defeated by him at Gorgora (on the southern shore of Lake Tana) in 1853. Ubié retreated to Tigré, and Ras Ali fled to Begemeder, where he eventually died. Kassa now ruled in Amhara, but his ambition was to attain to supreme power, and after conquering Gojam and Tigré, he proclaimed himself negusa nagast of Ethiopia under the name of Theodore III. He now turned his attention to Shoa which still remained unsubdued.

Struggle with Shoa.—Retracing our steps for a moment in that direction, we find that in 1813 Sahale (or Sella) Selassie, younger son of the preceding ruler of Shoa, Wassen Seged, had proclaimed himself king of Ifat, Shoa and the Galla. His reign was long and beneficent, and by his wise measures and personal generosity, and by extending his hospitality to Europeans, he brought his country within the closer ken of civilized European powers. During his reign he received the missions of Major W. Cornwallis Harris, sent by the governor-general of India (1841), and M. Rochet d'Héricourt, sent by Louis Philippe (1843), with both of whom he concluded friendly treaties on behalf of their respective governments. He was succeeded in 1847 by his eldest son, Haile Melikot, who, by increasing his dominions at the expense of the Galla, and by concluding a treaty with Ras Ali against Kassa in 1850 determined the latter to crush him at the earliest opportunity.

Thus it was that in 1855 Kassa, under the name of the emperor Theodore, advanced against Shoa with a large army. Dissensions broke out among the Shoans, and after a desperate and futile attack on Theodore at Debra-Berhan, Haile Melikot died of exhaustion and fever, nominating with his last breath his 11-year-old son Menelek as successor (Nov. 1855). After a hard fight, Menelek was defeated and handed over to the negūs, taken to Gondar and there trained in Theodore's service.

Decline of Power.—Theodore had by then reached the zenith of his career. He is described as being generous to excess, free from cupidity, merciful to his vanquished enemies, and strictly continent, but subject to violent bursts of anger and possessed of unyielding pride and fanatical religious zeal. He was also a man of intelligence, superior to those among whom he lived, with natural talents for governing and gaining the esteem of others. He had, further, a noble bearing and majestic walk, a frame capable of enduring any amount of fatigue, and is said to have been "the best shot, the best spearman, the best runner, and the best horseman in Abyssinia." Unfortunately, success turned his head, and he lost certain good influences around him by the death of his good queen Tavavich, and the murder by rebels of his two English friends and advisers, W. C. Plowden and J. T. Bell, whose deaths he avenged by the slaughter of 2,000 of the rebels.

His union with his second wife, Terunish, the proud daughter of the late Ras of Tigré, was a most unhappy one, and he seems to have given himself over to intoxication and lust, and to have exercised the most terrible cruelty in his campaigns against the Galla and the various districts in which rebellions broke out against him. This exhausted his strength and resources, and such of the country as he still dominated groaned under his heavy exactions.

Quarrel with Great Britain.—In Oct. 1862, Captain Cameron, who had been appointed in Feb of that year to succeed Mr. Plowden as British consul, was sent home by Theodore, with a letter to the queen of Great Britain, which reached the Foreign Office on Feb. 12, 1863. This letter was put aside and no answer returned, and to this in no small degree are to be attributed the difficulties that subsequently arose with that country. In Nov. despatches were received from England, but no answer to the emperor's letter, and this, together with a visit paid by Captain Cameron to the Egyptian frontier town of Kassala, greatly offended him. Accordingly in Jan. 1864 Captain Cameron and his suite, with Messrs. Stern and Rosenthal, were cast into prison. When the news of this reached England, the government resolved, when too late, to send an answer to the emperor's letter, and selected Mr. Hormuzd Rassam to be its bearer. The British party on arrival at the king's camp in Damot, on Jan. 25, 1866, were received with all honour, and were afterwards sent to Kwarata, on Lake Tana, there to await the arrival of the captives. The latter reached Kwarata on March 12 and everything appeared to proceed favourably. A month later they started for the coast, but had not proceeded far when they were all brought back and put into confinement. The Europeans, although detained as prisoners, were not at first unkindly treated; but in the end of June they were sent to Magdala, where they were soon afterwards put in chains, suffered hunger, cold and misery, and were in constant fear of death. Meanwhile one of them, Mr. Flad, had been sent by Theodore with a letter to Queen Victoria, asking for European workmen and machinery, and with a view if possible to effect the release of the prisoners by conciliatory measures, Mr. Flad was sent back, with some artisans and machinery, and a letter from the queen, stating that these would be handed over to his majesty on the release of the prisoners and their return to Massawa. This, however, failed to influence the emperor, and the British Government at length saw that they must have recourse to arms.

Sir Robert Napier's Expedition.—In July 1867 it was resolved to send an army into Abyssinia to enforce the release of the captives, under Sir Robert Napier (1st Baron Napier of Magdala). The landing-place selected was Mulkutto (Zula), on Annesley Bay, the point of the coast nearest to the site of the ancient Adulis, and we are told that "the pioneers of the English expedition followed to some extent in the footsteps of the adventurous soldiers of Ptolemy, and met with a few faint traces of this old-world enterprise" (C. R. Markham). The force amounted to upwards of 16,000 men, besides 12,640 belonging to the transport service, and followers, making in all upwards of 32,000 men. The task necessitated a march over 400 miles of a mountainous and little-known country, inhabited by savage tribes, to the camp or fortress of Theodore. The commander-in-chief landed on Jan. 7, 1868, and soon after the troops began to move forward through the pass of Senafé, and southward through the districts of Agamé, Tera, Endarta, Wojerat, Lasta and Wadela.

In the meantime the power of Theodore in the country was rapidly waning. Shoa had already shaken off his yoke; Gojam was virtually independent; Walkeit and Simen were under a rebel chief; and Lasta, Waag and the country about Lake Ashangi had submitted to Wagshum Gobassié, who had also overrun Tigré and appointed Dejaz Kassai his governor. The latter, however, in 1867 rebelled against his master and assumed the supreme power of that province. At the time when the British troops made their appearance in the country Theodore had thus been reduced to great straits. His army, which at one time numbered over 100,000 men, was rapidly deserting him, and he could hardly obtain food for his followers He resolved to quit his capital Debra-Tabor, which he burned, and set out with the remains of his army for Magdala. During this march he displayed an amount of engineering skill in the construction of roads, of military talent and fertility of resource, that excited the admiration and astonishment of his enemies. But after a heavy defeat near Magdala on April 10, Theodore sent Lieut. Prideaux, one of the captives, and Mr. Flad, accompanied by a native chief, to the British camp to sue for peace. Answer was returned, that if he would deliver up all the Europeans in his hands, and submit to the queen of Great Britain, he would receive honourable treatment. The captives were liberated and sent away, and accompanying a letter to the British general was a present of 1,000 cows and 500 sheep, the acceptance of which would, according to Eastern custom, imply that peace was granted. Through some misunderstanding, word was sent to Theodore that the present would be accepted, and he felt that he was now safe; but in the evening he learned that it had not been received, and despair again seized him. The next day, April 13, Magdala was stormed and taken, practically without loss, and within they found the dead body of the emperor, who had fallen by his own hand The inhabitants and troops were subsequently sent away, the fortifications destroyed, and the town burned. The queen Terunish having expressed her wish to go back to her own country, accompanied the British army, but died during the march, and her son Alamayahu, the only legitimate son of the emperor, was brought to England, as this was the desire of his father.[1] The success of the expedition was in no small degree owing to the aid afforded by the several native chiefs through whose country it passed, and no one did more in this way than Dejaz Kassa or Kassai of Tigré. In acknowledgment of this, several pieces of ordnance, small arms and ammunition, with much of the surplus stores, were handed over to him, and the British troops left the country in May 1868.

THE EMPEROR MENELEK II.

Early Struggles as King of Shoa.—It is now time to return to the story of the young prince Menelek, who, as we have seen, had been nominated by his late father as ruler of Shoa, but was in Theodore's power in Tigré. In 1865, he took advantage of Theodore's difficulties with the British government and escaped to Workitu, queen of the Wollo Galla country. The emperor, who held as hostage a son of Workitu, threatened to kill the boy unless Menelek were given up; but the gallant queen refused, and lost both her son and her throne. The fugitive meanwhile arrived safely in Shoa, and was there acclaimed as negüs. For the next three years Menelek devoted himself to strengthening and disciplining his army, to legislation, to building towns, such as Liché (near Debra-Berhan), Worra Hailu (Wollo Galla country), etc., and to repelling the incursions of the Galla. On the death of Theodore (April 13, 1868) many Shoans, including Ras Dargé, were released, and Menelek began to feel himself strong enough to undertake offensive operations against the northern princes. But these projects were of little avail, for Kassai of Tigré, had by this time (1872) risen to supreme power in the north With the help of the rifles and guns presented to him by the British, he had beaten Ras Bareya of Tigré, Wagshum Gobassié of Amhara and Tekla Giorgis of Gondar, and after proclaiming himself negusa nagast under the name of Johannes or John, was now preparing to march on Shoa Here, however, Menelek was saved from probable destruction through the action of Egypt. This power had, by the advice of Werner Munzinger (*q.v.*), the Swiss governor of Massawa, seized and occupied in 1872 the northern province of Bogos; and, later on, insisted on occupying Hamasen also, for fear Bogos should be attacked. John, after futile protests, collected an army, and with the assistance of Ras Walad Michael, hereditary chief of Bogos, advanced against the Egyptian forces, who were under the command of one Arendrup, a Dane. Meeting near the Mareb, the Egyptians were beaten in detail, and almost annihilated at Gundet (Nov. 13, 1875). An avenging expedition was prepared in the spring of the following year, and, numbering 14,000 men under Ratib Pasha, Loring (American), and Prince Hassan, advanced to Gura and fortified a position in the neighbourhood Although reinforced by Walad Michael, who had now quarrelled with John, the Egyptians were a second time (March 25, 1876) heavily beaten by the Abyssinians, and retired, losing an enormous quantity of both men and rifles. Colonel C. G. Gordon, governor-general of the Sudan, was now ordered to go and make peace with John, but the king had moved south with his army, intending to punish Menelek for having raided Gondar whilst he, John, was engaged with the Egyptians. Menelek's kingdom was meanwhile torn in twain by serious dissensions on the subject of the succession, but on the approach of John, the Shoans united for a time against their common enemy. After a few skirmishes, however, they melted away, and Menelek was obliged to submit and do obeisance to John The latter behaved with much generosity, but at the same time imposed terms which effectually deprived Shoa of her independence (March 1878). In 1879 Gordon was sent on a fresh mission to John on behalf of Egypt; but he was treated with scant courtesy, and was obliged to leave the country without achieving anything permanent.

Advent of the Italians.—The Italians now come on the scene. Assab, a port near the southern entrance of the Red Sea, had been bought from the local sultan in March 1870 by an Italian company, which, after acquiring more land in 1879 and 1880, was bought out by the Italian Government in 1882. In this year Count Pietro Antonelli was despatched to Shoa in order to improve the prospects of the colony by treaties with Menelek and the sultan of Aussa; but both John and Menelek became uneasy when Beilul, a port to the north of Assab Bay, was occupied by the Italians in Jan. 1885, and Massawa taken over by them from Egypt in the following month. This latter act was greatly resented by the Abyssinians, for by a treaty concluded with a British and Egyptian mission under Admiral Hewett and Mason Pasha in the previous year, free transit of goods was to be allowed through this port. In Jan. 1887, the Abyssinians, in consequence of a refusal from General Gené to withdraw his troops, surrounded and attacked a detachment of 500 Italian troops at Dogali, killing more than 400 of them Reinforcements were sent from Italy, whilst in the autumn the British Government stepped in and tried to mediate by means of a mission under Mr. (afterwards Sir Gerald) Portal. His mission, however, proved abortive, and after many difficulties and dangers he returned to Egypt at

[1] He was subsequently sent to school at Rugby, but died in his 19th year, on Nov. 14, 1879. He was buried at St. George's Chapel, Windsor.

the end of the year. In April 1888 the Italian forces, numbering over 20,000 men, came into touch with the Abyssinian army; but negotiations took the place of fighting, with the result that both forces retired, the Italians only leaving some 5,000 troops in Eritrea, as their colony was now called. Meanwhile John was also at war with the dervishes, who had in the meantime become masters of the Egyptian Sudan. Although he had set his troops in motion too late to relieve Kassala, Ras Alula, his chief general, inflicted a handsome defeat on Osman Digna at Kufit in Sept. 1885. Fighting between the dervishes and the Abyssinians continued, and in Aug. 1887 the dervishes entered and sacked Gondar. After some delay, King John took the field in force against the enemy, who were still harassing the north-west of his territory. A great battle ensued at Gallabat, in which the dervishes, under Zeki Tumal, were beaten. But a stray bullet struck the king, and the Abyssinians decided to retire. The king died during the night, and his body fell into the hands of the enemy (March 9, 1889).

Accession as Emperor of Abyssinia.—Immediately the news of John's death reached Menelek, he proclaimed himself king of kings of Ethiopia, and received the submission of Gondar, Gojam, and several other provinces, and later on of Mangasha, reputed son and heir of King John. As it happened, Count Antonelli was with Menelek when he claimed the throne, and promptly concluded (May 2, 1889) with him on behalf of Italy a friendly treaty, to be known hereafter as the famous Uccialli treaty. In consequence of this the Italians occupied Asmara, made friends with Mangasha and received Ras Makonnen,[1] Menelek's nephew, as his plenipotentiary in Italy; thus it seemed as though hostilities between the two countries had come to a definite end. For the next three years the land was fairly quiet, the chief political events being the convention (Feb. 6, 1891) between Italy and Abyssinia, protocols between Italy and Great Britain (March 24 and April 15, 1891) and a proclamation by Menelek (April 10, 1891), all on the subject of boundaries. As, however, the Italians became more and more friendly with Mangasha and Tigré the apprehensions of Menelek increased, till at last, in Feb. 1893, he wrote denouncing the Uccialli treaty, which differed in the Italian and Amharic versions. According to the former, the negūs was bound to make use of Italy as a channel for communicating with other powers, whereas the Amharic version left it optional. Meanwhile the dervishes were threatening Eritrea. A fine action by Colonel Arimondi gained Agordat for Italy (Dec. 21, 1893), and a brilliant march by Colonel Baratieri resulted in the acquisition of Kassala (July 17, 1894).

War with Italy.—On his return Baratieri found that Mangasha was intriguing with the dervishes, and had actually crossed the frontier with a large army. At Koatit and Senafé (Jan. 13–15, 1895) Mangasha was met and heavily defeated by Baratieri, who occupied Adigrat in March. But as the year wore on the Italian commander pushed his forces unsupported too far to the south Menelek was advancing with a large army in national support of Mangasha, and the subsequent reverses at Amba Alagai (Dec 7, 1895) and Makalle (Jan. 21, 1896) forced the Italians to fall back

Reinforcements of many thousands were meanwhile arriving at Massawa, and in Feb. Baratieri took the field at the head of over 13,000 men. Menelek's army, amounting to about 90,000, had during this time advanced, and was occupying a strong position at Abba Garima, near Adua (or Adowa). Here Baratieri attacked him on March 1, but the difficulties of the country were great, and one of the four Italian brigades had pushed too far forward. This brigade was attacked by overwhelming numbers, and on the remaining brigades advancing in support, they were successively cut to pieces by the encircling masses of the enemy. The Italians lost 4,600 white and nearly 3,000 native troops killed and wounded; the number of prisoners was estimated at between 2,500 and 3,000. The Abyssinians owned to a loss of over 3,000; but it is certain that their casualties were far greater, some writers placing the figure as high as 17,000. General Baldassera advanced with a large body of reinforcements to avenge this defeat, but the Abyssinians, desperately short of supplies, had already retired, and beyond the peaceful relief of Adigrat, no further operations took place. On Oct. 26 following, a provisional treaty of peace was concluded at Addis Ababa, annulling the treaty of Uccialli and recognizing the absolute independence of Abyssinia. This treaty was ratified, and followed by other treaties and agreements defining the Eritrean-Abyssinian and the Abyssinian-Italian Somaliland frontiers (*see* ITALY, *History*, and SOMALILAND, *Italian*).

[1] Ras of Harar, which province had been conquered and occupied by Menelek in Jan. 1887.

Consolidation and Extension of the Empire.—The war, so disastrous to Italy, attracted the attention of all Europe to Abyssinia and its monarch, and numerous missions, two Russian, three French and one British, were despatched to the country, and hospitably received by Menelek. The British one, under Mr. (afterwards Sir) Rennell Rodd, concluded a friendly treaty with Abyssinia (May 15, 1897), but did not, except in the direction of Somaliland, touch on frontier questions, which for several years continued a subject of discussion. During the same year (1897) a small French expedition under Clochette and de Bonchamps endeavoured to reach the Nile, but, after surmounting many difficulties, stuck in the marshes of the Upper Sobat, and was obliged to return. Another expedition of Abyssinians, under Dejaz Tasamma and accompanied by three Europeans—Faivre (French), Potter (Swiss), and Artomonov (Russian)— started early in 1898 and reached the Nile at the Sobat mouth in June, a few days only before Major Marchand and his gallant companions arrived on the scene. But no contact was made, and the expedition returned to Abyssinia.

In the same year Menelek subdued Mangasha, who was again rebelling against his authority, and later conducted a number of expeditions in different parts of the country, notably against the Galla, and added immense provinces to the empire. An important treaty was concluded on May 15, 1902, between England and Abyssinia for the delimitation of the Sudan-Abyssinian frontier. Menelek, in addition, agreed not to obstruct the waters of Lake Tana, the Blue Nile or the Sobat, so as not to interfere with the Nile irrigation question, and he also agreed to give a concession, if such should be required, for the construction of a British railway through his dominions, to connect the Sudan with Uganda. A combined British-Abyssinian expedition (Mr. A. E. Butter's) was despatched in 1901 to propose and survey a boundary between Abyssinia on the one side and British East Africa and Uganda on the other; and the report of the expedition was made public by the British Government in Nov. 1904. It was followed in 1908 by an agreement defining the frontiers concerned. It is also an interesting fact that between 1899 and 1904 the Abyssinians co-operated with the British in their campaigns against the Mad Mullah of Somaliland by sending joint expeditions on no less than four occasions.

Growth of European Influence.—The first concession for a railway was the one from the coast at Jibuti (French Somaliland) to the interior, granted by Menelek to a French company in 1894. The company having met with numberless difficulties and financial troubles, the French Government, on the extinction of the company's funds, came to the rescue and provided money for the construction. (In the alternative, British capitalists interested in the company would have obtained control of the line.) The French government's help enabled the railway to be completed to Diredawa, 28m from Harar, by the last day of 1902. Difficulties arose over the continuation of the railway to Addis Ababa and beyond, and the proposed internationalization of the line. These difficulties, which hindered the work of construction for years were composed (so far as the European Powers interested were concerned) in 1906 by the terms of an Anglo-French-Italian agreement, signed in London on Dec. 13 of that year.

Meanwhile the country slowly developed in parts and opened out cautiously to European influences. Most of the Powers appointed representatives at Menelek's capital—the British minister-plenipotentiary and consul-general, Lieut.-Colonel Sir J. L. Harrington, having been appointed shortly after the British mission in 1897. In Dec 1903 an American mission visited Addis Ababa, and a commercial treaty between the United States and

Abyssinia was signed. A German mission visited the country early in 1905 and also concluded a treaty of commerce with the negūs. Later in the year a German minister was appointed to the court of the emperor.

After 1897 British influence in Abyssinia, owing largely no doubt to the conquest of the Sudan, the destruction of the dervish power and the result of the Fashoda incident, was sensibly on the increase. Of the remaining powers France occupied the most important position in the country. Ras Makonnen, the most capable and civilized of Menelek's probable successors, died in March 1906, and Mangasha died later in the same year; the question of the succession therefore opened up the possibility that, in spite of recent civilizing influences, Abyssinia might still relapse in the future into its old state of conflict. The Anglo-French-Italian agreement of Dec. 1906, referred to above, contained provisions in view of this contingency. The preamble of the document declared that it was the common interest of the three Powers "to maintain intact the integrity of Ethiopia," and Article I. provided for their co-operation in maintaining "the political and territorial *status quo* in Ethiopia." Should, however, the *status quo* be disturbed, the Powers were to concert to safeguard their special interests. The terms of the agreement were settled in July 1906, and its text forthwith communicated to the negūs. After considerable hesitation Menelek sent, early in December, a note to the Powers, in which, after thanking them for their intentions, he stipulated that the agreement should not in any way limit his own sovereign rights. (E. Gl.; C F. R)

Lej Yasu.—The Emperor Menelek, who had converted a congeries of semi-independent kingdoms into a powerful state, died in 1913 and the country fell into a condition bordering on chaos. The stricken emperor had in 1908 nominated his grandson Lej Yasu (b. 1896) as his successor, under the regency of Ras Tessama, but no government was possible owing to the constant strife between the empress Taitu, the regent and other powerful nobles. In 1910 the empress was finally driven into retirement, and in 1911 Ras Tessama died.

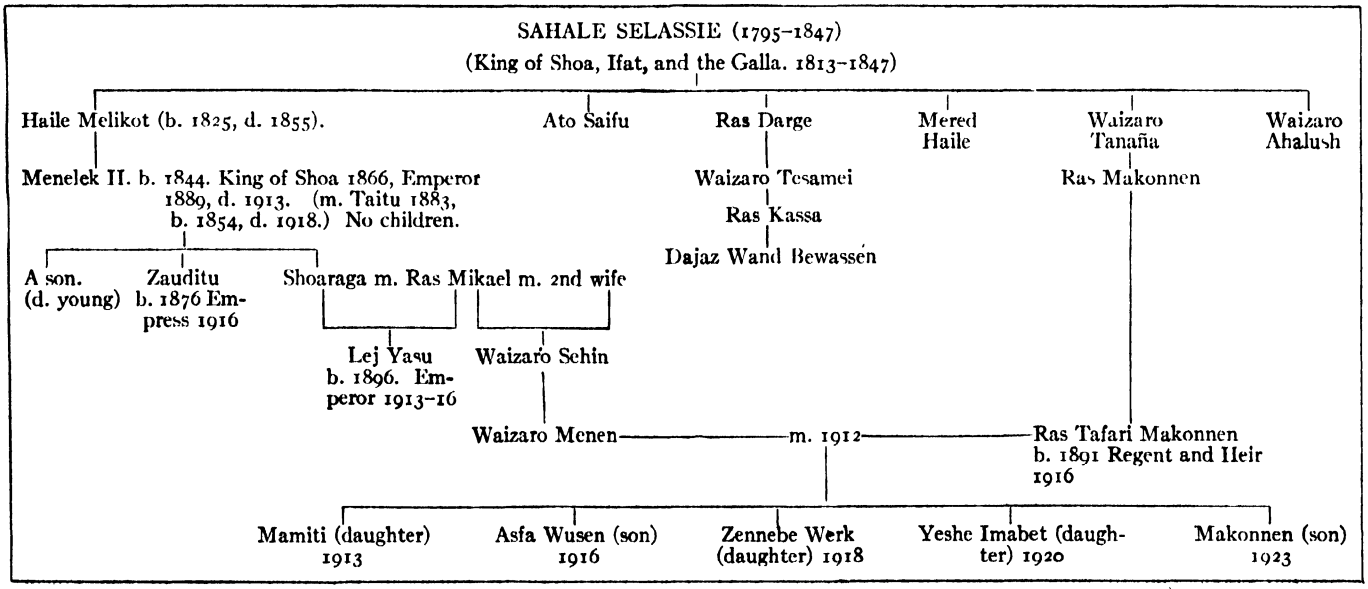
Lej Yasu then took the reins of government into his own hands, although he was never crowned, and the state of the country became steadily worse By his misgovernment, his tyrannical and dissolute conduct, and particularly by his inclination to Islam, he mortally affronted his own subjects, intensely proud as they were and are of their 15 centuries of Christian tradition. His support of the "Mad Mullah" of Somaliland, who claimed him as a cousin, and his efforts to build up a federation of Muslim states, anti-ally in its sentiments, also estranged the sympathies of the three great Powers with possessions bordering on Abyssinia. In Sept. 1916 he was excommunicated by the Abuna, the head of the Abyssinian Church. The great Rases, thus relieved of their oath of fealty, formally deposed him, and proclaimed Zauditu, a daughter of the Emperor Menelek, born in 1876, as Empress, and Dajazmach Tafari, born July 17, 1891, son of Menelek's nephew, Ras Makonnen, as Regent of the Empire, Heir to the Throne and Ras of Rases. Heavy fighting followed Lej Yasu's father, Ras Mikael of Wollo Galla, raised large Galla forces to aid his son, but the troops of the deposed ruler were defeated with great slaughter at Sagalle on Oct. 27, 1916. Ras Mikael was taken prisoner, and Lej Yasu became a wanderer, first of all in the Dankali country and later in the province of Tigré

EMPRESS ZAUDITU AND RAS TAFARI

Early Difficulties.—The coronation ceremonies of the new rulers took place in Feb 1917, but Zauditu and Tafari succeeded to a troubled heritage. The great Rases and provincial governors had fallen back into semi-independence, and sporadic fighting with the followers of Lej Yasu, who was not finally captured until 1921, continued for some years. The dual nature of the government made it difficult to exercise effective control, and stimulated intrigue, but little by little the regent gathered together the reins of government, and improvements in administration, both central and local, were slowly achieved

During this difficult period, in which he was criticized by the more reactionary Abyssinians for going too fast, and by European observers for not going fast enough, Ras Tafari exhibited many of the qualities of his father, Ras Makonnen, who had been not merely a fine soldier but a skilful diplomat, having conducted official missions to Paris, London and Rome. Tafari was aided in his task by the completion, in 1918, of the railway from the coast of French Somaliland to the capital, Addis Ababa This link with the outside world undoubtedly played a considerable part in maintaining and strengthening the Regent's position and in stimulating intercourse with Europe, so much interrupted by the World War as well as by internal events

The Succession.—Ras Tafari married Waizaro Menen, grand daughter of Ras Mikael, in 1912, and by her had two sons and three daughters, thus securing the succession to the throne in a direct line from the great King Sahale Selassie, of the House of Solomon. This is a very important matter from the point of view of Abyssinia's internal peace in the future, for the ex-emperor, Lej Yasu, is still alive, though in captivity, and the most powerful man in Abyssinia, Ras Kassa, is also a descendant of the Royal line (1928). The position of the rival claimants for the throne is exhibited in the following table —



Relations with Foreign Countries.—The African possessions of three European powers border on Abyssinia—Great Britain, France, and Italy—and of these the first named has by far the larger interests in the country. In the first place nearly 2,000 miles of British territory is coterminous with that of

Abyssinia; there are many hundreds of British and British-protected subjects resident there (Arabs, Indians, Somalis and others); and the question of the regulation of the waters of Lake Tana and the Blue Nile is closely linked with the subject of the irrigation of the Sudan. This latter question formed the subject of the Anglo-Italian exchange of notes in 1925, an agreement which caused some controversy owing to misunderstanding of its scope and intention. Its provisions, however, demonstrated clearly the absence of any desire for territorial expansion on the part of Britain at the expense of Abyssinia, a point emphasized by the fact that the Anglo-Abyssinian frontiers have all been fixed by treaty, and that no attempt to vary them has been made on the part of Britain. British policy towards Abyssinia has been part and parcel of her general policy since the eighties in the whole Nile basin—that is to protect the water needs of Egypt and the Sudan by treaty and agreement in those territories not actually in British occupation. The relations between Britain and Abyssinia are governed by the following treaties:—June 3, 1884, (a) settlement of differences between Abyssinia and Egypt, and (b) suppression of the slave trade; May 14, 1897, commerce, frontiers and transit of arms; May 15, 1902, Blue Nile and Lake Tana; and frontiers; Dec. 6, 1907, frontiers; April 13 and May 12, 1909, import duties. America has a commercial treaty with Abyssinia concluded in 1904; France and Italy have frontier delimitation treaties as well, and the former country concluded in 1908 an important treaty upon judicial procedure in respect to French subjects; Holland and Japan concluded treaties of friendship and commerce in 1926 and 1927.

Progress.—Ras Tafari's position was so far consolidated by 1922 that he was able to leave the country for a short visit to Aden, and in 1924 he visited the principal countries of Europe with an imposing retinue of over 20 Rases and officials, his absence lasting nearly five months. His greatest triumph was the admission of Abyssinia to the League of Nations on Sept. 28, 1923, subject to certain conditions as to the control of slavery and of the arms traffic. Progress, though slow according to European ideas, has since been made; the Regent opened a school at Addis Ababa into which he introduced European teachers, and a number of young Abyssinians were sent to America, England, and France for their education to be completed. A large American hospital has been erected and many roads have been made in and around Addis Ababa. European enterprise is beginning to take an interest in the country, and the infiltration of European ideas, though very slow and gradual, is real.

Much yet remains to be done. The illiteracy of the people, very few of whom can read or write, the existence of slavery, the authority and bigotry of the priesthood, and most of all the power of the great provincial chiefs, are obstacles to progress; the financial and general administration and also that of justice leave much to be desired, while the general condition of the peasantry, especially in those parts inhabited by conquered races, is far from satisfactory. But the guarantee of independence involved by admission to the League of Nations should tend to set at rest internal fears of foreign international rivalries and aspirations and thus facilitate domestic reform.

In May 1927 the duke of the Abruzzi was sent by the Italian Government to return the visit paid by Ras Tafari to Italy in 1924, and his week's stay at Addis Ababa was the occasion of a lavish display and much public rejoicing; the visit was doubtless intended to obliterate the effect caused by the 1925 Anglo-Italian Agreement which had antagonised Abyssinian feeling.

At this visit were also laid the foundations of an Italo-Abyssinian treaty of "perpetual friendship," which was signed at Addis Ababa on Aug. 2, 1928, providing for arbitration in all disputes arising between the two countries; and of a further, and unpublished (Sept. 1928), agreement for the cession to Abyssinia of a free zone at the port of Assab (in Eritrea) and the construction of a road thence to Addis Ababa.

A new and unexpected development in the Anglo-Abyssinian negotiations for the construction of works to regulate the flow of the Blue Nile occurred in 1926–27. The negotiations, which had been proceeding for nearly 30 years, had for their object the better irrigation of the Sudan and Egypt, and Abyssinia is bound by treaty to allow no works of the kind to be constructed without the agreement of Great Britain, and, other things being equal, to grant the concession for the work to British enterprise. A provisional arrangement, however, to build a dam on the river, was come to in Nov. 1927, between the Abyssinian Government and the J. G. White Engineering Corporation of America: a proposal against which the British Government protested as being a violation of their treaty rights.

During the autumn of 1928 friction between the empress and Ras Tafari reached such a pitch that the regent was pressed by his adherents to assume the title of king.

See James Bruce, *Travels to discover the source of the Nile* (1790); Sir H. C. Harris, *Highlands of Aethiopia* (1844); Mansfield Parkyns, *Life in Abyssinia* (1853). A. B. Wylde, *Modern Abyssinia* (1901), a valuable volume giving the results of many years' acquaintance with the country and people; Powell-Cotton, *A Sporting Trip through Abyssinia* (1902); Duchesne-Fournet, *Mission en Ethiopie* (1909), which contains a useful bibliography; G. Montandon, *Au pays Ghimirra* (Neuchâtel, 1913); C. Annatarone, *In Abissinia* (1914); L. de Castro, *Nella Terra dei Negus* (1915), a good general description; Major Maydon, *Simen, its Heights and Abysses* (1925), describing the mountainous northern country; C. F. Rey, *Unconquered Abyssinia as it is Today* (1923) and *In the Country of the Blue Nile* (1927), two books embodying a comprehensive study of the country as the result of four journeys therein. Arnold Hodson, *Seven Years in Southern Abyssinia* (1927), a valuable record of borderland difficulties.

For later geographical and kindred information, reference should be made to the *Geographical Journal* (London)—H. Weld Blundell, "A Journey through Abyssinia" (vol. xv. 1900) and "Exploration in the Abbai Basin" (vol. xxvii. 1906); Arnold Hodson, "Southern Abyssinia" (Feb. 1919) and "Notes on Abyssinian Lakes" (July 1922); Major Athill, "Through S.W. Abyssinia to the Nile" (Nov. 1920); C. F. Rey, "Abyssinia of To-day (Sept. 1922) and "A Visit to Gudrn and Gojam" (June 1926).

For Geology, the standard work is W. T. Blanford's *Geology and Zoology of Abyssinia* (1870); more recent information will be found in Rathjens, *Mitt. Geog Gesellschaft* (Munich, Sept. 1911), which includes a useful bibliography; Suess, *La face de la Terre* (vol. iii. Pt. 3, 1913); Professor Gregory, *The Rift Valleys and Geology of East Africa* (1921); G. W. Grabham, *Report of the Mission to Lake Tana* (Cairo, 1925).

For History, *see* the Hakluyt Society's translation of *The Portuguese Expedition to Abyssinia* (1902), which contains a valuable bibliography; Handbook No. 20 prepared by the Historical Section of the Foreign Office (1920), which also contains a useful bibliography; Sir E. Hertslet's *Map of Africa by Treaty* for treaties up to 1896; Sir E. W. Budge, *A History of Ethiopia* (1928).

Political questions are referred to by H. Le Roux, *Menelik et nous* (1901); Charles Michel, *La Question d'Ethiopie* (1905); T. Lennox Gilmour, *The Ethiopian Railway and the Powers* (1906); Pierre Alype, *L'Ethiopie et les convoitises allemandes* (1917) and *L'Empire des Negous* (1924); G E. Underhill, in the *Quarterly Review* (Jan. 1922); C. F. Rey, *Edinburgh Review* (Oct. 1926). (C. F. R.)

ABYSSINIAN CHURCH. As the chronicle of Axum relates, Christianity was adopted in Abyssinia in the 4th century. About A.D. 330 Frumentius was made first bishop of Ethiopia by Athanasius, patriarch of Alexandria. Little is known of church history down to the period of Jesuit rule, which broke the connection with Egypt from about 1500 to 1633.

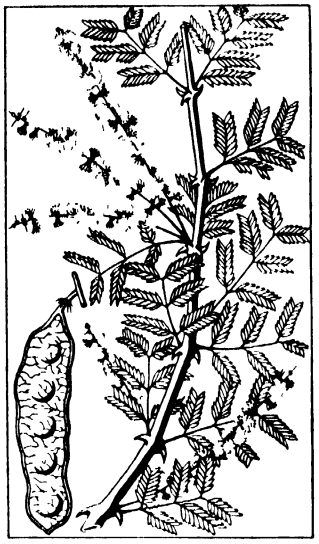
Early in the 16th century the church was brought under the influence of a Portuguese mission. The initiative in the Roman Catholic missions to Abyssinia was taken by Portugal, as an incident in the struggle with the Muslims for the command of the trade route to India by the Red sea. In 1507 Matthew, or Matheus, an Armenian, had been sent as Abyssinian envoy to Portugal to ask aid against the Muslims, and in 1520 an embassy under Dom Rodrigo de Lima landed in Abyssinia.

Generally the Abyssinians agree with the Copts in ritual and practice (*see* COPTIC CHURCH). The Septuagint was translated into the literary language, which is used for all services, though hardly understood. Saints and angels are highly revered, if not adored, but graven images are forbidden. Fasts are long and rigid. Confession and absolution, strictly enforced, give great power to the priesthood. Pilgrimage to Jerusalem is a religious duty and covers many sins.

For an account written shortly before the World War *see* Dowling, *The Abyssinian Church* (1909). The account of Alvarez was translated and edited for the Hakluyt Soc. by Lord Stanley of Alderley under the title *Narrative of the Portuguese Embassy to Abyssinia* (1881).

With reference to present social and political conditions, *see* ABYSSINIA On the architecture, *see* J. C. Hotten, *Abyssinia Described* (1868), and (especially with reference to monuments of heathen origin) Bent, *The Sacred City of the Ethiopians* (1896).

ACACIA, a genus of shrubs and trees belonging to the family Leguminosae and the sub-family Mimoseae. The small flowers are arranged in rounded or elongated clusters. The leaves are generally compound pinnate (*see* fig); in some instances more especially in the Australian species, the leaflets are suppressed and the leaf-stalks (petioles) become vertically flattened, and serve the purpose of leaves. The vertical position apparently prevents injury from the intense sunlight, as with their edges towards the sky and earth they do not intercept light so fully as ordinary horizontally placed leaves. There are about 550 species of acacia widely scattered over the warmer regions of the globe. They abound in Australia and Africa Various species yield gum True gum-arabic is the product of *Acacia Senegal,* abundant in both east and west tropical Africa *Acacia arabica* is the gum-arabic tree of India, but yields a gum inferior to the true gum-arabic Catechu (*q v*) or cutch, is procured from several species, but more especially from *Acacia catechu;* by boiling down the wood with this extract, true khaki cloth is dyed. The bark of *Acacia arabica,* under the name of *babul* or *babool,* is used in northern India for tanning The bark of various Australian species, known as wattles, is also very rich in tannin and forms an important article of export. Such are *Acacia pycnantha,* golden wattle, *A decurrens,* tan wattle, and *A. dealbata,* silver wattle. The pods of *Acacia nilotica,* under the name of neb-neb, and of other African species are also rich in tannin and used by tanners. The seeds of *Acacia niopo* are roasted and used as snuff in South America Some species afford valuable timber; such are *Acacia melanoxylon,* black wood of Australia, which attains a great size; its wood is used for furniture, and takes a high polish; and *Acacia homalophylla* (also Australian), myall wood, which yields a fragrant timber, used for ornamental purposes *Acacia formosa* supplies the valuable Cuba timber called sabicu *Acacia seyal* is supposed to be the shittah tree of the Bible, which supplied shittim-wood *Acacia heterophylla,* from Mauritius and Bourbon, and *Acacia koa* from the Sandwich Islands are also good timber trees. The plants often bear spines, especially those growing in arid districts in Australia or tropical and South Africa These sometimes represent branches which have become short, hard and pungent, or sometimes leaf-stipules *Acacia armata* is the kangaroo-thorn of Australia, *A giraffae,* the African camel-thorn In the Central American *Acacia sphaerocephala* (bull-thorn acacia) and *A spadicigera,* the large thorn-like stipules are hollow and afford shelter for ants, which feed on a secretion of honey on the leaf-stalk and curious food-bodies at the tips of the leaflets In common language the term Acacia is often applied to species of the genus Robinia (*q v*) which belongs also to the Leguminous family, but is placed in a different section *Robinia Pseud-acacia,* or false acacia, is cultivated in the milder parts of Britain, and forms a large tree, with beautiful pea-like blossoms. The tree is sometimes called the locust tree.



THE FLOWERING BRANCH AND POD OF THIS SPECIES (ACACIA SENEGAL) IS ONE OF 550 SPECIES SCATTERED OVER THE WARMER REGIONS OF THE GLOBE

ACADÉMIE NATIONALE DE MUSIQUE, the official title of the Paris Opéra, also known as the Théâtre National de l'Opéra, founded by Louis XIV. in 1669 and the most famous institution of its kind in the world. Lully, an Italian by birth but naturalized as a Frenchman, was the first composer of note associated with the Académie, of which he obtained control in 1672 Later Rameau became director and produced there nearly all of his many operas, and he was succeeded by Gluck as ruling spirit with Piccinni as his rival. Other eminent composers prominently identified with the Paris Opéra subsequently included Spontini, Cherubini, Rossini, Meyerbeer, Auber, Gounod, Saint-Saens and Massenet. The present building of the Paris Opéra, opened in 1875 and one of the most magnificent of its kind in existence, succeeded two others, both of which were destroyed by fire. Closely associated with the Paris Opéra is the Conservatoire de Musique, founded in 1784 under the name École royale de chant et de déclamation for the purpose of training opera singers and later widened in scope to include musical teaching and training of every kind

ACADEMIES. The word "academy" is derived from "the olive grove of Academe, Plato's retirement" (*see* under ACADEMY, GREEK) The schools of Athens after the model of the Academy continued to flourish almost without a break for nine centuries till they were abolished by a decree of Justinian "Academy," in its modern acceptation, may be defined as a society or corporate body having for its object the cultivation and promotion of literature, of science and of art, either severally or in combination, undertaken for the pure love of these pursuits, with no interested motive Modern academies, moreover, have, almost without exception, some form of public recognition; they are either founded, endowed or subsidized, or at least patronized, by the supreme head of the State The term "academy" has been loosely used in modern times In the 18th century it was frequently adopted by schools run by dissenters, and the name is often found attached to the public schools in Scotland and Northern Ireland We are only concerned here, however, with those institutions which are of historical importance in their various spheres



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

A RENAISSANCE CONCEPTION OF A GREEK ACADEMY FROM A 16TH CENTURY WOODCUT BY FRANCESCO MARCOLINI AFTER THE PAINTING, "THE ACADEMY OF KNOWLEDGE," BY GIUSEPPE PORTA

The first academy, as thus defined, though it might with equal justice claim to be the first of universities, was the museum of Alexandria founded at the beginning of the 3rd century B C by the first of the Ptolemies. There all the sciences then known were pur-

sued, and the most learned men of Greece and of the East gathered. Here, too, was the nucleus of the famous library of Alexandria. Modern literary academies may be said to trace their lineage in direct descent from the troubadours of the early 14th century. The first floral games were held at Toulouse in May, 1324, at the summons of a gild of troubadours, who invited "honourable lords, friends and companions who possess the science whence spring joy, pleasure, good sense, merit and politeness" to assemble in their garden of the "gay science" and recite their works. These floral games survived till about the year 1500. In 1694 the *Académie des Jeux Floraux* was constituted an academy by letters patent of Louis XIV. Suppressed during the Revolution it was revived in 1806, and still continues to award amaranths of gold and silver lilies, for which there is keen competition.

Provence led the way, but Italy of the Renaissance is the soil in which academies most grew and flourished. The *Accademia Pontaniana,* to give it its subsequent title, was founded at Florence in 1433 by Antonio Beccadelli of Palermo and fostered by Laurentius Valla. Far more famous was the *Accademia Platonica,* founded *c.* 1442 by Cosimo de' Medici, which numbered among its members Marsilio Ficino, Pico della Mirandola, Machiavelli and Angelo Poliziano. It was, as the name implies, chiefly occupied with Plato, but it added to its objects the study of Dante and the purification of the Italian language, and though it lived for barely half a century yet its influence as a model for similar learned societies was great and lasting.

I. SCIENTIFIC ACADEMIES

Austria.—The *Akademie der Wissenschaften* at Vienna, originally projected by Leibnitz, was founded by the emperor Ferdinand I. in 1846, and has two classes—mathematics and natural science, and history and philology.

Belgium and the Netherlands.—A literary society founded at Brussels in 1769 by Count Cobenzl, the prime minister of Maria Theresa, became in 1816 the *Académie royale des sciences et des Beaux-Arts de Belgique,* under the patronage of William I of the Netherlands In 1834 it became *Académie Royale Belgique,* while the Dutch portion took the name of the *Koninklijk Nederlander Instituut.* The Royal Institute of the Low Countries was founded in 1808 by King Louis Bonaparte. It was replaced in 1851 by the *Koninklijke Akademie* van Wetenschappen at Amsterdam, to which in 1856 a literary section was added

Denmark.—The *Kongelige danske videnskabernes selskab* (Royal Academy of Sciences) at Copenhagen owes its origin to Christian VI. (1742). It developed into a sort of learned club. The king took it under his protection, enlarged its scope by the addition of natural history, physics and mathematics, and in 1743 constituted it a royal academy with an endowment fund.

France.—The old *Académie des sciences* had the same origin as the more celebrated *Académie française.* A number of men of science had for some 30 years met together. They included Descartes, Gassendi, Blaise and Etienne Pascal. Hobbes, the author of *Leviathan,* was presented to it during his first visit to Paris in 1640. Colbert conceived the idea of giving an official status to this learned club. A number of chemists, physicians, anatomists and eminent mathematicians—among whom were Christian Huyghens and Bernard Frenicle de Bessy (1605–75), the author of a famous treatise on magic squares—were chosen to form the nucleus of the new society. Pensions were granted by Louis XIV. to each of the members, and a fund for instruments and experiment was placed at their disposal. They began their session on Dec. 22, 1666, in the royal library. At first the academy was rather a laboratory and observatory than an academy proper. Several foreign *savants,* in particular the Danish astronomer Roemer, joined the society; and the German physician and geometer, Tschirnhausen, and Sir Isaac Newton were made foreign associates. After the death of Colbert the labours of the academicians were diverted from the pursuit of pure science to such works as the construction of fountains and cascades at Versailles, and the mathematicians were employed to calculate the odds of the games of lansquenet and basset. In 1699 the academy was reconstituted. By its new constitution it consisted of 25 members, ten honorary, men of high rank interested in science, and 15 pensionaries, who were the working members. Of these three were geometricians, three astronomers, three mechanicians, three anatomists and three chemists. Each of these three had two associates, and, besides, each pensionary had the privilege of naming a pupil. There were eight foreign and four free associates. The constitution was purely aristocratical, differing in that respect from that of the French Academy, in which the principle of equality among the members was never violated. The leading spirits of the academy at this period were Clairault, Réaumur and Fontenelle, the popularizer of science. In the 18th century other prominent members were Laplace, Buffon, Lagrange, D'Alembert, Lavoisier and Jussieu, the father of modern botany. It was suppressed on April 8, 1793.

In 1795 the Convention decided on founding an *Institut National* which was to replace all the academies. In 1816 the *Académie des sciences* was reconstituted as a branch of the Institute. The new academy has reckoned among its members, besides many other brilliant men, Carnot the engineer, the physicists Fresnel, Ampère, Arago, Biot, the chemists Gay-Lussac and Thénard, the zoologists G. Cuvier and the two Geoffroy Saint-Hilaires. In France there were also academies in most of the large towns Montpellier, for example, had a royal academy of sciences, founded in 1706 by Louis XIV, reconstituted in 1847, and organized under three sections—medicine, science and letters There were analogous institutions at Toulouse, Nîmes, Arles, Lyons, Dijon, Bordeaux and elsewhere.

Germany.—The *Collegium Curiosum* was a scientific society, founded by J. C. Sturm, professor in the University of Altorf, in Franconia, in 1672, on the plan of the Accademia del Cimento It originally consisted of 20 members, and continued to flourish long after the death of its founder. Two volumes (1676–85) of proceedings were published by Sturm. The former, *Collegium Experimentale sive Curiosum,* begins with an account of the diving-bell, "a new invention"; next follow chapters on the camera obscura, the Torricellian experiment, the air-pump, microscope, telescope, etc. It is now extinct.

The *Preussische Akademie der Wissenschaften* in Berlin holds the first place in Germany. Its origin was the *Societas Regia Scientiarum* constituted in 1700 by Frederick I on the comprehensive plan of its first president, Leibnitz It was reorganized under Frederick II. on the French model furnished by Maupertuis, and received its present constitution in 1812. It is divided into two classes and four sections—physical and mathematical, philosophical and historical Among the contributors to its transactions (first volume published in 1710), to name only the dead, we find Immanuel Bekker, Bockling, Bernoulli, F Bopp, P Buttmann, Encke (of comet fame), L Euler, the brothers Grimm, the two Humboldts, Lachmann, Lagrange, Leibnitz, T Mommsen, J. Muller, G. Niebuhr, C. Ritter (the geographer), Savigny and Zumpt. To the *Berlin Academy* we owe the *Corpus Inscriptionum Graecarum,* the *Corpus Inscriptionum Latinarum,* and the *Monumenta Germaniae Historica*

The *Bayerische Akademie der Wissenschaften,* at Munich, founded in 1759, is distinguished by the part it has played in national education. Maximilian Joseph, the enlightened elector (afterwards king) of Bavaria, induced the Government to hand over to it the organization and superintendence of public instruction, and this work was carried out by Privy-councillor Jacobi, the president of the academy. In recent years the academy has specially occupied itself with natural history.

The *Preussische Akademie gemeinnutziger Wissenschaften,* at Erfurt, which dates from 1754 and devotes itself to applied science, and the Hessian academy of sciences at Giessen, which publishes medical transactions, also deserve mention

Great Britain and Ireland.—In 1616 a scheme for founding a royal academy was started by Edmund Bolton, an eminent scholar and antiquary, who in his petition to King James I. proposed that the title of the academy should be "King James, his Academe or College of honour" A list of the proposed original members is still extant, and includes the names of George Chapman, Michael Drayton, Ben Jonson, John Selden, Sir Kenelm Digby and Sir Henry Wotton. The death of King James put an

end to the undertaking. About 1645 the more ardent followers of Bacon used to meet, some in London, some at Oxford, for the discussion of subjects connected with experimental science. This was the original of the Royal Society (*q.v.*) which received its charter in 1662.

A society was formed in Dublin similar to the Royal Society in London, as early as 1683; but it was short-lived. The Royal Irish Academy grew from a society established in Dublin about 1782 by a number of gentlemen, most of whom belonged to the university. The first volume of transactions appeared in 1788.

Hungary.—The *Magyar Tudományos Társasay* (Hungarian Academy of Sciences) was founded in 1825 by Count Stephen Széchenyi for the encouragement of the study of the Hungarian language and the various sciences. It has a fine building in Budapest containing a picture gallery and housing various national collections.

Italy.—The *Academia Secretorum Naturae* was founded at Naples in 1560 by Giambattista della Porta. The condition of membership was to have made some discovery in natural science. Della Porta was suspected of practising the black arts and summoned to Rome to justify himself before the papal court. He was acquitted on those charges by Paul V., but commanded to close his academy.

The *Academia dei Lincei* was founded in 1603 by Federigo Cesi, the marchese di Monticelli. Galileo and Colonna were among its earliest members. As a monument the Lincei have left the magnificent edition of Fernandez de Oviedo's *Natural History of Mexico* (Rome, 1651, fol.), printed at the expense of the founder and elaborately annotated by the members. This academy was resuscitated in 1870 under the title of *Reale Accademia Nazionale dei Lincei,* with a literary as well as a scientific side, endowed in 1878 by King Humbert, and in 1883 it received official recognition from the Italian Government, being thereafter lodged in the Corsini palace, whose owner made over to it his valuable library and collections.

The *Accademia del Cimento* was founded at Florence in 1657 by Leopold de' Medici, brother of the grand duke Ferdinand II., at the instigation of Vincenzo Viviani, the geometrician. It was an academy of experiment, a deliberate protest against the deductive science of the quadrivium. It lasted only ten years, but the grand folio published in Italian (afterwards translated into Latin) in 1667 is a landmark in the history of science. It contains experiments on the pressure of the air (Torricelli and Borelli were among its members), on the incompressibility of water and on universal gravity.

Science in Italy is now represented by the *Reale Accademia di Scienze Lettere ed Arti degli Agrati in Rovereto,* formerly the *Reale Accademia delle Scienze* (Royal Academy of Sciences), founded in 1750 as a private society, and incorporated by royal warrant in 1783. It consists of 40 full members, who must be residents of Turin, 20 non-resident, and 20 foreign members. It publishes a yearly volume of proceedings and awards prizes for learned works. There are, besides, royal academies of science at Naples, Lucca and Palermo.

Portugal.—The *Academia Real das Sciencias* (now *Acad. das Sciencias de Lisboa*) dates from 1779 It was reorganized in 1851 and since then has been chiefly occupied in the publication of *Portugaliae Monumenta Historica.*

Russia.—The *Académie Impériale des sciences de Saint-Petersbourg* (*Imperatorskaya Akademiya naük*), was established on Dec. 21, 1725, by Catherine I. Shortly afterwards the empress settled a fund of £4,982 per annum for the support of the academy; and 15 eminent members were admitted and pensioned, under the title of professors in the various branches of science and literature. The most distinguished of these were Nicholas and Daniel Bernouilli, the two Delisles, Bilfinger and Wolff. At the accession of Elizabeth the original plan was enlarged and improved; learned foreigners were drawn to St Petersburg (Leningrad); and, what was considered a good omen for the literature of Russia, two natives, Lomonosov and Rumovsky, men of genius who had prosecuted their studies in foreign universities, were enrolled among its members. The annual income was increased to £10,659. Catherine II. utilized the academy for the advancement of national culture. By her recommendation the most intelligent professors visited all the provinces of her vast dominions, with most minute and ample instructions to investigate the natural resources, conditions and requirements, and report on the real state of the empire. The result was that no country at that time could boast, within so few years, such a number of excellent official publications on its internal state, its natural productions, its topography, geography and history, and on the manners, customs and languages of the different tribes that inhabited it, as came from the press of this academy. In its researches in Asiatic languages, oriental customs and religions, it proved itself the worthy rival of the Royal Asiatic Society in England. The first transactions, *Commentarii Academiae Scientiarum Imperialis Petropolitanae ad annum* 1726, with a dedication to Peter II, were published in 1728. In 1747 the transactions were called *Novi Commentarii Academiae,* etc.; and in 1777, *Acta Academiae Scientiarum Imperialis Petropolitanae.* The papers, hitherto in Latin only, were now written indifferently in Latin or in French. Of the *Commentaries,* 14 volumes were published; of the *New Commentaries* (1750–76) twenty. Of the *Acta Academiae* two volumes are printed every year. In 1872 there was published at St Petersburg, in 2 vols, the valuable *Tableau général des matières contenues dans les publications de l'Académie Impériale des Sciences de St. Petersbourg.* The academy of to-day has three divisions: (1) physical and mathematical sciences; (2) Russian language and literature; (3) historical science and philology. A large number of laboratories and museums are affiliated to it, as well as a physico-mathematical and an Indo-European Institute The Asiatic museum and the mineralogical museum are housed in this building, and also the academical botanical museum. The vast library of the Academy of Sciences is situated in a separate building, erected 1718–25. Its scientific publications are exempt from censorship and include transactions of its various sections, a monthly and a yearly journal. These are edited by the scientific staff of the academy, but published by the Soviet Government Publishing Department.

Spain.—The *Real Academia Española* at Madrid (*see* below) had a predecessor in the *Academia Naturae curiosorum* (dating from 1657) modelled on that of Naples It was reconstituted in 1847 after the model of the French Academy.

Sweden.—The *Kongliga Svenska Vetenskaps-academien* owes its institution to six persons of distinguished learning, among whom was Linnaeus. In 1739 they formed a private society, the *Collegium Curiosorum.* In March 1741 it was incorporated as the Royal Swedish Academy Though under royal patronage and largely endowed, it is, like the Royal Society in England, entirely self-governed. The dissertations read at each meeting are published in the Swedish language, quarterly, and make an annual volume. The first 40 volumes, octavo, completed in 1779, are called the *Old Transactions.*

Norway has an active Academy of Sciences at Oslo; Japan has an Imperial Academy at Tokyo; Yugoslavia has two academies, one Serbian at Belgrade and one Yugoslav at Zagreb. Czechoslovakia has the Czech Academy of Sciences and Arts at Prague.

II. ACADEMIES OF BELLES LETTRES

Belgium.—Belgium has always been famous for its literary societies. The little town of Diest boasts that it possessed a society of poets in 1302, and the Catherinists of Alost date from 1107. It is at least certain that numerous chambers of rhetoric (so academies were then called) existed in the first years of the rule of the house of Burgundy.

France.—The French Academy (*l'Académie française*) was established by order of the king in the year 1635, but in its original form existed four or five years earlier. About the year 1629 certain literary friends in Paris agreed to meet informally each week. The conversation turned mostly on literary topics; and when one of the number had finished some literary work he read it to the rest, and they gave their opinions upon it The fame of these meetings, though the members were bound to secrecy, reached the ears of Cardinal Richelieu, who promised his protec-

tion and offered to incorporate the society by letters patent. These were granted by the king on Jan. 29, 1635. The officers consisted of a director and a chancellor, chosen by lot, and a permanent secretary, chosen by vote. The director presided at the meetings, being considered as *primus inter pares*. The chancellor kept the seals and sealed all the official documents of the academy. The cardinal was *ex officio* protector.

The number of members was fixed at 40, but it was not till 1639 that the full number was completed. Their first undertaking consisted of essays written by the members in rotation. Next, at the instance of Cardinal Richelieu, they undertook a criticism of Corneille's *Cid*, the most popular work of the day. It was a rule of the academy that no work could be criticized except at the author's request, but fear of incurring the cardinal's displeasure wrung from Corneille an unwilling consent. The critique of the academy was re-written several times before it met with the cardinal's approbation. After six months of elaboration it was published under the title, *Sentiments de l'académie française sur le Cid*. This judgment did not satisfy Corneille, as a saying attributed to him on the occasion shows. *"Horatius,"* he said, referring to his last play, "was condemned by the Duumviri, but he was absolved by the people." But the crowning labour of the academy, begun in 1639, was a dictionary of the French language. By the 26th article of their statutes they were pledged to compose a dictionary, a grammar, a treatise on rhetoric and one on poetry. Jean Chapelain, one of the original members, drew up a plan for compiling the dictionary, which was to a great extent carried out. C. F. de Vaugelas was appointed editor-in-chief. The first edition of this dictionary appeared in 1694, the sixth and last in 1835, since when *compléments* have been added.

Reconstruction.—The old *Académie* perished with other pre-revolutionary academies in 1793, and it has little but the name in common with the present academy, a section of the institute. The object of the Convention in 1795 was, as already stated, to rebuild all the institutions that the Revolution had shattered and to combine them in an organic whole. The institute was at first composed of 184 members resident in Paris and an equal number living in other parts of France, with 24 foreign members, divided into three classes: (1) physical and mathematical science, (2) moral and political science, (3) literature and the fine arts. It held its first sitting on April 4, 1796 Napoleon as first consul suppressed the second class, as subversive of government, and reconstituted the other classes as follows: (1) as before, (2) French language and literature, (3) ancient history and literature, (4) fine arts. The class of moral and political science was restored on the proposal of M. Guizot in 1832, and the present institute consists of the five classes named above. Each class or academy has its own special jurisdiction and work, with special funds; but there is a general fund and a common library, which, with other common affairs, are managed by a committee of the institute—two chosen from each academy, with the secretaries.

The class of the institute which deals with the language and literature takes precedence, and is known as the *Académie française*. There was at first no perpetual secretary, each secretary of sections presiding in turn. Shortly afterwards J. B. Suard was elected to the post, and ever since the history of the academy has been determined by the reigns of its successive perpetual secretaries. The secretary, to borrow an epigram of Sainte-Beuve, both reigns and governs. Among the best known in the 19th century were Suard, François Juste Raynouard, François Andrieux and Villemain. Under Raynouard the academy ran a tilt against the abbé Delille and his followers. Under Auger it did battle with romanticism, "a new literary schism." Auger did not live to see the election of Lamartine in 1829, and it needed ten more years for Victor Hugo after many vain assaults to enter by the breach. The academy is professedly non-political. It accepted and even welcomed in succession the empire, the restoration and the reign of Louis Philippe, and it tolerated the republic of 1848; but to the Second Empire it offered a passive resistance, and no politician of the Second Empire, whatever his gifts as an orator or a writer, obtained an armchair. The one seeming exception, Emile Ollivier, confirms the rule. He was elected on the eve of the Franco-German War, but his *discours de réception*, a eulogy of the emperor, was deferred and never delivered. The institute has large vested funds in property, including the magnificent estate and library of Chantilly bequeathed to it by the duc d'Aumale It awards various prizes, of which the most considerable are the Montyon prizes, each of 20,000frs., one for the poor Frenchman who has performed the most virtuous action during the year, and one for the French author who has published the book calculated to prove of most service to morality.

A point of considerable interest is the degree in which, since its foundation, the French Academy has or has not represented the best literary life of France. It appears from an examination of the lists of members that a surprising number of authors of the highest excellence have, from one cause or another, escaped the honour of academic "immortality." When the academy was founded in 1634, the moment was not a very brilliant one in French letters. Among the 40 original members we find only ten who are remembered in literary history; of these four may reasonably be considered famous still—Balzac, Chapelain, Racan and Voiture. In that generation Scarron was never one of the 40, nor do the names of Descartes, Malebranche or Pascal occur. The one astounding omission of the 17th century, however, is the name of Molière, who was excluded by his profession as an actor; but the academy has made the *amende honorable* by placing in the *Salle des séances* a bust of Molière, with the inscription *"Rien ne manque à sa gloire, il manquait à la nôtre."* On the other hand, the French Academy was never more thoroughly representative of letters than when Boileau, Corneille, La Fontaine, Racine and Quinault were all members. Of the great theologians of that and the subsequent age, the academy included Bossuet, Fléchier, Fénelon and Massillon, but not Bourdaloue. La Bruyère and Fontenelle were among the 40, but not Saint-Simon, whose claims as a man of letters were unknown to his contemporaries. Early in the 18th century almost every literary personage of eminence found his place naturally in the academy The only exceptions of importance were Vauvenargues, who died too early for the honour, and two men of genius but of dubious social position, Le Sage and the abbé Prévost d'Exiles. The approach of the Revolution affected gravely the *personnel* of the academy Montesquieu and Voltaire belonged to it, but not Rousseau or Beaumarchais Of the Encyclopaedists, the French Academy opened its doors to D'Alembert, Condorcet, Volney, Marmontel and La Harpe, but not to Diderot, Rollin, Condillac, Helvétius or the Baron d'Holbach. Apparently the claims of Turgot and of Quesnay did not appear to the academy sufficient, since neither was elected. In the transitional period, when the social life of Paris was distracted and the French Academy provisionally closed, neither André Chénier nor Benjamin Constant nor Joseph de Maistre became a member. In the early years of the 19th century considerations of various kinds excluded from the ranks of the 40 the dissimilar names of Lamennais, Prud'hon, Comte and Béranger. Critics of the French Academy are fond of pointing out that neither Stendhal, nor Balzac, nor Théophile Gautier, nor Flaubert, nor Zola penetrated into the Mazarine palace. It is not so often remembered that writers so academic as Thierry and Michelet and Quinet suffered the same exclusion. In later times neither Alphonse Daudet nor the brothers de Goncourt, nor Guy de Maupassant were members. Verlaine, although a poet of genius, was of the kind that no academy can ever be expected to recognize.

Concerning the influence of the French Academy on the language and literature, the most opposite opinions have been advanced. Thus Matthew Arnold, in his *Essay on the Literary Influence of Academies*, has pronounced a glowing panegyric on the French Academy as a high court of letters, and a rallying-point for educated opinion, as asserting the authority of a master in matters of tone and taste. To it he attributes in a great measure that thoroughness, that openness of mind, that absence of vulgarity which he finds everywhere in French literature; and to the want of a similar institution in England he traces that eccentricity, that provincial spirit, that coarseness which, as he thinks, are barely compensated by English genius. Thus, too, Renan, one of its most distinguished members, says that owing to the academy "one

can say everything in the language of well-bred persons without being pedantic. Do not say they have done nothing, these obscure devotees of culture who spend their lives in investigating the credentials of words and weighing up syllables. They have produced a masterpiece—the French language." On the other hand, its inherent defects have been vigorously summed up by P. Lanfrey in his *Histoire de Napoléon.* The truth probably lies midway between the two extremes. Like all national institutions, the French Academy is a rather conservative body to which only people of a certain age and with well established reputations are elected. As a protest against such a state of things, the *Académie Goncourt* was founded by E. de Goncourt in 1896. It contains ten academicians whose principal function is to award an annual prize of 5,000 francs, preferably to a young novelist. None the less, since 1890, the *Académie française* may be said to have been fairly representative of the nation's culture. Among the critics may be cited, Brunetière Lemaître, Foguet, among the poets, Sully Prudhomme, Richepin, de Regnier, Valery; among the novelists, Bourget, Anatole France, Loti, Prevost; among the dramatists, Hervieu, Curel, Rostand, Brieux; among the historians, Masson, Vandal, Hanotaux, etc.; among the philosophers, Boutroux and Bergson. Of the writers best known abroad who have not been elected members of the academy are Maeterlinck, Romain Rolland, Proust and Gide.

Germany.—Of the German literary academies the most celebrated was *Die Fruchtbringende Gesellschaft* (the Fruitful Society), established at Weimar in 1617. Five princes were among the original members. The object was to purify the mother tongue. The German academies copied those of Italy in their quaint titles and petty ceremonials, and exercised little permanent influence on the language or literature of the country. Other noteworthy modern societies are the *Berlinsche Gesellschaft fur Deutsche Sprache,* the *Deutsche Shakespeare Gesellschaft,* and the *Goethe Gesellschaft.*

Italy.—Italy in the 16th century was remarkable for the number of its literary academies. Tiraboschi, in his *History of Italian Literature,* has given a list of 171; and Jarkius, in his *Specimen Historiae Academiarum Conditarum,* enumerates nearly 700 Many of these, with a sort of Socratic irony, gave themselves ludicrous names, or names expressive of ignorance. Such were the *Lunatici* of Naples, the *Estravaganti,* the *Fulminales,* the *Trapessati,* the *Drowsy,* the *Sleepers,* the *Anxious,* the *Confused,* the *Unstable,* the *Fantastic,* the *Transformed,* the *Ethereal.* "The first academies of Italy chiefly directed their attention to classical literature. . . . It was not till the writings of Bembo furnished a new code of criticism in the Italian language that they began to study it with the same minuteness as modern Latin" (Hallam, *Int. to Lit. of Europe*). The Italian nobility, excluded as they mostly were from politics, and living in cities, found in literature a consolation and a career. Such academies were oligarchical in their constitution; they encouraged culture, but tended to hamper genius and extinguish originality. Far the most celebrated was the *Accademia della Crusca* or *Furfuratorum;* that is, of bran, or of the sifted, founded in 1582. The title was borrowed from a previous society at Perugia, the *Accademia degli Scossi,* of the well-shaken. Its device was a sieve; its principal object the purification of the language. Its great work was the *Vocabulario della Crusca,* printed at Venice in 1612 It was composed avowedly on Tuscan principles, and regarded the 14th century as the Augustan period of the language. Paul Beni assailed it in his *Anti-Crusca,* and this exclusive Tuscan purism has disappeared in subsequent editions. The *Accademia della Crusca* is now incorporated with two older societies—the *Accademia degli Apatici* (the Impartials) and the *Accademia Florentina.*

Among the numerous other literary academies of Italy we may mention the Academy of Naples, founded about 1440 by Alphonso, the king; the Academy of Florence, founded 1540, to illustrate and perfect the Tuscan tongue, especially by the close study of Petrarch; the *Intronati* of Siena, 1525; the *Infiammati* of Padua, 1534; the *Rozzi* of Siena, suppressed by Cosimo, 1568. In 1690 the *Accademia degli Arcadi* was founded at Rome, for the purpose of reviving the study of poetry, by Crescimbeni, the author of a history of Italian poetry. Its members came to its meetings masked and dressed like Arcadian shepherds. Within ten years from its establishment the number of academicians was 600. The Royal Academy of Savoy was founded in 1719, and made a royal academy by Charles Albert in 1848. Its emblem was a gold orange-tree full of flowers and fruit; its motto "Flores fructusque perennes," the same as that of the famous Florimentane Academy, founded at Annecy by St. Francis de Sales. It published valuable memoirs on the history and antiquities of Savoy. Mention should also be made of the *Società Dantesca Italiana.*

Spain.—The *Real Academia Española* at Madrid held its first meeting in July 1713, in the palace of its founder, the duke d'Escalona. In 1714 the king granted them the royal confirmation and protection. The number of its members was limited to 24; the duke d'Escalona was chosen director for life, but his successors were elected yearly, and the secretary for life. Their object, as marked out by the royal declaration, was to cultivate and improve the national language. They were to begin with choosing carefully such words and phrases as have been used by the best Spanish writers; noting the low, barbarous or obsolete ones; and composing a dictionary wherein these might be distinguished from the former. Another important Spanish Academy is the *Real Academia de la Historia* at Madrid.

III. ACADEMIES OF ARCHAEOLOGY AND HISTORY

France.—The old *Académie des inscriptions et belles-lettres* (or *"Petite Académie,"* founded in 1663) was an offshoot of the French Academy, which then at least contained the *élite* of French learning. Louis XIV. was of all French kings the one most occupied with his own aggrandisement. Literature, and even science, he encouraged only so far as they redounded to his own glory. Thus it was that the Academy of Inscriptions arose. At the suggestion of Colbert a company (a committee we should now call it) had been appointed by the king, chosen from the French Academy, charged with the office of furnishing inscriptions, devices and legends for medals. It consisted of four academicians: Chapelain, then considered the poet laureate of France; the abbé Amable de Bourzeis (1606–71); François Charpentier (1620–1702), an antiquary of high repute, and the abbé Jacques de Cassagnes (1636–79). Their meetings were principally occupied with discussing the inscriptions, statues and pictures intended for the decoration of Versailles; and their first published work was a collection of engravings, accompanied by descriptions, designed for some of the tapestries at Versailles. Later Félibien, the learned architect, and the two great poets Racine and Boileau, were added to their number. A series of medals was commenced, entitled *Médailles de la Grande Histoire,* or, in other words, the history of *Le Grand Monarque.*

But it was to M. de Pontchartrain, comptroller-general of finance and secretary of State, that the academy owed its institution. By a new regulation, dated July 16, 1701, the *Académie royale des inscriptions et médailles* was instituted, being composed of ten honorary members, ten pensioners, ten associates, and ten pupils. In 1716 the regent changed its title to that of the *Académie des inscriptions et belles-lettres,* a title which better suited its new character.

In the great battle between the ancients and the moderns which divided the learned world in the first half of the 18th century, the Academy of Inscriptions naturally espoused the cause of the ancients, as the Academy of Sciences did that of the moderns. During the earlier years of the French Revolution the academy continued its labours uninterruptedly; and on Jan. 22, 1793, the day after the death of Louis XVI., we find in the *Proceedings* that M. Bréquigny read a paper on the projects of marriage between Queen Elizabeth and the dukes of Anjou and Alençon. On Aug. 2 of the same year the last séance of the old academy was held.

In the first draft of the new institute, Oct. 25, 1795, no class corresponded exactly to the old Academy of Inscriptions; but most of the members who survived found themselves re-elected either in the class of moral and political science, under which history and geography were included as sections, or more generally under the class of literature and fine arts, which embraced an-

cient languages, antiquities and monuments. In 1816 the academy received again its old name. Perhaps the subjects on which it has shown most originality are comparative mythology, the history of science among the ancients, and the geography and antiquities of France. The old academy has reckoned among its members De Sacy the orientalist, Dansse de Villoison (1750–1805) the philologist, Anquetil du Perron the traveller, Guillaume J. de C. L. Sainte-Croix and du Theil the antiquaries, and Le Beau, who has been named the last of the Romans. The new academy included the names of Champollion, A. Rémusat, Raynouard, Burnouf and Augustin Thierry.

In consequence of the attention of several literary men in Paris having been directed to Celtic antiquities, a *Celtic Academy* was established in that city in 1805. It still exists as *La société nationale des antiquaires de France.*

Great Britain.—The British Academy was the outcome of a meeting of the principal European and American academies, held at Wiesbaden in Oct. 1899. A scheme was drawn up for an international association of the academies of the world under the two sections of natural science and literary science, but while the Royal Society adequately represented England in science there was then no existing institution that could claim to represent England in literature. A separate society was therefore formed entitled "The British Academy for the promotion of historical, philosophical and philological studies," which on Aug. 8, 1902, was incorporated by royal charter. The objects of the academy are therein defined: "the promotion of the study of the moral and political sciences, including history, philosophy, law, politics and economics, archaeology and philology." The number of ordinary fellows (so all members are entitled) is restricted to 100 and the academy is governed by a president and a council of 15 elected annually by the fellows.

The published *Proceedings of the British Academy* amount already to 12 volumes. Other publications are *Supplemental Papers* (1911, etc.) and the annual *Schweich Lectures* on biblical archaeology, inaugurated in 1908. *The Fund* has also enabled the academy to forward the work of excavation in Bible lands. The series of *Social and Economic Records* under the direction of Sir Paul Vinogradoff was started in 1908, with the support of a Government grant. The publication, by the Clarendon Press, of the facsimile *Old Testament of the Codex Sinaiticus* (1911–22) was made possible by an anonymous gift. The academy has also published a facsimile of the Caedman ms.

In 1908 the academy organized the commemoration of the tercentenary of Milton's birth. It is helped by the foundation of the annual Master Mind lecture (one of a number of endowments, under the will of the late Henriette Hertz). In 1927 it celebrated its 25th anniversary, the hon. secretary, Sir Israel Gollancz, having held uninterrupted office since the beginning. Among other endowments may be mentioned the annual Shakespeare lecture, the annual Raleigh lectures on history, the Warton lecture on English poetry; the Philosophical lecture; the Italian lecture; the lecture on aspects of art; the lecture on English philology and literary history; the Cromer prize for Greek essay; the biennial prize for English studies. The academy administers also the Rose Mary Crawshay prize fund for English literature, an annual prize of £100 awarded to a woman of any nationality for work on English literature.

The school of oriental studies, now an integral part of the University of London, was largely the outcome of a scheme submitted to the academy in 1904 by the late Prof. Rhys Davids. The organization of imperial studies, now recognized in London and in other British universities, was directly due to proposals made by Sir Sidney Low to the academy in 1912. The English Place-Name Society, founded in 1921 to carry out the survey of English place-names, was inaugurated under the auspices of the British academy in 1923, as the result of a statement submitted by Prof. A. Mawer, now director of the society. The foundation of the British School of Archaeology in Jerusalem in 1919 was brought about by the academy, in conjunction with the Palestine exploration fund. The establishment of the British school at Jerusalem must take an important place among the more recent efforts of the academy. Among its recent excavations are those on the Hill of Ophel at Jerusalem, the results of which confirm the view as to the site of the city of David. Meanwhile remarkable discoveries have been made in the Near East (*see* ARCHAEOLOGY: *Western Asia*). Among the enterprises promoted by the academy is the *Encyclopaedia of Islam* (1908, etc).

The academy is closely associated with the newly established Union Academique Internationale. The principal proposals of the Union in which the academy is concerned are the following: (a) *Corpus vasorum* (1922, etc); (b) *Catalogue of Alchemical mss.* (1926, etc); (c) *Dictionary of Mediaeval Latin;* (d) *Forma Orbis Romani;* and (e) supplements to the *Corpora Inscriptionum graecarum et latinarum.*

Italy.—The *Accademia Ercolanese* (*Academy of Herculaneum*) was established at Naples about 1755, at which period a museum was formed of the antiquities found at Herculaneum, Pompeii and other places, by the marquis Tanucci. Its object was to explain the paintings, etc., discovered at those places, and for this purpose the members met every fortnight. The first volume of their labours appeared in 1775, and they have been continued under the title of *Antichità di Ercolano.* They contain engravings of the principal paintings, statues, bronzes, marble figures, medals, utensils, etc , with explanations. In the year 1807 an academy of history and antiquities, on a new plan, was established at Naples by Joseph Bonaparte, but the subsequent changes in the political state of Naples prevented the full and permanent establishment of this institution. In the same year an academy was established at Florence for the illustration of Tuscan antiquities, which published some volumes of memoirs.

IV. ACADEMIES OF MEDICINE AND SURGERY

Austria.—The Academy of Surgery at Vienna was instituted in 1784 by the emperor Joseph II. under the direction of the distinguished surgeon, Giovanni Alessandro Brambilla (1728–1800). In 1874 it ceased to exist; its functions had become mainly military and were transferred to newer schools.

France.—Charlemagne is said to have established a school of medicine in the Louvre, and various societies have been founded and privileges granted to the faculty by his successors. The *Académie de médecine* succeeded to the old *Académie royale de chirurgie et société royale de médecine* in 1820. The new academy was divided into three sections—medicine, surgery and pharmacy. In its constitution it closely resembled the *Académie des sciences.*

Germany.—The *Academia Naturae Curiosi,* afterwards called the *Academia Caesaraea Leopoldina,* was founded in 1662 by J. L. Bausch, a physician of Leipzig. The works of the *Naturae Curiosi* were at first published separately; but from 1784 this appeared annually under the title of *Ephemerides.* In 1687 the emperor Leopold took the society under his protection, and its name was changed in his honour. This academy has no fixed abode, but follows the home of its president. Its library remains at Dresden.

V. ACADEMIES OF THE FINE ARTS

France.—The *Académie royale de peinture et de sculpture* at Paris was founded by Louis XIV. in 1648, under the title of *Académie royale des beaux arts,* to which was afterwards united the *Académie d'architecture,* founded 1671. It is composed of painters, sculptors, architects, engravers and musical composers. From among the members of the society who are painters, is chosen the director of the French *Académie des beaux arts* at Rome, also instituted by Louis XIV. in 1677. The director's province is to superintend the studies of the painters, sculptors, etc., who, chosen by competition, are sent to Italy at the expense of the Government, to complete their studies in that country. The *Académie nationale de musique* is the official and administrative name given in France to the grand opera.

Great Britain.—The Royal Academy of Arts in London, founded in 1768, is described in a separate article. (*See* ACADEMY, ROYAL)

The *Academy of Ancient Music* was established in London in 1710, with the view of promoting the study and practice of vocal and instrumental harmony. About 1734 the academy became a

seminary for the instruction of youth in the principles of music and the laws of harmony. The *Royal Academy of Music* was formed for the performance of operas, composed by Handel and conducted by him at the theatre in the Haymarket. A contest between Handel and Senesino, one of the performers, in which the directors took the part of the latter, occasioned the dissolution of the academy after it had existed with honour for more than nine years. The present *Royal Academy of Music* dates from 1822, and was incorporated in 1830 It instructs pupils of both sexes in music. (*See* also the article CONSERVATOIRE for colleges of music)

The *Royal Academy of Dramatic Art* (incorporated in 1920), was originally founded by Beerbohm Tree in 1904. It provides a thorough training for the stage. Like the Royal Academy and the Royal College of Music it receives a grant of £500 a year from the Government. It awards annually certain scholarships, and also prepares for the diploma in dramatic art of London university. A somewhat similar institution is the School of Speech Training and Dramatic Art (incorporated), founded by Miss E. Fogerty, which also prepares for the stage

Italy.—In 1778 an academy of painting and sculpture was established at Turin. In Milan an academy of architecture was established so early as 1380, by Gian Galeazzo Visconti. About the middle of the 18th century an academy of the arts was established there, after the example of those at Paris and Rome. Before the effects of the French Revolution reached Italy this was one of the best establishments of the kind in that kingdom. The academy of the arts, which had been long established at Florence, fell into decay, but was restored at the end of the 18th century. But the treasures of this and the other institutions for the fine arts were greatly diminished during the occupation of Italy by the French. There are also academies of the fine arts in Mantua, Venice and Naples.

Russia.—The academy of St. Petersburg was established in 1757 by the empress Elizabeth, at the suggestion of Count Shuvalov, and annexed to the academy of sciences. It is now known as the *Akademiya Naük Soyuza Sovetskich Socialisticheskich Respublik.*

South America.—There are several small academies in the various towns of South America, the most important being that of Rio de Janeiro, founded by John VI. of Portugal in 1816 and now known as the *Escola Nacional de Bellas Artes.*

Spain.—In Madrid an academy for painting, sculpture and architecture, the *Academia de Bellas Artes de San Fernando,* was founded by Philip V. The minister for foreign affairs is president Prizes are distributed every three years. In Cadiz a few students are supplied by the Government with the means of drawing and modelling from figures; and such as are not able to purchase the requisite instruments are provided with them.

Sweden.—An academy of fine arts was founded at Stockholm in the year 1733 by Count Tessin. Such students as display distinguished ability obtain pensions from the Government, to enable them to reside in Italy for some years for the purposes of investigation and improvement. In this academy there are nine professors and generally about 400 students.

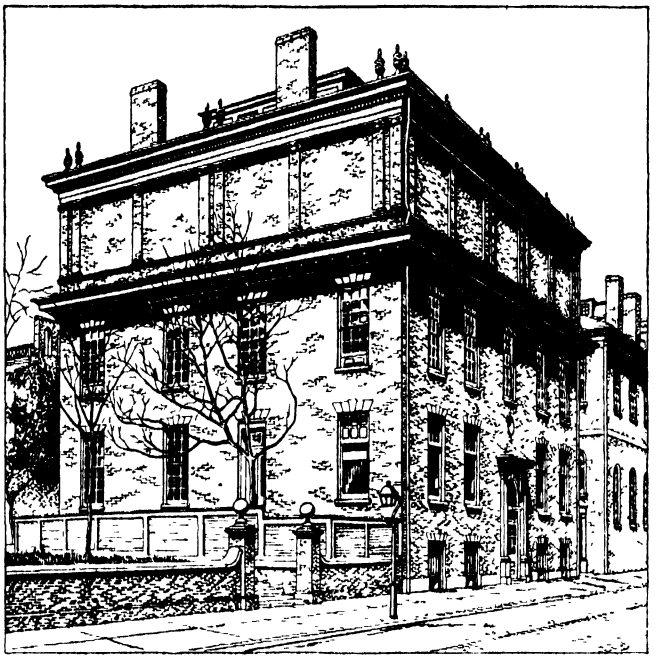
Austria.—In the year 1705 an academy of painting, sculpture and architecture was established at Vienna, with the view of encouraging and promoting the fine arts.

See also SOCIETIES, LEARNED.

The volume of excerpts from the general catalogue of books in the British Museum, "Academies," five parts and index, furnishes a complete bibliography. *See* also *Minerva* published in Berlin and Leipzig and *Index Generalis* published in Paris. (C. BR.)

United States.—The early organization of scholars in America took a form frankly imitative of that prevalent in Europe. Academies were organized in Philadelphia and Boston in the 18th century, which, like their European prototypes, were divided into different classes. Election to membership in them was in recognition of scholarly or scientific attainment, and they still closely resemble their European counterparts.

American scientists and scholars, however, have found their most effective organization in societies and associations of open membership, described in the article on Learned Societies. These frequently maintain a national headquarters at either Washington, D.C., or New York city, co-ordinate the work of the affiliated societies throughout the United States and even Canada and often issue an annual or quarterly publication, sometimes in addition to a more popular monthly magazine. There are, for example, the Archaeological Institute of America, organized in 1879, and the American Federation of Arts, which was organized in 1909 to further art in the United States by means of lectures, exhibitions and publications. There are, too, many so-called academies, clubs, societies, guilds, leagues and associations devoted to the



BY COURTESY OF AMERICAN PHILOSOPHICAL SOCIETY

THE ORIGINAL BUILDING OF THE AMERICAN PHILOSOPHICAL SOCIETY AT PHILADELPHIA FOR PROMOTING USEFUL KNOWLEDGE, WHICH WAS FOUNDED IN 1727 BY BENJAMIN FRANKLIN

preservation, study and furtherance of the fine arts, the physical and natural sciences, natural scenery and historic landmarks and to the improvement of cities (see *American Art Annual,* v. XXIV., 1927). Finally, there are various Federal, State and municipal art commissions that generally supervise the embellishment of public works.

Of the American organizations the following most nearly approximate the European *academy* as it has been considered here: The American Academy of Arts and Letters was organized in 1904 from within the membership of the National Institute of Arts and Letters. Founded in 1898 by members of the American Social Science Association, the National Institute of Arts and Letters now has a membership limited to 250 and divided into three sections: literature, art and music. To be elected to the Institute a candidate must be proposed by a member of his own group and receive a vote of the majority of his section and later a majority vote of those present at the annual meeting. Its executive office is in the Academy building at 633 West 155th street, New York city. The American Academy of Arts and Letters operates under a Federal charter. It is limited to 50 members, chosen from the membership of the Institute only. Unlike the Institute, it functions as a whole and a literary man is not necessarily elected to fill the chair formerly occupied by a literary man. Apart from the honour conferred by membership, the actual work of the Academy is to promote American literature and art by giving the stamp of its approval of the best that both the past and the present have to offer, by means of public addresses, by bringing to the United States representatives of other Academies and, through conferences and discussion, thereby helping to establish a literary and artistic entente between nations, and through its exhibitions, publications, collections and awards.

The American Academy of Arts and Sciences, Boston, the second oldest scientific society in the United States, was chartered in 1780 by a group of distinguished citizens of Massachusetts, including John and Samuel Adams and John Hancock. The membership is divided into three classes, covering the physical and mathematical, the natural and physiological, and the moral and political sciences. It includes fellows (limited to 600), associates and foreign honorary members, elected on the basis of recognition of scholarship or professional eminence. The academy publishes *Proceedings* and *Memoirs*. It administers various trust funds in aid of physical and chemical research, and awards the Rumford medal to the authors of "any important discovery or useful improvement in light or heat which shall have been made in any part of America." It has a commodious building but no considerable endowment. The library is rich in the fields of physics, chemistry, mathematics and in the publications of learned societies of other countries.

The American Philosophical Society Held at Philadelphia for Promoting Useful Knowledge is the oldest scientific association in the United States. The society is the outgrowth of the Junto founded by Franklin in 1727. In 1743 Franklin published *A Proposal for Promoting Useful Knowledge among the British Plantations in America*, which was so favourably received that in the same year the society was organized, with Thomas Hopkinson (1709–51) as president and Franklin as secretary. In 1769 it united with another scientific society founded by Franklin, called the American Society Held at Philadelphia for Promoting Useful Knowledge, and adopted its present name, adding the descriptive phrase from the title of the American Society, and elected Franklin president, an office which he held until his death (1790). The American Philosophical Society is national in scope and comprehends all departments of learning; its *Transactions* date from 1771, and its *Proceedings* from 1838. It has a hall in Philadelphia with meeting-rooms and a valuable library and collection of interesting portraits and relics. David Rittenhouse was its second and Thomas Jefferson its third president. In 1786 John Hyacinth de Magellan, of London, presented a fund, the income of which was to supply a gold medal for the author of the most important discovery "relating to navigation, astronomy or natural philosophy (mere natural history excepted)."

The National Academy of Sciences (1863) was incorporated by Congress with the object that it "shall, whenever called upon by any department of the Government, investigate, examine, experiment and report upon any subject of science or art." Its membership was first limited to 50; after the amendment of the act of incorporation in 1870 the limit was placed at 100; and in 1907 it was prescribed that the resident membership should not exceed 150 in number, no more than ten members to be elected in any one year, and that the number of foreign associated be restricted to 50 The constitution was later amended to provide that the membership shall not exceed 250 and that not more than 15 members shall be elected at one annual meeting. The academy is divided into ten sections: mathematics, astronomy, engineering, chemistry, geology and palaeontology, botany, zoology and anatomy, physiology and pathology, anthropology and psychology It gives several gold medals for meritorious researches and discoveries, and holds also a number of small trust funds, from the income of which grants are made for scientific research. It publishes scientific and biographical memoirs, an annual report and monthly proceedings.

The National Academy of Design was founded in 1826 and incorporated in 1828. The first president was Samuel Finley Breese Morse, a portrait painter who subsequently invented the telegraph. The number of "associates" is unlimited but the number of "academicians" is limited to 125 painters, 25 sculptors and 25 architects or engravers. Two exhibitions are given annually and each member is entitled to exhibit one work without approval by the jury of selection.

The American Institute of Architects was chartered in 1857 with Richard Upjohn as president and Richard M Hunt as secretary. It merged with the Western Association of Architects (founded 1884) in 1889 and has since been national in scope. Since 1902 admission to membership has required an accredited diploma, or scholarship, or passing an examination either technical or on the candidate's work and standing. An annual convention is held and an annuary and monthly journal are issued.

ACADEMY, GREEK, or **ACADEME,** the name given to the philosophic school founded by Plato. The name is derived from a pleasure garden or gymnasium situated in the suburb of the Ceramicus on the river Cephissus about a mile to the north-west of Athens from the gate called Dipylum. It was said to have belonged to the ancient Attic hero Academus, who, when the Dioscuri invaded Attica to recover their sister Helen, carried off by Theseus, revealed the place where she was hidden. Out of gratitude the Lacedaemonians, who reverenced the Dioscuri, always spared the Academy during their invasions of the country. It was walled in by Hipparchus and was adorned with walks, groves, and fountains by Cimon (Plut. *Cim.* 13), who bequeathed it as a public pleasure ground to his fellow citizens. Subsequently the garden became the resort of Plato (*q v.*) who had a small estate in the neighbourhood. Here he taught for nearly 50 years till his death in 348 B.C, and his followers continued to make it their headquarters. It was closed for teaching by Justinian in A.D. 529 along with the other pagan schools. Cicero borrowed the name for his villa near Puteoli, where he composed his dialogue, *The Academic Questions.*

The Platonic Academy (proper) lasted from the days of Plato to those of Cicero, and during its whole course there is traceable a distinct continuity of thought which justifies its examination as a real intellectual unit. On the other hand, this continuity of thought is by no means an identity. The Platonic doctrine was so far modified in the hands of successive scholarchs that the Academy has been divided into either two, three or five main sections (Sext Empir. *Pyrrh. Hyp.* i. 220). Finally, in the days of Philo, Antiochus and Cicero, the metaphysical dogmatism of Plato had been changed into an ethical syncretism which combined elements from the Scepticism of Carneades and the doctrines of the Stoics; it was a change from a dogmatism which men found impossible to defend, to a probabilism which afforded a retreat from Scepticism and intellectual anarchy. Cicero represents at once the doctrine of the later Academy and the general attitude of Roman society when he says, "My words do not proclaim the truth, like a Pythian priestess; but I conjecture what is probable, like a plain man; and where, I ask, am I to search for anything more than verisimilitude?" And again: "The characteristic of the Academy is never to interpose one's judgment, to approve what seems most probable, to compare together different opinions, to see what may be advanced on either side and to leave one's listeners free to judge without pretending to dogmatize."

The passage from Sextus Empiricus, cited above, gives the general view that there were three academies. the first, or Old, academy under Speusippus and Xenocrates; the second, or Middle, academy under Arcesilaus and Polemon; the third, or New, academy under Carneades and Clitomachus. Sextus notices also the theory that there was a fourth, that of Philo of Larissa and Charmidas, and a fifth, that of Antiochus. Diogenes Laertius says that Lacydes was the founder of the New Academy (i. 19, iv. 59). Cicero (*de Orat.* iii. 18, etc) and Varro insist that there were only two academies, the Old and the New. Those who maintain that there is no justification for the five-fold division hold that the agnosticism of Carneades was really latent in Plato, and became prominent owing to the necessity of refuting the Stoic *criterion.*

The general tendency of the Academic thinkers was towards practical simplicity, a tendency due in large measure to the inferior intellectual capacity of Plato's immediate successors. Cicero (*de Fin.* v. 3) says generally of the Old Academy: "Their writings and method contain all liberal learning, all history, all polite discourse; and besides they embrace such a variety of arts that no one can undertake any noble career without their aid . . . In a word the Academy is, as it were, the workshop of every artist" It is true that these men turned to scientific investigation, but in so doing they escaped from high altitudes in which Plato thought, and tended to lay emphasis on the mundane side of philosophy.

Of Plato's originality and speculative power, of his poetry and enthusiasm they inherited nothing, "nor amid all the learning which has been profusely lavished upon investigating their tenets is there a single deduction calculated to elucidate distinctly the character of their progress or regression" (Archer Butler, *Lect. on Anc. Phil.* ii. 315).

The modification of Academic doctrine from Plato to Cicero may be indicated briefly under four heads.

(1) Plato's own theory of Ideas was not accepted even by Speusippus and Xenocrates. They argued that the Good cannot be the origin of things, inasmuch as Goodness is only found as an attribute of things. Therefore, the idea of Good must be secondary to some other more fundamental principle of existence. This unit Speusippus attempted to find in the Pythagorean number theory. From it he deduced three principles, one for numbers, one for magnitude, one for the soul. The Deity he conceived as that living force which rules all and resides everywhere. Xenocrates, though like Speusippus infected with Pythagoreanism, was the most faithful of Plato's successors. He distinguished three spheres, the sensible, the intelligible, and a third compounded of the two, to which correspond respectively, sense, intellect, and opinion (δόξα). Cicero notes, however, that both Speusippus and Xenocrates abandon the Socratic principle of hesitancy.

(2) Up to Arcesilaus, the Academy accepted the principle of finding a general unity in all things, by the aid of which a principle of certainty might be found. Arcesilaus, however, broke new ground by attacking the very possibility of certainty. Socrates had said, "This alone I know, that I know nothing." But Arcesilaus went farther and denied the possibility of even the Socratic minimum of certainty: "I cannot know even whether I know or not." Thus from the dogmatism of the master the Academy plunged into the extremes of agnostic criticism.

(3) The next stage in the Academic succession was the moderate scepticism of Carneades which owed its existence to his opposition to Chrysippus, the Stoic. To the Stoical theory of *apprehensible* (or *knowable*) *presentation,* by which they expressed a conviction of certainty arising from impressions so strong as to amount to real knowledge, he opposed the doctrine of *inapprehensible* (or *unknowable*) *presentation,* which denied any necessary correspondence between perceptions and the objects perceived. He saved himself, however, from absolute scepticism by the doctrine of probability or verisimilitude, which may serve as a practical guide in life. Thus his criterion of imagination is that it must be credible, irrefutable, and attested by comparison with other impressions; it may be wrong, but for the person concerned it is valid. In ethics he was an avowed sceptic. During his official visit to Rome he gave public lectures, in which he successively proved and disproved with equal ease the existence of justice.

(4) In the last period we find a tendency not only to reconcile the internal divergences of the Academy itself, but also to connect it with parallel growths of thought. Philo of Larissa endeavours to show that Carneades was not opposed to Plato, and further that the apparent antagonism between Plato and Zeno was due to the fact that they were arguing from different points of view. From this syncretism emerged the prudent non-committal eclecticism of Cicero, the last product of Academic development.

For detailed accounts of the Academicians *see* SPEUSIPPUS. XENOCRATES, etc., also STOICS and NEOPLATONISM. Histories of philosophy by Erdmann, Zeller, and Windelband, and Th. Gomperz, *Greek Thinkers,* ii. 270 (Eng. trans., 1905).

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, THE, was organized in 1812. It has a large library and a museum with several million specimens. The scientific staff of the Academy (1928), includes 12 permanently attached investigators and 15 research associates. The society has published *Journals* since 1817, and *Proceedings* since 1841; it also publishes the *Manual of Conchology* and the *American Journal of Conchology.* The American Entomological Society (in 1859–67 the Entomological Society of Philadelphia, and since 1876 affiliated with this academy) has regularly published its *Proceedings* or *Transactions* since 1861, *Memoirs* since 1916 and the *Entomological News* (a monthly).

ACADEMY, ROYAL. The Royal Academy of Arts in London, to give it the original title in full, was founded in 1768, "for the purpose of cultivating and improving the arts of painting, sculpture and architecture." It was the outcome of many attempts which had previously been made in England to form a society which should have for its object the advancement of the fine arts. No time was lost in establishing the schools, and on Jan. 2, 1760, they were opened at some rooms in Pall Mall, a little eastward of the site now occupied by the Junior United Service club, the president, Sir Joshua Reynolds, delivering on that occasion the first of his famous "Discourses." The opening of the first exhibition at the same place followed on April 26.

The government of the Academy was by the "Instrument" vested in "a president and eight other persons, who shall form a council." Four of these were to retire every year, and the seats were to go by rotation to every Academician. The number was increased in 1870 to 12, and reduced to ten in 1875. The rules as to retirement and rotation are still in force. Newly elected Academicians begin their two years' service as soon as they have received their diploma. The council has, to quote the "Instrument," "the entire direction and management of the business" of the Academy in all its branches, and also the framing of new laws and regulations; but the latter, before coming into force, must be sanctioned by the general assembly of Academicians and approved by the sovereign. The original number of Academicians was fixed in the "Instrument" at 40, and has so remained. Each Academician on his election has to present an approved specimen of his work—called his diploma work—before his diploma is submitted to the sovereign for signature. On receiving his diploma he signs the Roll of Institution as an Academician, and takes his seat in the general assembly. The class of Associates, out of whom alone the Academicians can be elected, was founded in 1769.

One of the most important functions of the Royal Academy, and one which for nearly a century it discharged alone was the instruction of students in art. The first act, as has been shown, of the newly founded Academy was to establish schools—"an Antique Academy," and a "School for the Living Model" for painters, sculptors and architects. A school of painting was added in 1815, and special schools of sculpture and architecture in 1871. The schools consist of an antique school, a school of painting, a school of drawing from the life, a school of modelling from the life and an architectural school. Admission is gained by submitting specimens of drawing or modelling, and the successful candidates, called probationers, have then to undergo a further test in the schools, on passing which they are admitted as students for five years. Female students were first admitted in 1860. There are permanent curators and teachers in all the schools, but the principal teaching is done by the keeper and visitors—Academicians and Associates—elected to serve in each school.

Another of the principal objects to which the profits of the Royal Academy have been devoted has been the relief of distressed artists and their families.

The source from which have been derived the funds for carrying on the varied work of the Royal Academy, its schools, its charities and general cost of administration, and which has enabled it to spend large sums on building, and provided it with the means of maintaining the buildings, has been the annual exhibitions. There is an annual winter exhibition of works by old masters and deceased British artists, and a summer exhibition of works by living artists.

Presidents of the Royal Academy.—Sir Joshua Reynolds, 1768–92; Benjamin West (resigned), 1792–1805; James Wyatt, 1805; Benjamin West (re-elected), 1806–20; Sir Thomas Lawrence, 1820–30; Sir Martin Archer Shee, 1830–50; Sir Charles Lock Eastlake, 1850–65; Sir Francis Grant, 1866–78; Frederic, Lord Leighton of Stretton, 1878–96; Sir John Everett Millais, 1896; Sir Edward John Poynter, Bt., 1896–1918; Sir Aston Webb, G C V.O., 1919–24; Sir Frank Dicksee, K C.V.O., 1924.

The library contains about 11,000 volumes, dealing with the history, the theory and the practice of the various branches of the fine arts, some of them of great rarity and value. It is open daily to the students and members, and to others on introduction.

The trust funds administered by the Royal Academy include the following: The Turner fund, the Creswick fund, the Landseer fund, the Armitage fund, the Leighton bequest and the Edward Stott fund

BIBLIOGRAPHY.—The literature concerning the Royal Academy consists chiefly of pamphlets and articles of more or less ephemeral value. More serious works are: William Sandby, *The History of the Royal Academy of Arts* (1862) (withdrawn from circulation on a question of copyright); *Report from the Select Committee on Arts and their Connection with Manufactures, with the Minutes of Evidence and Appendix* (1836); *Report of the Royal Commission on the Royal Academy, with Minutes of Evidence and Appendix* (1863); Martin Archer Shee, *The Life of Sir M. A. Shee, P R A* (1860); C. R Leslie, R.A., and Tom Taylor, *Life and Times of Sir Joshua Reynolds, P R A* (1865); J. E. Hodgson, R A., and F. A Eaton, Sec R A, *The Royal Academy and its Members, 1768–1830* (1905). But the chief sources of information on the subject are the minute-books of the council and of the general assembly, and the annual reports, which, however, only date from 1859. (F. A. E, W. R M L)

ACADIA or **ACADIE,** a district in what is now Nova Scotia and eastern New Brunswick, so named either because Verrezzano (*q v.*) called a part of the coast *Arcadia* in 1524, or from the Micmac *acadie,* fertile land, found in several place-names Visited by Champlain in 1603 and by De Monts in 1604, and colonized by France, Acadia was a bone of contention in the wars between France and England. It became English under the treaty of Utrecht in 1713. In 1755 the inhabitants, numbering about 3,000 were deported by the English, who suspected their loyalty. This deportation is the theme of Longfellow's *Evangeline* The Acadians were distributed among the English colonies One party made its way to Bayou Teche, Louisiana, where Cable has described their modern life After the peace of 1763, about 800 returned to New Brunswick, where the name Acadien is still current.

See G P. Bible, *An Historical sketch of the Acadians* (1892); H. F Graham, *The Acadian Exile* (1919).

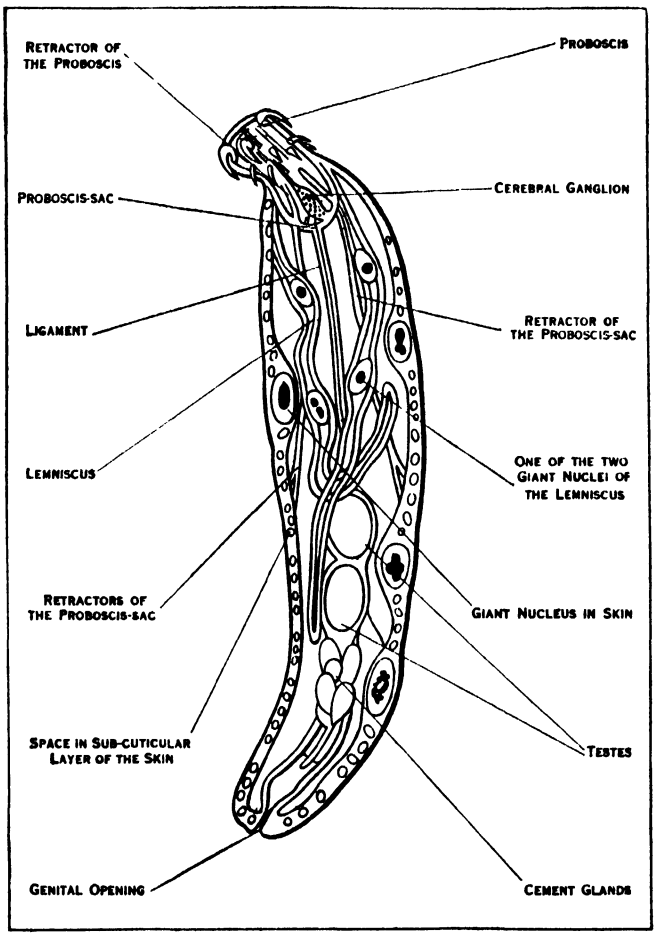
ACAJUTLA, a Pacific port of Salvador, Central America, terminus of the British-owned Salvador railroad, and coffee-shipping centre for the republic. The population is about 1,000, and the port an open roadstead, passengers and freight being handled by lighters. The town is 65m distant from San Salvador and 12m from Sonsonate

ACANTHOCEPHALA, a group of cylindrical, parasitic worms, often included with the Nematoda and Nematomorpha in a phylum Nemathelminthes, but of very doubtful affinities

There is no mouth or alimentary canal, but a retractile proboscis, contained in a muscular sac and armed with recurved hooks for attachment to the host. The body-wall consists of (1) a cuticle; (2) a syncytial subcuticular layer containing few nuclei and traversed by branching vessels containing fluid; (3) a layer of circular muscle fibres; and (4) a slight layer of longitudinal muscle fibres. Connected with the base of the proboscis are a pair of sac-like organs called the lemnisci. The nervous system consists of a central ganglion in the proboscis-sac, giving off nerves to the proboscis and body Excretory organs in the form of a pair of branching nephridia have been described in certain species and these organs are connected by canals with the vagina or ejaculatory duct.

The sexes are separate, the reproductive organs in both being supported by a "ligament" which runs from the proboscis-sac to the posterior end of the body. The male has paired testes and several pairs of "cement glands," connected with the ejaculatory duct, which opens into a protrusible "bursa copulatrix." In the female, the ova are discharged in masses from the ovary into the fluid of the body-cavity, where fertilization and segmentation take place. Connected with the vagina is a structure known as the "bell," which selects the ripe eggs and passes them into the uterus, returning immature ova to the body-cavity. The genital aperture is at the posterior end of the body.

The adult worms live in the intestine of vertebrates, the ova escaping with the faeces of the host. The larval forms are found encapsuled in the body-cavity of some animal (usually a crustacean, insect or lower vertebrate) liable to be eaten by the final host. For example, the larvae of the large *Macracanthorhynchus hirudinaceus* (*Echinorhynchus gigas*) of the pig occur in the grubs of the cockchafer and rose-beetle; the larva of *Echinorhynchus gigas* lives in *Gammarus puler* and in small fish, the adult is common in many freshwater fish: *E. polymorphus,* larval host the crayfish, adult host the duck; *E angustatus* occurs as a larva in *Asellus aquaticus,* as an adult in perch, pike and barbel; *E porrigens* is common in the fin-whale, and *E strimosus* is often found in the seal.



BY COURTESY OF MACMILLAN & CO , LTD

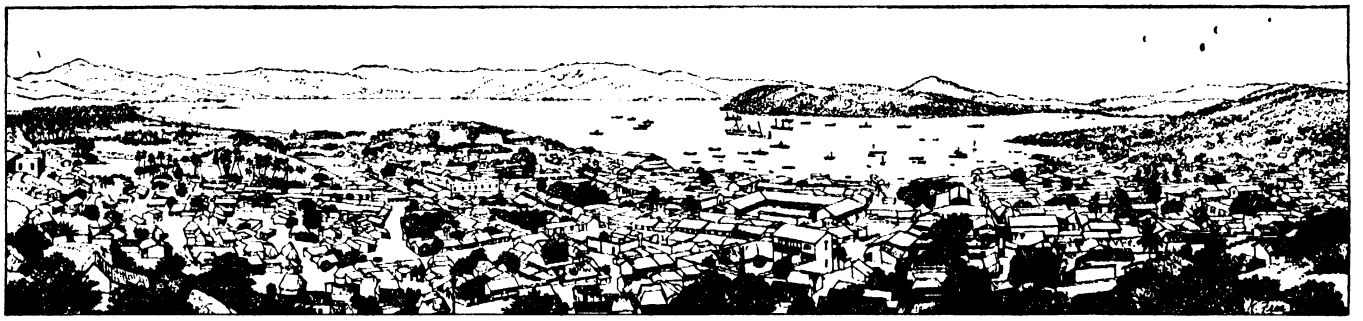
A SECTION THROUGH A MALE SPECIES OF THE ACANTHOCEPHALA (NEOECHINORHYNCHUS RUTILI) FROM CAMBRIDGE NATURAL HISTORY, "WORMS, ROTIFERS AND POLYZOA"

The Acanthocephala are a group of worms parasitic in the intestines of vertebrates. Their young stages are found in the body-cavity of some animal liable to be eaten by the final host. Thus the larvae of a species found in the pig occur in the grubs of the cockchafer and rose-beetle

Some 35 genera of Acanthocephala are recognized, and variously arranged by different authors in from four to as many as eight families (H. A B)

ACANTHOPTERYGII, the most specialized section of the bony fishes (Teleostii), characterized by the possession of spines on the first dorsal fin and by the absence usually of a duct connecting the air-bladder with the alimentary canal. (*See* FISH.) They include the perch, the mackerel, the bass (*qq v.*) and other well known and important fishes besides numerous less noteworthy forms. In the perches and basses the anterior dorsal fin is armed with formidable spines

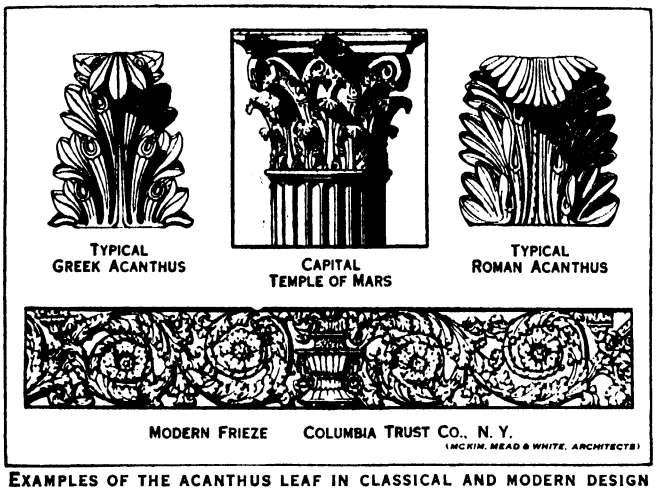
ACANTHUS, a genus of plants belonging to the family Acanthaceae. The species are natives of the southern parts of Europe and the warmer parts of Asia and Africa. The best known is *Acanthus mollis* (brankursine, or bears' breech), a common species throughout the Mediterranean region, having large, deeply cut, hairy, shining leaves. Another species, *Acanthus spinosus,* is so called from its spiny leaves. They are bold, handsome plants, with stately spikes, 2 to 3ft. high, of flowers with spiny bracts. *A. mollis, A. latifolius* and *A. longifolius* are broad-leaved species; *A. spinosus* and *A. spinosissimus* have narrower, spiny toothed leaves. In decoration, the acanthus was first reproduced



BY COURTESY OF THE MEXICO CITY "EXCELSIOR"

THE HARBOUR OF ACAPULCO, THE BEST ON THE PACIFIC COAST OF MEXICO, IS SAID TO BE THE THIRD LARGEST IN THE WORLD. THE CITY, SITUATED ON A DEEP, SEMICIRCULAR BAY, ALMOST LAND-LOCKED, IS BUILT ON A NARROW STRIP OF LOW LAND, SCARCELY A HALF-MILE WIDE, BETWEEN THE SHORE LINE AND THE LOFTY, ENCIRCLING MOUNTAINS

in metal, and subsequently carved in stone by the Greeks. It was afterwards, with various changes, adopted in all succeeding styles of architecture as a basis of ornamental decoration. There are two types, that found in the *Acanthus spinosus*, which seems to have been followed by the Greeks, and that in the *Acanthus mollis*, which seems to have been preferred by the Romans.



EXAMPLES OF THE ACANTHUS LEAF IN CLASSICAL AND MODERN DESIGN

A CAPPELLA or **ALLA CAPPELLA,** Italian musical terms meaning literally "as in a chapel or church," whence they have come to be applied to compositions intended to be sung without instrumental accompaniment; or, alternatively, compositions accompanied in a particular way, viz., without the introduction of harmony or parts.

A CAPRICCIO, in music a direction signifying that the piece to which it is attached is of a fanciful, capricious nature, and is to be played in like manner.

ACAPULCO, a city and port of the State of Guerrero on the Pacific coast of Mexico, 190m. S.S.W. of the city of Mexico. Its population in 1900 was 4,932, and in 1921 5,768. It is situated on a deep, semicircular bay, almost land-locked, easy of access and with so secure an anchorage that vessels can safely lie alongside the rocks that fringe the shore. It is the best harbour on the Pacific coast of Mexico, and it is a port of call for steamship lines running between Panama and San Francisco. The town is built on a narrow strip of low land, scarcely half a mile wide, between the shore line and the lofty mountains that encircle the bay. There is great natural beauty in the surroundings, but the mountains render the town difficult of access from the interior, and give it an exceptionally hot and unhealthy climate. The effort to admit the cooling sea breezes by cutting through the mountains a passage called the Abra de San Nicolás had some beneficial effect. Acapulco was long the most important Mexican port on the Pacific, and the only depot for the Spanish fleets plying between Mexico and Spain's East Indian colonies. The town has no railway connection but the old Acapulco-Mexico city road has been rebuilt (1927) and made fit for automobile traffic. The town suffered considerably from earthquakes in July and August 1909. There are exports of hides, cedar and fruit, and the adjacent district of Tabares produces cotton, tobacco, cacao, sugar cane, Indian corn, beans and coffee.

ACARNANIA, a district of ancient Greece, bounded on the west by the Ionian sea, on the north by the Ambracian gulf, on the east and south by Mt. Thyamus and the Achelous. Its most populous region was the plain of the Achelous, commanded by the principal town Stratus; its people long continued in semi-barbarism, communication with the rest of Greece being impeded by mountain ridges and lagoons, but there were a few Corinthian colonies on the coast, founded in the 7th century B.C.; they were ruined in the 5th, through Athenian intervention. In 391 the Acarnanians submitted to Spartan control; in 371, to Theban. In the Hellenistic age they were constantly assailed by their Aetolian neighbours. But they remodelled their ancient cantonal league, apparently after the pattern of Aetolia, and in the 3rd century they formed a close alliance with Philip V. of Macedonia in his Roman wars. For their sympathy with his successor Perseus they were deprived of their federal capital Leucas and required to send hostages to Rome (167 B.C.). The country was desolated by Augustus, who drafted its inhabitants into Nicopolis and Patrae. Acarnania took a prominent part in the national uprising of 1821; it is now joined with Aetolia as a province. Several ancient sites in Acarnania have well-preserved walls, especially Stratus, Oeniadae and Limnaea.

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ACARUS (ăk'ă-rus), a genus of Arachnids, represented by the cheese mite and other forms. (*See* ARACHNIDA.)

ACASTUS, son of Pelias (*q.v.*), but friend of Jason; he took part in the Calydonian boar-hunt and the Argonautic expedition. After his father's death he instituted splendid funeral games in his honour. His wife Astydameia (called Hippolytē in Horace, *Odes* iii. 7, 17) fell in love with Peleus (*q.v.*), who had taken refuge at Iolcus, and accused him falsely to her husband (*cf.* BELLEROPHON, HIPPOLYTUS). Acastus thereupon left Peleus asleep on Mount Pelion, having first hidden his famous sword. On awaking, Peleus was attacked by the Centaurs, but saved by Cheiron. Having recovered his sword he returned to Iolcus and slew Acastus and Astydameia.

ACATALEPSY. In the history of philosophy the Greek term *acatalepsy* was first used by Pyrrho the sceptic to express the view that the human mind has no direct apprehension of material objects. One is consequently not justified in making assertions about what things really *are in themselves*. Each person can only say how things *appear to him*.

ACAULESCENT, a term used of a plant apparently stemless, as dandelion, the stem being almost suppressed.

ACCADIAN, an adjectival form of the name Accad or Akkad. Sumer and Akkad were the principal sub-regions of Babylonia (*q.v.*) and in view of the dialectical and ethnological differences between the peoples of the two regions, the terms Sumerian and Accadian came to represent the languages and ethnic groups of the two regions. (*See* SUMER and SUMERIA.)

ACCA LARENTIA, in Roman legend, the wife of the shepherd Faustulus, who saved the lives of Romulus and Remus. Attempts have been made to explain the wolf-legend by suggesting that Larentia was called *lupa* ("courtesan," literally "she-wolf") on account of her immoral character (Livy i. 4; Ovid, *Fasti,* iii. 55). According to another account, Larentia was a beautiful girl whom Hercules won at dice (Macrobius i. 10; Plutarch, *Romulus,* 4, 5, *Quaest. Rom.,* 35; Aulus Gellius vi. 7). By his advice she married a wealthy Etruscan named Tarutius. She inherited his property and bequeathed it to the Roman people, who instituted in her honour a yearly festival called Larentalia (Dec. 23). According to some, Acca Larentia was the mother of the Lares, and symbolized the fertility of the earth—in particular the city lands and their crops.

See Mommsen, "Die echte und die falsche Larentia," in *Römische Forschungen,* ii. (1879); E. Pais, *Ancient Legends of Roman History* (Eng. trans. 1906), whose views on the subject are criticized by W. W. Fowler in W. H. D. Rouse's *The Year's Work in Classical Studies* (1907); C Pascal, *Studi di antichità e Mitologia* (1896).

ACCELERANDO (Ital.), in music a direction signifying that the *tempo,* or speed of performance, is to be quickened.

ACCELERATION, as used in mechanics, a term denoting the rate of change in the velocity of a moving body. It is what the increment in velocity in a unit of time would be if the rate of change were uniform for that unit. When a body falls in a vacuum near the earth's surface, the increment in velocity is about 32·16ft per second, and this is known as the acceleration of gravity In astronomy the term has other uses, as when it refers to the time which the stars gain upon the sun in passing the meridian each day (*See* MECHANICS; UNITS, DIMENSIONS, OF GRAVITATION.)

ACCELERATOR, in a motor-car (*q.v.*) the pedal which operates the throttle and thus controls the engine speed.

ACCELEROMETER. This instrument consists essentially of an elastic cantilever (*q v*) loaded at its free end Accelerations perpendicular to the cantilever produce a deflection One type consists in a semicircular glass fibre fixed at both ends, the mass centre being situated in the middle of the arc; this instrument measures accelerations normal to the plane of the semicircle. *The air-speed recording accelerometer* is a combination of the foregoing with a diaphragm gauge in connection with the Pitot and static tubes (*see* AERIAL NAVIGATION), and is used to deduce the flight-path of an aircraft.

ACCENT, a term used by the earlier Greek grammarians for the musical accent which characterized their own language, but later the term became specialized for quantity in metre, whence comes the Eng. *prosody* (Lat. *accentus,* a literal translation of Gr. *προσῳδία*) In all languages there are two kinds of accent: (1) musical chromatic or pitch accent; (2) emphatic or stress accent. The former indicates differences in musical pitch between one sound and another in speech, the latter the difference between one syllable and another which is occasioned by emitting the breath in the production of one syllable with greater energy than is employed for the other syllables of the same word. These two senses are different from the common usage of the word in the statement that someone talks with a foreign or with a vulgar accent.

In different languages the relations between pitch and stress differ very greatly. The pitch accent is well-marked, for example in Lithuanian and Swedish. Modern Greek has changed from pitch to stress, the stress being generally laid upon the same syllable in modern as bore the pitch accent in ancient Greek. In the majority of European languages, however, stress is more conspicuous than pitch. To the existence of stress in the original language from which Greek, Latin, Celtic, Teutonic, Slavonic and other languages of Europe are descended, must be attributed a large part of the phenomena known as ablaut or gradation. In modern languages we get *Acton* out of the O E. *āc-tūn* (oak-town), and more recently the contrast between *New Town* and *Newton.* The strong stress accent existing in the transition period between Latin and French led to the curtailing of long Latin words like *latrocínium* or *hospitâle* into the words which we have borrowed from French into English as *larceny* and *hotel.*

In both pitch and stress accent different gradations may be observed. In pitch, the accent may be uniform, rising or falling. Or there may be combinations of rising and falling or of falling and rising accents upon the same syllable. In ancient Greek there were (1) the acute (´), a rising accent; (2) the grave (`), apparently merely the indication that in particular positions in the sentence the acute accent is not used where it would occur in the isolated word; and (3) the circumflex, which, as its form (^) shows, and as ancient grammarians state, combines the rising and the falling accent upon the same syllable, this syllable being always long. Different Greek dialects varied the syllables of the word: in historical times the accent had become limited to the last three syllables of a word. The theory that, as every vowel has its own natural pitch, and a frequent interchange between *e* (a high vowel) and *o* (a low vowel) occurs in the Indo-European languages, *e* originally went with the highest pitch accent, while *o* appeared in syllables of a lower pitch, has no certain foundation, as there are many exceptions. Somewhat similar distinctions characterize stressed syllables. According as the strength of the expiration is greatest either at the beginning, the end or the middle of the syllable, the accent is a falling, a rising, or a rising and falling one. Syllables in which the stress is produced continuously whether increasing or decreasing are called single-pointed, those in which a variation in the stress occurs without being strong enough to break the syllable into two are called double-pointed. There is no separate notation for stress accent, but the acute (´) is used for the increasing, the grave (`) for the decreasing stress, the circumflex (^) for the rising and falling (increasing and decreasing) and (˘) for the opposite. A separate notation is needed

The relation between the two accents in the same language at the same time is a subject which requires further investigation. In prehistoric times the stress in Latin must have rested upon the first syllable in all cases Only on this hypothesis can be explained forms like *peperci* (perfect of *parco*) and *collido* (a compound of *laedo*), for throughout the historical period the stress rested in these words upon the second syllable from the end.

Besides the accent of the syllable and of the word, there remains a more complicated problem, the accent of the sentence. From earliest times some words have become parasitic or enclitic upon other words. Pronouns more than most words are modified from this cause, but conjunctions like the Gr *τε* ("and"), the Lat. *que,* have throughout their whole history been enclitic upon the preceding word A very important word may be enclitic, as in English *don't, shan't.*

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ACCEPTANCE, generally, a receiving or acknowledgment of receipt; in law, the act by which a person binds himself to comply with the request contained in a *bill of exchange (q.v.),* addressed to him by the drawer. Acceptance may be either general or qualified. A *general* acceptance is an engagement to pay the bill strictly according to its tenor, and is made by the drawee subscribing his name, with or without the word "accepted," at the bottom of the bill, or across the face of it. *Qualified* acceptance may be a promise to pay on a contingency occurring, *e g*, on the sale of certain goods consigned by the drawer to the acceptor. No contingency is allowed to be mentioned in the body of the bill on pain of rendering the bill non-negotiable. But a qualified acceptance is quite legal, and equally binding with a general acceptance upon the acceptor when the contingency has occurred It is also a qualified acceptance where the promise is to pay only part of the sum mentioned

in the bill, or to pay at a different time or place from those specified. As a qualified acceptance is so far a disregard of the drawer's order, the holder is not obliged to take it; and if he chooses to take it he must give notice to antecedent parties, acting at his own risk if they dissent. A bill can be accepted in the first instance only by the person or persons to whom it is addressed; but if he or they fail to do so, it may, after being protested for non-acceptance, be accepted by some one else "*supra* protest," for the sake of the honour of one or more of the parties concerned in it, and he thereupon acquires a claim against the drawer and all those to whom he could have resorted.

For *acceptance of an offer, see* CONTRACT.

Acceptance has a further technical meaning in law in the case of delivery of goods pursuant to a prior contract for sale Either an expression by the buyer of his assent to become owner, or his doing of some act inconsistent with the seller's ownership—such as selling or using part of the goods, will constitute such an acceptance. The effect is, in English law, to make impossible the later rejection of the goods, and leave the buyer a remedy in damages for any non-compliance of the goods with the contract In some American States the acceptance, at least if not accompanied by an express claim of non-compliance, will wholly bar the buyer from any later claim that the goods were not up to contract. Under the prevailing American doctrine laid down in the Uniform Sales Act, however, the buyer can at his option if the goods accepted do not comply, either have damages, or return the goods and forego damages. If the contract is oral and no part payment has been made, both delivery and acceptance of some portion of the goods are necessary to make the contract enforceable at all. (X)

United States.—In the United States trade acceptances are rediscountable at the Federal Reserve Bank if the date of maturity be not more than 90 days from the date offered for discount, except in the case of agricultural paper, for which the limit is 180 days. The Federal Reserve Bank shall take such steps as it deems necessary to satisfy itself as to the eligibility of any trade acceptance offered for rediscount and may require a recent financial statement of one or more of the parties to the instrument. To satisfy itself that the acceptance meets the primary requirement of arising out of a current merchandise transaction, the Federal Reserve Bank rules that "it must bear on its face or be accompanied by evidence satisfactory to the Federal Reserve Bank that it was drawn by the seller of the goods on the purchaser of such goods." Such evidence may consist of a certificate on or accompanying the acceptance to the following effect. *The obligation of the acceptor of this bill arises out of the purchase of goods from the drawer.* Such certificate may be accepted by the Federal Reserve Bank as sufficient evidence, provided, however, that the Federal Reserve Bank, in its discretion, may inquire into the exact nature of the transaction underlying the acceptance

By the use of the trade acceptance, the seller of goods instead of having merely an open book account on a credit transaction, procures a negotiable evidence of the debt. The actual conversion of the original draft into a trade acceptance is accomplished when the buyer (drawee) writes across its face the word "accepted," together with the date and the place of payment, either at a banking house or at the place of business of the seller (drawer), and affixes his signature. Upon receipt of the accepted draft, the seller of goods (drawer) may either hold it to maturity and then collect, or discount it to procure immediate funds

Authoritative information on current usage in connection with trade acceptances is published from time to time in the *Federal Reserve Bulletin* under "Rulings of the Federal Reserve Board" and "Opinions of Counsel of the Federal Reserve Board." (J. H. B.)

ACCEPTILATION, in Roman and Scots law, a verbal release of a verbal obligation. This formal mode of extinguishing an obligation contracted verbally received its name from the book-keeping term *acceptilatio,* entering a receipt, *i e ,* carrying it to credit. The words conveying the release had to correspond to, or strictly cover, the expressed obligation

ACCESS, approach, or the means of approaching In law, the word is used in various connections. The presumption of a child's legitimacy is negatived if it be proved that a husband has not had access to his wife within such a period of time as would admit of his being the father. (*See* LEGITIMACY.)

In the law of easements (*see* EASEMENT), every person who has land adjoining a public road or a public navigable river has a right of access to it from his land. So, also, every person has a right of access to air and light through an ancient window. For the right of access of parents to children under the guardianship of the court, *see* INFANT.

ACCESSION, in law, a method of acquiring property adopted from Roman law, by which, in things that have a close connection with or dependence on one another, the property in the principal draws after it the property in the accessory, according to the principle, *accessio cedet principali.* Accession may take place either in a natural way, such as the growth of fruit or the birth of animals, or in an artificial way. The various methods may be classified as (1) land to land by accretion or alluvion (*q v*), (2) movables to land (*see* FIXTURES); (3) movables to movables; (4) movables added to by the art or industry of man; this may be by specification, as when wine is made out of grapes, or by confusion, or commixture, which is the mixing together of liquids or solids, respectively. In the case of industrial accession ownership is determined according as the natural or manufactured substance is of the more importance, and, in general, compensation is payable to the person who has been dispossessed of his property.

In a historical or constitutional sense, the term "accession" is applied to the coming to the throne of a dynasty or line of sovereigns or of a single sovereign "Accession" sometimes likewise signifies consent or acquiescence. Thus, in the bankruptcy law of Scotland, where there is a settlement by a trust-deed, it is accepted on the part of each creditor by a "deed of accession."

ACCESSORY, a person concerned in the commission of a felonious offence, not as principal, but by participation; as by advice, command, aid or concealment In certain crimes there can be no accessories, all concerned being principals, whether present or absent at the time of their commission There is no accessory to misdemeanour.

There are two kinds of accessories—*before* the fact and *after* it The first is he who commands or procures another to commit felony and is not present himself; for if he be present he is an abettor (*q.v*) The second is he who, knowing a man has committed a felony, receives, harbours or assists him An accessory before the fact is liable to the same punishment as the principal; and there is now indeed no practical difference between such an accessory and a principal in regard either to indictment, trial or punishment Accessories after the fact are in general punishable with imprisonment (with or without hard labour) for a period not exceeding two years. (*See* the Accessories and Abettors Act 1861)

ACCIACCATURA, in music, an old type of ornament in pianoforte and organ playing which consisted in reinforcing a particular note by striking simultaneously with it the note below it, the latter being then immediately released (From Ital. *acciaccature,* to crush) Nowadays it is more often applied to the shorter kind of *appoggiatura* (*q v.*).

ACCIAJUOLI, DONATO (1428–1478), Italian scholar, was born at Florence and became gonfalonier of the city in 1473. His works are: a Latin translation of some of Plutarch's *Lives* (Florence, 1478); Commentaries on Aristotle's *Ethics* and *Politics;* and lives of Hannibal, Scipio and Charlemagne. In the work on Aristotle he had the co-operation of his master Argyropulos.

ACCIDENCE, the term for the grammatical changes to which words are subject in their inflections as to gender, number, tense and case (a mis-spelling of "accidents," from the Latin neuter plural *accidentia,* casual events). Also used for a book containing the rudiments of grammar, and so of any subject of art.

ACCIDENT. This term has a perplexing variety of meanings, which are, however, not entirely disconnected when considered historically. The meaning of the term varies with the antithesis intended. To this, accordingly, attention must be paid

in any context in which "accident" occurs. The following account deals with the principal antitheses and attempts to indicate the way in which the term "accident" acquired its various meanings.

(1) *Accident and Substance.*—Perhaps the oldest use of the term "accident" was by way of contrast with the term "substance" or "thing." "Substance" means the basic reality which has various qualities, stands in various relations, etc. These qualities, relations, etc., on the other hand, need a basis or support to qualify—they are "accidents," accessions to something that is there to bear them (substance). Among the schoolmen, accordingly, almost any quality was commonly called an accident; and this usage was fairly common even in the 17th century—"accident" and "substance" corresponding roughly to "quality" and "thing" respectively, as these terms are commonly used.

(2) *Accident and the Self-existing.*—In the strict sense of the term, as distinguished from its more usual meaning even among philosophers, the term "substance" means that which exists in itself and through itself, and when so interpreted its familiar contrast with "accident" naturally prompts the application of the term "accident" to *anything* that is dependent on some other thing In this case, even what are commonly called "things" or "substances" will be classed among "accidents" Thus for Spinozism there is only one Substance, namely God, who alone is self-existing, while all finite things and even the so-called "infinite modes" (such as motion) are really "accidents," or dependent existents. Cartesianism, too, made this admission, or one very like it to all intents and purposes, but allowed the name "substance," in a qualified sense (that is, in the popular sense) to finite bodies and to souls.

(3) *Real Accidents.*—The antithesis between "accident" and "substance" just explained (2), clearly cuts across the distinction between "quality" and "thing," with which, according to one usage, it coincided more or less (1). Now, some of the schoolmen maintained that there are certain sense-qualities of things which are not dependent on the substances with which they are sometimes combined, but can exist by themselves, apart from such substances. These alleged independent or self-existing qualities they called "real accidents"

(4) *Accident and Essence*—The distinctions between "substance" and "accident" explained in (1) and (2) naturally led people to regard an "accident" as something less important than substance, as something not *essential* to substance; and so the term "accident" was contrasted with whatever is not really essential to anything. Thus in logic, for instance, the so-called *fallacy of accident* is the erroneous assumption that a claim to know anything or anybody implies a knowledge even of all that is non-essential in relation to it or him. Similarly, in the doctrine of the Predicables (*q v*), as commonly expounded in books on logic, the predicable "accident" is contrasted with the other four predicables in the sense that any predicate asserted of a subject but not essential to it is called an "accident" of it, whereas any predicate essential to the subject of which it is affirmed belongs to one or other of the remaining predicables.

(5) *Accident, Necessity and Design.*—The kinship between what is "essential" and what is "necessary" has prompted the common use of "accident" for what is otherwise called a "chance" occurrence. And by a somewhat similar extension of its meaning the term "accident" has come to be applied in law to any occurrence or result that could not have been foreseen by the agent (because not necessarily involved in his action), or to a result not designed (and, therefore, presumably not foreseen), and lastly, to anything unexpected.

(6) *"Essential" and "Accidental" Accidents.*—One curious consequence of the multiplicity of meanings of "accident" is that by using the noun in the sense explained in (1) and the adjective in the sense explained in (4) the schoolmen distinguished between "essential" accidents and "accidental" accidents (*i e*, qualities).

ACCIDENTALISM, a term used (1) in philosophy for any system of thought which denies the causal nexus and maintains that events succeed one another haphazard or by chance (not in the mathematical but in the popular sense). In metaphysics, accidentalism denies the principle of universal causation, that is, the doctrine that everything occurs or results from a definite cause In this connection it is synonymous with Tychism, a term used by C. S. Peirce for the theories (like that of Plato, *e g.*) which make chance an objective factor in the process of the universe Opponents of this accidentalism maintain that what seems to be the result of chance is in reality due to a cause or causes which, owing to the lack of imagination, knowledge or scientific instruments, we are unable to detect. In ethics the term is used, like indeterminism, to denote the theory that mental change cannot always be ascribed to previously ascertained psychical states, and that volition is not causally related to the motives involved An example of this theory is the doctrine of the *liberum arbitrium indifferentiae* (liberty of indifference), according to which the choice of two or more possibilities is affected neither by contemporaneous data of an ethical or prudential kind nor by crystallized habit (character). (2) In painting, the term is used for the effect produced by accidental lights (Ruskin, *Modern Painters*, I. ii 4, iii, §4, 287). (3) In medicine, it stands for the hypothesis that disease is only an accidental modification of the healthy condition, and can, therefore, be avoided by modifying external conditions.

ACCIDENTALS, in music, are signs signifying that the notes to which they are attached have to be raised, lowered, or restored to their original pitch as the case may be. Thus a sharp (♯) raises a note a semi-tone, a flat (♭) lowers it a semi-tone, while a natural (♮) restores it once again to its former status Each sign may also be doubled, though in the case of the double sharp, signifying the raising of the note by two semi-tones, the sign × is used instead of ♯♯; ♭♭, indicating a double flat, signifying the lowering of the note by two semi-tones; and ♮♮ serving to correct or cancel a preceding double-sharp or double-flat, although in modern practice a single natural (♮) is usually considered sufficient for this purpose. Accidentals introduced in the course of a piece apply only during the bar in which they occur, whereas when placed at the beginning of a composition, and constituting thereby what is called its signature, they govern the notes affected throughout the whole of the piece; but in the latter case they are not properly called accidentals. For an explanation of the origin and application of the signs employed for accidentals, *see* under MUSICAL NOTATION.

ACCIDENT INSURANCE, PERSONAL. This class of insurance dates from the industrial revolution of the last century and was introduced in consequence of the frequency of railway accidents. Under English law, in insurance there are certain primary principles to be observed First, there is the principle of "the utmost good faith" (*uberrima fides*), which must always exist if the contract as between the insured and the insurers is to be maintained. The proposer must not withhold from the insurers any fact or circumstance which in anyway affects the risk to be undertaken and, to emphasize this principle, an exact copy of the proposal form completed by the applicant is endorsed on the policy Whilst it is impossible strictly to apply the principle of indemnity to personal accident insurance, it being obviously impossible to indemnify for loss of life or limbs or eyesight, nevertheless it is not permissible for an insured to provide for weekly benefits greatly in excess of his normal weekly earnings, as this might prove an incentive to lengthen a period of disability It is a condition of a personal accident policy that the insured shall not, without the consent of the insurers, effect further policies with other companies and at the outset any such additional insurances must be disclosed, though this restriction does not apply to coupon insurances. Prior to the passing of the Fatal Accidents (Damages) Act, 1908, payments under accident policies were generally applied to the reduction of damages payable by a negligent third party, but this is no longer the case.

In all classes of insurance the insurers have to contend both with the physical and moral hazards. By the former, in personal accident insurance, is meant the abnormal risk of accident due to physical defects of the individual, whilst the moral hazard relates to the individual's moral character in so far as he may endeavour to defraud the insurers either by misstatement of facts or by presenting fraudulent claims.

Accidents-only Policies.—The commonest form of policy is that which covers accidents only, and for this class of insurance the occupation of the proposer is of the utmost importance. Preferential rates are quoted for professional men, whilst occupations involving manual employment with only slightly greater hazards warrant an increased premium, as do persons engaged in manual labour and using tools. The proposal form also requires particulars, *inter alia*, as to the height and weight of the proposer, as these factors, together with previous accident experience, must influence an underwriter in his estimation of the risk. Abnormality in these directions may render it necessary to refuse the proposal.

The policy states that the insurers will pay the benefits specified following "accidental bodily injury caused solely and directly by violent external and visible means." These words are used in their ordinary meaning, and when it has been necessary to refer cases to the courts it has always been shown that, provided the occurrence causing the accident has been something which was neither expected nor designed, then the expression "accidental" has been fulfilled. There must, however, be some sign of violence and there must also be a visible effect produced upon the person concerned. The benefits provided by such a policy are in the event of:—

(1) Death . . . . . The capital sum.
(2) Total loss by actual physical separation at or above the ankle or wrist of two limbs, or the loss of sight of both eyes, or the loss of one limb and the loss of sight of one eye . . . . The capital sum.
(3) Total loss as in (2) of one limb or the sight of one eye . . . . . One-half of the capital sum.

The above misfortunes must occur within three calendar months of the happening of the accident.

(4) Temporary total disablement from engaging in or giving attention to the insured's occupation. Corresponding weekly benefit.
(5) Temporary partial disablement in similar circumstances. . . . One-third or one-quarter of benefit under (4).

The liability for the weekly payments is limited to 26 or 52 weeks, as the case may be, in respect of any one year of insurance. When one of the capital sums is payable no claim can be made for weekly compensation and if a payment has already been made for weekly compensation which is followed by a misfortune warranting a capital payment the total liability of the insurers cannot exceed the latter sum.

Accidents and Specified Diseases Policies.—Accidents-only policies were soon followed by a demand for policies covering diseases and insurances are freely issued covering certain specified diseases, for which weekly benefits are provided. The accident benefits are similar to those mentioned above, though the insured is given the advantage of double benefits if he is killed or injured in an accident to a passenger lift, train, tramcar, omnibus or other licensed vehicle plying in the streets for public hire in which he is travelling as a passenger. If the injury, whilst not warranting the payment of one of the capital sums, results in total disablement for a period of not less than 12 months an annuity is payable so long as the disability continues. A similar annuity is provided should the insured lose completely and irrecoverably the sight of both eyes by disease, or should he contract paralysis involving permanent loss of power in at least two limbs, and provided that this condition has existed for at least six months. Such policies remain in force wherever the insured may reside in the world as regards the accidents cover, but so far as the diseases are concerned the cover is restricted to civilized regions.

Many insurers offer bonus additions to the capital sums insured without additional premium and such sums are increased annually by 5% during the continuance of the policy till the original sums are increased by 50%. Reductions from the renewal premiums are often allowed up to 10%, whilst in addition bonuses are given to life policy holders and sometimes to total abstainers. On the payment of an additional premium, usually 10%, medical expenses, including operation fees and hospital charges, may be covered, subject to a reasonable limit.

Accidents and All Sickness Policies.—Such policies are similar to those previously described, but in addition weekly payments are made to the insured if, as a result of any illness necessitating treatment by a qualified medical practitioner giving a certificate specifying the disease, he is confined to the house for a period of not less than seven days and is totally disabled and prevented from attending to any part of his business. The insured does not actually receive payment till the total liability of the insurers has been ascertained. The period during which compensation may be payable varies between 26 and 104 weeks, though most insurers limit their liability to 52 weeks. Temporary partial disablement benefits are provided whilst the insured is convalescent, but the weekly payments are reduced to one-quarter of those payable for total incapacity by illness and the period is usually limited to four weeks. Such policies are terminated when the insured reaches the age of 60 and no payment is made for any illness contracted within four weeks after the commencement of the insurance. The illness risk is limited to the country in which the policy is issued, subject to the consent of the insurers should the insured propose to travel. A few insurers issue non-cancellable accidents and illnesses policies. Such insurances are uncommon, but provided that the renewal premiums are paid the policy continues till the age of 55, when the insurance terminates. Premiums are calculated on an actuarial basis.

General Policy Conditions.—Apart from those conditions which it has been necessary to discuss in passing, policies provide that, apart from the death benefit, no assignment of the policy shall be valid. In the event of an accident the insured must, within 21 days of its occurrence, notify the insurers and send them full particulars, accompanied by satisfactory medical evidence. The insured must, if required by the insurers, submit to a medical examination by the insurers' doctor and in the event of death the insurers are entitled to order a post-mortem examination at their own expense. If the insured changes his occupation he must notify the insurers and he must also advise them should he suffer any disease, physical defect or infirmity, thus giving the insurers an opportunity of reconsidering the risk. A cancellation clause is provided and the insurers may, by giving seven days' written notice to the insured, terminate their liability without prejudice to any claim which may arise prior to the termination of such notice. All differences arising out of the contract must be referred to arbitration.

Sickness Indemnities.—The benefits under such policies are similar to those provided by the accidents-only policy and in addition a weekly indemnity is provided for periods of continuous disability not exceeding 52 consecutive weeks. If as the result of a disease or illness the insured loses the use of two limbs or the sight of both eyes the insurers will pay him, in lieu of any other indemnity, excepting surgical or hospital fees, the weekly indemnity specified in the policy during the period in which the insured is disabled up to a maximum of a 100 weeks. No payment is made for any disease for which the insured is not treated by a physician nor for any disease in respect of which disability commences whilst the policy is not in force.

Coupon Insurance.—In recent times there has been a considerable growth in this class of business, which is generally undertaken by insurance companies on behalf of the periodicals concerned. The benefits, unlike those of the ordinary personal accident policies issued by insurance companies, apply only to more uncommon accidents and the weekly payments are generally very limited. Their most striking feature is the enormous capital sums which are offered as an inducement to buy the newspaper or magazine concerned and, whilst such insurances may be regarded favourably by the readers of certain journals, they should not be led to dispense with the more certain cover provided by the ordinary personal accident policies which are not subject to such irritating restrictions. (A. G. M. B.)

AMERICAN PRACTICE

With regard to accident and health insurance in the United States, American practice differs in various details from that of Great Britain, though the general principles are the same. In America the *proposer* is called the *applicant* and the *proposal* becomes the *application*, while the *capital sum* is styled *principal sum*. The word "indemnity" as used in American policies is

synonymous with "benefit," the amounts provided in the policies being classed as fixed or premeasured indemnity, regulated in amount by the ability or willingness of the insured to pay, and the policy becomes a valued benefit contract; there is no provision by which the amounts payable may be reduced in case of disability even though benefits payable under all insurance carried exceed the insured's earnings, but underwriters exercise great care against overinsurance in the original issue, requiring each applicant to certify that his earnings are in excess of benefits payable under all insurance carried and usually limiting the amount of insurance permitted to approximately three-fourths of the earnings

There is never any right of subrogation in American policies by which the insured surrenders any claims against a third party who may be responsible for his injury. American policies do not carry a condition prohibiting the obtaining of additional insurance without consent of the company, but some contain a condition to the effect that if other insurance is obtained without notice to the company the amount of existing insurance is proportionately reduced. A great variety of accident policies, and also of accident and health policies, is issued in America, with many variations in amounts payable and in the sundry features. With a fixed principal sum payable for accidental death and a fixed weekly benefit payable for disability, there may be variations in the percentage of principal sum payable for loss of eyesight, or for loss of one or more limbs, or even for the degree of loss of a particular limb. Likewise, many variations occur in the period for which disability benefit is payable. It may be limited to a specified number of weeks, varying from a few to many, or the period for which benefit is payable may be limited only by the period of disability. Under the most common practice no period limit is fixed in case of disability from accident, while a limit of fifty-two weeks in case of disability from sickness is most favoured.

Partial disability is usually provided for at the rate of 50% of the total disability rate in respect to disability caused by accidental injury, but is not generally provided for in case of sickness disability, though in some instances a certain provision may be made for partial disability, or disability not requiring confinement to the house may be classified as partial and a smaller benefit provided. The usual American accident policy provides specific sums for loss of life, limb or sight and a stated weekly benefit for disability, while the usual health policy, commonly combined with the accident policy into a single document, provides a stated weekly benefit for disability due to sickness with occasional additional payments in case of complete blindness or complete paralysis Most accident policies contain a provision doubling the benefits payable in case of accidents occurring in public passenger conveyances, elevators or burning buildings, and some include in this class other hazards more or less incident to the risk of travel.

Other provisions common in American policies include additional payments against surgical operations, hospital treatment, nursing and payment of doctors' bills in the case of non-disabling injuries. Some include an optional clause under which in case of certain specified injuries, such as fractures and dislocations, the insured may elect to take a lump sum in lieu of the disability benefit. There is no real uniformity as respects the inclusion of these subordinate features. Some accident policies are of more restricted scope and may exclude from their coverage a certain class of accidents, specified in greater or less number, in which case proportionately less premium is charged. There is also a great variety of special or "limited" policies designed to insure only against a certain class or a small number of classes of accidents. These are often referred to as "coupon" insurance because generally sold by special advertising or offered as an inducement to purchase of goods, subscription to a newspaper or other periodical. Generally they apply to accidents of least common occurrence and because of that fact a merely nominal price is charged, and are issued upon receipt of coupons attached to the advertisement.

The insuring clause most commonly in use in America differs somewhat in wording from that in use in Great Britain. Usually it defines the insurance to be "against bodily injuries caused directly and independently of all other causes by accidental means," or by violent and accidental means, or by external, violent and accidental means, and there are other variations of verbiage without significant change of substance, the purpose always being to insure against the physical results of injury to the body caused wholly by accident, as distinguished from the natural processes following either wholly or partly from disease, degeneration or disintegration, which latter in case of disability becomes the function of health insurance and in case of death becomes the function of life insurance.

Health Insurance.—The most favoured form of health insurance in America insures against all sicknesses from whatever cause, and in such policies there are numerous variations. They may provide for all disability from the first day thereof to a specified period or without limitation. They may exclude from benefit the initial period of any disability and cover only disability after one week, or after a number of weeks or a number of months, with premiums varying in proportion. They may restrict payment of benefit to the period of confinement to house or may be without this restriction. They may exclude sickness contracted within a certain short period after the date of the policy or may cover any sickness contracted after the policy date. Additional payments may cover surgical operations, hospital treatment and nursing charges, or any or all of these may be omitted. Usually health policies stipulate that the insured must be under the treatment of a physician during any period for which disability may be claimed in order that there may be competent certification and that the necessary disability may be delimited as far as possible by proper care and treatment. So-called "limited" health policies are also issued to some extent, which confine their coverage to disability from certain diseases specifically named. Untold variations in this respect may be devised with proportionate variations in premium.

Statutory Provisions.—Those provisions of accident and health policies that relate to the performance and operation of the contract after issue are generally regulated by law. Many states have enacted statutes prescribing certain "standard provisions" which must be included in all such policies and prohibiting the inclusion of any contradictory or inconsistent conditions Even in the states where such statutes have not been enacted it is the common practice of the companies to issue the same policies uniformly in all of them. These provisions govern such matters as the pro-rata reduction of the insurance in case of a change of occupation to one more hazardous, alterations or assignments of policies, reinstatement after lapse, the timely giving of notice and filing of proof of claim, examination by the company's physician in connection with claims, time for payment after proof, right of cancellation by insured in case of change of occupation to one less hazardous, rights of beneficiary, time when legal proceedings may be instituted. Certain other provisions may be included or omitted at the option of the issuing company. These permit reservation by the company of a right to cancel or to refuse to renew the policy, reduction of the amount of insurance in case additional insurance is obtained without notice, deduction from any benefit payable of premium then due and unpaid, limitation of the amount of insurance one person may have under various policies in the same company, limitation of the coverage within certain minimum and maximum age limits

American policies do not require notice by the insured of a change of occupation, but the effect of such change, if any, is regulated by the statutory provisions. No notice is required from the insured of any change in his state of health except when it is to be made the basis of a claim for benefit. No arbitration clause is included in American policies, such a provision being commonly held illegal as tending to oust the courts of their jurisdiction.

Physical Condition of Applicant.—In the underwriting of both accident and health insurance the general physical condition of the applicant is given much weight, the application requiring disclosure of his present physical condition and past health record, which may influence the action of the underwriter even in the

issue of accident insurance where the state of health suggests susceptibility to more serious results in case of accident than would be common with a normal person, while both physical condition and health record are even more carefully considered when the application is for health insurance because of the possibly greater susceptibility to disease or sickness.

Premium Rates.—The premium rates for accident insurance are governed wholly by occupation, a basic rate first being fixed to cover the general hazards of life outside of the occupation and this rate being increased in proportion to additional hazards involved by the occupational exposure. For this purpose all known occupations are classified by the companies and they are brought into groups of relatively equal risk, resulting in some eight or more different rate classes as indicated by developed experience. Rates for health insurance do not commonly vary according to occupation, though benefit provisions often vary for the purpose of adjusting the cost in such occupations as involve particular exposure to occupational disease.

Canadian Practice.—In the Dominion of Canada general practices and forms of policies are very similar to those of the United States and statutory standard provisions also are required, these being substantially similar to those in use in the United States though differing in minor particulars and phraseology.

See M W Van Auken, *Ready Reference Digest of Accident and Health Insurance Law* (Albany, N Y, 1922), S. S Huebner, "Modern Insurance Tendencies," *Am. Acad of Pol. Sci., Annals*, vol. cxxx, No. 219 (Philadelphia, 1927). (S. M. La M.)

ACCIUS or Attius, **LUCIUS,** Roman tragic poet, the son of a freedman, was born at Pisaurum in Umbria, in 170 B C. He must have lived to a great age, since Cicero (*Brutus*, 28) speaks of having conversed with him. His plays, which are praised by ancient writers (Horace, *Epistles*, ii. 1, 56; Cicero, *Pro Plancio*, 24), were mostly free translations from the Greek, but a few (including *Brutus* and *Decius*) were on Roman subjects. About 700 lines are extant and are given in Ribbeck (*Tragic Lat. Relig.*).

Accius wrote other works of a literary character: *Didascalicōn* and *Pragmaticōn libri*, treatises in verse on the history of Greek and Roman poetry, and dramatic art in particular; *Parerga* and *Praxidica* (perhaps identical) on agriculture; and an *Annales*. He also introduced innovations in orthography and grammar.

See Boissier, *Le Poète Accius* (1856); L. Müller, *De Accii fabulis Disputatio* (1890); Ribbeck, *Geschichte der romischen Dichtung* (1892), editions of the tragic fragments by Ribbeck (1897), of the others by Bahrens (1886); Plessis, *Poésie latine* (1909).

ACCLAMATION, in deliberative or electoral assemblies, a spontaneous shout of approval or praise (Lat. *acclamatio*), the adoption of a resolution or the passing of a vote of confidence or choice unanimously, in distinction from a ballot or division In the Roman senate votes were passed by acclamation in such forms as *Omnes, omnes, Aequum est, Iustum est*, etc.: and the praises of the emperor were celebrated in prearranged sentences by the whole body of senators.

In ecclesiastical councils vote by acclamation is common, the question being put in the form, *placet* or *non placet*. The Sacred College has elected popes by acclamation, when the cardinals simultaneously "acclaimed" one of their number as pontiff. In modern parliamentary usage a motion is carried by acclamation when approval is expressed by shouting such words as *Aye* or *Agreed*.

ACCLIMATIZATION, in the broad sense, is a term applied to the fact that plants or animals may be introduced, artificially or naturally, into a country with a climate different from that of their original habitat, and may successfully propagate there What would come to the same thing is the successful persistence and propagation of plants and animals in a country whose climate has undergone some notable change, such as would be involved in the setting in of an ice age or a period of aridity. In this broad usage the term acclimatization is practically synonymous with naturalization.

But in its narrow usage acclimatization means a process by which organisms are changed in the course of generations in adaptation to new climatic conditions in the same or in another country. This usage implies the theoretical postulate of racial adaptation to withstand climatic influences which were at first more or less unfavourable. The establishment of the adaptation might be interpreted by some along Lamarckian and by others along Darwinian lines, and this raises additional theoretical questions.

Thus some investigators, *e g.*, G. M. Thomson, who find little evidence of acclimatization in the strict sense, prefer to keep the term naturalization, which expresses an indisputable fact that organisms may thrive well when taken to another and in some respects different country. Willis defines acclimatization as "the accustoming of plants to new conditions and climates till they are not only capable of growing there but also of reproducing themselves freely." Thus, though the cherry and apple will grow well in the hills of Ceylon they are not acclimatized, for they do not produce fertile seed.

Effects of Naturalization.—When plants and animals get a footing in a new and different country, what changes may be looked for? (1) There is often a marked increase in the number of individuals in a given area, as is illustrated by the multiplication of the rabbits in Australia, or of greenfinches and skylarks in New Zealand The reason is twofold: favourable conditions, such as abundant food, may increase the rate of multiplication, and there may be an absence of the enemies and other checks which kept the numbers down in the old country. There have been some costly verifications of the numerical increase that is apt to follow naturalization, as in the familiar case of rabbits in Australia and New Zealand.

(2) Another consequence that has been repeatedly noted is increase in individual size and perhaps vigour The new conditions prove unusually stimulating Speaking of plants introduced into New Zealand, G. M. Thomson writes: "Water-cress—a plant of two to four feet in length in European waters—grew in some streams to a length of from 12 to 14ft., and with stems as thick as one's wrist." This riotous exuberance is due positively to the stimulating conditions of the new territory, and negatively to the absence of the previous checks.

The popular interpretation of the rapid spread of introduced plants, *e g.*, "weeds," in new countries, is that they come from places where the struggle for existence is keener and where they have therefore become particularly efficient. According to Willis, "the real explanation, in all but a very few doubtful cases, is that their spread is due to change of conditions This has usually been effected by man, who has often altered, or even destroyed, the conditions under which many societies of plants formerly flourished, thus giving a fair field to those newcomers that were suited to the new circumstances"

(3) Many naturalists have concluded that the lessening of the stringency of natural selection after transport to a new country allows an increase in the number of varieties, and the survival of peculiar forms, which would be speedily eliminated in the original environment. Thus, if there are few enemies, one might expect more numerous conspicuous variants, such as albinos. Here the careful work of G M. Thomson is of great value. In 1891, he concluded that conspicuous colour-variations were on the increase among the rabbits introduced into New Zealand, and also among introduced birds like sparrows, thrushes, blackbirds, skylarks and starlings. Thirty years later he definitely withdrew this conclusion, the fallacy being that he was at first so busy looking for anomalous characters that he met with many, and unconsciously exaggerated the ratio of their occurrence. But inquiry must be made in other fields to see whether there is nothing to be said for the old view.

(4) So many naturalizations have been effected in different parts of the world that one would expect to find it easy to collect instances of change of habit; but there seems to be a strong conservative tendency among animals introduced into new haunts. When domesticated animals are transported to a wilder country there is sometimes an interesting individual rehabilitation of a long lost ancestral trait Thus cows taken from Scotland to wilder conditions in California have been known to hide their calves in the thicket when they went to graze in the open. Sometimes, however, something novel occurs. Thus, sheep in New

Zealand have shown in some places the novel habit of stripping off long pieces of bark from the gaya trees. On the whole it seems that change of habit in consequence of naturalization is infrequent and very gradual.

(5) Some types are quickly at home in a new country, but do not show external change. Horses, rabbits, rats, sparrows, and fowls are usually somewhat indifferent to change of climate, while a tough animal like the yak of the Tibetan mountains refuses to thrive below a certain altitude.

Individual adjustments may be of much importance though they do not meet the eye, as in the case of adaptation to high altitudes. When a man accustomed to life near sea-level settles in a place at a high altitude, there is likely to be, if he thrives, an increase in the haemoglobin content of the blood. This is due at first to a reduction in the volume of the plasma and a concentration of corpuscles, but secondarily to an increased corpuscle-formation. At very high altitudes there is some evidence of an increase in the affinity of haemoglobin for oxygen. Another change is demonstrable in the reaction of the blood to the acid side, and this is also useful since less carbon dioxide is required to stimulate the respiratory centre, thus increasing pulmonary ventilation. We have referred to this adaptation to high altitudes because it illustrates an adjustment that can be established only by intimate inquiry. It is highly probable that similar adjustments are exhibited by many animals when they have to face a marked climatic change.

Many facts confirm the suggestion that the success or failure of attempted naturalization may depend on inconspicuous constitutional peculiarities. Thus G. M. Thomson notes for New Zealand that the greenfinch and the chaffinch have thriven remarkably, while the allied linnet has failed. "The reasons for these failures are often so obscure that no plausible explanation has yet been given."

A hint of the frequent subtlety of conditions may be found in cases where the attempted naturalization of a plant fails, as of heather in Ceylon, because the associated root-fungus or mycorrhiza will not grow.

(6) When an organismal change directly induced by some change in environment, nutrition, or habit, takes such a grip that it persists after the inducing conditions have ceased to operate, it is called a modification, or less conveniently, an individually acquired character There seem to be some climatic modifications, and the following may be mentioned: (*a*) An Englishman who works half his lifetime under a tropical sun may become so tanned that the deposit of melanin pigment in the skin does not disappear during all the years in which he enjoys his pension at home. Of course it must not be inferred that the blackness of the negro's skin was directly produced in this way by the tropical sun. (*b*) Nägeli brought some Alpine plants to the Botanical Garden at Munich, and there many of them became in the first year so much modified that they were hardly recognizable as the same species. Their descendants in the garden were also quite different from the Alpine originals. Thus the small hawkweeds (*Hieracium*) became large and thickly branching with abundant blossoms. The modifications were very striking, and in some cases many generations were observed—even for 13 years. The re-appearance was probably due to the fact that the original modifications were directly re-impressed on each successive crop, for when the plants were removed from the rich garden to poor, gravelly soil, the acquired characters gradually disappeared, and the plants exhibited once more the original Alpine characters. There was no convincing evidence of hereditary entailment.

It is important not to think of these matters too simply. Thus, as Goldschmidt points out, the normal development of particular characters, such as general growth and pigment formation, has been "harmonized" for a definite environment. But they have different temperature coefficients, and novel conditions may throw them out of harmony. Moreover, modifications resulting from climatic change must not be thought of as necessarily beneficial. Thus some Lepidoptera tend to melanism in the cold, and others at high temperatures, without there being any demonstrable advantage in either case.

(7) If evidence could be obtained of the hereditary entailment of climatic modifications, this would serve as a basis for a Lamarckian theory of acclimatization. It is necessary to inquire afresh whether there are any facts supporting the Lamarckian interpretation. Bordage records some observations on peach-trees (*Prunus persica*) grown from seed of European origin sown in Reunion. For ten years or so the trees shed their leaves as in Europe. Later on, after 20 years, a considerable degree of evergreenness was exhibited. There was no bare period. When seeds of these partial evergreens were sown in the lowlands they grew into trees verdant throughout the year, but the same was true of seeds sown in certain mountainous districts with a considerable degree of frost. They also grew up into young peach-trees which were also evergreen. But European seeds sown in similar situations developed into ordinary deciduous trees. This is a peculiar case and may be interpreted as follows: The original imports underwent a gradual constitutional change—some modification of their metabolism; this might affect the constitution of the seed during the period when it was still part and parcel of the parent's body. The change in the metabolism might result in the affected seeds developing into evergreens, though the direct environmental influence would work in the opposite direction. It is unfortunate that the observations were not carried further.

A famous case, often referred to, is that of the feral horses of the Falkland islands, which Darwin studied on his "Beagle" voyage (1833). He says that the horses and also the cattle were introduced by the French in 1764. Whereas the cattle are large, the horses are small, and Darwin speaks of them as "having degenerated." "They have lost so much strength that they are unfit to be used in taking wild cattle with the lazo: in consequence, it is necessary to go to the great expense of importing fresh horses from the Plata. At some future period the southern hemisphere probably will have its breed of Falkland ponies, as the northern has its Shetland breed." Darwin regarded the degeneration of the Falkland islands horse as due to the humid climate and the lack of suitable food, but it is difficult to believe that marked changes were effected between 1764 and 1833. It would be necessary to know more about the horses originally imported.

Various statements have been made in regard to changes brought about in the hair of sheep, goats, cattle, sheep-dogs, and even cats, when these animals are taken to a more rigorous climate. It is said that the fur becomes longer and thicker, which would be a useful adaptation. But there is a lack of precision in these statements, and a regrettable absence of measurements. It would be useful to know what additions were made to the coat after the climatic change; whether the offspring, exposed to the cold from birth, showed further additions; and the character of the fur in the grand-offspring. As regards modifications, no inference can be drawn from the occurrence of adaptive peculiarities, unless the history is known.

On the whole we are forced to the conclusion that the evidence of the heritability of climatic modifications is unsatisfactory.

Natural Acclimatization in the Past.—All the world over there are instances of related species flourishing under different climatic conditions, and few evolutionists have any hesitation in regarding these as the outcome of divergent evolution. It may be recalled that while Darwin did not think much of man's achievements in acclimatizing, he had no doubt as to Nature's powers in this direction.

Three saving-clauses should be kept in mind: (*a*) When two nearly related species are thriving in climatically different surroundings, it should not be taken for granted, as it usually is, that all their differences are now part and parcel of the inheritance. Some of the differences may be modificational, hammered on each successive generation in the course of development. There is need for more experimental study of species. (*b*) There has been a tendency to strain the interpretation of specific characters as adaptive to particular conditions of life, such as those implied in climate. Many characteristics separating related species in different localities may be reasonably interpreted as climatic adaptations, but each case should be carefully judged on its merits. (*c*) When a species is extending its range in consequence perhaps

of increasing numbers, the factor of isolation may come into operation, say in the form of a river or a watershed, and variations may be separated off which have no particular relation to the new territory or climate in which the leaders of the advance find themselves. Thus new species may arise by the physical segregation of diversely varying contingents of an advancing army, till the climatic difference itself may become an isolating factor.

Accepting, with these saving-clauses, the idea of natural acclimatization, we must now ask how it may have been effected. The Lamarckian answer involves the postulate of the transmissibility of modifications, especially of functional modifications; and the evidence of this, summed up by Kammerer (1924) and by MacBride (1924), appears inconclusive. The interpretation which seems to involve fewest assumptions is that of Darwin. In discussing acclimatization (1868), Darwin laid most emphasis on the natural selection of spontaneous variations. As to these variations he expressly says "there is no evidence that a change in the constitution of the offspring necessarily stands in any direct relation with the nature of the climate inhabited by the parents." In regard to selection he lays emphasis on two points: (*a*) the organism's power of resistance to difficult conditions in the new climate, and (*b*) some useful change in the period of reproduction, such as earlier flowering and fruiting.

To Darwin's interpretation an addition may be suggested. It is conceivable that the climatic peculiarities may affect the metabolism of the organism through and through, and may thus serve as stimuli to the variability of the germ-cells. If the climatic peculiarity should induce (*a*) an adaptive modification in the body of the organism and (*b*), at the same time, a variation in the germ-cells which finds expression as a similar new character in the offspring, the phenomenon is called "parallel induction." It must be distinguished theoretically from the transmission of a somatic modification; it is a change induced in the germ-cells along with, but not through, the bodily modification.

But it is possible that climatic peculiarities may penetrate into the germ-cells and affect them without producing any modification in the body. Thus W. L. Tower subjected full-grown potato-beetles (*Leptinotarsa*) to peculiar conditions of temperature and humidity during the time when the eggs were maturing, and found that "mutations" occurred in a certain proportion of the offspring The parents were not affected, having passed the plastic stage; and some of the eggs were not affected at all. Moreover, the same environmental peculiarity, analogous to a climatic change, did not always evoke the same mutation. Some of the mutations in colour and markings were very striking; others affected minute details of structure. In subsequent generations there was no reversion. This case is of particular interest in connection with acclimatization, for the artificial environmental conditions, effected in large steel and glass cages, were comparable to different climatic conditions in which different species of potato-beetle live.

By Muller in particular it has been shown that an exposure of the germ-cells of the fruit-fly (*Drosophila melanogaster*) to appropriate doses of X-rays is followed by numerous mutations, which often breed true. This experimental irradiation illustrates the possible action of the environment as a variational stimulus. A mutation following a climatic change might have this origin. As Weismann said many years ago (1904): "It does not seem impossible that the climate may have a variational influence upon certain determinants of the germ-plasm, for we have already seen that the influence of cultivation may incite plants and animals to hereditary variations, and that slowly increasing disturbances in the equilibrium of the determinant system may thereby be produced, which may suddenly find marked expression as 'mutations.' But there is little probability that *adaptations*, that is, transformations corresponding to the altered climate, can arise in this way!" The meaning of this last sentence is that Weismann believed these adaptations were the outcome of the prolonged natural selection of fluctuating variations in the germ-plasm.

The Darwinian theory, as applied to natural acclimatization, may be briefly resumed in more technical terms. In any species in any given environment there will be an observable percentage of variations from type in a given number of births, and these variations yield a curve of frequency or probable error. The steepness of the curve is a measure of the variability of the species. The aberrants on all sides are pruned off by selection. If the environment is changed, selection may no longer operate on the same axis as before, but may tend to prune off variations on one side of the mean more than on another. In the course of time, the apex of the curve, representing the type form, will shift to suit the new conditions, since more of the aberrants on the favoured side will live to reproduce.

Quite a separate question is this: that the new environment may increase the variability of the species, flattening the curve of probable error. The effect of this is that selection has more material to work with, and therefore attains its end more rapidly, although of the variations appearing as many will be unfavourable as favourable. A species in which there is little variation presents a greater inertia to the shifting effect of altered climatic conditions than a variable species. In the less variable species there will be relatively fewer favourable variations to mate with the type.

Bateson's Silliman Lectures contain a valuable criticism of the somewhat facilely accepted views (*a*) that local and climatic varieties are adaptational, (*b*) that the influences of environment have directly led either to the production of these varieties or to their selective stabilization, and (*c*) that there is gradual transition—or mass transformation—from one species to another in response to climatic influences. Bateson lays much emphasis on the rôle of isolation and on the intrinsic character, *e.g.*, Mendelian dominance of the sporadic variations that are of frequent occurrence.

Of importance in connection with acclimatization is Erwin Baur's study of cultivated snapdragons, especially *Antirrhinum majus*. He finds a frequent occurrence of small mutations, transmissible in Mendelian fashion, often showing themselves in "pure lines," and sometimes suggesting an enhancement of vigour, as when a mutant appears with deeper green in its leaves. According to Baur wild species of snapdragon, like garden races, have often arisen by the summation of small mutations.

Change of Climate.—So far we have considered what may happen when organisms are naturalized, perhaps acclimatized, in a new and different environment. But similar biological problems are raised when we think of the changes that occur or have occurred in the fauna and flora of a country after some drastic alteration of the climate—towards aridity or humidity, towards markedly higher or lower temperature. To what extent have changes of climate functioned as factors in organic evolution? (1) In extreme cases, as when a country is covered with glaciers, there may be an almost complete elimination of life, as happened over the greater part of Britain during the quaternary glacial periods. (2) In less severe conditions the gradual setting in of unfavourable climatic conditions would exert a selective influence. Thus xerophytic plants with reduced transpiration would tend to survive when arid conditions encroached; quickly flowering and fruiting plants, entrenched below ground in winter, with reserves in rhizome and bulb, would tend to survive when the snow began to cover the ground for many months of the year. In a country becoming warmer there might be survival value in aestivation; in a country becoming colder the advantage might be with the hibernators. In scores of ways a gradual change of climate would sift the fauna and flora.

(3) Some animals able to move about for considerable distances and not too slowly would be prompted by climatic changes to shift their quarters. As the severity of the ice ages spread southwards in Europe, many northern mammals came with it, thus remains of reindeer, lemming, and arctic fox are found in deposits far to the south. As milder climates set in and the glaciers melted, the descendants of some of the arctic types, like reindeer and white fox, were able to trek for the north. Some, however, remained as refugees on the mountains, like the snow vole (*Microtus nivalis*) of the high Alps. Some of the true bird migrations may owe their origin in part to distant climatic changes such as those of the quaternary ice ages (*see* MIGRATION).

(4) It is reasonable to suppose, though difficult to prove, that change of climate in a country induced important changes of

habit. Thus Barrell and Lull have suggested that continental elevation and consequent aridity, especially in the Himalayan region, led in the Miocene or early Pliocene ages to a dwindling of the forested area where man's ancestors were at home. The alternatives were to find other forests in warmer countries, as the present-day anthropoid apes did, or to be eliminated, or to come to earth, and begin afresh on a new line of life. The last solution may have been of critical moment in the evolution of Hominoids.

(5) Climatic changes in a country may also have played an important part in punctuating the life-history. A kind of variation which has not received adequate attention may be called "temporal." It includes alterations in the tempo, or rate, or rhythm of metabolic processes, or in the duration of particular phases in the life-history. In vertebrate animals, at least, this might be brought about by variations (also, of course, requiring to be accounted for somehow) in the secretory activity of the ductless or endocrinal glands, the hormones of which serve now as accelerators and again as brakes. The life-histories of many types differ from one another in the shortening or lengthening of particular arcs on the life-curve or trajectory. Here is a kind of evolution to which climatic variations may have applied a frequent spur. Thus when the rate of development was such that the life-cycle could not be completed in the first summer, there would be a tendency to favour variations in the direction of interpolating a larval phase, as in insects, suited for an accumulation of reserves, a reduced intensity of life in cold weather, a diminished exposure of vulnerable surface, and so on. Opinions may differ in regard to particular cases, but it is a legitimate and instructive inquiry to associate temporal variations in the life-curve with seasonal and with climatic periodicities.

The Arctic tundra is marked by a long dark winter of bitter cold and a short nightless summer of intense illumination, therefore it is reasonable to postulate a prolonged process of elimination as the climate changed—an elimination of those types which did not vary in the direction of quick-flowering and quick-fruiting, dying down in winter, dispensing with all but a little water, and accumulating stores in underground parts.

Among the features of the life-curve that may be tentatively associated with climatic changes, the following may be suggested —the length of the mammalian gestation and the season for giving birth; the periodicities of migrating birds; the interpolation of periods of winter sleep, rest, coma, lethargy and even de-differentiation. Every trajectory of life should be looked at in the light of the evolution of climates.

Often in the history of the earth a change towards great cold has involved severe elimination. In humid periods there tends to be abundant succulent fodder for browsing animals and extensive forests affording shelter. Diminution of moisture, if it does not go too far, favours the increase of grasses and of grazing animals. Aridity makes the forests shrink and prompts the search for new haunts. The times of quickening, the "expression-points" or "pulsations" of evolution, may often be correlated with climatic changes, chiefly in temperature and humidity, due sometimes to topographic, at others to general atmospheric, conditions. Behind these, again, lie larger factors still, such as shrinkages of the earth's crust.

Interaction of Endemic and Introduced Faunas.—(1) The newcomers may destroy the indigenous or previously naturalized forms. Thus the mongoose, introduced into Jamaica, destroyed the indigenous "cane-rats" and the alien ship-rats. The introduced animals may become so numerous that they make life difficult for their predecessors though they do not actually devour them. They may, for instance, seriously reduce the food-supply, but they may be prejudicial with varying degrees of directness. When the brown rat (*Rattus norvegicus*) found its way to Britain in the early 18th century, it proved itself hardier, more plastic, and more fecund than the black rat (*Rattus rattus*), with the result that in 50 years the latter was almost exterminated except in places where it was continually being re-introduced by ships.

Sometimes the influence is more subtle. Thus an extension of squirrels into an area may be followed by the reduction of the number of wood-pigeons. There does not seem at first sight any intersection of the two lives; but squirrels, though largely vegetarian, cannot resist killing and eating the young squabs in the nest; and this is, from the farmer's point of view, a useful check.

The introduction of an animal into a new country may involve the introduction of its parasites; thus rats harbour rat-fleas which disseminate bubonic plague, and it is from rats that pigs, and thence men, become infected with the disease of trichinosis, which is due to *Trichinella spiralis*, a small Nematode. Many of these inter-relations are very subtle; thus the problem of getting rid of Bilharziasis in Durban is easier than it is in Japan, for in South Africa the only host of the adult parasite is man, whereas in Japan it also occurs in cattle. In both countries the juvenile stages are spent in various water-snails, and their abundance or rarity in turn is correlated with the presence of water-birds which feed upon them and of water-plants on which they feed.

The Case of New Zealand.—The peculiar value of New Zealand in reference to the problems of naturalization is that the introduction of the majority of the non-indigenous larger animals is more or less definitely known; *see* G. M. Thomson's masterly study: *The Naturalization of Animals and Plants in New Zealand* (Cambridge, 1922).

Apart from two species of bats, it is doubtful if there are any indigenous mammals in New Zealand; but 48 species have been introduced, 44 purposely and four accidentally. The four comprise the mouse and three rats, one of which, the Maori rat (*Mus exulans*), has disappeared since European settlement began. Twenty-five of the 48 species of mammals are at present well-established and feral in certain districts—wallaby, common opossum, sooty opossum, pig, horse, various deer, cattle, sheep, goats, chamois, cat, ferret, stoat, weasel, black rat, brown rat, mouse, rabbit, hare and hedgehog.

About 130 species of birds have been purposely introduced into New Zealand since the date of Captain Cook's landing, and 24 have become truly wild, such as mallard, pheasant, pigeon, skylark, thrush, blackbird, hedge sparrow, rook, starling, Indian mynah, house sparrow, chaffinch, goldfinch, greenfinch and yellow-hammer.

On the other hand, since 1868, nine species of birds have become either very rare or extinct, such as native crows, huia, native thrushes, the burrowing parrot *Stringops*, the native quail, and the white heron. Others, once abundant, have been driven back into areas where there has not been much settlement. As to the causes, Thomson writes: "It must not be supposed that it is the introduced animals alone which have produced this effect, even though rats, cats, rabbits, pigs, cattle, stoats and weasels, as well perhaps as some kinds of introduced birds, have penetrated beyond the settled districts. It is largely the direct disturbance of their haunts and breeding-places, and the interference with their food supply, which has caused this destruction and diminution of the native fauna."

What is true for birds holds also for lower animals, from lizards to insects; but again the reasons are to be found in human intervention rather than in direct competition with newcomers. This is corroborated by the fact that there have been some notable cases of increase during the last 50 years. Thus the bell-bird has become abundant in the South island, though scarce in the North; and the harrier has greatly increased, perhaps in relation to the abundance of young rabbits. The wax-eye or blight bird (*Zosterops coeruleus*) has apparently increased greatly since first recorded in 1832, perhaps in relation to the supply of animal food about houses and stockyards. The case of the long-tailed cuckoo (*Urodynamis taitensis*) is interesting as an illustration of the complexity of inter-relations. It seems to have become increasingly numerous during the past 30 years, and this is attributed to the increase of small European birds, whose eggs and young it eats, and also to the food afforded in and about trout-hatcheries

The Case of Scotland.—Analogous to G. M. Thomson's study of New Zealand is Dr. James Ritchie's *Influence of Man on Animal Life in Scotland* (1920). Both are books of distinction In ancient times—long before the ice ages and long before man reached Scotland—the British area was simply an outlying part of

the European continent, and must have shared its fauna. But of this original European fauna there are almost no British remains. There set in a succession of ice ages, interrupted by milder interglacial periods. Vast ice-sheets, sometimes 3,000 feet thick, covered the whole of Scotland and most of England, except an area along what is now the south coast. Almost all the old animal tenants of Scotland were eliminated. When the ice-sheets melted, there was a repeopling of Britain from the Continent, for there were grassy lowlands stretching across parts of the present North Sea. The repeopling brought back many mammals, lower animals and flowering plants. Some subsequent surface-movement led to complete insulation, shutting the door to further colonization as far as the larger land animals are concerned Small creatures are, of course, readily introduced on the feet of birds.

Except for some indications, not yet fully worked out, in Inchnadamph caves in Sutherlandshire, there is no evidence of Palaeolithic man in Scotland, though he lived in Britain farther south; the first-comers to Scotland, perhaps 8,000 years ago, were Neolithic. What higher animals greeted Neolithic man when he arrived in Scotland? The answer is: the present mammalian fauna, minus some that have been introduced later, such as rabbits, rats, and domestic mammals, and plus some that have been lost, such as reindeer, bear, and wolf. As regards their origin, the original Scottish mammals, present when man established himself, might be grouped in three contingents: (*a*) those distinctively arctic, like the reindeer and the lemming; (*b*) those of the forests, like the red deer and the elk; and (*c*) those of the plains like the hare and the wild horse.

Reindeer, probably of the woodland or caribou variety, persisted as wild animals in the north of Scotland until the 12th century Beside the reindeer may be included the giant fallow deer (Irish elk) and the true elk, the former extinct, the latter no longer represented in Britain. The red deer and the roe deer are persistent representatives of the old fauna; the fallow deer is a subsequent introduction.

Appearing first in inter-glacial deposits, but lasting for many centuries along with man, was the wild ox or urus (*Bos primigenius*), once widespread in Europe Man did not domesticate it in Scotland, but it may have crossed with the Celtic shorthorn (*Bos taurus longifrons*) which he brought with him when he came. The wild boar (*Sus scrofa*), on the other hand, was one of the early Scottish mammals, doubtless spreading from the forests of central Europe, and it was domesticated in Scotland as elsewhere. There were wild horses in Scotland before man arrived—the Celtic pony type (*Equus agilis*), common long ago in western Europe; and traces of these linger in the Hebridean pony and the Shetland pony. But the main stock of domesticated horses probably came in the train of the Neolithic herdsmen from the continent, notably perhaps from Scandinavia.

As to the larger carnivores, the wolf lingered in Scotland till the 17th century, even to 1743, according to some. Its disappearance was especially connected with the shrinkage of the forests, and with more determined wolf-hunting, which was compulsory as late as the 15th century. The brown bear lingered in Scotland into the Christian era, and with it the lynx.

Of the original small carnivores there is a persistence of fox, badger, otter, polecat, stoat, weasel, wild cat and marten. The last is dwindling to the vanishing point; the wild cat is rare, but of recent years notably on the increase Seals continue to hold their own, but the walrus, which used often to visit Scottish coasts, has been persecuted into extreme rarity. Most cetaceans, except porpoises, become scarcer every year.

Among rodents, the beaver and the lemming have disappeared; the common hare and the mountain hare have increased, partly through preservation and partly because of greater abundance of food afforded by the spread of agriculture. The rabbit is an instance of naturalization, for it was unknown in Britain before the Norman conquest. Both the black rat and the brown rat are aliens, the former dating from the time of the Crusaders and the second from about the middle of the 18th century. The small native rodents, the voles and mice, hold their own, and so do the insectivores—the hedgehog, the mole and the shrews.

Taking a general survey, we see that there has been in Scotland an introduction of domesticated sheep, cattle, horses, fallow deer, dog, cat, poultry, pheasants and a few more. The wild rabbits were probably introduced deliberately, the rats unwittingly. Since man settled in Scotland the fauna has lost about 14 species of mammals and birds, and while Ritchie points out that the total number of species is actually greater, the standard is lower. The noble has been exchanged for the ignoble—the elk for the earthworm; the visible has been exchanged for the invisible—the beaver for the bug!

The case of Scotland is instructive since the area is small and the fauna well-known, and Dr. Ritchie's careful study shows the complexity of the factors that are often involved in faunistic change. Besides the alterations in climate, there are those involved in deforestation, drainage, the extension of arable land, and the reduction of wild corners. Much has depended on man's attitude to the wild life of the country, for he sometimes preserves and sometimes exterminates. The introduction of new types has, no doubt, its influence on those in possession, but this is often far from being a case of sheer competition.

Where man plays a large part two main processes may be recognized. On the one hand, there is a diminution in the number of larger, more highly evolved types, partly because they are apt to be dangerous to human life or destructive of stock and crops, partly because of fashion and a pride in trophies, but partly as the result of slow processes such as deforestation and the spread of agriculture. On the other hand, "while man lops off giants at the head of the scale he adds insignificant pigmies at the bottom," partly by carelessness, as in the case of rats and cockroaches, partly by thoughtlessness, as in the case of rabbits in Australia or sparrows in the United States.

Method of Naturalization.—What should man do when he wishes to naturalize a valuable plant or animal in a new and markedly different country? If trial has shown that naturalization is not easy, the transporter should work with those varieties which seem most likely to be suitable. Attention should also be paid to the quality of variability, for some stocks are much more fixed than others. It may be useful to transport individuals of the most promising stocks to some intermediate station, where selection may be made among the variations that continue to arise Darwin noted that "Merino sheep bred at the Cape of Good Hope have been found far better adapted for India than those imported from England." (*Variation*, 1868, p. 305.) In cases where success in the new country seems to depend on the possession of a particular character, such as thick fur or woolly leaves, the variants selected would be those tending most markedly in that direction, but Mendelian methods might enable the breeder to "graft" on to the tentative imports the desirable character in question if it existed elsewhere in an allied race. By more systematic selection of heritable variations and by Mendelian hybridizing, it seems likely that the process of acclimatization might be greatly extended and hastened.

Willis notes that man has often failed in naturalization by attempting too much abruptly. Learning from failure, he is now trying gradual transitions, "as in the way he has treated Liberian coffee in Java, taking the seed of successive generations a few score yards higher up each time, till he has persuaded the tree to do well at a much higher elevation than that to which it is naturally suited." The attempts to acclimatize the beautiful *Cyperus papyrus* in the Ceylon Botanic Garden failed when seed from Europe was used, but seed from Saharanpur in India succeeded at once. The moral is that man must moderate his impatience and take a hint at least from Nature's operations by small steps throughout long periods.

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(J. A. TH.)

ACCOLADE, a ceremony used in conferring knighthood; but whether it was an embrace (according to the use of the modern French word *accolade*), or a slight blow on neck or cheek, is not agreed. Gregory of Tours writes that the early kings of France kissed the knights on the left cheek; and William the Conqueror is said to have made use of the blow in conferring knighthood on his son Henry. At first it was given with the fist, but for this was substituted a gentle stroke with the flat of the sword on the side of the neck, or on either shoulder. In Great Britain the sovereign still employs this latter form. "Accolade" is also a technical term in music-printing for a sort of brace joining separate staves; and in architecture it denotes a form of decoration on doors and windows.

ACCOLTI, BENEDETTO (1415–1466), Italian jurist and historian, was born at Arezzo, in Tuscany. He was for some time professor of jurisprudence in the University of Florence, and in 1459 became chancellor of the Florentine Republic. In conjunction with his brother Leonardo he wrote in Latin a history of the first crusade, entitled *De Bello a Christianis contra Barbaros gesto pro Christi Sepulchro et Judaea recuperandis libri tres* (Venice, 1432; Italian trans., 1543; French trans., 1620), which, though itself of little interest, is said to have furnished Tasso with the historic basis for his *Jerusalem Delivered.* His brother FRANCESCO (1418–1483) was also a distinguished jurist.

ACCOLTI, BERNARDO (1465–1536), Italian poet, born at Arezzo, was the son of Benedetto Accolti. Known in his own day as *l'Unico Aretino,* he acquired great fame as a reciter of impromptu verse. He was listened to by large crowds, composed of the most learned men and the most distinguished prelates of the age. His works, under the title *Virginia, Comedia Capitoli e Strambotti di Messer Bernardo Accolti Aretino,* were published at Florence in 1513 and have been several times reprinted.

His brother, PIETRO ACCOLTI (1455–1532), was made cardinal by Julius II. He was abbreviator under Leo X., and drew up in 1520 the bull against Luther. In 1524 he became archbishop of Ravenna. Pietro's nephew, BENEDETTO (1497–1549), was also a cardinal, under Clement VII., and a writer of Latin verse.

ACCOMMODATION, in theology has two chief meanings. (1) It is used to describe the method of adapting the presentation of truth to the learners' capacity. In a sense all revelation of God must be "accommodated" to man: the naked revelation would be so dazzling as to blind him. When Jesus withheld certain truths from the disciples because they could not yet bear them (John xvi. 12) he was practising accommodation. Teaching by symbol or parable, too, is accommodation. (2) When words used with a definite reference to one subject are applied to another subject we have accommodation in a more special sense. Thus Matthew ii. 15 states that Jesus was taken to Egypt that the word of the prophet, "Out of Egypt did I call my son," might be fulfilled: but the prophecy quoted, Hosea xi. 1, quite clearly means Israel by "my son."

In biology accommodation is used to describe adjustments achieved by an individual organism over and above those which it makes as part of its inheritance. In psychology it means "the process by which habit is modified, cancelled and added to" (J. M. Baldwin). For accommodation in optics *see* OPTICS.

ACCOMMODATION BILL. An accommodation bill, as its name implies, is a bill of exchange (*q.v.*) accepted and sometimes endorsed without any receipt of value in order to afford temporary pecuniary aid to the person accommodated.

ACCOMPANIMENT, a musical term for that part of a vocal or instrumental composition added to support and heighten the principal vocal or instrumental part; either by means of other vocal parts, single instruments or the orchestra. Owing to the early custom of only writing the accompaniment in outline, by means of a "figured bass," to be filled in by the performer, and to the changes in the number, quality and types of the instruments of the orchestra, "additional" accompaniments have been written for the works of some of the older masters; such are Mozart's "additional" accompaniments to Handel's *Messiah* (*see* article on HANDEL). In the case of songs an accompaniment may consist merely of a few chords of the simplest kind or take the most elaborate form and constitute the most striking feature of the composition. In the latter case the performance of such accompaniments calls for the highest skill and constitutes a distinctive branch of the pianist's art, demanding the amplest powers of execution and first-class musicianship, especially when the player is called upon, as sometimes happens, to transpose a difficult accompaniment at sight for the convenience of the singer. Accompanying is also an important branch of conducting, in the case of concertos, choral music, and so forth.

ACCOMPLICE, in law, one who is associated with another or others in the commission of a crime, whether as principal, abettor, or accessory (*q.v.*). Although the uncorroborated evidence of an accomplice is admissible in law, and may be acted upon by a jury, it is the duty of the judge to warn the jury that it is always dangerous to convict on such evidence, and he should advise them not to convict (*R.* v. *Baskerville,* 25 Cox. C.C. 524).

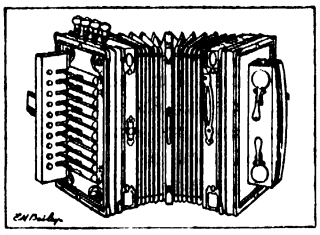
ACCORAMBONI, VITTORIA (1557–1585), an Italian lady famous for her great beauty and accomplishments and for her tragic history. She was born in Rome of a family belonging to the minor *noblesse* of Gubbio, which migrated to Rome. After refusing several offers of marriage for Vittoria, her father betrothed her to Francesco Peretti (1573), a nephew of Cardinal Montalto, who was regarded as likely to become pope. Vittoria was admired by the most brilliant men in Rome, and being luxurious and extravagant she and her husband were soon plunged in debt. Among her admirers was P. G. Orsini, duke of Bracciano, and her brother Marcello, wishing to see her the duke's wife, had Peretti murdered (1581). The duke himself was suspected of complicity as he was believed to have murdered his first wife Isabella de' Medici. They were married shortly after. But attempts were made to annul the marriage; Vittoria was imprisoned, and only liberated through the interference of Cardinal Carlo Borromeo. On the death of Gregory XIII., Cardinal Montalto, her first husband's uncle, was elected in his place as Sixtus V. (1585); he vowed vengeance on the duke of Bracciano and on Vittoria, who, warned in time, fled first to Venice and thence to Salò in Venetian territory. Here the duke died in Nov. 1585, bequeathing all his personal property to his widow. Vittoria, overwhelmed with grief, went to live in retirement at Padua, where she was followed by Lodovico Orsini, a relation of her late husband and a servant of the Venetian republic, to arrange amicably for the division of the property. But Lodovico hired a band of bravos and had Vittoria assassinated (Dec. 22, 1585). He himself and nearly all his accomplices were afterwards put to death by order of the republic.

About Vittoria Accoramboni much has been written and she has been greatly maligned by some biographers. Her story formed the basis of Webster's tragedy, *The White Devil* (1612), and of Ludwig Tieck's novel *Vittoria Accoramboni* (1840); it is told in D Gnoli's vol. *Vittoria Accoramboni* (Florence, 1870), and an excellent sketch of her life is given in Countess E. Martinengo-Cesaresco's *Lombard Studies* (London 1902).

ACCORD, in law, an agreement between two parties, one of whom has a right of action against the other, to give and accept in substitution for such right any good legal consideration. Such an agreement when executed discharges the cause of action and is called *Accord and Satisfaction.* This specific form of pleading is obsolete in England.

ACCORDION, a small portable reed wind instrument with keyboard, one of the smallest members of the organ family, invented in 1829 by Damian, in Vienna. It consists of a bellows of many folds, to which is attached a keyboard with from five to 50 keys. The keys on being depressed, while the bellows are being worked, open valves admitting the wind to free reeds, the pitch of the note being determined by the length and thickness of the reeds. The right hand plays the melody on the keyboard, while the left works the bellows and manipulates the two or three bass harmony keys, which sound the simple chords of the tonic and

dominant. The archetype of the accordion is the cheng (*q.v.*) or Chinese organ, between which and the harmonium it forms a connecting link structurally. Improvements in the construction of the accordion produced the concertina (*q.v.*), melodion and melophone.



THE ACCORDION, ONE OF THE SMALLEST MEMBERS OF THE ORGAN FAMILY, WAS INVENTED BY DAMIAN, A VIENNESE, IN 1829

ACCORSO (ACCURSIUS), **MARIANGELO** (*c.* 1490–1544), Italian critic, was born at Aquila in the kingdom of Naples. He was a great favourite with Charles V., at whose court he resided for 33 years, and by whom he was employed on various foreign missions. He was the first editor of the *Letters of Cassiodorus*, with his *Treatise on the Soul* (1538); and his edition of *Ammianus Marcellinus* (1533) contains five books more than any former one. The affected use of antiquated terms, introduced by some of the Latin writers of that age, is humorously ridiculed by him, in a dialogue in which an Oscan, a Volscian and a Roman are introduced as interlocutors (1531).

ACCOUNT, a term of very various use in book-keeping, banking and stock exchange terminology (*see* BANKING AND CREDIT) indicating counting, reckoning, especially of moneys paid and received, hence a statement made as to the receipt and payment of moneys. The following are some of its chief usages:—

Balanced account, an account in which the total debits equal the total credits and which has been ruled off to indicate that fact.

Balancing account, an account contained in a subsidiary ledger which shows in aggregate and also in reverse, as to debit and credit, the total of the detail accounts. The use of such an account makes a ledger self-balancing. The information contained in a balancing account is essentially that found in a *controlling account* although the debits and credits appear in reversed order in the *balancing account.*

Closed account, same as balanced account (*q.v.*).

Contra account, an account of contrary tendency which must be considered with another account because of an interlocking relationship. For example, a customer of a business may also be a creditor. If the amount he owes as a customer is less than the amount that is due him as a creditor, the business may remit a check for the net amount. The term used in referring to the amount due from the customer in this case is *contra account.*

Controlling account, an account in the general ledger which reflects in aggregate the details of two or more accounts of the same tendency. Ordinarily the underlying accounts are operated in a subsidiary ledger.

Impersonal account, an account which is not a *personal account* (*q.v.*). Any expense or income account is an impersonal account.

Mixed account, an account containing two or more separate classes of transactions. The "merchandise account," for example, contains a record of purchases, sales, purchase returns, purchase allowances, sales returns, sales allowances, freight and cartage, etc. In modern accounting, a separate account called a *simple account* is maintained for each class of transactions.

Nominal account, an account which reflects a change in the financial condition of a business. Thus, it is an account which finally finds its way into the profit and loss account; *e.g.,* sales, purchases, interest, discount, salaries, wages, commission and advertising expense. All of the accounts appearing in a statement of income, and profit and loss, are *nominal accounts.*

Open account, an account which is not in balance, *i.e.,* an account containing a debit or a credit excess; opposite of *closed account.*

Personal account, an account operated under the name of an individual, an organization or a business enterprise.

Private account, an account maintained in a Private Ledger (*q.v.*). Information of a confidential nature which must be shown on the accounting records can best be treated in the private set of accounts.

Real account, an account used in displaying the financial status of a business. All accounts used in a "balance sheet" are real accounts; thus they represent assets, liabilities and capital.

Simple account, an account containing entries relating to a single class of transactions; opposite of mixed account. Sales returns, purchase allowances, interest on notes receivable and administrative salaries are *simple accounts.* (*See* ACCOUNTING, BOOK-KEEPING.)

As a stock exchange term, "account" is used in several senses:—

(1) The periodical settlements occurring, in London, monthly for British Government and a few other first-class securities, and fortnightly for all others.

(2) The period between two settlements. A 19-day account is one in which 19 days elapse between one pay day and another.

(3) The volume or condition of commitments. A speculator is said to have a large account open when he has dealt heavily either for the rise or fall.

An account is also any statement as to acts or conduct, or quite simply any narrative report of events, etc. A further sense-development is that of esteem, consideration. (G. L. C.)

ACCOUNTANCY AND ACCOUNTANTS. Originally, accountancy was the same thing as account-keeping or bookkeeping, and "accountant" and "bookkeeper" were interchangeable terms, but an increasing recognition of the importance of accounting in the development of modern business methods has led here, as elsewhere, to the division of labour. In the early days of navigation it was doubtless reasonable to assume that the man who navigated a canoe was in all probability also the man who designed and constructed it: to-day, the distinctions between the engineer officer, the naval architect and the shipbuilder are clearly defined and well recognized. Much the same process of evolution has been going on in the accountancy world, and although the distinction may not yet be universally accepted, it may be stated that, whereas the bookkeeper is the person who keeps the books or accounting records of an undertaking, the accountant is rather the person who decides how such records ought to be kept. The term accountancy is now generally applied to all the work that falls to the lot of the accountant, although under modern conditions (as is shown later on) that work is now exceedingly varied and often extends far beyond the region of accounts.

Early History.—Very little is known of the origin of accountancy as a profession. In the modern acceptation of the word, however, a professional man is one who places his skill and learning at the disposal of all and sundry for a reward, as distinct from one who serves a single employer. Accordingly, while there are several references in mediaeval and even classic times to stewards and auditors, these references do not throw much light upon the origin of professional accountancy, as the persons referred to were manifestly in the whole-time employment of a single individual or body. The first association of accountants of which there is any record is the *Collegio dei Raxonati,* which was founded in Venice in 1581, but it is by no means certain that the members of this body were professional or public accountants, or whether they were not rather employees of public bodies. At Milan, however, in 1742, the Government established a scale of charges for accountants, so it may be assumed that then, if not earlier, professional accountancy (as here defined) actually existed in that city. It has been said that the first Scottish professional accountant was one George Watson, born in Edinburgh in 1645; but whether he was really able to carry on a practice as a professional accountant in addition to his "large private banking business" seems somewhat doubtful. Holden's *Triennial Directory of London, Westminster and Southwark* was first published in 1799, and contains the names of 11 accountants. The *British Universal Directory,* published in 1790, had given the names of five accountants only. It seems clear, therefore, that there was very little professional accountancy in London before the 19th century, and in the issue of *Holden* for 1822 the number of practising accountants had only risen to 73. Indeed, little progress was made by professional accountancy in Great Britain, or elsewhere, until the middle of the 19th century, when (so far at least as Great Britain is concerned) it received a great impetus from

the growth of limited liability companies, and a little later from the Bankruptcy Act, 1869, which to a very large extent withdrew the administration of insolvent estates from the hands of public officials. The advent of the limited liability company led to business operations being undertaken upon a scale which had formerly not been thought of. The proper control of these large scale operations naturally called for better accounting systems than had formerly been deemed adequate.

Organization.—The first step in the direction of organizing professional accountancy in Great Britain was taken when the *Society of Accountants* in Edinburgh was incorporated by Royal Charter in 1854. Similar societies in Glasgow and Aberdeen were also incorporated by Royal Charter in 1855 and 1867 respectively. Each of these bodies, however, had assigned to it definite geographical limitations, although the individual members of all three may, and do, practise in various parts of the world. The *Institute of Accountants* was formed in London in 1870, was incorporated by Royal Charter in 1880 as *The Institute of Chartered Accountants in England and Wales,* provision at the same time being made for all accountants then practising in England or Wales to become members. *The Society of Incorporated Accountants and Auditors* was registered under the Companies Act in 1885. (Special articles on the two last-named bodies appear elsewhere.) *The Institute of Chartered Accountants in Ireland* was incorporated in 1888.

Accountancy Elsewhere.—But little development has as yet taken place on the continent of Europe as regards professional accountancy, but professional bodies have existed in Holland, Sweden and Belgium since 1895, 1899 and 1903 respectively. Most British colonies have one or more professional bodies of their own.

Duties.—It has been stated that originally accountants were bookkeepers. Hence, naturally, as soon as the necessity or desirability of checking, criticizing or auditing the records of accounting parties was appreciated, skilled accountants whose probity could be relied upon would naturally be selected for the work. In the first instance, accordingly, professional accountants were in the main auditors of other people's accounts. Where the auditing was not a whole-time job there were obvious economies in securing the services of a professional accountant, while the fact that he was a professional accountant ensured his independence. As, however, the centre of gravity tended to shift in Great Britain from agriculture to industry, the professional accountant found thrust upon him an ever-enlarging sphere of activities over and above his primary function as an expert in accounts. In addition to the audit of the accounts of companies, institutions and private concerns, professional accountants are frequently called upon to design systems of accounting for new or growing concerns; to assist in the establishment of an adequate system of cost accounts; to prepare business statistics; to investigate accounts in connection with partnership changes, the amalgamation of business interests, or the flotation of companies formed to acquire established businesses; to deal with compensation cases on the compulsory purchase of businesses by railway companies or public bodies; to give expert evidence on matters relating to accounts; to prepare accounts for the use of counsel in both civil and criminal proceedings; and to act as arbitrators, umpires or referees in differences relating to matters of accounts or finance. They also very frequently act as secretaries of companies whose operations are not upon a sufficiently large scale to justify a whole-time appointment, and the accounts of executors and trustees under wills and settlements are often kept by professional accountants. In addition, professional accountants act as trustees in bankruptcy; trustees under deeds of arrangement; liquidators of companies; receivers for debenture holders; and managers of businesses where a receiver is in possession of the assets.

Mode of Entering the Profession.—Anyone desirous of becoming an English chartered accountant must first serve under articles with a practising member for five years, or three years in the case of graduates. A premium of from 150 to 500 guineas is usually required. Before signing articles, the pupil must have passed the preliminary examination of the Institute, or some accepted equivalent of matriculation standard. After half the period of articles has expired, the pupil may submit himself for his intermediate examination in general commercial knowledge, bookkeeping and accounts and auditing; on the termination of his articles, before admission as a member, he must pass his final examination in advanced bookkeeping and accountancy (including costing and taxation); auditing; partnership and executorship law and accounts (including the rights and duties of executors, trustees and receivers); bankruptcy and company law; the principles of mercantile law and the law of arbitrations and awards; and either (*a*) economics, (*b*) banking, currency and foreign exchanges or (*c*) actuarial science. The standard set is a high one, and real ability, as well as hard work, is necessary to secure a pass.

The regulations of Scottish chartered accountants as to admission, etc., are upon similar lines, there being a general examining board which deals with candidates articled to members of all three bodies. In Scotland as a rule no premium is charged, but no salary is paid during the period of articles The Institute of Chartered Accountants in Ireland also has similar regulations. The regulations for admission to the Society of Incorporated Accountants and Auditors are also upon somewhat similar lines, save that candidates may be articled to members who are not in public practice, and therefore not able to give them the same opportunities of acquiring a general experience in accountancy. The premium is usually lower than that charged by English chartered accountants.

Statutory Regulations.—In New Zealand and South Africa there are statutory registers of public accountants, and only those upon the register are permitted to undertake certain specified accountancy duties. The registration of professional accountants has been mooted at various times from 1889 onwards, but opinions are so divided as to its desirability that statutory registration in Great Britain seems as far off as ever.

BIBLIOGRAPHY.—Richard Brown, *A History of Accounting and Accounts* (1905); A. H. Woolf, *A Short History of Accountants and Accounts* (1912); L R. Dicksee, *The Fundamentals of Accountancy* (1921); *The Accountant,* vol. i. (1877); *The Accountants' Journal,* vol. i. (1883); *The Accountants' Magazine,* vol. i. (1897); *Incorporated Accountants' Journal,* vol. i. (1889). (L. R. D.)

United States.—Accountancy, in the United States, is among the newer professions. In the short time of its existence it has not acquired the traditions which characterize such of the older professions as law, medicine and theology. The first formal recognition was given to accountancy in the laws of New York State in April 1896. Since that time all of the States have officially recognized the public accountant by creating the title, certified public accountant (C.P A.), such title to be granted or awarded to applicants who satisfy the requirements regarding character, education and professional skill of the State in which recognition is sought. While there is still a lack of uniformity among the several States in the matter of requirements, there is a constant tendency toward greater strictness as laws are modified and new legislation enacted.

As indicative of the requirements imposed by State laws, the following summary sets forth the standard maintained by New York State: (*a*) an applicant for the certificate of certified public accountant must submit evidence that he is over 21 years of age and of good moral character; (*b*) he must present evidence of the successful completion of four years' work in an approved secondary school, including among his subjects those specified by the State department of education; (*c*) he must submit evidence of five years' experience in accountancy, at least two of which must have been in the office of a certified public accountant and of no less grade than that of junior accountant; such two years' accounting experience must have been in the office of a certified public accountant in this State or in the office of one residing in another State holding a certificate from such State granted on no lower requirement than that of this State, and he must submit evidence of three years' experience attained prior to his admission to the C.P.A. examination; (*d*) he must take professional examinations conducted by the State department of education in the following subjects: theory of accounts, auditing,

practical accounting and commercial law The passing grade in each subject is 75%. A candidate who fails in one subject only may take a subsequent examination in that subject to be given within two years from the date of the examination at which he passed the other three subjects.

In the United States, as in other countries, a high standard of professional ethics is fostered. The accountant acting as custodian of his client's interests must safeguard them in every legitimate way. His service to the client carries with it a strict responsibility to the client which cannot be divided or escaped. Confidences of the client must be held inviolable. The acceptance of contingent fees is frowned upon by members of the profession. As an obligation to the client, the accountant must keep himself informed on current developments in the profession.

Education for accountancy, in the United States, was formally provided for as early as 1881. In that year the Wharton School of Finance and Economy of the University of Pennsylvania was established. In 1898 the University of Chicago opened its College of Commerce and Politics (later known as the School of Commerce and Administration), and the University of California its College of Commerce. Two years later there were established at New York university the School of Commerce, Accounts and Finance; at Dartmouth college the Amos Tuck School of Administration and Finance; and at the University of Vermont, a department of economics and commerce. In the first quarter of the new century business education developed throughout the entire country so that at the opening of the year 1925 about 183 American colleges and universities provided instruction in business. In practically all of these schools, education for accountancy has dominated the business curricula.

See H. R. Hatfield, *Accounting, Its Principles and Problems* (1927); T. A. Budd, *The Interpretation of Accounts* (1927); and H. C Greer, *How to Understand Accounting* (1928). (J. T. MA.)

ACCOUNTANT-GENERAL, a former official of the court of chancery, whose duties have been transferred to the paymaster-general (*q.v.*).

ACCOUNTANTS' SOCIETIES. British law does not in general compel the registration of accountants, but only chartered or incorporated accountants may audit the accounts of municipal corporations, and only accountants who are members of some professional body legally incorporated may appear for clients before the income tax authorities. Usually, however, local authorities and the great British trading bodies employ none but members of the great professional accountants' societies.

The Institute of Chartered Accountants of England and Wales was incorporated by royal charter in 1880, and in 1927 had 7,659 members, of whom all but 3% had qualified by serving under articles and passing examinations Fellows use the abbreviation "F.C A."; Associates "A.C A." The institute has a fine headquarters in Moorgate place, London.

The Society of Incorporated Accountants and Auditors was incorporated in 1885, and in 1927 had over 5,000 members. Its members consist of fellows (F S A A.) and associates (A S A A) The head office is in Gresham street, London.

Other accountant's societies in the United Kingdom include the Corporation of Accountants, the London Association of Accountants, and the Central Association of Accountants. There are also the chartered institutes of Edinburgh, Glasgow and Aberdeen, and two Irish societies. Scotland led the way, for the Society of Accountants in Edinburgh was formed in 1854.

In each State, a society of certified public accountants (*q.v.*) operates. In addition to the various state societies, there are several important national organizations. The American Society of Certified Public Accountants, and the American Institute of Accountants are comprised of professional accountants. The National Association of Cost Accountants is composed of professional accountants and others whose interests lie in the cost phases of accounting. For information regarding American professional requirements, *see* ACCOUNTANCY.

The growing complexities of industry, trade and taxation throughout the world have given great importance to the societies, which maintain the standard of the accountants' profession.

ACCOUNT CURRENT, a running account which is likely to extend over an interminable period and which, if balanced, is usually opened again immediately; *e. g.*, a holding company which markets merchandise may have an account current with a subsidiary company which manufactures a product. The entire output of the factory may be turned over to the holding company and periodic charges made for merchandise thus transferred. The holding company may make advances from time to time to cover values received. Thus the account may not be in balance for a considerable time although an accurate statement of debits and credits will always be available in the account current. Merchants who sell on consignment frequently maintain accounts current with their consignees. An account current differs from the usual trade account in that the latter is usually settled at regular intervals, monthly, seasonally or otherwise. (G. L. C.)

ACCOUNT RENDERED, an expression used in referring to an account a statement of which has already been delivered to the customer. In business it is customary, for the purpose of verification, to send to each customer whose account is not in balance a statement showing the debits (charges) and credits for the current period (usually one month). If this balance is not liquidated before the end of the following period, the next statement of account has as its first entry "Account rendered" or "To account rendered" and the unpaid balance is shown. Thus an economy of time results because it becomes unnecessary to include all items arising since the account was last in balance. (G L. C.)

ACCOUNT SALES, a financial statement rendered by a merchant who has received goods on consignment showing sales, charges (usually commission and guaranty), and a net amount either credited to consignor's account or remitted by cheque. This form of financial statement is used extensively by commission merchants and factors and serves the consignor or principal as a basis for accounting.

ACCOUNT SALES
of merchandise received from
A. B. BLANK
to be sold for his account and risk
RENDERED BY BLACK AND WHITE, 27 WASHINGTON ST.,
NEW YORK CITY, *April 15, 19—*

19—			
April 4	Received:		
	Lot No. 3		$1,200.00
	SALES		
April 8	Lot No. 3 .		1,450.00
	CHARGES		
	Freight and cartage .	$37.50	
	Commission 5% .	72 50	110.00
E &O.E.	Net proceeds by cheque enclosed		$1,340.00

(G L. C)

ACCOUNTS PAYABLE, in accounting terminology, amounts owed by a business to its creditors and not evidenced by notes, bonds, acceptances or other recognition. Loans from officers or partners of an enterprise should be considered as loans payable rather than accounts payable; creditors accounts with debit balances should be listed as other accounts receivable rather than as a deduction from accounts payable. In its broader sense, the term includes amounts received in advance for merchandise that has not been shipped, rentals received in advance, etc.

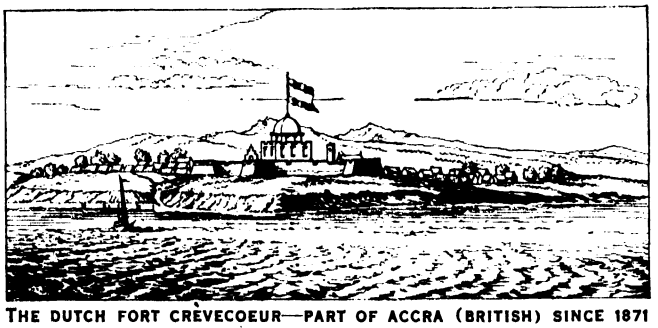
ACCOUNTS PAYABLE LEDGER, a subsidiary ledger containing the accounts of creditors. It is a device used to facilitate the book-keeping of a business enterprise. The operation of this type of ledger makes possible a division of labour in an accounting department; the work of posting to creditors' accounts can be carried on independently of the work on customers' accounts and general ledger accounts. The sum of the account balances in the accounts payable ledger should agree with the balance of accounts payable controlling account (*q.v.*) as shown in the general ledger. (*See* BOOK-KEEPING.) (G. L. C.)

ACCOUNTS RECEIVABLE, in accounting terminology, amounts due to a business by its trade debtors for merchandise sold to them, or for services rendered, on a credit basis. It should be noted that only obligations arising from trade transactions should be included. Loans to officers of a company should be considered as loans receivable rather than accounts receivable; creditors' accounts with debit balances should be considered as an offset against accounts payable rather than accounts receivable. In the preparation of a balance sheet, this term, without qualification, may be assumed to represent items which can be collected within a period usual to the trade or industry of which the business is a part. In its broader sense, the term includes all unsettled claims against debtors which are not represented in the form of promissory notes or trade acceptances. (G. L. C.)

ACCOUNTS RECEIVABLE LEDGER, a subsidiary ledger containing the accounts of customers. In a business organization which sells on credit to many customers, it is impracticable to keep customers' accounts in the general ledger. The necessity of having several clerks posting the accounts at the same time makes a segregation imperative. An additional advantage lies in the greater ease with which errors can be localized. In a small business with a limited number of accounts, one accounts receivable ledger will suffice; in a larger business involving many thousands of accounts, 15 or 20 customers' ledgers may be required. The grouping of accounts is usually arranged on an alphabetical basis; *e.g.*, if two such ledgers are used, one would contain accounts of customers whose names start with letters from A–K, and the other, L–Z. Sometimes the grouping is arranged on a territorial basis; *e.g.*, a separate ledger might be kept for the customers served by each branch office of a business, in which case the names would be arranged alphabetically in each ledger. The accounts receivable ledger is kept in agreement with the general ledger by means of controlling account (*q.v.*); the total of the balances of customers' accounts should agree with the balance in the controlling account. Ordinarily, a separate controlling account is kept for each accounts receivable ledger. (*See* BOOKKEEPING.) (G. L. C.)

ACCOUTREMENT (a French word, probably derived from *à* and *coustre* or *coutre*, an old word meaning one who has charge of the vestments in a church), clothing; apparel; a term used especially, in the plural, of the military equipment of a soldier other than his arms and clothing.

ACCRA, a port on the Gulf of Guinea in 5° 31′ N., 0° 12′ W., since 1876 capital of the British Gold Coast colony. Population



THE DUTCH FORT CRÈVECOEUR—PART OF ACCRA (BRITISH) SINCE 1871—FROM AN ENGRAVING MADE IN 1746. ACCRA BECAME THE CAPITAL OF THE GOLD COAST COLONY IN 1876

(1927) about 40,000. The name is derived from the Fanti word *Nkran* (an ant), by which designation the tribe inhabiting the district was formerly known. The town grew up around three forts established in close proximity—James (British, named after James II.), Crèvecoeur (Dutch) and Christiansborg (Danish). The last-named was ceded to Britain in 1850, Crèvecoeur not till 1871. Accra preserves the distinctions of James Town, Ussher Town and Christiansborg, indicative of its tripartite origin. Ussher Town represents Crèvecoeur, the fort being renamed after H. T. Ussher, administrator of the Gold Coast (1867–72). Christiansborg, the finest of the three forts, is the official residence of the governor of the colony; James Fort is a prison. Otoo street, the main thoroughfare, on which are Holy Trinity church (built 1895), banks and business premises, runs two miles in a straight line. In Victoriaborg, a suburb of Ussher Town, are the residences of the principal officials, and here a racecourse has been laid out. (Accra is almost the only point along the Gold Coast where horses thrive.) Accra has many schools and hospitals and five miles north is Achimota college (opened 1927), the chief educational establishment in the Gold Coast. Accra is connected by cable with Europe and South Africa, and is the sea terminus of a railway to Kumasi. Ships anchor about a mile off-shore and lighterage is by surf boat. There is a breakwater and jetty with wharves. Accra has a wireless telegraph station.

ACCRETION, an addition to that which already exists; increase in any substance by the addition of particles from the outside. In law, the term is used for the increase of property caused by gradual natural additions, as on the seashore or on a river bank or by the formation of a riverine island. (*See* ALLUVION.)

ACCRINGTON, municipal and parliamentary borough, Lancashire, England, 23m. N. by W. of Manchester, on the London Midland and Scottish railway. Population (1891) 38,603; (1921) 43,595. It lies in a deep valley on the Hindburn, a feeder of the Calder.

Accrington (Akerenton, Alkerington, Akerington) was granted by Henry de Lacy to Hugh, son of Leofwine, in Henry II.'s reign, but came again into the hands of the Lacys, and was given by them (*c.* 1200) to the monks of Kirkstall, who converted it into a grange. It returned to the Lacys in 1287, was granted in parcels, and like their other lands became merged in the duchy of Lancaster. In 1836 Old and New Accrington were merely straggling villages with about 5,000 inhabitants. By 1861 the population had grown to 17,688 owing to the railway junction, and it increased with the rapid development of the Lancashire coalfield. Cotton spinning and printing works, cotton-mill machinery works, dye-works, collieries and transport work employ the people. The church of St. James dates from 1763. The original chapel was probably an oratory which was an offshoot of Kirkstall Abbey. Ecclesiastically, Accrington was dependent on Altham till after the middle of the 19th century. The charter of incorporation is of 1878. The borough is under a mayor, eight aldermen and 24 councillors. Together with the urban districts of Church, Clayton-le-Moors and Oswaldtwistle, Accrington returns one member to parliament. Area of municipal borough 3,427 acres.

ACCRUED DIVIDENDS, the amount of the dividend on a stock which may be presumed to have been earned during the period between the last dividend payment and a later stipulated date. Of course such an accrual of dividend is a mere presumption since dividends are necessarily uncertain until at the end of a dividend period it has been ascertained that there is a surplus from which to pay one, and it has been duly declared. It is quite unusual to sell stock for a certain price "plus accrued dividends," although in cases of stock with dividend guaranteed (*see* GUARANTEED STOCK) or of preferred stock of companies in which the dividend is practically certain, it is sometimes done. Stocks are not sold "with accrued dividend" on organized exchanges, although it is the common custom to sell bonds "with accrued interest" (*q.v.*). The term accrued dividend must not be understood to carry intimation that dividends are in arrears (*q.v.*), that idea being conveyed by the expression "cumulated dividend" or "accumulated dividend" (*q.v.*). (*See* DIVIDEND.) (J. H. B.)

ACCRUED EXPENSES, costs which have accumulated but which have not been paid or formally entered in the accounting records. Such items ordinarily are not represented by formal claims against a business and hence are not included in accounts payable. Thus, in determining operating costs for a given period, one must consider not only the expenses which have already been entered in the accounts but also any additional expenses applicable to the period but as yet unentered. Thus compensation owed to an employee for services performed since the last date of payment, rent owed to the property owner, interest on moneys borrowed, etc., are in the nature of accrued expenses (*see* INTEREST, DIVIDENDS). (G. L. C.)

ACCRUED INCOME, revenue which has been earned but which has not been received or formally entered in the accounting records. In the preparation of a financial statement of income for a given period of time, such amounts must be considered if an accurate result is to be obtained. Thus income represented by rents on leased property must be accrued to date of statement, even though such rents are not due from tenants and will not be paid until a later date. Similarly, interest on notes receivable and on loans receivable must be calculated and applied to the accounting period in which such income is earned. (*See* INTEREST, DIVIDENDS.) (G. L. C.)

ACCRUED INTEREST, the amount of interest on a bond which has been earned over the period from the date of the last interest payment to some specified date, but which will not be paid by the issuer of the bond until the next regular interest date. Bonds are almost invariably sold at a certain price plus accrued interest. Thus if the interest dates on a certain bond are Feb. 1 and Aug. 1, and the bond is sold on May 1, the buyer will pay the seller the stipulated price plus the interest for the three months during which the seller's money has been invested in the bond, and on Aug. 1 he will receive from the issuing corporation the full six months' interest for the period from Feb. 1 to Aug. 1. Half of this interest will repay the buyer for the accrued interest which he paid to the seller, and the other half will be the interest for the three months during which his own money was invested in the bond. By specific agreement or notification bonds may be sold "flat," *i. e.*, without considering any accrued interest. Defaulted bonds and income bonds are usually sold flat since the interest to be received from them, if any, is always problematical. (*See* BONDS, FLAT INTEREST.) (J. H. B)

ACCUMULATED DIVIDEND, dividend on cumulative stock which was due but was not paid during one or more previous dividend periods. Such unpaid back dividends accumulate and it is essential that it be paid in full before any dividend can legally be paid on the common stock. (*See* CUMULATIVE STOCK, DIVIDEND.)

ACCUMULATION, in law, the continuous adding of the interest of a fund to the principal, for the benefit of some person or persons in the future. Previous to 1800 this accumulation of property was not forbidden by English law, provided the period during which it was to accumulate did not exceed that forbidden by the law against perpetuities; viz., the period of a life or lives in being, and 21 years afterwards. In 1800, however, the law was amended in consequence of the eccentric will of Peter Thellusson (1737–97), an English merchant, who directed the income of his property, consisting of real estate of the annual value of about £5,000 and personal estate amounting to over £600,000, to be accumulated during the lives of his children, grandchildren and great-grandchildren, living at the time of his death, and the survivor of them. The bequest was held valid (*Thellusson* v. *Woodford*, 1798, 4 Vesey, 237).

To prevent such a disposition of property in the future, the Accumulations Act, 1800 (known also as the "Thellusson Act") was passed, by which (as altered and re-enacted by the Law of Property Act, 1925) it was enacted that no property should be accumulated for any longer term than either (1) the life of the grantor or settlor; or (2) the term of 21 years from his death; or (3) during the minority of any person living or *en ventre de sa mère* at the time of his death; or (4) during the minority of any person who, if of full age, would be entitled to the income directed to be accumulated. The act does not extend to any provision for payment of the debts of the grantor or of any other person, nor to any provision for raising portions for the children or remoter issue of the settlor, or any person interested under the settlement, nor to any direction touching the produce of timber or wood. It does not apply to property in Ireland. The act has been amended by the Accumulations Act, 1892, which forbids accumulations for the purpose of the purchase of land for any longer period than during the minority of any person or persons who, if of full age, would be entitled to receive the income. The Accumulations Act, 1800, was applied to heritable property in Scotland by the Entail Amendment Act, 1848, and the saving clause as to provision for payment of debts was disapplied to Scotland by the Entail (Scotland) Act, 1914. The Accumulations Act, 1892, applies to Scotland.

(*See* also TRUST AND PERPETUITY.)

ACCUMULATIVE STOCK: *see* CUMULATIVE STOCK.

ACCUMULATOR (STORAGE CELL). In the case of a voltaic electrical battery or primary cell, the progress of a chemical reaction or series of reactions is utilized for the production of an electric current, and on completion of the chemical changes, the efficiency of the battery may be restored by renewing the electrodes and electrolyte. With an accumulator or secondary cell, on the other hand, the change of chemical into electrical energy is a reversible process and, by applying an electric current to the cell, the chemical substances involved in the reaction are restored to their original condition. Theoretically any reversible cell can be used as an accumulator of electrical energy. Cells of practical importance to which this article is limited are the lead-acid cell and the nickel-iron alkali cell. The former of these is based on the changes which metallic lead and its compounds undergo in dilute sulphuric acid by the action of the current. The accumulator devised by Planté in 1859, consisted of two sheets of lead separated by strips of rubber and rolled in the form of a spiral. After repeatedly charging and discharging with occasional reversals of polarity the capacity of the cell is gradually built up, one plate acquiring a coating of spongy lead and the other one of lead peroxide (fig. 1).

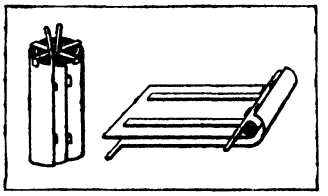


FIG. 1.—ACCUMULATOR DEVISED BY R L G. PLANTÉ, WHICH LAID THE FOUNDATION OF MODERN METHODS

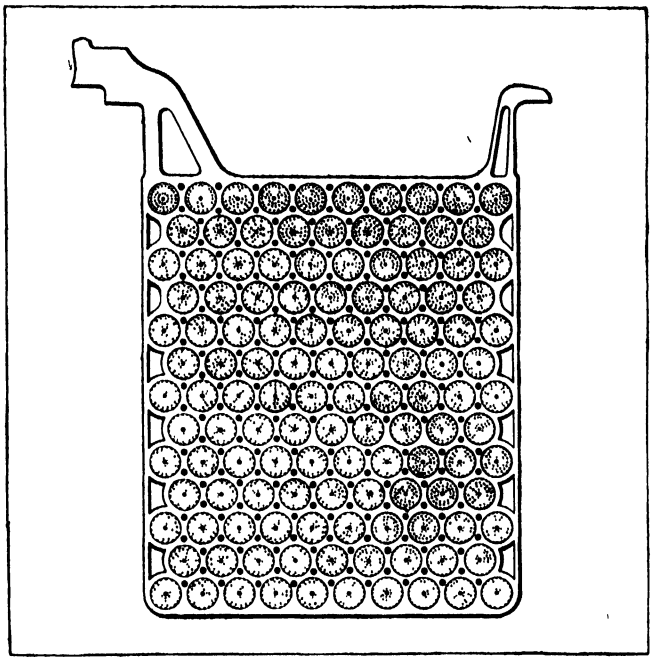
In 1881 Faure[1] devised a process for pasting on the plates compounds of lead which could be more easily formed into the active materials of the cells. A marked increase in the capacity over the Planté cell was thus obtained, but the adherence of the active material to the plates proved to be unsatisfactory. The numerous types of cells now in use differ principally in the manner in which these active masses of spongy lead and lead peroxide are produced and retained in the electrodes. Volckmar in 1881 introduced the use of lead plates provided with perforations which were filled with a mass of pulverized lead. Swan[2] devised a grid of cellular structure to act as support for the active material. The Correns grid patented in 1888 consists of a double lattice or mesh work of intersecting ribs of triangular cross section with the apexes pointing inwards so as to form rectangular spaces into which the paste is pressed.

Modern Types of Construction.—With the positive plates, the grids also play an important part in conducting and distributing the current, since the resistivity of lead peroxide is as high as 5·6 to 6·8 ohm cms. or some 300,000 times that of pure lead. At the present time, the metal used for the construction of grids consists of an alloy of lead with about 7% of antimony. The alloy is more resistant against electro-chemical corrosion than pure lead and does not lose its strength as a support by being attacked as the battery is used. Further on moulding the grids the alloy enables the production of sharper castings through the property of the molten alloy of expanding slightly in solidifying and it has the further advantage over lead of a lower temperature coefficient of expansion. The grids for positive and negative plates are frequently of a similar construction though the negative grid may be lighter on account of the higher conductivity of its filling and of its being less subject to corrosion. The paste most commonly used as a filling for the grids consists of litharge, PbO, or red lead, Pb_3O_4, or a mixture of the two. The mixture is made into a stiff paste with sulphuric acid, when a reaction occurs which leads to a binding together or cementing of the material on account of the formation of lead sulphate and peroxide in accordance with the equation:—

$$PbO + H_2SO_4 = PbSO_4 + H_2O$$
$$Pb_3O_4 + 2H_2SO_4 = PbO_2 + 2PbSO_4 + 2H_2O$$

[1] *Electrician*, vi. 323; vii. 122, 249.
[2] *Electrician*, 1882, viii. 142, Brit. Pat. 2272, 1881.

The pasted plates are allowed to dry and then alternately oxidized and reduced by electrolysis in dilute sulphuric acid or a sulphate solution. By the process known as "formation" the plates which are designed for the positives are made the anode in the forming tank and the plates for the negatives are made the cathode. It is impracticable and undesirable to remove the last trace of lead sulphate. Formation by this process usually requires



BY COURTESY OF CHLORIDE ELECTRICAL STORAGE CO , LTD.

FIG 2.—THE ROSETTE POSITIVE PLATE HAS CIRCULAR PERFORATIONS INTO WHICH ARE PRESSED ROSETTES OF CORRUGATED PURE LEAD TAPE

several days to complete when the paste of the negatives becomes reduced to metallic lead and that of the positives oxidized to peroxide.

The Planté type of plate which is largely used for positives may consist of a lead plate provided with deep grooves or thin vertical laminations strengthened at intervals by horizontal binding ribs. In a further modification, the Rosette positive plate (fig 2), the plate is provided with circular perforations into which are pressed rosettes of corrugated pure lead tape. These rosettes provide the active material, and during the process of formation they expand in the holes in the grid.

A form of plate employed extensively for the negatives of stationary batteries is the box type (fig 3).

This consists of a hard lead alloy frame cast in two halves, each having an outer face of finely perforated sheet lead and a grid cast on the inner face. The active material is inserted into the box or cages formed by placing the two halves of the grid against each other, after which the latter are riveted together. This device enables the use of spongy lead in a loose form which would not be retained by an open grid This type of plate is not, however, suitable for light portable cells on account of the extra weight and thickness of the plates.

The Planté type of plate is used almost exclusively for the positives of modern cells for general purposes where weight is not the main consideration but for negatives this type of plate has been practically entirely superseded by other designs which employ the Faure system of the pasted plate. The life of a pasted positive is short compared with a Planté plate but for most purposes this disadvantage is compensated by its greater capacity for a given weight, and the pasted type of positive is in general use for every kind of portable cell, such as those employed for car lighting and starting, electric vehicles and tram lighting.

The accumulator or battery is completed by assembling in juxtaposition a group of the positive plates with a suitable parallel spacing. The plates are secured by burning the projecting lugs on the top surface to connecting bars of lead or lead-antimony alloy. A group of negative plates are arranged in the same manner, with the projecting lugs on the side opposite to the lugs of the positives. The two groups are interleaved, the positive and negative groups alternating Actual contact between plates of opposite polarity is prevented by the insertion of a suitable type of separator.

The types of separators used include grooved boards of wood, glass, rubber or celluloid which secure the plates along their edges or else thin perforated diaphragms of hard rubber which are connected between the plates and prevent short circuiting through buckling of the plates or the formation of metallic connection through scaling or "sprouting" from the electrodes. An improved design of separator is described by M Wilderman[1]. In this method use is made of a porous form of ebonite which is moulded from powder and mounted in a frame of solid ebonite. By means of electro-osmotic action, liquid is drawn through the pores of the diaphragm during the charge or discharge of the cell and the circulation of electrolyte on the surfaces of the plate is thus promoted The increase in the diffusion of free acid brought about by this automatic mixing and circulation of the electrolyte between the electrodes improves the performance of the cell by raising the capacity at a given discharge rate. The frame of the diaphragm which fits closely in between the plates prevents at the same time their buckling and bending The assembled plates are then mounted in the containing vessel composed of glass, celluloid, hard rubber or lead-lined wood and an electrolyte of a solution of sulphuric acid in water added. The complete cell is always arranged so that the outside or end plates are negative. The cells are connected in series for which purpose the positive bar of each cell is joined by burning or bolting to the negative bar of the next cell in the series.

The electrolyte employed for lead batteries consists of a dilute solution of sulphuric acid. For stationary batteries of low discharge rate, a solution of density 1·20 to 1·23 is employed, corresponding to 28–32% by weight of acid in solution while for

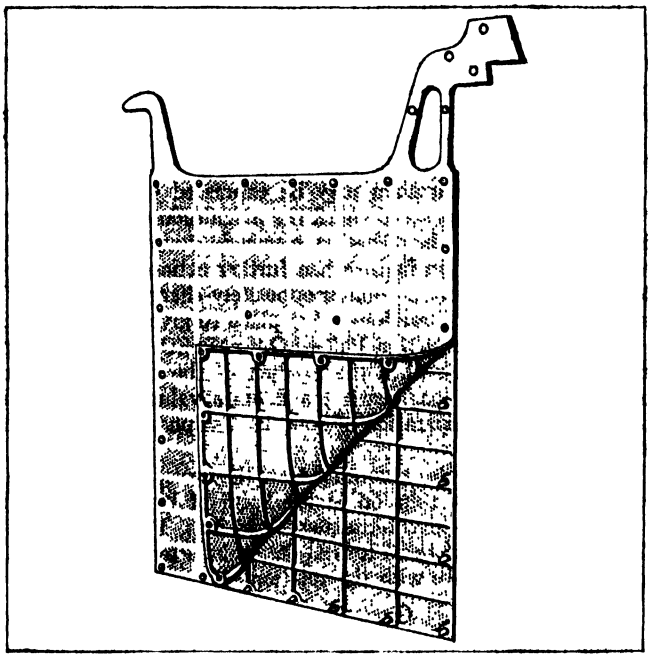


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FIG. 3.—A FORM OF PLATE KNOWN AS THE BOX TYPE IS USED EXTENSIVELY FOR THE NEGATIVES OF STATIONARY BATTERIES

portable batteries and those of high discharge rate such as employed in starting, and truck and tractor batteries, a solution of density 1·27 to 1·30 is employed corresponding to 36–40% by weight of acid in solution. In hot climates acid of lower concentration is required on account of the increased rate of chemical action.

Chemical Characteristics of the Lead Accumulator.—A feature of the lead accumulator is that the reacting lead com-

[1] *Chem. Ind.* 1927, xlvi. 51.

pounds and products are highly insoluble in the electrolyte; the only change which is produced in the electrolyte during charging and discharging is consequently a variation in the concentration of sulphuric acid. This change in concentration is brought about both through the formation of lead sulphate and through the production of water by the reaction attending the discharge, and conversely, the production of sulphuric acid and loss of water from the electrolyte.

The mechanism of the action of the lead accumulator during the charging is most satisfactorily explained by the "double sulphate" theory first put forward by Gladstone and Tribe in 1882. This theory accounts most directly for the observed formation of lead sulphate at the electrodes and the fall in concentration of sulphuric acid during discharge. The total chemical change occurring during the operation of the cell is accordingly expressed by the equation.

$$PbO_2+Pb+2H_2SO_4 \rightleftarrows 2PbSO_4+2H_2O,$$

the reaction proceeding from left to right during discharge and conversely from right to left during charge. During the discharge, both the lead peroxide of the positive and the lead of the negative plate are thus transformed into lead sulphate, and sulphuric acid is removed from, and water added to, the electrolyte. During the charge, lead sulphate is oxidized at the anode to lead peroxide and reduced to lead at the cathode, in both cases with liberation of sulphuric acid to the electrolyte while loss of water occurs by electrolytic decomposition. A cell is fully charged when the plates regain their original condition and the passage of the current produces no further change in the active materials which consist of lead peroxide and spongy lead respectively. When current is passed beyond this stage "gassing" results at both plates due to the liberation of free hydrogen which occurs at the cathode and oxygen at the anode. The free "gassing" at both plates and the attainment of a maximum of specific gravity of the electrolyte are indications of the completion of charging.

Theory of the Electrical Changes.—During discharge of the cell the reactions at the electrodes which lead to the production of current may be represented as follows: At the negative electrodes the finely divided lead on account of its solution pressure exerts a tendency to assume the ionic condition, whereby each atom of lead acquires two positive charges, the corresponding negative charge being imparted to the electrode, charging this to a definite potential. The phenomenon may be expressed by the equation $Pb = Pb'' + 2\ominus$ and proceeds until the magnitude of the potential charge acquired by the negative electrode counterbalances the tendency of the lead to ionize when further action ceases. In the electrolyte the lead ions encounter oppositely-charged ions of SO_4''. Interaction between these ions takes place to give an equilibrium represented by the equation $Pb'' + SO_4'' \rightleftarrows PbSO_4$. In accordance with this equilibrium, when the product of the concentration of the Pb'' and SO_4'' ions reaches a definite value known as the solubility product, separation of solid lead sulphate occurs on the electrode.

At the positive pole, according to a theory of Le Blanc, lead peroxide passes into solution in the form of hydrate $Pb(OH)_4$ which dissociates to give tetravalent lead ions, Pb'''' and OH'. The concentration of these ions is determined by their solubility product in accordance with the relation

$$C_{(Pb'''')}C_{(OH')_4}=k,$$

C is the concentration and k is a constant. The Pb'''' ions may also be regarded as entering into equilibrium with the SO_4'' ions to form $Pb(SO_4)_2$. This compound can only be present at a very low concentration and exerts a tendency to lose two positive charges and change to bivalent lead, or $Pb'''' \rightarrow Pb'' + 2\oplus$. The positive charge is delivered to the outside circuit and the bi-valent lead then reacts to form lead sulphate as at the negative pole and the lead peroxide of the positive is thus gradually replaced by solid lead sulphate. A further chemical reaction which accompanies the above changes during the discharge of the cell is the combination of H' ions formerly associated with SO_4'' and the OH' ions from the lead tetrahydrate, to form water. The complete reactions which take place during the discharge can be expressed by the following scheme:—

$$PbO_2+4H' \rightleftarrows Pb'''' + 2H_2O$$

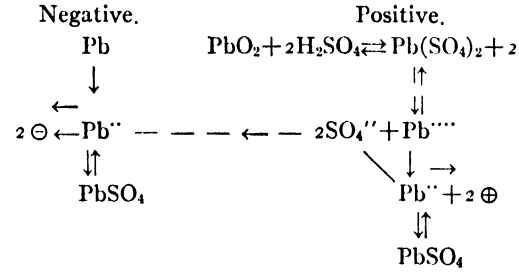
At the negative pole lead sulphate dissolves to a certain extent and dissociates to Pb'' and SO_4'' ions and on the application of an external potential more negative than the cell the charges on the Pb'' ions are neutralized and the atoms are deposited on the electrode as solid lead, while the accompanying SO_4'' ions migrate towards the positive pole. At the positive pole the bi-valent lead ions acquire a further charge and are changed into tetravalent ions which then react with water in accordance with the following reactions.—

$$Pb'''' + 2H_2O = PbO_2 + 4H'$$
$$Pb'''' + 4H_2O = Pb(OH)_4 + 4H'$$

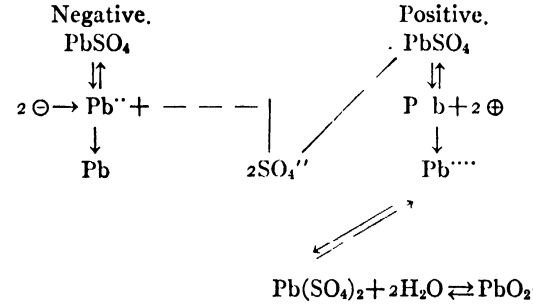
The tetravalent lead may alternatively be regarded as first forming lead bisulphate with the free SO_4'' ions. The lead bisulphate reacts as follows.—

$$Pb(SO_4)_2 + 2H_2O \rightleftarrows PbO_2 + 2H_2SO_4$$

The total change in the cell during discharge may accordingly be represented by the scheme:—



and conversely, during the charge the reaction is represented by the table:—



$$Pb(SO_4)_2 + 2H_2O \rightleftarrows PbO_2 + 2H_2SO_4$$

Liebenow (*Zeit. Elektroch,* ii., 420, 653 (1895) developed a somewhat different theory to explain the reactions taking place in the lead accumulator. This is based on the assumption that a solution of lead sulphate contains, in addition to Pb'' and SO_4'' ions, a certain quantity of PbO_2'' ions, formed by the union of Pb'' with O'' ions of the water, or else by hydrolysis, thus $Pb'' + 2H_2O = PbO_2'' + 4H'$.

At the positive electrode, lead peroxide passes into solution as PbO_2'', imparting two positive charges to the electrode. This then reacts with the H' ions of the acid as follows:—

$$PbO_2'' + 4H' = Pb'' + 2H_2O.$$

The lead ions combine with the SO_4'' ions of the acid to form the solid sulphate

$$Pb'' + SO_4'' = PbSO_4.$$

At the negative electrode, the change consists in the passing of lead into the ionic condition and then combining with a SO_4'' ion to form solid sulphate as represented by the Le Blanc theory.

During charging the reverse action occurs, *i.e.,* at the positive pole, PbO_2'' ions and at the negative Pb'' ions are precipitated from solution. The ions in solution are furnished by the $PbSO_4$, accumulated at the electrodes.

Influence of Impurities in the Electrolyte on the Operation of the Cell.—On account of the deleterious action of most impurities, distilled water only should be used in the preparation of the electrolyte. Rain water, if uncontaminated, may be em-

ployed. The influence of different impurities on the action of the cell has been investigated by G. W. Vinal and F. W. Altrup[1] who ascertained, by periodic weighings of the plates, the amount of formation of lead sulphate which results from the discharge of either the positive or negative plates in sulphuric acid. A certain amount of lead sulphate is formed as the result of local action when the plates are immersed in even the purest acid solutions

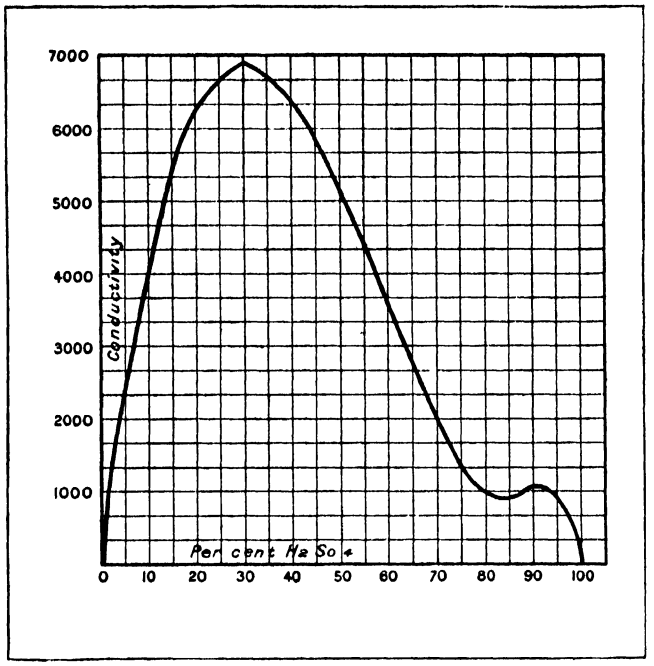


FIG. 4 —RELATIVE CONDUCTIVITY OF ALL THE STRENGTHS OF SULPHURIC ACID SOLUTIONS

obtainable. Detrimental impurities may act in the following ways. (1) by corroding the plate, (2) by accelerating the formation of lead sulphate or (3) by being deposited in the pores of the plates. It was found that electrolyte, containing only one part of platinum in ten million parts of solution, increased the local action at the negative plates by 50%. A metal of this type is mainly harmful in destroying the "overvoltage" of the cell on which its stability depends. The potential difference between the charged accumulator plates is greater than the value normally required to decompose the electrolyte with the liberation of hydrogen and oxygen The fact that this reaction does not occur and lead to the discharge of the cell on standing is due to the high overvoltage or passivity exerted by the electrodes to the evolution of these gases In the presence of a highly electro-negative metal this overvoltage effect is destroyed

Copper, like platinum, deposits on the negative plate, but produces less effect. Iron in the ferric condition is reduced to the ferrous condition at the negative plate and then is oxidized to the ferric condition at the positive plate, and also to some extent by the air. The action of iron on the negative plates is much more pronounced than on the positives and the local action produced is in excess of the amount which would be calculated from the reduction of the ferric sulphate. Manganese deposits as peroxide upon the positive plates, and produces serious effects. It covers the active material of the plate, closes the pores and causes a large amount of charging current to be wasted as gas.

ELECTRICAL CHARACTERISTICS

Accumulators in Repose.—Accumulators contain only three active substances—spongy lead on the negative plate, spongy lead peroxide on the positive, and dilute sulphuric acid between them. Sulphate of lead is formed on both plates during discharge and brought back to lead and lead peroxide again during charge and there is a consequent change in the strength of acid during every cycle. The chief properties of these substances are shown in the Table.

[1] *Jour. Amer. Instit. Elect. Eng.* 1924, xliii. 709.

TABLE

Substance.	Colour.	Density.	Specific resistance.
Lead . .	Slate blue	11 3	0·0000195 ohm.
Peroxide of lead.	Dark brown	9·28	5·6 to 6·8 „
Sulphuric acid after charge .	Clear liquid	1·210	1 37 ohm.
Sulphuric acid after discharge .	„	1·170	1·28 „
Sulphuric acid in pores	„	below 1 03	8·0 „
Sulphate of lead.	White	6·3	non-conductor

The curve in fig 4 shows the relative conductivity of all the strengths of sulphuric acid solutions, and by its aid and the figures in the preceding table, the specific resistance of any given strength can be determined.

The lead accumulator is subject to three kinds of local action. First and chiefly, local action on the positive plate because of the

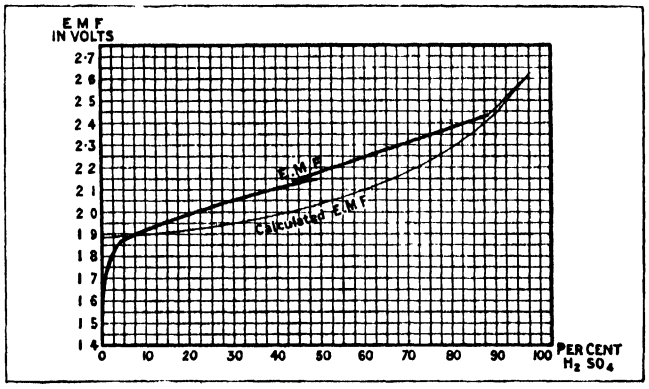


FIG. 5.—THE EFFECT OF THE STRENGTH OF THE SULPHURIC ACID ON THE ELECTROMOTIVE FORCE

contact between lead peroxide and the lead grid which supports it. In carelessly made or roughly handled cells this may be a very serious matter. It would be so in all circumstances if the lead sulphate formed on the exposed lead grid did not act as a covering for it. It explains why Planté found "repose" a useful help in "forming" and also why positive plates slowly disintegrate; the lead support is gradually eaten through. Secondly, local action on the negative plate when a more electro-negative metal settles on the

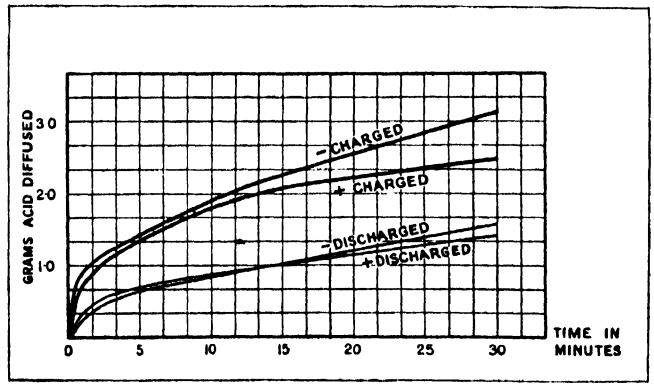


FIG. 6 —THE RATE OF DIFFUSION FROM PLATES SOAKED IN ACID OF 1.175 DENSITY AND THEN PLACED IN DISTILLED WATER

lead. This often arises when the original paste or acid contains metallic impurities. Similar impurity is also introduced by scraping copper wire, etc., near a battery. Thirdly, local action due to the acid varying in strength in different parts of a plate. This may arise on either plate and is set up because two specimens of either the same lead or the same peroxide give an e.m.f. when placed in acids of different strengths. J. H. Gladstone and W. Hibbert found that the e.m f. depends on the difference of strength (*Jour. Inst. Elect. Eng.* 1892). The observations with very strong acid were difficult to obtain. C. Hein (*Elek. Zeit* 1889), F. Strienz (*Ann.*

Phys. Chem. xlvi. 449) and F. Dolezalek (*Theory of Lead Accumulators*, p. 55) have also given tables.

It is only necessary to add to these results the facts illustrated by the following diffusion curves, in order to obtain a complete explanation of the behaviour of an accumulator in work. Fig. 6 shows the rate of diffusion from plates soaked in acid of density 1·175 and then placed in distilled water as described in a paper by R. Duncan and H. Weigand (*Elec. World* N Y. 1889), who were the first to show the importance of diffusion. About one half the acid diffused out in 30 minutes, a good illustration of the slowness of this process. The rate of diffusion is much the same for both positive and negative plates, but slower for discharged plates than for charged ones.

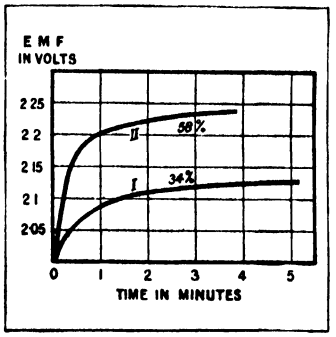


FIG. 7.—THE INFLUENCE OF DIFFUSION ON THE ELECTROMOTIVE FORCE

The influence of diffusion on the electromotive force is illustrated by fig. 7. A cell was prepared with 20% acid. It also held a porous pot containing stronger acid, and into this the positive plate was suddenly transferred from the general body of liquid. The e.m.f. rose by diffusion of stronger acid into the pores. Curve I. in fig. 7 shows the rate of rise when the porous pot contained 34% acid, curve II. was obtained with the stronger (58%) acid. Of these two curves the first is more useful because its conditions are nearer those which occur in practice.

At the end of a discharge it is a common occurrence for the plates to be standing in 25% acid, while inside the pores the acid may not exceed 8% or 10%. If the discharge is stopped, we have conditions somewhat like fig. 7 and the e.m f. begins to rise and increases by about 0·08 volt in one minute.

In examining the effect of repose on a charged cell, Gladstone and Tribe's experiments show that peroxide of lead lying on its lead support suffers from local action, which reduces one molecule of PbO_2 to sulphate at the same time that an atom of the grid below it is also changed to sulphate. There is thus not only a loss of the available peroxide but a corrosion of the grid or plate. It is through this action that the supports gradually give way. On the negative plate an action arises between the finely divided lead and the sulphuric acid, with the result that hydrogen is set free:—

$$Pb + H_2SO_4 = PbSO_4 + H_2.$$

This involves a diminution of available spongy lead, or loss of capacity, occasionally with serious consequences. In the discharge it becomes sulphated in excess since the better positive maintains the e.m.f. too long. In the succeeding charge, the positive is fully charged before the negative and the differences between them tend to increase in each cycle.

Charge and Discharge.—The most important practical considerations with an accumulator are.—its maximum rate of working; capacity at various discharge rates; efficiency; and length of life. Apart from mechanical injury all these depend primarily on the construction of the cell, and then on the method of charging and discharging. For each type and size of cell there is a normal maximum discharging current. Up to this limit any current may be taken; beyond it, the cell may suffer if discharge be continued for any appreciable time. The most important point to attend to is the voltage at which discharge will cease. The potential difference at terminals must not fall below 1·80 volt during discharge at ordinary rates (10 hours) or 1·75 to 1·70 volt for 1 or 2 hour rate. These voltages indicate that the acid in the pores is not being renewed fast enough, and that if the discharge continues the chemical action will change: sulphate will not be formed *in situ* for want of acid. Any such change in action is inimical to reversibility and therefore to life and constancy in capacity. Thus when at low discharge rates the voltage is 1·80 volt, the acid in the pores has weakened to a mean value of about 2·5% (*see* fig. 5) which is quite consistent with some part of the interior being practically pure water. With high discharge rates, as much as 0·1 volt may be lost in the cells by ordinary ohmic fall, so that a voltage reading of 1·75 corresponds to an e.m.f. of a little over 1·8 volt, and a very weak density of the acid inside the pores. Guided by these figures an estimate can be made of the permissible drop in terminal volts for any given working conditions.

Fig. 8 shows a typical discharge curve. Noteworthy points are: (1) at the beginning and at the end there is a rapid fall in P.D. with an intermediate period of fairly uniform value, (2) when the P.D. reaches 1·6 volt the fall is so rapid that there is no advantage in continuing the action. When the P.D. had fallen to 1·6 volt the cell was automatically switched into a charging circuit, and with a current of 9 amperes yielded the curve in fig. 9. Here again there is a rapid variation in P.D. (in these cases a rise) at the beginning and end of the operation. The cells were now carried through the

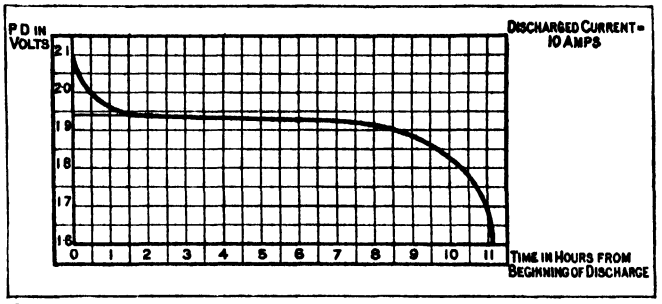


FIG. 8 —CHANGE IN ELECTROMOTIVE FORCE WITH TIME OF DISCHARGE

same cycle several times, giving almost identical values for each cycle. After some days, however, they became more and more difficult to charge, and the return on discharge was proportionately less. It became impossible to charge up to a P D. of 2 4 volts, and finally the capacity fell away to half its first value. Examination showed that the plates were badly scaled, and that some of the scales had partially connected the plates. These scales were removed and the experiments resumed, limiting the fall of P.D. to 1·8 volt. The difficulties then disappeared, showing that discharge to 1·6 caused injury that did not arise at a limit of 1·8. Before describing the new results it will be useful to examine these two cases in the light of the theory of e m f. already given. (a) At the moment when previous charging ceases the pores of the positive plate contain strong acid, brought there by the charging current. There is consequently a high e.m.f. But the strong acid begins to diffuse away at once and the e.m f. falls rapidly. Even if the cell were not discharged this fall would occur, and if it were allowed to rest for 30 minutes or so the discharge would have begun with the thin line (fig. 8). (b) The pores being clogged by sulphate, the peroxide cannot acquire acid by diffusion, and when 5% is

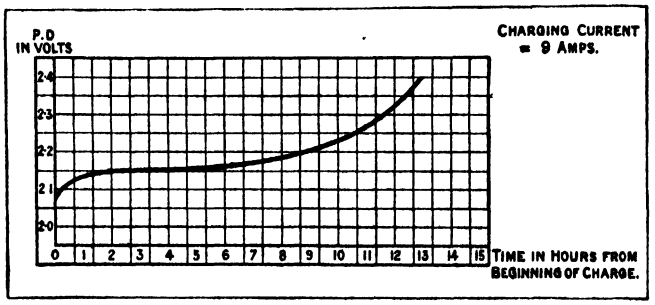


FIG. 9.—CHANGE OF ELECTROMOTIVE FORCE WITH TIME OF CHARGE

reached the fall in e.m.f. is disproportionately large (*see* fig. 5). If discharge is stopped, there is an almost instantaneous diffusion inwards and a rapid rise in e.m.f.

Capacity of the Cell.—A knowledge of the capacity of the cell for storing electric energy is of great importance, and is readily determined by allowing a regulated current from a fully-charged cell to pass through a recording ammeter or copper voltmeter until the voltage has fallen to about 1·8 volt. The product of the amount of current in amperes by the length of time in hours gives the capacity of the accumulator in ampere-hours. The rate

of discharge must be noted, as the capacity varies somewhat with the rate at which current is taken from the cell.

In fig. 10 diagrams are given of two types of chloride cells showing the curves of voltages during charges following 5-hour discharges, and curves for discharges at 1, 3, 5 and 10 hour rates.

Current and Energy Efficiencies.—The current or ampere-hour efficiency is the ratio of amp. hours yielded during discharge to the amp. hours required to restore it to its original value by charging. In practice, a current efficiency of 90–95% is normally obtained under working conditions. The energy or watt-hour

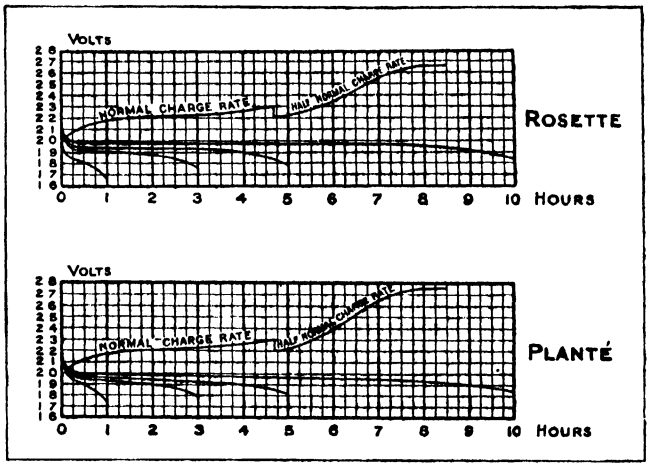


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FIG. 10.—VOLTAGES DURING CHARGES FOLLOWING 5-HOUR DISCHARGES AND CURVES FOR DISCHARGES AT 1, 3, 5 AND 10 HOUR RATES FOR TWO TYPES OF CHLORIDE CELLS

efficiency is of the greatest value in gauging the practical results of an accumulator. The watt-hours taken up by a cell during charge or given up during discharge are given by the expression: time (in hours) x amperes x average volts. The watt-hour efficiency is consequently equivalent to the product of the ampere-hour efficiency into the ratio of the average volts on discharge to average volts on charge. The watt-hour efficiency of a cell in practice usually ranges from 72 to 78% and is higher for low than for high rates of charge and discharge.

TYPES OF ACCUMULATORS

The Tudor Cell.—The Tudor accumulator is designed primarily for use as a stationary battery and is suitable for lighting and power requirements generally where a large capacity and high efficiency are required. The positive plates are made of pure lead and cast in one piece with thin vertical ribs and provided with

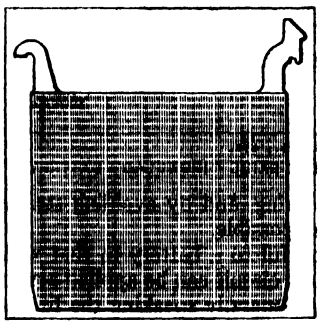

FIG. 11.—THE ONE-PIECE POSITIVE PLATE OF THE TUDOR CELL

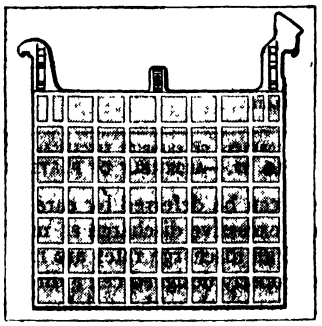

FIG. 12.—THE TWO-PIECE NEGATIVE PLATE OF THE TUDOR CELL

slot-shaped intervening pieces. The ribs are intersected at intervals by shorter horizontal supports to give the plates rigidity in both directions. By means of an improved Planté process an adherent and homogeneous coating of peroxide is formed on the large surface provided by these plates. As the coating of active material on the surface is thin, plates can be charged and discharged at high rates without damage. Each negative plate consists of two lead grids riveted together; stout horizontal and vertical ribs divide the inside space into a number of small compartments which are filled with active material. The sheets of perforated lead on the outer surface of the plates hold the active material in position but at the same time allow free circulation of the acid (figs. 11 and 12).

Each pair of plates is separated either by glass tubes which are held in position by guiding pieces cast on to the lugs of the negative plates, or by wood board separators which have previously been specially treated to remove deleterious matter. In cells with lead-lined wood boxes, glass tubes are also inserted between the end negative plates and the lead lining of the box to prevent the plates coming into direct contact with the lead lining.

The Chloride Cell.—The chloride cell has a Planté positive with a pasted negative. For the positive a lead casting is made, about 0·4in. thick pierced by a number of circular holes about ½in. in diameter. Into each of these holes is thrust a roll or rosette of lead ribbon, which has been cut to the right breadth (equal to the thickness of the plate) then ribbed or gimped and finally

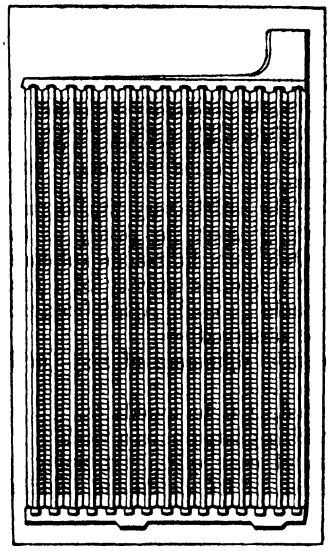

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FIG. 13.—THE POSITIVE PLATE OF THE EXIDE "IRONCLAD" BATTERY

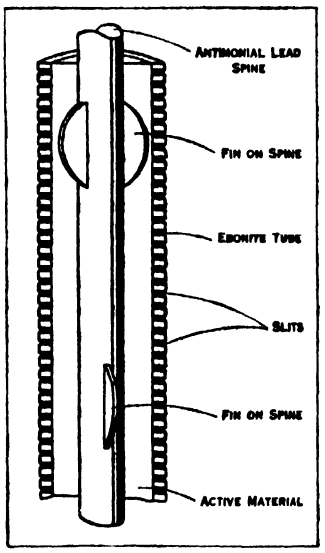

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FIG. 14.—CROSS-SECTION OF THE EXIDE "IRONCLAD" TUBE

coiled into a rosette (*cf.* fig. 2). The rosettes have sufficient spring to fix themselves in the holes of the lead plate, but are keyed in position by a hydraulic press. The plates are then "formed" by passing a current for a long time. The negative plate consists of a grid with thin vertical ribs, connected horizontally by small bars of triangular section. The bars on the two faces are "staggered," that is, those on one face are not opposite those on the other. The grid is pasted with a lead oxide paste and afterwards reduced; this is known as the "exide" negative.

The larger sizes of negative plate are of the "box" type, formed by riveting together two grids and filling the intervening space with paste (*cf.* fig. 3).

Exide Ironclad Battery.—This type of battery is designed primarily for use with electric locomotives, trucks, tractors, cranes and other purposes where heavy duty and resistance against vibration are required. The positive plate (fig. 13) is built up of a number of specially shaped antimonial-lead rods held in a vertical plane by top and bottom castings of lead. These rods are surrounded by sheaths, or tubes, of a special class of ebonite in which they stand concentrically, the space between the rod and the tube being filled with active material. (For complete cell *see* fig. 20.)

In this plate the peroxide of lead used for the active material is so applied that it fills entirely the space round the lead rod and when fully "formed" becomes a close-fitting tube making good contact with the supporting rod. The ebonite tubes are slitted horizontally to allow the electrolyte to gain access to the active material; and, further, they are of an appreciably elastic nature,

and so allow for expansion or contraction of the active material. The slitting of the tubes (figs. 14; 15) is so conducted that no active material can fall out and yet the resistance to the electrolyte is reduced to a minimum. The negative plate is similar to that of the ordinary Exide cell but is made of increased thickness and arranged to have approximately the same commercial life as the positive plate so as to avoid renewals.

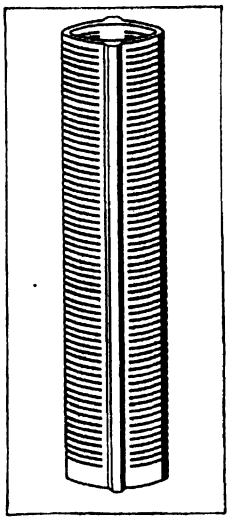

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FIG. 15.—SIDE VIEW OF EXIDE "IRONCLAD" TUBE

Figs. 16, 17 and 18 show the negative plate which consists of a grid of hard antimonial lead supporting and containing strips of active material which is applied to the grid in the form of paste. To prevent contact between the grids through buckling or distortion, thin diaphragms of prepared and treated wood are applied on each side of the positive plate as in fig. 19.

A vehicle battery consists of a number (often 40 to 80) of cells, coupled by connecting straps. At a normal discharge rate of 5 hours the capacity of the large units ranges from 3·5 to 4·8 amp hours per lb. of cell according to the design. At an average voltage of 2, this corresponds to from 7·0 to 9·6 watt hours per lb. of the active material employed.

Care of Lead Accumulators.—The satisfactory working and durability of batteries depends largely upon the purity of the electrolyte employed in the cells Only pure brimstone sulphuric acid diluted with distilled water to a specific gravity of 1·200–1·210 at a temperature of 60° F. should be used. Apart from this the following simple rules should be observed:—

1. Never discharge below a potential difference of 1·85 (or in rapid discharge 1·8) volt.
2. Never leave the cells discharged, if it be avoidable.
3. Give the cells a special equalizing charge once a week.
4. Make a periodic examination of each cell, determining its e.m f., density of acid, the condition of its plates and freedom from growth.

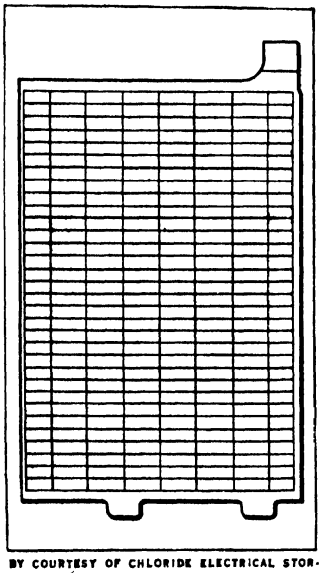

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FIG. 16.—THE NEGATIVE PLATE OF THE EXIDE "IRONCLAD" BATTERY AS IT APPEARS BEFORE TREATMENT

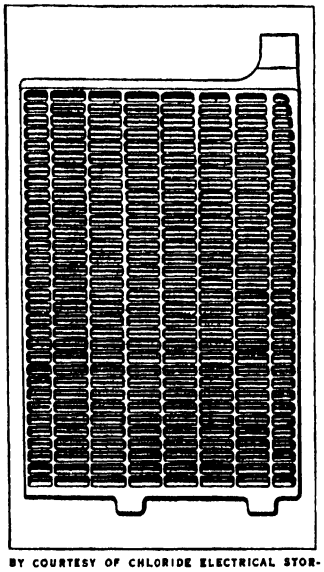

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FIG. 17.—ANTIMONIAL LEAD GRID OF THE EXIDE "IRONCLAD" BATTERY BEFORE PASTING

5. If any cell shows signs of weakness, keep it off discharge till it has been brought back to full condition. See that it is free from any connection between the plates which would cause short-circuiting; the frame or support which carries the plates sometimes becomes covered by a conducting layer. To restore the cell, two methods can be adopted. In private installations it may be disconnected and charged by one or two cells reserved for the purpose; or, as is preferable, it may be left in circuit, and a cell in good order put in parallel with it. This not only prevents the faulty one from discharging, but keeps it supplied with a charging current till its potential difference is normal.

Every battery attendant should be provided with a hydrometer and a voltmeter. The former enables him to determine from time to time the density of the acid in the battery. The voltmeter should read up to about three volts. Some form of wooden scraper should be supplied to remove any growth from the plates. The scraping must be done gently, with as little other disturbance as possible. By the ordinary operations which go on in the cell, small portions of the plates become detached. It is important that these should fall below the plates, lest they short-circuit the cell, and therefore sufficient space ought to be left between the bottom of the plates and the floor of the cell for these "scalings" to accumulate without touching the plates, and they should be disturbed as little as possible. The liquid must be kept above the top of the plates. Experience shows the advisability of using distilled water for this purpose. It may sometimes be necessary to replenish the solution with some dilute acid, but strong acid must never be added to the cell.

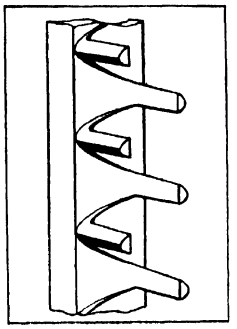

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FIG. 18 —CROSS-SECTION OF GRID OF EXIDE BATTERY

The chief faults are buckling, growth, sulphating and disintegration. Buckling of the plates generally follows excessive discharge, caused by abnormal load or by accidental short-circuiting At such times asymmetry in the cell is apt to make some part of the plate take much more than its share of the current. That part then expands unduly, as explained later, and curvature is produced. The only remedy is to remove and press it back into shape as gently as possible. Growth arises generally from scales from one part falling on some other—say, on the negative. In the next charging the scale is reduced to a projecting bit of lead, which grows still further because other particles rest on it. The remedy is, gently to scrape off any incipient growth Sulphating, the formation of a white hard surface on the active material, is due to neglect or excessive discharge. It often yields if a small quantity of sulphate of soda be added to the liquid in the cell. Disintegration is due to local action, and there is no ultimate remedy. The end can be deferred by care in working, and by avoiding strains and excessive discharge as much as possible.

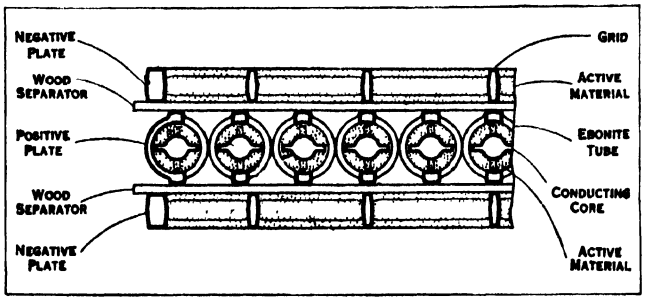

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FIG. 19.—ASSEMBLY OF PLATES IN THE EXIDE "IRONCLAD" BATTERY

High discharge rates are not harmful to a battery in that with a properly designed cell a direct short circuit can be applied across the terminals without doing harm. Generally speaking the life of a battery is cut down more by improper charging than by any amount of discharging at high rates. Discharging at high rates should not be confused with over-discharging at high rates, that is, to continue to take current from a battery after it has become nominally discharged. A battery in a discharged condition, or in an over-discharged condition will sulphate very rapidly, and every effort should be made to prevent a battery from lying in a discharged condition any longer than is absolutely necessary. If a

battery is discharged below 1·76 volts, lead sulphate causes an increase in volume of each of the plates, setting up strains in them and tending to buckle them and cause the active material to crack and drop off. The injurious results at voltages below this value arise because then the pores contain water. The chemical reaction is altered and oxide or hydrate is formed which will partially dissolve, to be changed to sulphate when the sulphuric acid subsequently diffuses in. But formed in this way it will not appear mixed with the active masses in the electrolytic paths, but more or less alone in the pores. In this position it will obstruct the passage and isolate some of the peroxide. Further, when forming in the narrow passage its disruptive action will tend to force off the outer layers.

When cells have been allowed to remain any length of time in a discharged condition, the sulphate becomes very hard and brittle, and when the battery is placed on charge, small quantities flake off and fall to the bottom of the jar. This results in loss of active material and gradual disintegration of the plates. The positive plate is affected to a greater extent than the negative as it has less mechanical strength, consequently positive plates have a shorter life than negative. The more porous the active material the greater depth the acid will penetrate to and the greater will be the capacity of the battery. The current must be distributed equally over the surface of each plate in order to ensure an equal life of all parts, otherwise some portions would be worked more than others.

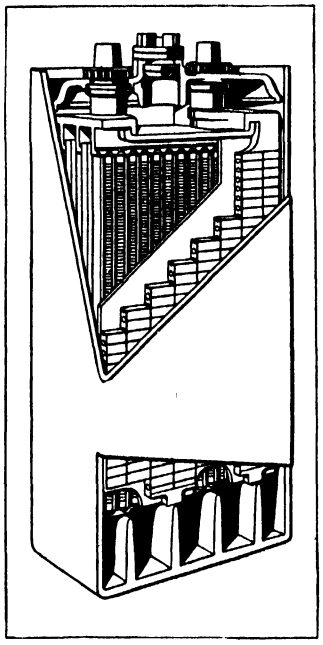

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FIG. 20.—THE EXIDE "IRONCLAD" CELL WITH PARTS CUT AWAY TO SHOW CONSTRUCTION

Accumulators in Central Stations.—As the efficiency of accumulators is not generally higher than 75% and machines must be used to charge them, it is not directly economical to use cells alone for public supply. Yet they play an important and an increasing part in public work, because they help to maintain a constant voltage on the mains and can be used to distribute the load on the running machinery over a much greater fraction of the day. Used in parallel with the dynamo, they quickly yield current when the load increases, and immediately begin to charge when the load diminishes, thus largely reducing the fluctuating stress on dynamo and engine for sudden variations in load.

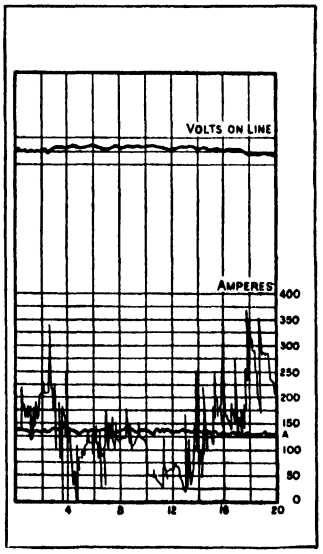


FIG. 21.—BY THE APPLICATION OF ACCUMULATORS TO FLUCTUATING LOADS THE CELLS TAKE THE PEAK OF THE LOAD, THUS RELIEVING THE DYNAMO OF SUDDEN CHANGES

Regulation of the potential difference is managed in various ways. More cells may be thrown in as the discharge proceeds, and taken out during charge, but this method often leads to trouble as some cells get unduly discharged, and the unity of the battery is disturbed. Sometimes the number of cells is kept constant for supply, but the P.D. they put on the mains is reduced during charge by employing regulating cells in opposition. Both these plans have proved unsatisfactory, and the battery is now preferably joined across the mains in parallel with the dynamo. The cells take the peaks of the load and thus relieve the dynamo and engine of sudden changes as shown in fig. 21. Here the line current (shown by the erratic curve) varied spasmodically from 0 to 375 amperes, yet the dynamo current varied from 100 to 150 amperes only (*see* line A). At the same time the line voltage (535 volts normal) was kept nearly constant. In the late evening the cells became exhausted and the dynamo charged them. Extra voltage was required at the end of a "charge" and was provided by a "booster." Originally a booster was an auxiliary dynamo worked in series with the chief machine and driven in any convenient way. It has developed into a machine with two or more exciting coils, and having its armature in series with the cells (*see* fig. 22). The exciting coils act in opposition, the one carrying the main current sets up an e.m.f. in the same direction as that of the cells, and helps the cells to discharge as the load rises. When the load is small, the voltage on the mains is highest and the shunt exciting current greatest.

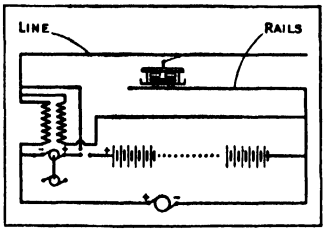


FIG. 22.—APPLICATION OF ACCUMULATORS AS "BOOSTERS"

Batteries should be kept free from dirt and corrosion. Terminals should be occasionally removed and covered with vaseline to maintain good contact. Most troubles occur after a battery has finished its useful life, the length of which depends upon the design, the quality of the materials of which it is constructed, the care given to it and the relation of the current put in to that taken out; the useful life of a battery should be from 4 to 5 years. In commercial practice, however, a smaller battery working at a higher rate is generally employed in order to economize in weight, size and cost and the useful life of such a battery is between 1½ and 3 years, in which case the battery requires greater attention.

NICKEL-IRON ALKALINE CELLS

In this type of accumulator which was invented and developed by Edison, the active materials of the electrodes consist of the oxides of iron and nickel which are immersed in an electrolyte of potassium hydroxide.

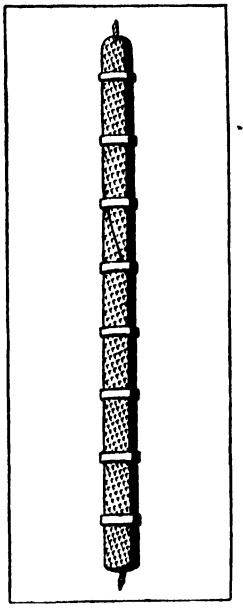


FIG. 23.—ONE OF THE INDIVIDUAL POSITIVE TUBES OF THE EDISON ACCUMULATOR

Construction and Assembly.—The active material of the positive plates is nickel hydrate. As this material is only a poor conductor, its resistance is reduced by mixing with a better conducting material. The means adopted is to fill a helical tube (fig. 23) made from finely perforated nickelled steel strip with alternately-arranged thin layers of nickel hydrate, the positive active material, and fine metallic nickel flake. Each tube is about 4in. long and ¼in. diameter, and contains over 300 of these highly-compressed double layers. Each tube is surrounded and reinforced externally by steel rings equidistantly spaced. The complete positive plate (fig. 24) consists of a light nickelled steel grid on which a double row of the unit tubes already described is mounted. To prevent plate distortion, adjacent tubes are wound oppositely, a right-hand wound tube being mounted adjacent to a left-hand wound one, and so on.

The negative plates of the cell also consist of an assemblage of small units, but of oblong pocket form instead of being tubular. Iron oxide prepared in a special manner, and incorporated with a trace of mercury to improve the conductivity, is enclosed in flat steel pockets, which, like the tubes in the positive plate, are made of nickelled steel strip, finely perforated. These units are mounted in a light, punched,

nickelled steel frame and subject to hydraulic pressure of 120 tons in order to prevent subsequent loosening and to corrugate the faces of the pockets. The assembled cell consists of a series of positive and negative plates as indicated in fig. 25. Contact between adjacent plates is prevented by hard rubber strips and pin insulators, while sheets of the same material prevent contact of the plates with the sides of the nickel plated steel container.

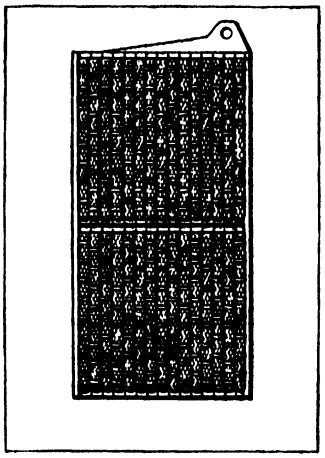


FIG. 24.—THE COMPLETE POSITIVE PLATE OF THE EDISON BATTERY

The terminal posts of the assembled plates project through insulated and liquid-tight stuffing glands or boxes mounted in the welded-in top of the cell which is also provided with a combined filler cap and gravity gas escape non-return valve.

The electrolyte which is employed consists of a solution of potash in distilled water with a small percentage of lithia. The density of the electrolyte does not change to any large degree between charge and discharge. The proper level of the electrolyte in the cell is subsequently maintained by the additions of distilled water.

Electrolytic Reactions.—On first charging the cell, the green nickel hydrate becomes more highly oxidized and becomes black

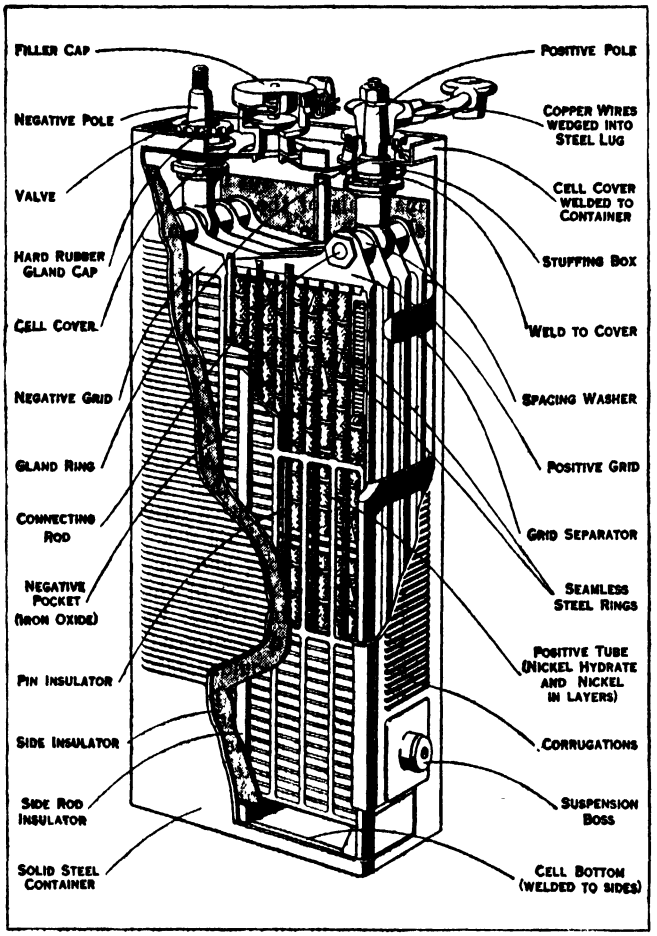


FIG. 25.—THE ASSEMBLED EDISON ACCUMULATOR WITH PARTS CUT AWAY TO SHOW THE CONSTITUENT FEATURES OF CONSTRUCTION

in colour, while the iron oxide is reduced to a chemically pure form of iron Various equations have been proposed to represent the chemical reactions occurring during the operation of the cell That which most probably holds is the following (change from left to right represents discharging; that from right to left the charging reaction):—

$$2Ni(OH)_3+Fe \rightleftarrows 2Ni(OH)_2+Fe(OH)_2$$

The material in the positive plate is not homogeneous but consists of mixtures or possibly a solid solution of the different oxides of nickel. On charging, the lower oxides of nickel are brought by the current to a higher degree of oxidation though not completely to NiO_2 on account of the instability of this compound. According to Foerster (*Electrical World* [London] 1922, p. 270) the potential of the fully-charged plate corresponds to that of NiO_2, when these fall by 0·1 volt to a value at 18° C with a 20% potassium hydroxide solution, of 1·36 volt, corresponding to the oxide Ni_2O_3. The change occurring during the operation of the cell is thus seen to consist only of a transference of OH' from the active mass of one electrode to the other. The net effect is thus the transfer of oxygen from one plate to the other. During discharge the electrolyte becomes more concentrated at the nickel or positive plate through the liberation of hydroxyl ions and the concentration falls by the same amount at the negative plate through the combination of hydroxyl ions. The total change of concentration throughout the electrolyte is consequently only that due to the incomplete hydration of the Ni_2O_3. According to this effect the electrolyte becomes slightly more concentrated on discharge and more dilute on charge.

Voltage, Capacity and Efficiency.—The average working voltage of this cell is 1·2 volts at the normal or 5-hour rate of discharge. The behaviour during charge or discharge is shown in fig. 26. The capacity of the cell is affected only very little by the rate of discharge and amounts to from 7·5 to 12 amp. hours per lb. of assembled battery. The energy capacity amounts to from 8·5 to 15 watt hours per lb. of cell according to the size of cell.

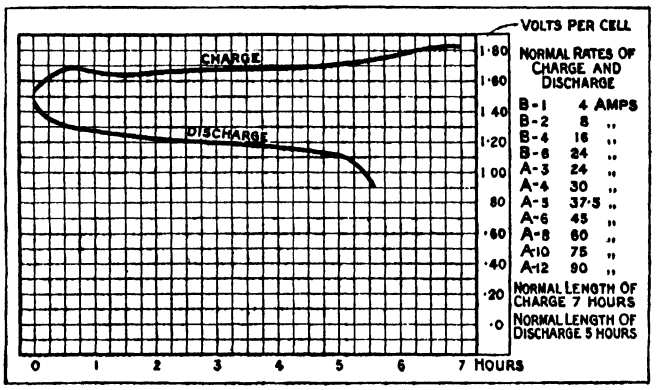


FIG. 26.—THE NORMAL RATES OF CHARGE AND DISCHARGE OF THE EDISON ACCUMULATOR

An output of one h.p. hour can thus be obtained for a weight of 50–60 lb. At the normal rate of charge and discharge the ampere-hour efficiency as rated by the manufacturer is 80%, and the watt-hour efficiency 60%.

The advantages of the Edison over the lead accumulator are its longer life, lighter weight, greater robustness against vibration and its immunity from harm due to standing in a discharged condition, being overdischarged, short circuited or charged in the reverse direction. (J. N. P.)

BIBLIOGRAPHY.—G. Planté, *Recherches sur l'électricité* (1879); Gladstone and Tribe, *Chemistry of Secondary Batteries* (1884); E. J. Wade, *Secondary Batteries* (1901); F. Dolezalek, *The Theory of the Lead Accumulator* (1906); G. W. Vinal, *Storage Batteries* (New York, 1924); M. Arendt, *Storage Batteries* (1928).

ACCURSIUS (Ital. ACCORSO), **FRANCISCUS** (1182-1260), Italian jurist, was born at Florence about 1182. A pupil of Azo, he first practised law in his native city, and was afterwards appointed professor at Bologna. He arranged into one body the almost innumerable comments and remarks upon the Code, the Institutes and Digests. This compilation, bearing the title *Glossa ordinaria* or *magistralis*, but usually known as the Great Gloss, though written in barbarous Latin, has more method than that of any preceding writer on the subject. The best edition of it is that of Denis Godefroi (1549–1621), published at

Lyons in 1589. His eldest son, FRANCISCUS (1225–93), who also filled the chair of law at Bologna, was invited to Oxford by King Edward I., and in 1275 or 1276 lectured on law in the university.

ACCUSATION, a legal term signifying the charging of another with wrong-doing, criminal or otherwise. For the accusation of another of a crime or of misconduct for the purpose of extortion, *see* BLACKMAIL.

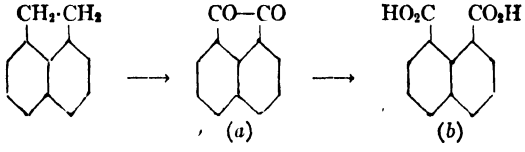
ACCUSATIVE, a case of the noun, denoting primarily the object of verbal action or the destination of motion.

ACE, the number one at dice, or the single point on a die or card; also a point in the score of racquets, lawn-tennis, tennis and other court games.

From its conventional use as the highest in a suit in card-games, the word has been employed (in France and elsewhere) to signify an aeroplane pilot of supreme skill and daring.

ACELDAMA (AKELDAMA, R. V.), land (originally a potter's field) said in Matthew to have been bought by the priests for a burial ground for strangers with the money which was returned by Judas, and could not be put into the treasury "because it was the price of blood," Aramaic חקל דמא, "the field of blood," Acts i. 19; *cf.* Matt. xxvii. 8. Acts ascribes its purchase to Judas himself, perhaps by mere compression. Manuscript authority gives AKELDAMACH (Ἀκελδαμάχ, Westcott and Hort) "the field of thy blood," which is unsuitable. Klostermann's suggestion *Probleme im Aposteltexte* (1883, pp. 1–8), "the field of sleep" (*dmak,* "he slept," used especially of sleep in death, *e.g.,* Targum of Job. iii. 12, Syr.: *dmaka,* "sleep") is very attractive, suggesting "cemetery," and although there is no other example of such a Jewish title the figure is old (Dan. xii. 2). If so, Akeldama will be only the popular, perhaps Christian, nickname. In any case Acts i. 19 can hardly be as early as St. Peter's speech in which it is incorporated. No plausible explanation is given for "ch" being added to Akeldama, and there is only one exactly parallel case, the mysterious *Sirach* for *Sira* (Ecclus. L. 27 [29]). Tradition from the fourth century places the plot on the Hill of Evil Counsel—"a little level plot overhanging the valley of Hinnom." . . . The potters probably "had here a cave in which their work was carried on." (*See* Schick, P E F Q. 1892, pp. 283–289.) (A. L. W.)

ACENAPHTHENE, an aromatic hydrocarbon first isolated from coal tar by M. P. E. Berthelot and subsequently synthesized from α-ethylnaphthalene. Crystallizing from alcohol in colourless needles, it melts at 95°C. and boils at 278°. Its formula is $C_{12}H_{10}$. On oxidation with chromic acid it yields (*a*) acenaphthenequinone employed in the manufacture of ciba scarlet and other red vat dyes; (*b*) naphthalic acid, a starting point in the production of perylene vat dyes. (*See* DYES, SYNTHETIC.)



Acenaphthene, which readily undergoes nitration and sulphonation, forms a characteristic orange picrate melting at 161°.

BIBLIOGRAPHY.—A. E. Everest, *The Higher Hydrocarbons* (1927). (G. T. M.)

ACEPHALI (ἀκέφαλοι), a term applied to sects having no head or leader; and in particular to a strict Monophysite sect that separated itself, in the end of the 5th century, from the rule of the patriarch of Alexandria (Peter Mongus), and remained "without king or bishop" till it was reconciled by Mark I. (799–819) (Gr. ἀ, privative, and κεφαλή, head).

See Gibbon, ch. xlvii. (vol. v., p. 129 in Bury's ed.).

ACEPHALOUS, headless, whether literally or metaphorically, leaderless. The word is used literally in biology, and metaphorically in prosody or grammar for a verse or sentence with a beginning wanting. In zoology, the Mollusca are divided into cephalous and acephalous (Acephala), according as they have or have not a head. The Acephala , or Lamellibranchia (*q.v.*), are the bivalve shell-fish. In botany the word is used for ovaries not terminating in a stigma.

ACERENZA (anc. *Acheruntia*), province of Potenza, Italy, the seat of an archbishop, 15½m. N.E. of the station of Pietragalla, which is 9m. N.W. of Potenza by rail, 2,730ft. above sea-level. Pop. (1921) 4,372. Its situation is one of great strength

ACERRA, town and episcopal see, province of Naples, Italy, 9m. N.E. from Naples. Pop. (1921) 15,987 (town), 18,200 (commune). The town lies on the right bank of the river Agno, 90ft. above sea, in a fertile but somewhat marshy district, formerly malarious. It became a city with Latin rights in 332 B.C.; was destroyed by Hannibal (216 B.C.); restored (210); served as Roman headquarters in the Social War (90).

ACERRA, in Roman antiquity a small box or pot for holding incense; also a little altar placed near the dead on which incense was offered every day till the burial. In ecclesiastical Latin, an incense boat.

ACETABULUM, the Latin word for a vinegar cup, an ancient Roman vessel, used as a liquid measure (equal to about half a gill); it is also used in biology for certain cup-shaped parts; *e.g.,* the socket on the hip girdle for the head of the thigh-bone, the receptacle of Fungi, etc.

ACETALDEHYDE or simply "aldehyde," is the second aldehyde (*q.v.*) of the aliphatic series. It occurs in the "first runnings" from alcohol stills, wood spirit, petroleum, etc. It is produced when ethyl alcohol is oxidized and gives acetic acid on oxidation (CH_3·CHO). It has a characteristic odour, not unlike ivy leaves.

ACETALS, the ethers (*q.v.*) and esters (*q.v.*) derived from the glycols. (*See* GLYCOLS.) The *aromatic acetals* are derivatives of catechol (*q.v.*).

ACETAMIDE: *see* AMIDES.

ACETANILIDE, also called *antifebrin,* made by the interaction of glacial acetic acid (*q.v.*) with aniline (*q.v.*). It is a febrifuge or antipyretic, used in headaches and fevers, of which it reduces the pain without removing the cause. The dose is 0·1 to 0·3 grams (1½ to 5 grains). It is liable to cause aniline poisoning, a depressant action on the heart muscle, resulting in collapse, nausea, vomiting and a blueness of lips and nails. The last is caused by certain chemical changes in the blood, whereby red corpuscles lose their power to carry oxygen. Acetanilide is a white, crystalline substance melting at 115° C, boiling at 305° C and soluble in water, alcohol or ether. Its chemical formula is C_6H_5·NH·CO·CH_3.

ACETATES: *see* ACETIC ACID.

ACETIC ACID, the organic acid which gives to vinegar (from which it derives its name) its characteristic sharp taste, is the second of the series of aliphatic acids, formic acid (*q.v.*) being the first. Its formula is CH_3·CO_2H, and it occurs in nature in plant juices occasionally as free acid, but more generally as calcium or potassium salts. Three processes are available for large-scale production of acetic acid, CH_3·COOH.

1. Fermentation Processes.—Several species of bacteria convert dilute alcoholic liquors into impure acetic acid, in the form ordinarily known as vinegar. This bacterial fermentation, which takes place in the presence of air and a certain amount of nutrient phosphates and nitrogenous material necessary for the feeding of the bacteria, involves the oxidation of ethyl alcohol (*see* ALCOHOL) into dilute acetic acid. A more concentrated acid is obtainable by neutralizing the dilute acid with lime to form calcium acetate and then distilling a mixture of this salt with strong sulphuric acid. In the oxidation of alcohol to acetic acid the living acetic bacteria may be replaced by specific enzymes (unorganized ferments) or even by spongy platinum or palladium since either of these, in the presence of air, oxidizes the alcohol first to acetaldehyde and then to acetic acid.

2. Destructive Distillation of Wood.—A considerable proportion of the acetic acid of commerce is obtained by the destructive distillation of wood, the hard woods yielding 4·70 to 6·5% of the concentrated acid.

3. Synthetic Acetic Acid.—The starting point in the industrial synthesis of acetic acid is calcium carbide made in the electric furnace from limestone and coal. The acetylene evolved from the carbide by addition of water is converted into acetaldehyde

by passing into hot dilute sulphuric acid containing mercuric sulphate. The acetaldehyde is further oxidized by air or oxygen in the presence of a catalyst consisting of the oxides of metals such as iron, vanadium and uranium, acetic acid being thereby formed.

Anhydrous acetic acid, usually termed glacial acetic acid owing to its ice-like crystallization at 16·7°C., has a very pungent odour and boils at 118°C. to a heavy inflammable vapour. Its alkali salts are soluble in water. Ferrous and ferric acetate are used as mordants in dyeing (*q.v.*) Normal lead acetate is known in commerce as sugar of lead and basic copper acetates are known as verdigris (*q.v.*).

Acetic acid and the acetates are detected by heating with ethyl alcohol and sulphuric acid; ethyl acetate is evolved and recognized by its fragrant odour. When heated with arsenious oxide, acetates give rise to the malodorous and highly poisonous cacodyl oxide.

Pharmacology and Therapeutics.—Glacial acetic acid is sometimes used as a caustic for corns. Vinegar (with 5% acetic acid) is taken as a cure for obesity, but this application is undesirable since continued use may so injure the mucous membrane of the stomach as to cause indigestion and a morbid reduction in weight. The soluble acetates, and especially potassium acetate, are useful medicinal agents for after absorption in the blood, they are oxidized to carbonates, thus acting as *remote* alkalis increasing the alkalinity of the blood or reducing the acidity of the urine without the disturbing influence of alkalis on the digestive tract.

ACETO-ACETIC ESTER, ethyl acetoacetate is an outstanding example of a chemical substance having a dual character arising from the possession of two different molecular structures. Such substances are called tautomeric compounds (*see* ISOMERISM and TAUTOMERISM). The substance is an ester (*q.v.*), and has the molecular formula $C_6H_{10}O_3$. The two tautomeric forms are represented by

$$CH_3{\cdot}CO{\cdot}CH_2{\cdot}CO{\cdot}OC_2H_5 \text{ (ketonic form) and}$$
$$CH_3{\cdot}C(OH){:}CH{\cdot}OC_2H_5 \text{ (enolic form),}$$

and ordinary specimens of the ester as handled in commerce may be regarded as consisting of 93% of the former in equilibrium with 7% of the latter. When treated by reagents which combine with ketones, such as sodium bisulphite, hydroxylamine, phenylhydrazine and hydrocyanic acid, the ketonic character of the ester is manifested, and when acted upon by reagents such as phosphorus pentachloride, diazomethane, ammonia and amines, which detect alcoholic (enolic) groups, then its enolic nature is revealed.

In 1911 L. Knorr separated the two forms of the ester in a state of purity. The ketonic modification was frozen out of the equilibrium mixture at −78° C and the enolic modification was isolated in the liquid condition by decomposing the sodium derivative with hydrogen chloride at the same low temperature. In these experiments it was found to be essential to use silica vessels. The ester was first discovered by A. Geuther in 1863 and its ketonic nature was unravelled by E. Frankland and B. F. Duppa in 1865. The original method of production is still employed on a manufacturing scale. Sodium, either molten or in wire form, is added to dry ethyl acetate containing a little ethyl alcohol. When all the metal has dissolved the mixture is acidified with dilute acetic or sulphuric acid and the crude acetoacetic ester, which is partially miscible with water, separates as an oil on addition of common salt and is purified by distillation under diminished pressure. The ester is a colourless, fragrant liquid boiling, with slight decomposition, at 181° C under a pressure of 760 mm.

In the sodium condensation a little alcohol is needed to promote the solubility of the metal and this action of alcohol is indicated in the following equations:—

i. $2C_2H_5{\cdot}OH + 2Na = 2C_2H_5{\cdot}ONa + H_2$
ii. $CH_3{\cdot}CO{\cdot}OC_2H_5 + C_2H_5ONa = CH_3{\cdot}C(OC_2H_5)_2{\cdot}ONa$
iii. $CH_3{\cdot}C(OC_2H_5)_2{\cdot}ONa + CH_3{\cdot}CO{\cdot}OC_2H_5 = 2C_2H_5OH + CH_3{\cdot}C(ONa){:}CH{\cdot}CO{\cdot}OC_2H_5$.

In the chemical laboratory acetoacetic ester is a valuable synthetic reagent, for its sodium derivative when acted on by an alkyl iodide yields an alkylacetoacetic ester, and the sodium derivative of the latter ester by similar means furnishes a dialkylacetoacetic ester. These alkyl- and dialkyl-acetoacetic esters may be employed in producing either higher ketones or higher fatty acids (*see* CHEMISTRY: *Organic, Aliphatic*). The ester has also been employed in the synthesis of pyridines (*q.v.*), quinolines (*q.v.*), furfuranes (*q.v.*), pyrazoles (*q.v.*), pyrroles (*q.v.*), and compounds of the purine group (*q v.*).

In addition to the foregoing scientific uses acetoacetic ester is utilized industrially in the manufacture of synthetic drugs and dyes. Of these drugs the best known is antipyrine (*q.v.*) which is prepared by methylating phenylmethylpyrazolone, the condensation product of acetoacetic ester and phenylhydrazine.

Several important dyes belong to the pyrazolone series. Eriochrome red (Chrome fast red B) is manufactured by successively condensing acetoacetic ester with phenylhydrazine and with diazotized 1-amino-β-naphthol-4-sulphonic acid. A series of yellow dyes and pigment colours is similarly produced by condensing the ester successively with various aromatic hydrazines and diazocompounds (*see* DYES, SYNTHETIC).

ACETONE is present in very small quantities in normal urine, in the blood, and in larger quantities in diabetic patients, and is the simplest representative of the aliphatic ketones. It results with other ketones from the destructive distillation of wood and other cellulosic derivatives, and for this reason it is present in crude wood spirit (methyl alcohol). It has the formula $CH_3{\cdot}CO{\cdot}CH_3$ and is thus dimethyl ketone. Acetone is a colourless, fragrant, inflammable, mobile liquid, boiling at 56·3° C and miscible in all proportions with water, alcohol and ether. It has very useful solvent properties, dissolving considerable quantities of acetylene gas (*q.v.*). It dissolves many fats and resins and is a solvent for cellulose nitrate and acetate. On account of the latter properties, it finds extensive use in the manufacture of cordite and of artificial silk.

On account of its valuable properties as a solvent and as an organic reagent, acetone is prepared on a large scale, the processes available being as follows.—

1. The dry distillation of calcium acetate leading to the formation of acetone and calcium carbonate.
2. The catalytic (*see* CATALYSIS) decomposition of glacial acetic acid into acetone, carbon dioxide, and water when it is passed over heated metallic oxides such as alumina and thoria.
3. The fermentation of maize, rice, horse chestnut meal or other starchy materials with a bacterium discovered by A. Fernbach, the starch present being converted into a mixture of normal butyl alcohol (2 parts) and acetone (1 part).

Acetone is employed in many organic syntheses. Dehydrating agents convert it successively into mesityl oxide and phorone, and on distillation with sulphuric acid it is transformed by elimination of water into mesitylene (1:3:5-trimethylbenzene) In conjunction with *ortho*nitrobenzaldehyde, it has been used to prepare artificial indigo.

Therapeutic Applications.—The ketones in general give rise to narcosis and lowering of blood pressure and acetone itself produces intoxication and sleep but is less powerful than ether or chloroform, although less toxic than ethyl alcohol. When treated with chlorine, bromine, or iodine in presence of alkali, acetone is converted respectively into chloroform, bromoform, or iodoform. It is the starting point in the production of the narcotic drug sulphonal.

ACETOPHENONE or Phenyl Methyl Ketone is the simplest representative of the mixed aliphatic-aromatic ketones. It crystallizes in colourless leaflets with a characteristic odour; it melts at 20° C and boils at 202° C, is volatile in steam and has the composition, $C_6H_5{\cdot}CO{\cdot}CH_3$. It occurs to a small extent in coal tar and, having feebly basic properties, is extracted from the heavy oil fractions (b.p. 160–190°) with sulphuric acid.

Acetophenone condenses with phenylhydrazine but does not combine with sodium hydrogen sulphite. It results from the distillation of a mixture of dry calcium acetate and benzoate but is best prepared by condensing benzene and acetyl chloride with

aluminium or ferric chloride in carbon disulphide. It has anaesthetic and sopotific properties and under the name of hypnone has been used as a drug to induce sleep. With hydroxylamine it condenses to acetophenoneoxime, $C_6H_5{\cdot}C(CH_3){:}NOH$, which, under the influence of phosphorus pentachloride in ether is converted into the isomeric acetanilide, $C_6H_5NH{\cdot}CO{\cdot}CH_3$, this transformation being an example of the so-called Beckmann change which occurs with ketone oximes in general.

p-Aminoacetophenone also has anaesthetic properties, whereas the condensation product of acetophenone and phenetidine is an antipyretic substance. On adding sodium to acetophenone dissolved in ethyl acetate the sodium derivative of benzoylacetone is produced from which benzoylacetone, $C_6H_5CO{\cdot}CH_2CO{\cdot}CH_3$ is obtained by acidification, this condensation being a typical example of the Claisen reaction.

ACETYLENE is a colourless gaseous compound of 7·75% of hydrogen and 92·25% of carbon, used as a fuel, both in the oxy-acetylene process for the welding and cutting of metals, and also for isolated or independent lights. It is of great interest to the chemist, being the simplest of all the *unsaturated* organic compounds with the composition CH:CH (*see* CHEMISTRY: *Organic*). If subjected to a pressure of 61·6 atmos. at the critical temperature of 36·5° C, it suddenly becomes a colourless transparent liquid. At lower temperatures it becomes liquid under less pressure, *e.g.*, at 15° C under slightly less than 38 atmos, and at −82° C under one atmos. On a slight further reduction of temperature, the liquid contracts considerably, passing to a crystalline solid.



BY COURTESY OF LINDE AIR PRODUCTS CO

CUTTING METAL WITH AN OXY-ACETYLENE FLAME, ONE OF INDUSTRY'S MANY USES OF ACETYLENE

The characteristic and unpleasant smell generally associated with acetylene is not due to this gas at all, but to traces of impurities in the calcium carbide from which it is made in all ordinary cases (*see* below).

The density of pure gaseous acetylene is 0·91 (air=1), whereas that of marsh gas (methane) is 0·55, and of town gas (coal-gas, usually with some water gas) between 0·40 and 0·55. Its higher density signifies that acetylene requires pipes and nozzles of larger bore to pass the same volume of gas without greater pressure, but this disadvantage is offset by the fact that a given heating or lighting effect is obtainable from a considerably smaller volume of acetylene than of either of the other gases named. One litre of dry acetylene at 0° C and under 760mm. pressure weighs 1·1613 gram; one cu.ft. of acetylene, saturated with water vapour at 60° F and 30in. pressure, weighs 0·0675lb. Its mean coefficient of expansion between 0° and 100° C is 0·003738 (air =0·003671).

The density of liquid acetylene is 0·613 at −80° C, 0·451 at 0° C and 0·397 at 30° C; the coefficient of expansion is thus exceptionally high—0·00224 for each degree. The figures also show that liquid acetylene is one of the lightest of liquids. It is of interest only from the scientific standpoint, because it behaves as an explosive when subjected to heat or when exposed to a spark, and its manufacture and sale are generally prohibited.

Water at 15° C dissolves 1·15 times its volume of gaseous acetylene at atmospheric pressure; at 0° C, 1·73 times, and at 30° C, 0·84 times. Whereas this degree of solubility in water is considerably higher than that of other fuel gases, it is not such as to preclude the use of water as a confining liquid in acetylene-generating plant and gasholders. In special cases in which it is desirable to reduce the diffusion of acetylene through the seals of such plant, fresh water is replaced by a saturated solution of calcium chloride, which at 15° C dissolves only 0·06 of its volume of acetylene, or by strong brine. A saturated solution of common salt at 15° C dissolves 0·21 of its volume of acetylene. These saline solutions freeze at considerably lower temperatures than fresh water, and consequently gasholders in which they are employed as the confining liquid may be used without protection from mild frosts. On the other hand, they shorten the life of the plant, their corrosive action on iron and other metals being greater than that of water. A water solution of glycerine is an alternative which is non-corrosive and does not affect metals.

Acetylene dissolves more freely in most organic liquids than in water. At ordinary temperature and pressure one volume of each of the following liquids dissolves the number of volumes of acetylene shown:

	Vols.		Vols.
Carbon disulphide	1 0	Chloroform	4 0
Water	1 15	Amyl alcohol	3 5
Lime water patd. at 20°C	1 23	Absolute ethyl alcohol	6 0
Paraffin oil	1·5	Acetic acid	6 0
Benzene	4·0	Acetone	25·0

"Dissolved Acetylene."—The relatively large solubility in acetone was first observed by G. Claude and A. Hess in 1897, who stated in the *Comptes Rendus* of that year that the solubility was also very nearly proportional to the pressure, being 12×25=300 vols. at a pressure of 12 atmos. They pointed out that the coefficient of expansion of the solution in acetone was very much lower than that of liquid acetylene, and moreover, the solution did not explode when a wire in it was raised to bright redness. Their observations led ultimately to the development of the present method of supplying acetylene in portable steel cylinders, in which it is safely stored under pressure as a solution in acetone. Acetone increases in volume by 4·4% for each atmosphere pressure at which it is saturated with acetylene. Consequently acetone in which acetylene is dissolved under an absolute pressure of 16 atmos. occupies 1+(16×0·044)=1·684 times its original volume. This pressure, viz., 15 atmos. above the normal, is that to which steel cylinders packed with porous substance and containing acetone, are permitted by law to be charged with acetylene in Great Britain. The cylinders must first have been tested and found to show no permanent stretch after being subjected for 15 minutes to four times the charging pressure. Similar regulations are enforced in other countries in regard to the supply of acetylene in steel cylinders. The cylinders are now usually seamless or solid-drawn. In the U.S., acetylene cylinders are constructed with welded or biased heads or tops.

Acetylene dissolved under pressure in acetone in steel cylinders is known commercially as "dissolved acetylene." Its production has become a considerable industry in most countries, on account of the convenience to users of a portable supply of acetylene, with relief from the provision and supervision of generating and purifying plant. Since the volume of acetone varies with the amount of acetylene dissolved in it, it is obvious that the cylinders in use must be only partially filled with the liquid, the remaining space being occupied by compressed gaseous acetylene. Such compressed free acetylene would be liable to explode if the cylinder were exposed to great heat or shock, but this risk is avoided by first filling the cylinder with inert porous material, the interstices in which will be sufficiently small to prevent any explosion which may happen to be initiated at some point therein extending beyond that point. The porous material in this respect acts similarly to the fine wire gauze of a miner's safety lamp, which prevents the flame within the lamp igniting explosive gas outside it. Various porous materials have been used for this purpose, *e.g.*, dried clay, porous brick, infusorial earth, Kieselguhr and charcoal, singly or in admixture with or without a binder. In Great Britain the porous material preferred is the vegetable fibre, kapok, the resilient properties of which cause it to be evenly distributed, and free from open spaces of such a size that, should an explosion occur, it would assume dangerous magnitude. Kapok has the dual advantage of providing spaces between its fibres, and of having natural capillaries within the latter.

Current practice in Great Britain is to pack the cylinder uniformly with kapok until the solid matter of the latter occupies one-fifth of the capacity of the cylinder, thus leaving four-fifths

as interstices in the kapok packing. Then acetone is run in to fill a further two-fifths; leaving two-fifths of the internal volume of the cylinder for expansion of the acetone on charging with acetylene, and any subsequent exposure to heat. Cylinders of dissolved acetylene thus prepared are convenient and safe.

Uses.—Acetylene requires 2·5 times its volume of oxygen to effect its complete combustion; consequently all the oxygen present in 11·95 times its volume of air is used up when acetylene is burned in open jets. Such jets are employed as lights in portable lamps, buoys, road signals, isolated premises, etc., but the consumption of acetylene for lighting is small compared with its use in the industrial welding and cutting of metals, for which purposes it is consumed in a blow-pipe to which a supply of undiluted oxygen is given from a steel cylinder containing that gas under pressure. Acetylene is an "endothermic" compound, which means that heat has been absorbed in its formation; and this heat is given out again, in addition to the heat of combustion of its constituent carbon and hydrogen, when acetylene is burned On this account, acetylene affords a higher flame temperature than other fuel gases. Its calorific value lies, according to different observers, between 11·8 and 12·2 cals per grm. Taking Berthelot and Matignon's figure of 12·13, the calorific value of one litre of acetylene at 0° C and 760mm., dry, is 14·086 calories, and that of one cu ft. at 60° F, 30in., and saturated, is 1,474 B.Th U. (British standard conditions). For comparison with the latter figure, it should be mentioned that town gas in Great Britain averages about 500 B Th U., and natural gas in U S A. nearly 1,000 B.Th U.

Disadvantages.—Acetylene in itself has very slight toxic properties, but certain of the impurities, such as phosphine, which occur in it before purification, are highly toxic. Nevertheless, even crude acetylene may be inhaled with less risk than ordinary town gas

A mixture of acetylene with air will explode from a light or spark, according to F. Clowes, unless the acetylene forms less than 3% or more than 82% of the mixture. Other observers give a more limited range to the explosive mixture, but it is certainly very much wider in similar conditions than for coal gas or natural gas, and greater care should be exercised to avoid both escapes of acetylene and naked lights in the proximity of leaks It must be emphasized, however, that acetylene at ordinary pressures cannot be made to explode in the absence of air, oxygen or chlorine, and in this respect it is similar to coal gas and other fuel gases. When, however, it is compressed to more than 2 atmos , a spark or red-hot wire will effect its dissociation, which will spread through the whole, and the heat liberated by reason of its endothermic character will give rise to all the effects of an explosion. On this account in most countries acetylene may not be compressed to more than 2 atmos., unless it is within a porous material, as described above.

Carbides.—Acetylene was discovered by E Davy in 1836, when he decomposed with water a black mass, produced by strongly heating a mixture of calcined tartar and charcoal. The mass contained potassium carbide. Other metallic carbides were produced between that year and 1891–92, when calcium carbide was made in an electric furnace almost simultaneously by H. Moissan on a very small scale in Paris, and by T. L. Willson, a Canadian electrical engineer, at an aluminium works at Spray, near Leaksville, North Carolina. Before the close of the year 1895, the commercial production of calcium carbide had been started at Niagara, at Froges (France) and at Foyers (Scotland). Its manufacture is now conducted on a large scale in most countries where water-power is obtainable at low cost, notably in Norway and Sweden, Shawinigan (Quebec) and Niagara. The world's output varies from year to year and cannot be estimated closely, but it may be mentioned that the imports of calcium carbide into Great Britain in the years 1924, 1925 and 1927 have averaged about 40,000 tons per annum. The United States and France ordinarily consume larger quantities than Great Britain. Other carbides which yield acetylene when brought in contact with water are those of potassium, sodium, lithium, barium and strontium, but calcium carbide is the most economical to produce and use. (*See* also CARBIDES.)

Calcium carbide is a compound of calcium and carbon, having the formula CaC_2, and therefore containing, in its pure state, 37·47% of carbon. It interacts with water immediately it is brought in contact with it, yielding 40·62% of its weight of acetylene (dry), and slaked lime. This yield of acetylene is equivalent to:

5 600 cu ft. at 0° C, 760mm , and dry, per lb. of pure CaC_2.
or 6 16 cu.ft. at 60° F, 30in., and saturated, per lb. of pure CaC_2.
or 349 7 litres at 0° C, 760mm., and dry, per kg. of pure CaC_2.
or 375·6 litres at 15° C, 760mm., and saturated per kg. of CaC_2.

Commercial calcium carbide contains upwards of 20% of inert material, and is ordinarily guaranteed to give a standard yield of 4·80 cu.ft., at 60° F, 30in., and saturated, per lb , or the equivalent figure of 300 litres, at 15° C, 760mm. and saturated, per kg. This standard represents fairly closely the average yield obtainable from commercial carbide in 1925–27, though occasionally the inert material in the carbide falls as low as 10%, and on the other hand sometimes reaches as much as 30%. Pure calcium carbide has a specific gravity of 2·22, and resembles fine-grained granite or hard limestone in appearance and hardness. The commercial product is broken and screened to lumps of convenient size for different uses, and is packed for transport in air-tight steel drums of 50 and 100kg. capacity. Since it evolves acetylene slowly when exposed to damp air, and rapidly when wetted, calcium carbide is everywhere subject to special regulations for transport by sea and land, and for storage.

Calcium carbide is manufactured by heating together in the electric furnace a mixture of lime and anthracite containing about 40% of the latter. Both materials must be as free as possible from impurities, and especially from compounds of phosphorus, sulphur or silicon, which render the resultant carbide liable to produce acetylene containing phosphine, hydrogen sulphide and silicon hydride Carbide is sold generally under a guarantee that the gas it yields shall not contain more than 0·05% by volume of phosphine, or 0·15% of hydrogen sulphide. These impurities are inimical to the satisfactory use of the acetylene for either lighting or welding, and it is necessary to pass the gas before it is used through a vessel containing a purifying agent which will abstract them Purifying agents which will abstract phosphine completely and economically, without acting upon the acetylene, have been sought in many directions, but only three classes of materials have found practical application. The principal active constituents of these materials are:—(1) chlorine liberated from a hypochlorite as used in "Acagin," "Puratylene" and "Klinger's Material"; (2) oxygen derived from an acid solution of chromic acid absorbed by infusorial earth, as in "Heratol," or from an ill-defined iron-silicic-acid compound, as in "Carburylene"; and (3) copper, as an acid solution of cuprous chloride absorbed in infusorial earth, as in "Frankolin." All these materials, when properly prepared, may be regarded as effective in that 1lb. will abstract the impurities from 80 to 200 cu ft. of acetylene produced from carbide of the normal degree of purity. It is obvious, however, that the purifying material will be exhausted less quickly the smaller are the proportions of phosphine and hydrogen sulphide in the crude gas, and consequently there is an initial advantage in calcium carbide which is relatively free from phosphorus and sulphur compounds.

Acetylene is obtained from calcium carbide by bringing the latter in contact with water, and innumerable forms of "generators" have been devised with the object of effecting and controlling the reaction between the carbide and the water in such a manner that the acetylene shall be liberated at the desired rate. The reaction, represented by the formula $CaC_2+2H_2O=C_2H_2+Ca(OH)_2$, is one in which heat is set free. Thus, 1lb. of pure calcium carbide decomposed with excess of water liberates about 4,380 B.Th.U. (or one kg. liberates 2,433kg.-calories). These figures become more significant if it is borne in mind that 4,380 B.Th.U. represents the heat imparted to 2·92gals. of water in raising it from 62° F to its boiling point. Except on the very small scale of a bicycle lamp, therefore, no acetylene generator can depend on atmospheric cooling for the dissipation of the liberated heat. Generators must, in practice, be so designed that

the heat liberated therein shall be imparted to water, which shall be available in sufficient volume not to be raised to the boiling point. The water may be so disposed or circulated that it gives up its heat rapidly to the atmosphere.

In small generators, water commonly drips on to the carbide, at a rate controlled by a hand-operated valve and, or by the restriction of the free egress of the evolved gas. In large generators, however, the carbide either is dropped into a large excess of water, or is intermittently submerged by a local excess of water. Provision should be made for the sludge of slaked lime, which is the residue of the decomposition of carbide, to settle down out of close contact with carbide which has not already been decomposed. The sludge is, in most instances, withdrawn or run off at intervals in a semi-fluid condition. The rapid decomposition of a large charge of carbide may raise particles of metal inside the generator to a temperature above that at which acetylene ignites in air, and it is important that generators, liable to be recharged at short intervals, should be so constructed that air cannot enter the heated interior during discharging and recharging.

The harmfulness of overheating in generators, through inadequate cooling, lies in the fact that acetylene is a compound which is transformed, when heated to temperatures not much above that of boiling water, into polymerides or other hydrocarbon compounds, such as benzene, which have the same or nearly the same percentage composition, but are not gaseous at ordinary temperatures, or have not the same value as illuminating or heating gases. The fact that acetylene is prone to polymerization (*q.v.*), and to enter into combination, at comparatively low temperatures, makes it a very valuable medium for the manufacture of a number of organic chemicals such as acetaldehyde (*q.v.*), acetic acid (*q.v.*) and acetone (*q.v.*).

Lighting.—Acetylene for lighting purposes is burned, under a pressure of about 4in. water-seal, in steatite jets so designed that the issuing gas draws sufficient air into the flame to effect the combustion of the gas without smoke being produced. The acetylene flame thus formed is the most highly self-luminous of all ordinary gas flames, and its spectral character is such that colours are seen by it as in daylight. Burners in general use consume either 0·5 or 0·7 cu.ft. of acetylene per hour, and give a light equivalent to between 40 and 50 candles per cubic foot consumed. Acetylene may also be used to raise mantles to incandescence, and its illuminating effect is thereby raised to about 100 candles per cubic foot. Mantle burners are best fitted for use in conjunction with "dissolved acetylene," which gives an adequate constant pressure for their proper action.

Special forms of blow-pipes are used to produce the oxy-acetylene flame for the welding and cutting of steel and other metals, for which purposes acetylene finds its principal outlet.

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ACETYLENE, IN MEDICINE. Acetylene, which when pure loses its usual offensive smell, is an anaesthetic when inhaled and was first used as such in 1924. Like ethylene (*q.v.*) it is in the experimental stage at present. Its efficiency is between that of gas-oxygen and ether. It has the advantage that far greater amounts of oxygen can be given with it, up to about 50%, than with ethylene or nitrous oxide. (*See* ANAESTHETICS.) (W. S. S.)

ACHAEA. (1) A district on the north coast of the Peloponnese, between the mountains of Erymanthus and Cyllene and the Corinthian Gulf; bounded on the west by Elis, east by Sicyon, sometimes included in Achaea. The 12 cities in its narrow fertile coastland formed a religious confederacy, meeting in Poseidon's sanctuary at Helicé: from this developed the political ACHAEAN LEAGUE (*q.v.*) of Hellenistic times.

(2) Achaea Phthiotis is a district south of Thessaly and west of the Gulf of Pagasae (Volo). For the origin of the name, and relations between north and south Achaea, *see* ACHAEANS.

(3) "Achaea" was the name given by the Romans to the province formed in 140 B.C. for the mainland of Greece south of Thessaly, Epirus and Acarnania, which were included in "Macedonia." Its administrative capital was Corinth.

(4) Achaea in the middle ages was a principality, formed within the same region after the Latin conquest of the Eastern empire (A.D. 1204): the first prince being William de Champlitte (d. 1209). It survived, with various dismemberments, until 1430, when the last prince, Centurione Zaccaria, ceded the remnant to his son-in-law, Theodorus II., despot of Mistra. In 1460 it was conquered, with the rest of the Morea, by the Turks.

(5) Achaea in modern Greece is the Peloponnesian district (1), mainly engaged in currant growing, the crop being shipped from Patras and Aegion (Vostitza).

ACHAEAN LEAGUE, a confederation of the towns of Achaea in ancient Greece. Isolated on their narrow strips of plain, these towns were exposed to the raids of pirates from the north of the Corinthian gulf As a protection against such dangers the earliest league of 12 Achaean cities arose. In the 4th century, we find it fighting in the Theban wars (368–362 B.C.), against Philip (338) and Antipater (330). Antigonus Gonatas dissolved the league; but by 280 B.C. four towns combined again, and before long the ten surviving cities of Achaea had renewed their federation. Much was due to the statesmanship of Aratus (*q.v.*), who initiated an expansive policy; in 228 it included Arcadia, Argolis, Corinth and Aegina.

Aratus probably also organized the new federal constitution. The league embraced city-States which maintained their internal independence and powers of self-government. Only in foreign politics and war was their competence restricted.

The central government was democratic. The legislative powers resided in a popular assembly, meeting at Aegium, in which every member of the league over 30 years of age could speak; each city counted one on a division. Extraordinary assemblies could be convoked in special emergencies. A council of 120 delegates served as a committee for preparing the assembly's programme. The chief magistracy was the *strategia* which combined with an unrestricted command in the field a large measure of civil authority and had practically the sole power of introducing measures before the assembly. The ten *demiurgoi*, who presided over this body, formed a kind of cabinet. Philopoemen (*q.v.*) transferred the seat of assembly from town to town by rotation, and placed dependent communities on an equal footing with their former suzerains.

The league prescribed uniform standards and coinage; it summoned contingents, imposed taxes and fined or coerced refractory members.

The first federal wars were against Macedonia, against Antigonus Gonatas and Aetolia and, with Aetolia, against Demetrius. A greater danger arose (227–223) from the attacks of Cleomenes III. (*q.v.*) Owing to Aratus's irresolute generalship the indolence of the burghers and the inadequacy of its troops, the league lost much of its territory. The assembly negotiated with Antigonus Doson, who recovered the lost districts but retained Corinth for himself (223–221). When Philip V. came to the rescue against the Aetolians he annexed much of the Peloponnese. Under Philopoemen the league, with a reorganized army, routed the Aetolians (210) and Spartans (207, 201). After their neutrality during the Macedonian War the Roman general, T. Quintius Flamininus, restored their lost possessions, bringing the Peloponnese under Achaean control. In 150 B.C. the league, in defiance of Rome, attacked Sparta. The federal troops were routed near Corinth by L. Mummius Achaicus (146). The Romans now dissolved the league, and took measures to isolate the communities. Augustus instituted an Achaean synod comprising the dependent cities of Peloponnese and central Greece.

The chief defect of the Achaean league lay in its lack of provision for securing efficient armies and regular payment of imposts, and for dealing with disaffected members. It is the glory of the league, however, to have combined city autonomy with an organized central administration, and in this way to have postponed the entire destruction of Greek liberty for over a century. (*See* ROME. *History*)

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Greek History; L. Whibley, *A Companion to Greek Studies* (1916). The chief classical authorities are Polybius (esp. ii, iv., v., xxiii. and xxviii.), who is followed by Livy (xxxii., xxxv., xxxviii., etc.); Pausanias vii. 9. 24.

ACHAEANS. The name Achaeans is used in the Homeric poems in much the same sense as that in which the name Hellenes came to be used in later times. To Homer the Hellenes were a small tribe in Southern Thessaly (*Il.* ii. 684), but from the 8th century onwards the name became a general designation for all Greek-speaking peoples. Whether the name Achaeans was quite so general in its application is still a matter of doubt, but for practical purposes we may regard it as parallel. According to the traditional genealogies Achaeus was the son of Xuthus, son of Hellen.

The name has been connected with that of the Germanic tribe, Ingaevones, a connection that is possible but, perhaps, not very convincing. No light is thrown by it upon the meaning of the name. The Achaeans were a Greek-speaking people, but whether their dialect was Aeolic, Ionic or of the Arcadian type is a question that cannot yet be decided. The Homeric poems are in an artificial literary dialect.

The exact relationship between the Achaeans and Mycenaean culture is still a matter of doubt. The view held by Sir William Ridgeway was that the Achaeans were invaders from the north, a people of northern characteristics, of the fair-haired, grey-eyed type, bringing to Greece a civilization of Danubian origin distinguished by the use of iron, similar to the Hallstatt and Villanova cultures. The former inhabitants were, in his view, of a short, dark Mediterranean type, but Greek-speaking. It was the Achaeans who, according to this view, brought the *labialising* dialects to Greece.

The view more generally held, however, has been that the Mycenaean peoples were not Greek-speaking. The question depends to some extent upon another: What was the language spoken by the Minoan peoples of Crete, of whose culture the Mycenaean was an offshoot? There is no real evidence that the Minoans spoke Greek, or even an Indo-European language at all, and indeed there are many considerations that point to the conclusion that they did not.

A third and more recent view is that the Greek-speaking peoples came to Greece in three separate waves, Ionian, Achaean and Dorian, the first invasion occurring about the 17th century B.C. The Mycenaean civilization was an Achaean civilization, Greek-speaking, and differing in certain notable respects, for example, in dress, from the Minoan. The Greek invaders subdued a previous non-Greek population and first destroyed the Minoan civilization, afterwards reconstituting it, mingled with northern elements, their advent having much the same effect as the barbarian conquest of the Roman empire.

The facts hitherto known are these. There had existed an early population of Greece having a close connection with Anatolia. A large number of place names occur throughout the Greek mainland as well as in Macedonia, Epirus and Thrace which are paralleled in Asia Minor, notably those in *-νθος* and *=σσος*. These are generally regarded as being non-Indo-European and therefore non-Greek. The Greeks were aware of the existence of earlier inhabitants of their country and the Aegean islands, whom they called by the general name of Pelasgians (*q.v.*), distinguishing, however, Leleges and Carians, the latter of whom inhabited the south-western corner of Asia Minor in historical times.

Again, it is probable, if not certain, that the whole Peloponnese, and possibly parts of Central Greece, were inhabited by Ionians previous to their conquest by Achaeans. The traditional home of the Ionians was in the north-eastern Peloponnese, whence they were driven to Attica and the Cyclades by an Achaean invasion. The fact that the name Ionian was applied to the sea west of Greece, on whose shores no Ionians lived in historical times, nor could have done so for many centuries previously, shows that the whole Peloponnese at least must once have been regarded as Ionian. The Achaeans emerge into history in the middle of the 14th century B.C. In the year 1922 a reference to them (Akhkhiyawa) in one of the Hittite texts of that date was read by Dr. Forrer. They were at that time an important naval power situated in the western regions of Asia Minor and the island of Lesbos, and were under the leadership of a prince named Attarsiyas. They appear to have been also in Cyprus and Pamphylia. Later, as has been already mentioned, in the Homeric age the Achaeans were lords of the Peloponnese and as far north as Thessaly, and their name, so far as can be gathered, was employed as a general designation for all Greeks.

The physical characteristics of the Achaeans are difficult to determine, and not a very safe guide. Three passages in the *Odyssey* refer to tallness of stature as a mark of beauty, and it was, perhaps, therefore rare. Heroes are sometimes referred to both by Homer and Hesiod as fair-haired (*ξανθός*) (though the epithet may mean nothing more than not having *black* hair) and we know that both in classical and Roman times blue or grey eyes were rare in Greece.

In classical times the name Achaeans was confined to the people inhabiting the strip of land along the north coast of the Peloponnese, between the Corinthian gulf and the northern Arcadian mountains. They were for the most part subject to Dorian overlords, and their dialect was Doric. After the days of the Macedonian supremacy the Achaean League became one of the most powerful influences in Greece, and it was this fact that led the Romans, when they made the country into a province, to give it the name of Achaea. (*See* DORIANS; IONIANS; GREECE, *History.*)

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ACHAEMENES (HAKHAMANI), the eponymous ancestor of the royal house of Persia, the Achaemenidae. According to Darius in the Behistun inscription and Herod. iii. 75, vii. 11, he was the father of Teïspes, the great-grandfather of Cyrus. Whether he really was an historical personage, or merely the mythical ancestor of the family, cannot be decided. According to Aelian (*Hist. anim.* xii. 21), he was bred by an eagle. We learn from Cyrus's proclamation that Teïspes and his successors had become kings of Anshan; *i e*, a part of Elam (Susiana), where they ruled as vassals of the Median kings, until Cyrus the Great in 550 B.C. founded the Persian empire. After the death of Cambyses, the younger line of the Achaemenidae came to the throne with Darius, whose father Hystaspes was, like Cyrus, the great-grandson of Teïspes. Cyrus, Darius and all the later kings of Persia call themselves Achaemenides (*Hakhāmanishiya*). With Darius III. *Codomannus* the dynasty became extinct and the Persian empire came to an end (330 B.C.). The adjective *Achaemenius* is used by the Latin poets as the equivalent of "Persian" (Horace, *Odes,* ii. 12, 21). *See* PERSIA. The name Achaemenes is borne by a son of Darius I., brother of Xerxes. After the first rebellion of Egypt, he became satrap of Egypt (484 B.C., Herod. vii. 7). He commanded the Persian fleet at Salamis, and was (460 B.C.) defeated and slain by Inarus (Herod. iii. 12), the leader of the second rebellion of Egypt (*see* also Diodorus xi. 71).

ACHAEMENIDAE, the Graecized name of the family of the ancient Persian kings. (*See* PERSIA: *Ancient History.*)

ACHARD, FRANZ CARL (1753–1821), Prussian chemist, was born at Berlin on April 28, 1753, and died at Kunern, in Silesia, on April 20, 1821. He was a pioneer in turning to practical account A. S. Marggraf's discovery of the presence of sugar in beetroot, and by the end of the 18th century he was producing considerable quantities of beet-sugar, though by a very imperfect process, at Kunern, on an estate which was granted him, about 1800, by the king of Prussia. There, too, he carried on a school of instruction in sugar-manufacture. He published several volumes of chemical and physical researches and discovered, among other things, a method of working platinum.

ACHARIUS, ERIK (1757–1819), Swedish botanist, was a pupil of Linnaeus at Uppsala University, and devoted himself to the study of lichens. His most important work is *Lichenographia Universalis* (Göttingen, 1804).

ACHATES, the companion of Aeneas in Virgil's *Aeneid.* The expression "fidus Achates" has become proverbial for a loyal and devoted companion.

ACHELOUS (mod. *Aspropotamo,* "white river"), the largest river in Greece (130m.). It rises in Mt. Pindus, and, dividing Aetolia from Acarnania, falls into the Ionian Sea. Its water is charged with fine mud, which is deposited along its banks in fertile, marshy plains. At its mouth, a number of small islands (Echinades) have been enveloped in this deposit. It was formerly called Thoas, from its impetuosity, and its upper portion Inachus, the name Achelous being restricted to the shorter eastern branch. The name is given to several other rivers in Greece, and appears in cult and in mythology as that of the typical river-god.

ACHENBACH, ANDREAS (1815–1910), German landscape painter, was born at Cassel on Sept. 29, 1815, and died on March 31, 1910. He was a pioneer of the German realistic school. He studied at Düsseldorf under Schirmer, but emancipated himself from the contemporary school of landscapists which delighted in the representation of romantic scenery. He was the first artist of the Düsseldorf school who painted nature for its own sake. As a young man he sought inspiration in Holland and Norway. His pictures of the stormy North sea, of Dutch canal scenes and of Rhineland villages contrasted favourably with the sentimental landscapes of his contemporaries. His works are to be found at the Berlin National Gallery, the New Pinakothek in Munich, and the galleries at Dresden, Darmstadt, Cologne, Düsseldorf, Leipzig and Hamburg.

His brother, OSWALD ACHENBACH (1827–1905), is distinguished for his colourful renderings of the Bay of Naples, of Rome and of Venice. He broke away from the traditional classicist interpretation of these scenes and revelled in strong and glowing colour effects. His works are exhibited at most of the important German galleries of modern art.

ACHERNAR, α Eridani, the brightest star in the constellation Eridanus (*q v.*).

ACHERON (Gr. river of "woe"), name of several rivers of Greece. In Greek mythology the name is specially given to a river of Hades, over which departed souls were ferried by Charon. Later Greek and Roman poets used it to designate the lower world generally.

ACHESON, EDWARD GOODRICH (1856–), American inventor, was born at Washington (Pa.), on March 9, 1856. He was compelled to earn his living at an early age, but devoted his leisure to mechanical invention and experiment. Becoming interested in electricity, he entered the employ of Thomas A. Edison. In 1881 he assisted in the preparation of the Edison exhibit at the Paris International Exposition and later, for the Edison interests, installed the first electric lights in Italy, Belgium and Holland. On returning to the United States he resumed his experiments. He discovered a new abrasive substance of great cutting power, which he named carborundum. Inventing a method of producing a remarkably pure synthetic graphite, he organized in 1899 the Acheson Graphite Co., to handle the patent. This company met with great success. His numerous patents cover methods of producing metallic silicon cheaply; the lubricants known as oildag, aquadag and gredag; the treatment of clay to increase plasticity (Egyptianized clay).

ACHIACHARUS, the name of an eastern sage whose "sayings" spread far and wide and had a remarkable influence on the world's gnomic literature. His history and moralizing sayings have been preserved, in whole or in part and with interesting minor variations, in Syriac, Arabic, Ethiopic, Armenian and Slavonic translations, and fragments of his teaching have survived among the Jewish papyri from Elephantine (*see* later). Rumanian and old Turkish versions are also in existence.

In the story of his life he is represented as the chief adviser of the Assyrian king Sennacherib. He adopted a nephew, Nadan by name, to succeed him. Profligate and wearied by Achiacharus' unending inculcation of wisdom in proverbial form, Nadan brought about his uncle's downfall. But saved from death by his executioners, Achiacharus survived in an underground dungeon and resumed his former position at court when the king was in dire need of his services as an envoy and magician who could satisfy the demands of the king of Egypt. Thus he built a castle in the air and twisted ropes out of sand. On his return to Assyria he took vengeance on his nephew, flogged him, condemned him to his former dungeon-dwelling, constantly visited him to taunt him and give him instruction in which, as in Aesop's fables, animals and birds give expression to shrewd moral and ethical ideals. Nadan avoided execution by swelling out suddenly and bursting asunder, thus anticipating and possibly inspiring one of the New Testament descriptions of the end of Judas.

The date of composition and the original home of this work are matters of dispute. The Elephantine Papyri provide evidence that it was in existence by the fifth century B.C. The mention of Sennacherib may well point to Mesopotamia as its original home. But the story and the sententious sayings contained in it are probably far older than the Assyrian Empire. Sennacherib's name was probably inserted in the story when it had already assumed a fixed form in most other respects and had already embarked on its career of permeating the literature and thought of Palestine, Egypt and the Mediterranean coastlands.

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ACHILL, the largest island off Ireland, separated from the Curraun peninsula of the west coast by the narrow Achill sound. Pop. (1921) 5,260. It is included in Mayo Its shape is triangular, and is 15m. from east to west and 12m. from north to south. Area 57sq m. The island is mountainous, the highest points being Slieve Croaghaun (2,192ft) in the west, and Slievemore (2,204ft.) in the north; the extreme western point is the bold and rugged promontory of Achill head, and the north-western and south-western coasts consist of cliffs reaching 800ft. in Minaun, near Keel on the south. The seaward slope of Croaghaun is abrupt and the scenery beautiful. Desolate bogs alternate with the mountains; and the inhabitants earn a scanty subsistence by fishing and tillage, or go to England and Scotland during the harvesting. The Congested Districts Board has made efforts to improve the condition of the people, and a branch of the Great Southern railway to Achill sound, together with a swivel bridge across the sound, improved communications. In Dugort is a Protestant colony, known as "the Settlement," founded in 1834. There are megalithic remains at Slievemore and elsewhere.

ACHILLES, son of Peleus (*q v*) and Thetis; bravest, handsomest and swiftest of the army of Agamemnon. According to Homer, he was brought up by his mother at Phthia with his cousin and intimate friend Patroclus (*q.v.*); his teachers were Phoenix and Cheiron. The non-Homeric tales of his childhood contain obvious folk-tale themes. Thetis had seven children, all of whom she put into the fire or a cauldron (*see* DEMETER; HERCULES), to make them immortal All died save Achilles; because Peleus interfered at this point, Thetis left him. (Fairy Bride theme.) Or, Thetis dipped the child in the waters of the river Styx, by which (like Sigurd Fafnirs-bane) he became invulnerable, except that part of his heel by which she held him; whence the proverbial "heel of Achilles."

During the first nine years of the war as described in the *Iliad,* Achilles ravaged the country round Troy, and took 12 cities. In the tenth year occurred the quarrel with Agamemnon. In order to appease the wrath of Apollo, who had visited the camp with a pestilence, Agamemnon had restored Chryseis, his prize of war, to her father, a priest of the god, but as a compensation deprived Achilles, who had openly demanded this restoration, of his favourite slave Briseis.

Achilles refused further service, and rejected offers of compensation for the insult. During his absence the Greeks were hard pressed, and at last he allowed Patroclus to personate him, lending him his chariot and armour. When Hector slew Patroclus Achilles

was reconciled to Agamemnon, got new armour from Hephaestus, slew Hector, and, after dragging his body around the walls of Troy, restored it to Priam at his earnest entreaty.

The *Iliad* concludes with the funeral rites of Hector. It makes no mention of the death of Achilles, but hints at its taking place "before the Scaean gates" The *Odyssey* mentions his funeral. The *Aethiopsis* took up the story of the *Iliad*. It told how Achilles, having slain the Amazon Penthesileia and Memnon (*q.v.*), was himself slain by Paris, whose arrow was guided by Apollo to his vulnerable heel. He was worshipped in many places: at Leuke, where he was honoured with offerings and games; in Sparta, Elis, and especially Sigeum on the Hellespont, where his famous tumulus was erected.

Behind these legends there probably lies a real man, certainly not a sun-, river- or other god. No certain statue of him, but numerous other representations in art, survive (*see* GREEK ART).

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ACHILLES, TENDON OF. The large tendon inserted into the heel bone (calcaneus), at the back of the ankle, by means of which the calf muscles of the leg extend and invert the foot. These muscles sometimes become shortened, owing to overdevelopment, or sometimes to the continued use of high-heeled shoes, or they may be congenitally short. This defect sometimes leads to fallen arches and to pain in the foot so severe that lengthening the tendon by surgical means becomes necessary. This important tendon is named after Achilles, the great hero of the Trojan war and the central figure of Homer's *Iliad*. According to Greek legend, when Achilles was born, his mother dipped him in the river Styx. This bath made all parts of his body invulnerable except the heel by which she had held him, and it was in this heel that he later received a mortal wound.

ACHILLES TATIUS, of Alexandria, Greek rhetorician, author of the erotic romance, the *Adventures of Leucippe and Cleitophon*, flourished about A.D. 450, perhaps later. Suidas, who alone calls him Statius, says that he became a Christian and eventually a bishop (like Heliodorus, whom he imitated) but there is no evidence of this. Photius, while severely criticizing his lapses into indecency, highly praises the conciseness and clearness of his style, which, however, is artificial and laboured.

The large number of existing mss. attests the popularity of the romance. (*Editio princeps*, 1601; first important critical edition by Jacobs, 1821; later editions by Hirschig, 1856; Hercher, 1858. There are translations in many languages; in English by Anthony H[odges], 1638, and R. Smith, 1855. *See* also ROMANCE.)

Suidas also ascribes to this author an *Etymology*, a *Miscellaneous History of Famous Men*, and a treatise *On the Sphere* Part of the last is extant under the title of *An Introduction to the Phaenomena of Aratus*. But if the writer is the *prudentissimus Achilles*, referred to by Firmicus Maternus (about 336) in his *Matheseos libri*, iv. 10, 17 (ed. Kroll), he must have lived long before the author of *Leucippe*. The fragment was first published in 1567, then in the *Uranologion* of Petavius, with a Latin translation, 1630.

ACHILLINI, ALESSANDRO (1463–1512), Italian philosopher and anatomist, was born at Bologna, Oct. 29, 1463, and died there Aug. 2, 1512. A much admired lecturer at Bologna and Padua, he was called the "second Aristotle."

BIBLIOGRAPHY.—His works were printed at Venice (1508, 1545, 1551 and 1568).

ACHIMENES, a genus of plants (family Gesneraceae, to which belong also Gloxinia and Streptocarpus), natives of tropical America, and well known in cultivation as stove or warm greenhouse plants. They are herbaceous perennials, generally with hairy serrated leaves and handsome flowers. The corolla is tubular with a spreading limb, and varies widely in colour, being white, yellow, orange, crimson, scarlet, blue or purple.

ACHIN (Dutch, Atjeh), and dependencies, is a Dutch Government in Sumatra, Dutch East Indies. It forms the northern extremity of the island, the boundary extending from Salahadji, a point on the east coast, just north of Aru bay, to a point on the west coast, about mid-way between Singkel and Barus, has an area of 20,544sq.m, and is divided into three assistant-residencies. It is very mountainous, with long ranges, running parallel with the axis of the island, and, particularly, in the east and extreme north-west, spurs projecting towards the coast. Most of the interior is mountainous, but, except in the extreme north, there is a fairly wide coastal plain, narrower in the east than in the west. The highest peaks are Bandahara (10,100) and Peperkison (9,000), on the southern central boundary, and Peuet Sagu (9,270), and Boer Ni Telong (8,500), in the north. In the north the coast is very varied, the cliffs, crowned with dense vegetation, rising precipitously from the sea in places, whilst in other parts there are sandy beaches or cultivated and well-populated plains. Elsewhere the coast is flat, and, in places, marshy. The rivers are short, and run down sharply to the coast. The largest, the Singkel, on the west coast, is almost useless for shipping, owing to the bar at its mouth, but further up stream it forms a good means of communication, in spite of its rapids. The ports of Achin are Oleh-leh and Sigli on the north, Edi on the east, and Meulaboh on the west. Oleh-leh is the gate-way to Kota Raja, the capital of Achin. Kota Raja is situated on the Achin river, some three miles up from the sea. The capital of Achin, when this was the wealthiest and most powerful sultanate in Northern Sumatra, having suzerainty over territory in the Malay Peninsula, Kota Raja still possesses remains of its former glory, but it consists largely of wooden and attap-roofed houses, built in *kampongs*, with the old Achinese Citadel (now garrison-quarters), a large Mosque, the modern residences of the governor and civil staff, offices of the administration, European business premises, together with two small hotels. Three bridges span the river. Kota Raja has a cable station, is connected by telegraph with Medan, and thence across the island with Padang and the south generally. A steam tramway links it up with Oleh-leh and, across country, with Sigli, on the north-east coast, whence it proceeds to Kuala Simpang (Aru bay), where it joins up with a coastal line southward to Tandjung Balai An agricultural adviser, representing the department of agriculture, trade and industry, is stationed at Kota Raja, and the town has a population of 9,882, composed of 912 Europeans and Eurasians, 6,251 natives, and 2,719 foreign Asiatics. The principal industries of Achin are silk-weaving, gold-working, wood-carving and ship-building, and there is a fishing and coasting trade. Rice is the food staple, grown more under *sawah* culture than *ladang*, and there are irrigation works for rice culture. Pepper, copra and palm oil are the chief exports, but sugar-cane and fruit trees are grown, cattle-breeding is carried on, and there are over 20,000 acres under rubber (Hevea). Imports (1925) 8,688,052 and exports 20,881,154 guilders. Pop. (1925) 740,340, composed of—Europeans and Eurasians 2,428, natives 723,471, and foreign Asiatics, including Chinese, 14,441. The Achinese are Malayan, but smaller and thinner than the Malays, with darker skin and larger eyes. The people of the highlands (*orang tunông*) are prouder and more courageous and independent than those of the lowlands (*orang barŏh*), but both are fond of warfare. The nobility usually claim Arab descent, and there are evidences of old-time contact with Hindus. Both men and women wear the characteristic wide Achinese trousers; the women are skilful weavers; the men fairly good craftsmen and skilled agriculturists. Rice, fish and vegetables, eaten twice daily, form the usual fare, betel-nut is used universally, and opium-smoking is indulged in, but strong drink is used only amongst the upper classes. Houses are built on piles, divided into several rooms, generally with front and back verandah, reached by steps. They stand in a fenced courtyard, with fruit trees about them, —the domestic animals and birds live underneath—and are usually untidy in appearance. In a *meneusah*, without the village, the young unmarried men and strangers sleep, and it is also used for meetings and religious observances. Society is divided into families; there are traces of an old matriarchal form, but the patriarchal system is now general. Marriage is celebrated at an early age, divorce is rare, and polygamy is not common, except amongst the highest classes. The position of the Achinese woman is high. Achin is under direct Dutch Government, but many Achinese chiefs exercise authority as Government officials. The Achinese are Mohammedans.

The people are fond of competitions in recitations of poetry, and of musical performances on native instruments; also of feasts and gambling, whilst animals are kept for fighting purposes.

See C. Snouck Hurgronje, *The Achehnese* (Leyden, 1906).

(E. E. L.)

HISTORY

Northern Sumatra was visited by a number of European travellers in the middle ages, for example Marco Polo, Friar Odorico and Nicolo Conti (*qq.v.*). But the first voyager to visit Achin, known then by that name, was Alvaro Tellez, a captain of Tristan d'Acunha's fleet, in 1506. It was then a mere dependency of the adjoining state of Pedir. By 1526 Achin had assimilated all the other states of northern Sumatra, but its power was at its height in the time of Sultan Iskandar Muda (1607–36). At that period the territory extended from Aru opposite Malacca round the north to Benkulen on the west, 1,100 miles of seaboard; the island of Nias with the continental states of Johor, Pahang, Kedah and Perak were subject states.

The traders of the 17th century went to Achin for gold. The first Dutch (1599) and first English (1602) commercial ventures to the Indies were to Achin. Letters were sent from Queen Elizabeth and King James I. to the princes of Achin. But jealousy and suspicion interfered with trade and the English factory, erected several times, was not long maintained. The French attempted unsuccessfully in 1621 to establish relations as, in spite of all difficulties, the trade was important. William Dampier (*c.* 1688) speaks of the number of foreign merchants settled there.

The Portuguese were constantly warring with the kings of Achin until the former lost Malacca (1641). Iskandar Muda sent 60,000 men against Malacca in 1615, but the Portuguese held out. From 1641 four queens successively reigned over Achin, but in 1699 the Arab or fanatical party suppressed female government and put a chief of Arab blood on the throne. From that time Achin's power decayed rapidly.

After the restoration of Java to the Netherlands in 1816 a good deal of weight was attached by the neighbouring British colonies to the maintenance of influence in Achin, and in 1819 a treaty of friendship was concluded by Achin with the Calcutta Government which excluded other European nationalities from fixed residence in Achin. When the British Government, in 1824, made a treaty with the Netherlands, surrendering the remaining British settlements in Sumatra in exchange for certain possessions on the continent of Asia, no reference was made in the articles to the Indian treaty of 1819; but an understanding was exchanged that it should be modified, while no proceedings hostile to Achin should be attempted by the Dutch.

This reservation was formally abandoned by the British Government in a convention signed at The Hague on Nov. 2, 1871; and in March 1873 the Government of Batavia declared war upon Achin. Doubtless there was provocation, for the sultan of Achin had not kept to the understanding that he was to guarantee immunity from piracy to foreign traders; but the necessity for war was greatly doubted, even in Holland. A Dutch force landed at Achin in April 1873 and attacked the palace, but was defeated. Another attempt ended in the fall of Achin in Jan. 1874. General van der Heyden seemed to have quelled them (1878–81), but in 1896 they revolted again and not till 1898 and the succeeding year did General van Hentsz restore order. In 1901 the pretender-sultan fled to the Gajoes, a neighbouring tribe inland and for three years heavy fighting went on. Due to the pretender's escape the Dutch have had continual trouble, and, although the coast of Achin is subdued, the interior is still independent and troublesome.

See P. J. Veth, *Atchin en zijne betrekkingen tot Nederland* (Leyden, 1873); J. A. Kruijt, *Atjeh en de Atjehers* (Leyden, 1877); Kielstra, *Beschrijving van den Atjeh-oorlog* (The Hague, 1885); Renaud, *Jaarboek van het Mynwezen* (1882); J. Jacobs, *Het famille-en Kampongleven op Groot Atjeh* (Leyden, 1894); C. Snouck Hurgronje, *De Atjehers* (Batavia, 1894, trans. 1906); W. Volz, *Nord-Sumatra; Die Gajoländer* (Berlin, 1912). *See* also *Tijdschrift voor Taal en Volkenkunde Nederlandsche Indie.*

ACHINESE, a Sumatran tribe of Proto-Malayan stock modified by Hindu and Arab elements, the darker complexion of the lowlanders as distinct from the highlanders of the tribe being attributed to a greater infusion of South Indian blood. They are Muslims, but not very strict, and early in the 13th century became important in the East Indies, having commercial and political relations with Egypt, Europe and Japan. Noted for valour and love of freedom, they long maintained their independence against the Dutch. They are excellent craftsmen; women go unveiled and there is very little polygamy. Their language, though Malayan, contains many Sanskrit words, and there are other remnants of their former Hindu or Buddhist culture.

See E. Marsden, *History of Sumatra* (1783), C. Snouck Hurgronje, *The Achehnese* (1906).

ACHINSK. (1) A province in the Siberian area of the R.S.F.S.R. Area 65,204sq.km. Pop. (1926) 392,000; urban 24,997; rural 367,003 It consists of pine, spruce and birch forest, with open grassy areas on which rye and wheat are grown by the peasants and immigrant colonists. The winter is severe and occasionally early frosts ruin the crops. Gold is found to the west of the town of Achinsk (2) A market centre, lat. 56° 30′ N., long. 90° 35′ E., on the Chulym river, which links it with the Ob river. It is on the Trans-Siberian railway and has a branch to the rich Minusinsk district.

ACHOLI, a negro people of the upper Nile valley, akin to the Shilluks of the White Nile. They frequently decorate the temples or cheeks with wavy or zigzag scars, and also the thighs with scrolls; some pierce the ears. Their huts are circular with a high peak, a mud sleeping-platform, jars of grain and a sunk fireplace; they are decorated with geometrical or conventional designs in red, white or grey. The Acholi are good hunters, using nets and spears, and keep goats, sheep and cattle. In war they use spears and long, narrow shields of giraffe or ox hide. Their language is Nilotic. Their religion is a vague fetishism.

ACHROMATIC LENS, a combination of two or more lenses corrected for chromatic aberration. (*See* OPTICS; LENS; PHOTOGRAPHY. *Apparatus*)

ACHURCH, JANET (MRS. C. CHARRINGTON) (1864–1916), English actress, was born in Manchester She first appeared at the Olympic Theatre, London, Jan 8, 1883, with Geneviève Ward in the farce of *Betsy Baker.* Two years later she joined Frank Benson's company and played Shakespearean heroines; but her chief success was gained as Nora Helmer in Ibsen's *A Doll's House,* when that play was first produced in England in 1889. She appeared later in other Ibsen plays and in those of Bernard Shaw

ACID, the name loosely applied to any sour substance; in chemistry it has a more precise meaning, denoting a substance containing hydrogen which may be replaced by metals with the formation of salts. An acid may therefore be regarded as a salt of hydrogen. A still more recent and broader conception is that of an acid as a "proton donator" (T. M. Lowry) *i e.,* a substance which is capable of yielding a hydrogen atom stripped of its electron to a "proton acceptor" or base. Of the general characters of acids we may here notice that they dissolve alkaline substances, certain metals, etc., neutralize alkalis and redden many blue and violet vegetable colouring matters such as litmus.

The ancients probably possessed very little knowledge of acids. Vinegar (or impure acetic acid), which is produced when wine is allowed to stand, was known to both the Greeks and Romans, who considered it to be typical of acid substances, this is philologically illustrated by the words ὀξύς, *acidus,* sour, and ὄξος *acetus,* vinegar. Other acids became known during the alchemistic period; and the first attempt at a generalized conception of these substances was made by Paracelsus, who supposed them to contain a principle which conferred the properties of sourness and solubility. Somewhat similar views were promoted by Becher, who named the principle *acidum primogenium,* and held that it was composed of the Paracelsian elements "earth" and "water" At about the same time Boyle investigated several acids and established their general characteristics.

The phlogistic theory of the processes of calcination and combustion necessitated the view that many acids, such as those produced by combustion, *e.g.,* sulphurous, phosphoric, carbonic, etc.,

should be regarded as elementary substances. This principle more or less prevailed until it was overthrown by Lavoisier's doctrine that oxygen was the acid-producing element; Lavoisier was led to this conclusion by the almost general observation that acids were produced when non-metallic elements were burnt. This doctrine, in turn, was overthrown by the researches of Davy, Gay-Lussac and Thénard on hydrochloric acid and chlorine, and of Gay-Lussac on hydrocyanic acid, which established beyond all cavil that oxygen was not essential to acidic properties. Davy and, almost simultaneously, Dulong suggested that hydrogen and not oxygen was the acidifying principle.

Dalton's theory was strongly supported when J. Liebig promoted his doctrine of polybasic acids. Dalton's idea that elements preferentially combined in equiatomic proportions had as an immediate inference that metallic oxides contained one atom of the metal to one atom of oxygen, and a simple expansion of this conception was that one atom of oxide combined with one atom of acid to form one atom of a neutral salt. This view, which was specially supported by Gay-Lussac and Leopold Gmelin and accepted by Berzelius, necessitated that all acids were monobasic. The untenability of this theory was proved by Thomas Graham's investigation of the phosphoric acids; for he then showed that the ortho- (ordinary), pyro- and meta-phosphoric acids contained respectively 3, 2 and 1 molecules of "basic water" (which were replaceable by metallic oxides) and one molecule of phosphoric oxide, P_2O_5. Graham's work was developed by Liebig, whose researches on organic acids—citric, tartaric, cyanuric, comenic and meconic—led him to formulate as the criterion of polybasicity the existence of compound salts with different metallic oxides, and ultimately to adopt the tenet that "acids are particular compounds of hydrogen, in which the latter can be replaced by metals." Further, he held that "neutral salts are those compounds of the same class in which the hydrogen is replaced by its equivalent in metal."

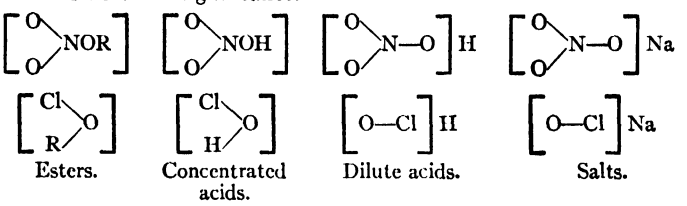
The hydrogen theory and the doctrine of polybasicity as enunciated by Liebig is the fundamental characteristic of the modern theory. A polybasic acid contains more than one atom of hydrogen which is replaceable by metals; moreover, in such an acid the replacement may be entire with the formation of normal salts, partial with the formation of acid salts, or by two or more different metals with the formation of compound salts (*see* SALTS). These facts may be illustrated with the aid of orthophosphoric acid, which is tribasic:

Normal salt.	Acid salts.	Compound salt.
Ag_3PO_4.	Na_2HPO_4; NaH_2PO_4.	$Na(NH_4)HPO_4$.
Silver phosphate.	Acid sodium phosphates.	Microcosmic salt.

This conception of acids was extended along the lines of the electrolytic dissociation theory of S. A. Arrhenius (1887). Pure hydrogen chloride is practically a non-conductor of the electric current, and so also is pure water; when the two are mixed, however, highly conducting solutions of hydrochloric acid result. According to the Arrhenius hypothesis, the hydrogen chloride molecule was split into two "ions"—a positive hydrogen ion, written as H^+ or H', and a negative chlorine ion, Cl^- or Cl'—each of which contributed towards the carrying of the current; all the fundamental properties of acids were attributed to the existence of the hydrogen ion in their aqueous solutions. Objections often urged against this view were (1) that the chlorine ion shows none of the peculiar properties of the element, and (2) that, since hydrogen and chlorine combine so strongly with such a large evolution of heat, it was difficult to understand how the mere process of dissolution in water could suffice to separate them as ions. To a large extent these objections are met by the current views on the electronic structure of atoms (*q.v.*), according to which the chlorine atom, holding seven valency electrons, achieves its maximum stability by acquiring the single electron of the hydrogen atom to form an octet and to become negatively charged, whereas the hydrogen atom, having lost its electron and become positively charged is now unique in that it holds no electrons at all (*i.e.*, it is what is called a proton); these ions differ fundamentally, therefore, from their corresponding elements.

It will be noted that, although the solvent (water, in the case discussed) was stated to be essential for the development of the acidic properties of hydrogen chloride, the various theories described attach no significance to the rôle of this solvent. H. E. Armstrong has consistently pointed out this anomaly, and he and many others (A. Lapworth, H. Goldschmidt, and T. M. Lowry, for example) have attempted to remove it; for Armstrong's views his writings should be consulted (*Proc. Roy. Soc.*, 1923, *A*, 103, p. 610), but it is possible to generalize as to the trend of other workers' views. These are, briefly, that the hydrogen ion (proton) becomes associated with one or more molecules of solvent to give positive ions, of which the simplest would be OH_3^+. Here again there is a divergence of opinion, because some attribute the peculiar properties of acids (especially that of catalysis [*q.v.*]) to this complex ion, whereas others ascribe them to a small or even a very minute portion of hydrogen ions which remain as such and escape this association with the solvent.

Studies of the absorption spectra and other properties of acids, their esters, their dilute solutions, and their saline solutions have led to the belief, more especially in the case of oxygen-containing acids, that the pure or concentrated acid has a structure resembling that of the esters (A. Hantzsch, K. Schäfer), whereas in dilute aqueous solution its structure is analogous to that of the salts. In this respect, the pure acid is what Hantzsch terms a pseudo-acid—that is, it only functions as a true acid after having undergone a change of structure. Such a change is indicated by Schäfer's scheme below, which, however, is merely diagrammatic and has no other significance.



Esters. Concentrated acids. Dilute acids. Salts.

It is remarkable that very pure concentrated acids are inert towards metals in many cases. V. H. Veley has made a study of the properties of pure nitric acid, which, according to Hantzsch, has the same absorption spectrum as its vapour or its esters, but quite different from that of dilute solutions. Hantzsch (1925) found similar relationships to hold for hydrobromic and hydriodic acids, and he therefore suggests that aqueous solutions of acids are salts of the hypothetical "hydroxonium" radical, thus: $[H_3O]Br$, hydroxonium bromide; $[H_3O]NO_3$, hydroxonium nitrate. His views receive support from the isolation of "nitronium" salts from very concentrated solutions of acids; thus, nitronium diperchlorate, $[N(OH)_3]\ [ClO_4]_2$, and nitronium monoperchlorate, $[NO(OH)_2]ClO_4$, are stable crystalline salt-like compounds which can be recrystallized from concentrated perchloric or nitric acid, respectively. Moreover, mixtures of concentrated nitric and sulphuric acids are highly conducting, whereas the pure acids alone are only feebly so; this is regarded as evidence in favour of the existence of salt-like compounds in the solution, $[N(OH)_3]\ [HSO_4]_2$ and $[NO(OH)_2]\ [HSO_4]$ analogous to the perchlorates, and the isolation (by Weber, 1871) of nitronium pyrosulphate, $[N(OH)_3]S_2O_7$, affords similar evidence. By analogy, therefore, concentrated nitric acid contains a certain amount of nitronium nitrate, $[N(OH)_3](NO_3)_3$.

Reference should be made to the articles CHEMICAL ACTION and SOLUTIONS for the theory of the strength or avidity of acids.

Organic Acids.—Purely organic acids are characterized by the presence of the univalent group—CO·OH, termed the carboxyl group, in which the hydrogen atom is replaceable by metals with the formation of salts, and by alkyl radicals with the formation of esters. The basicity of an organic acid, as above defined, is determined by the number of carboxyl groups present. Hydroxy-acids are carboxylic acids which also contain a hydroxyl group; similarly we may have aldehyde-acids, ketone-acids, etc. Since the more important acids are treated under their own headings, or under substances closely allied to them, we shall here confine ourselves to general relations.

It is convenient to distinguish between aliphatic and aromatic

acids; the first named being derived from open-chain hydrocarbons, the second from ringed hydrocarbon nuclei. Aliphatic monobasic acids are further divided according to the nature of the parent hydrocarbon. Methane and its homologues give origin to the "paraffin" or "fatty series" of the general formula $C_nH_{2n+1}COOH$, ethylene gives origin to the acrylic acid series, $C_nH_{2n-1}COOH$, and so on. Dibasic acids of the paraffin series of hydrocarbons have the general formula $C_nH_{2n}(COOH)_2$; malonic and succinic acids are important members. It is evident from the foregoing general formulae that the complications due to isomerism will increase with the length of the chain of carbon atoms, and for further information on the higher or more complicated acids the reader is referred to any standard work on organic chemistry (*see* CHEMISTRY: *Organic*). A list of certain of the acids present in fats and oils is given in the article GLYCERIDES.

Syntheses of Salts of Organic Acids.—The simplest syntheses are undoubtedly those in which a carboxyl group is obtained directly from the oxides of carbon, carbon dioxide and carbon monoxide. The simplest of all include: (1) the synthesis of sodium oxalate by passing carbon dioxide over metallic sodium heated to 350°–360° C; (2) the synthesis of potassium formate from moist carbon dioxide and potassium, potassium carbonate being obtained simultaneously; (3) the synthesis of potassium acetate and propionate from carbon dioxide and sodium methide and sodium ethide; (4) the synthesis of salts of aromatic acids by the interaction of carbon dioxide, sodium and a bromine substitution derivative; (5) the synthesis of aromatic hydroxy-acids by the interaction of carbon dioxide and sodium phenolates (*see* SALICYLIC ACID). Carbon monoxide takes part in the syntheses of sodium formate from sodium hydroxide, or soda lime (at 200°–220°C), and of sodium acetate and propionate from sodium methoxide and sodium ethoxide at 160°–200° C. Carboxyl is introduced into aromatic groups by the action of carbonyl chloride on aromatic hydrocarbons in the presence of aluminium chloride, acid-chlorides being formed which are readily decomposed by water to give the acid The saponification of nitriles, obtained by the interaction of potassium cyanide with a halogen substitution derivative or a sulphonic acid, leads successively to acid-amides and acids. (*See* AMIDES)

Acids frequently result as oxidation products, being almost invariably formed in all cases of energetic oxidation. The higher fatty hydrocarbons (waxes) when subjected to long treatment with oxygen at 100°C with or without a terpenoid catalyst yield fatty acids similar to palmitic and stearic acids (F. Francis, 1924) Also, primary alcohols and aldehydes (*q.v.*), both of the aliphatic and aromatic series, readily yield on oxidation acids containing the same number of carbon atoms. These reactions may be shown thus: $R{\cdot}CH_2OH \rightarrow R{\cdot}CHO \rightarrow R{\cdot}CO{\cdot}OH$. In the case of aromatic aldehydes, acids are also obtained by means of "Cannizzaro's reaction" (*see* BENZALDEHYDE). An important oxidation synthesis of aromatic acids is from hydrocarbons with aliphatic side chains; thus toluene, or methyl-benzene, yields benzoic acid; the xylenes, or dimethyl-benzenes, yield methyl-benzoic acids and phthalic acids. Ketones, secondary alcohols and tertiary alcohols yield a mixture of acids on oxidation. We may also notice the disruption of unsaturated acids at the double linkage into a mixture of two acids, when fused with potash. In the animal organism fatty acids are converted by oxidation at the β-carbon atom into simpler acids of lower carbon content. This oxidation is also effected by purely chemical means by hydrogen peroxide and potassium persulphate.

Phenylopropionio acid, $C_6H_5{\cdot}CH_2{\cdot}-CH_2{\cdot}CO_2H$, is eliminated in urine as hippuric acid, $C_6H_5{\cdot}CO{\cdot}NH_2{\cdot}CH_2{\cdot}CO_2H$.

Mention should also be made of syntheses of organic acids through the Grignard reaction (*q.v.*) and through malonic ester and acetoacetic ester (*q.v.*, and CHEMISTRY: *Organic*). By electrolysing a solution of potassium ethyl succinate,

$$KO_2C{\cdot}(CH_2)_2CO_2C_2H_5,$$

the $KO_2C{\cdot}$ groups are split off and the two residues

$$\cdot(CH_2)_2CO_2C_2H_5$$

combine to form the ester $(CH_2)_4(CO_2C_2H_5)_2$. In the same way, by electrolysing a mixture of a metallic salt and an ester, other nuclei may be condensed; thus potassium acetate and potassium ethyl succinate yield $CH_3{\cdot}CH_2{\cdot}CH_2{\cdot}CO_2C_2H_5$.

(A. D M.; G. T. M.)

Lunge and Cummings, *Manufacture of Acids and Alkalis* (1923).

ACIDALIUS, VALENS (1567–1595), German scholar and critic, was born at Wittstock on May 25, 1567, and died at Neisse on May 25, 1595, at the age of 28. Acidalius wrote notes on Velleius Paterculus (1590), Curtius (1594), the panegyrists, Tacitus and Plautus, published after his death.

See Leuschner, *Commentatio de A. V. Vita, Moribus, et Scriptis* (1757).

ACID BASE EQUILIBRIUM: *see* DIET AND DIETETICS.

ACIDIMETRY, the determination of the quantity of free acid (*q.v.*) in a substance. There are several methods of estimation, one of the chief being by volumetric analysis (*q.v.*). A convenient method for the aqueous solution of a fairly pure acid is the determination of its specific gravity by means of a hydrometer (*q.v.*). (*See* CHEMISTRY: *Analytical.*)

ACINACES, from the Greek. An ancient Persian sword, short and straight, and worn, contrary to the Roman fashion, on the right side, or sometimes in front of the body, as shown in the bas-reliefs found at Persepolis. Among the Persian nobility it was frequently made of gold, being worn as a badge of distinction. The acinaces was an object of religious worship with the Scythians and others (Herod. iv. 62).

ACIREALE (anc. ACIS), town and episcopal see, province of Catania, Sicily; 9m. N.E from Catania by rail. Pop. (1921) 22,956 (town), 31,161 (commune) The thermal springs were used by the Romans. It took its name from the river Acis, into which Acis, the lover of Galatea, was changed after he had been slain by Polyphemus.

ACIS, in Greek mythology, the son of Pan (Faunus) and the nymph Symaethis, a beautiful shepherd of Sicily, the lover of the Nereid Galatea. His rival the Cyclops Polyphemus surprised them together, and crushed him to pieces with a rock. His blood, gushing forth from beneath, was metamorphosed by Galatea into the river bearing his name (now Fiume di Jaci) (Ovid, *Met.* xiii. 750; Silius Italicus, *Punica*, xiv 221).

ACKER, CHARLES ERNEST (1868–1920), American inventor and manufacturer, was born in Bourbon, Ind , on March 19, 1868. Following his graduation at Cornell university in 1888 he practised electrical engineering in Chicago, Ill , until 1893. He originated a process for making caustic soda from molten salt by electrolysis, and established works in Niagara Falls, N Y , for the manufacture of soda and other chemical products. He devised various other chemical and electro-chemical processes, and obtained numerous patents for his inventions pertaining to electrochemical manufacture. In recognition of his services to chemical technology he was awarded in 1902 the Elliott Cresson medal of the Franklin institute. He died in Ossining, N Y , on Oct. 18, 1920.

ACKERMAN, FRANCIS (*c.* 1335–87), Flemish soldier and diplomat, was born at Ghent. He was partly responsible for inducing Philip van Artevelde to become first captain of the city of Ghent in 1382. He secured for Ghent assistance from the citizens of Brussels, Louvain and Liége, and, as admiral of the Flemish fleet, visited England and obtained a promise of help from King Richard II After Artevelde's death in Nov. 1382, Ackerman acted as leader of the Flemings. He took part in the conclusion of the treaty of peace between Ghent and Philip the Bold, duke of Burgundy, in Dec. 1385. Trusting in Philip, and ignoring the warnings of his friends, Ackerman remained in Flanders and was murdered at Ghent on July 22, 1387, leaving a memory of chivalry and generosity.

See Jean Froissart, *Chroniques*, ed S. Luce and G. Raynaud (Paris, 1869–97); Johannes Brandon, *Chronodromon*, ed. K. de Lettenhove in the *Chroniques relatives à l'histoire de la Belgique sous la domination des ducs de Bourgogne* (Brussels, 1870).

ACKERMANN, LOUISE VICTORINE CHOQUET (1813–1890), French poet, was born in Paris on Nov. 30, 1813. Educated by her father in the philosophy of the encyclopaedists, Victorine Choquet went to Berlin in 1838 to study German, and there married in 1843 Paul Ackermann, an Alsatian philologist.

After little more than two years of happy married life her husband died, and Mme. Ackermann went to live at Nice. In 1855 she published *Contes en vers,* and in 1862 *Contes et poésies.* Very different from these simple and charming *contes* is the work on which Mme. Ackermann's real reputation rests. She published in 1874 *Poésies, premières poésies, poésies philosophiques,* a volume of sombre and powerful verse, expressing her revolt against human suffering. Soon after the publication of this volume Mme. Ackermann removed to Paris, where she gathered round her a circle of friends, but published nothing further except a prose volume, the *Pensées d'une solitaire* (1883, Eng. trans., Glasgow, 1921), to which she prefixed a short autobiography. She died at Nice on Aug. 2, 1890.

See also Anatole France, *La vie littéraire,* 4th series (1892); the comte d'Haussonville, *Mme. Ackermann* (1882); M. Citoleux, *La poésie philosophique au XIXe siècle* (vol. i. 1906); O. B. P. G. de Cléron, *Mme. Ackermann d'après des lettres et des papiers inédits* (1892).

ACKERMANN, RUDOLPH (1764–1834), Anglo-German inventor and publisher, was born on April 20, 1764 at Schneeberg, in Saxony. He had been a saddler and coach-builder for ten years in different German cities and in Paris and London, when, in 1795, he established a print-shop and drawing school in the Strand. Ackermann set up a lithographic press, and applied it in 1817 to the illustration of his *Repository of Arts, Literature, Fashions, etc.* (monthly until 1828). Rowlandson and other distinguished artists were regular contributors. He also introduced the fashion of the once popular English annuals, beginning in 1825 with *Forget-me-not;* and he published many illustrated volumes of topography and travel, *The Microcosm of London* (1808–11), *Westminster Abbey* (1812), *The Rhine* (1820), *The World in Miniature* (1821–26), etc. Ackermann was an enterprising man; he patented (1801) a method for rendering paper and cloth waterproof, erected a factory at Chelsea for the purpose and was one of the first to illuminate his own premises with gas. Indeed the introduction of lighting by gas owed much to him. After the battle of Leipzig Ackermann collected nearly a quarter of a million sterling for German sufferers. He died at Finchley, Middlesex, on March 30, 1834.

ACKNOWLEDGMENT, an admission that something has been given or done, a term used in law in various connections. The acknowledgment of a debt, if in writing signed by the debtor or his agent, is sufficient to take it out of the Statutes of Limitations. The signature to a will by a testator, if not made in the presence of two witnesses, may be afterwards acknowledged in their presence. The acknowledgment by a woman married before 1882 of deeds for the conveyance of real property, not her separate property, requires to be made by her before a judge of the High Court, or of a county court, or before a perpetual or special commissioner. Before such an acknowledgment can be received, the judge or commissioner is required to examine her apart from her husband, touching her knowledge of the deed, and to ascertain whether she freely consents. In some British colonies this acknowledgment applies even to separate estates. An acknowledgment to the right of the production of deeds of conveyance is an obligation on the vendor, when he retains any portion of the property to which the deeds relate, and is entitled to retain the deeds, to produce them from time to time at the request of the person to whom the acknowledgment is given, to allow copies to be made, and to undertake for their safe custody (Conveyancing Act, 1881, section 9). The term "acknowledgment" is, in the United States, applied to the certificate of a public officer that an instrument was acknowledged before him to be the deed or act of the person who executed it. "Acknowledgment money" was the sum paid in some parts of England by copyhold tenants on the death of the lord of the manor.

ACKTÉ-JALANDER, AÏNO (1876–), Finnish opera singer, studied singing in Paris, and later was for a number of years (1897–1904) one of the leading sopranos at the Grand Opéra, where her exceptional powers won general recognition. In 1904 she went to New York, where she was no less successful at the Metropolitan Opera (1904–06). In 1907 she paid her first visit to England, taking part in a winter season at Covent Garden, under the management of Ernest van Dyck. In 1910 she was again at Covent Garden, attracting this time much attention in the title part of Strauss's "Salome" on the occasion of its first production in England by Sir Thomas Beecham. Subsequently she settled down in her native Finland, where she enjoys the highest favour.

ACLAND, SIR HENRY WENTWORTH, BART. (1815–1900), English physician and man of learning, was born near Exeter on Aug. 23, 1815, and died at Oxford on Oct. 16, 1900. He was regius professor of medicine at Oxford from 1858 to 1894. He was also a curator of the university galleries and of the Bodleian Library, and from 1858 to 1887 he represented his university on the General Medical Council, serving as president from 1874 to 1887. Acland took a leading part in the revival of the Oxford medical school and in introducing the study of natural science into the university. The establishment of the Oxford university museum, opened in 1861, as a centre for the encouragement of the study of science, especially in relation to medicine, was largely due to his efforts. "To Henry Acland," said his lifelong friend, John Ruskin, "physiology was an entrusted gospel of which he was the solitary preacher to the heathen" at Oxford. Acland published a study of the outbreak of cholera at Oxford in 1854, together with various pamphlets on sanitary matters, and served on the royal commission on sanitary laws in England and Wales, in 1869.

See *Sir Henry Wentworth Acland,* a memoir by J. B. Atlay, with portraits (1903).

ACME, the highest point attainable. (Gr. ἀκμή, point.)

ACMITE or **AEGIRITE,** a mineral of the pyroxene (*q.v.*) group, essentially a sodium and ferric metasilicate, $NaFe(SiO_3)_2$. In its crystallographic characters it is close to ordinary pyroxene (augite and diopside), being monoclinic and having nearly the same angle between the prismatic cleavages. There are, however, important differences in the optical characters; the birefringence of acmite is negative, the pleochroism is strong and the extinction angle on the plane of symmetry measured to the vertical axis is small (3°–5°). The hardness is 6–6½, and the specific gravity 3·55. Crystals are elongated in the direction of the vertical axis, and are blackish green (aegirite) or dark brown (acmite) in colour. It is isomorphous with augite; mixed crystals are not uncommon.

The mineral is a characteristic constituent of igneous rocks rich in soda, such as nepheline-syenites, phonolites, etc. It was first discovered as slender crystals, sometimes a foot in length in the pegmatite veins of the granite of Rundemyr, near Kongsberg in Norway, and was named by F. Stromeyer in 1821 from the Gr. ἀκμή, a point, in allusion to the pointed terminations of the crystals. Acmite forms an important constituent of a granitic rock (rockallite) occurring on the islet of Rockall in the North Atlantic, and is notable for its content of zirconia 2·68%. Aegirite (named from Aegir, the Scandinavian sea-god) was described in 1835 from the elaeolite-syenite of southern Norway. The essential identity of acmite and aegirite has long been established.

ACNE, a skin eruption produced by inflammation of the sebaceous glands and hair follicles, the essential point in the disease being the plugging of the mouths of the sebaceous follicles by a "comedo," familiarly known as "blackhead." It is generally acknowledged that the cause of this disease is a specific organism (*B. acnes*). The affection occurs in the form of red pimples or papules, which may become pustular and be attended with much surrounding irritation of the skin. It is commonest in early adult life, and occurs on the chest and back as well as on the face, where it may, when of much extent, produce great disfigurement. It is apt to persist for months or even years, but usually in time disappears entirely, although slight traces may remain in the form of scars or stains upon the skin. Acniform eruptions are sometimes produced by the internal use of certain drugs, such as the iodide or bromide of potassium. (*See* BLACKHEAD.)

Treatment.—The face should be held over steaming water for several minutes, and then thoroughly bathed. The blackheads should next be removed, not with the finger-nail, but with an inexpensive little instrument known as the "comedo expressor." When the more noticeable of the blackheads have been expressed, the face should be firmly rubbed for three or four minutes with a lather made from a special soap composed of sulphur, camphor

and balsam of Peru. Any lather remaining on the face should be wiped off with a soft handkerchief. As this treatment might give rise to some irritation of the skin, it should be replaced every fourth night by a simple application of cold cream. Of drugs used internally sulphide of calcium, in pill, ⅛ grain three times a day is a useful adjunct. The patient should take plenty of exercise in the fresh air, a very simple but nourishing diet, and, if present, constipation and anaemia must be suitably treated.

Acne rosacea is a more severe and troublesome disorder, a true dermatitis with no relation to the foregoing, and in most cases secondary to seborrhea of the scalp. It is characterized by great redness of the nose and cheeks, accompanied by pustular enlargements on the surface of the skin, which produce marked disfigurement. Although often seen in persons who live too freely, it is by no means confined to such, but may arise in connection with disturbances of the general health, especially of the function of digestion, and in females with menstrual disorders. It is exceedingly intractable to treatment, which is partly local and partly constitutional. Of internal remedies preparations of iodine and of arsenic are sometimes found of service.

ACOELOMATA, a word sometimes used in zoology in contradistinction to Coelomata (*q.v.*) to denote those animals in which no second body cavity (coelom, *q.v.*) is present. The group includes the Coelenterata and Platyhelminthes (*qq.v.*).

ACOEMETI, an order of Eastern monks who celebrated the divine service without intermission day or night (Gr. ἀκοίμητος, sleepless). This was done by dividing the communities into choirs, which relieved each other by turn in the church. Their first monastery was established on the Euphrates in the beginning of the 5th century. In Constantinople (*c.* 460) the famous monastery of the Studium, founded by the consular Studius, was put in the hands of the Acoemeti and became their chief house, so that they were sometimes called Studites.

Bibliography.—*See* the article in Smith and Cheetham, *Dictionary of Christian Antiquities;* Herzog-Hauck, *Realencyklopadie* (3rd ed.); also the general histories of the time.

ACOLYTE, the highest of the four minor orders in the Roman Church (Gr. ἀκόλουθος, follower). The office is unknown in the Eastern Church, except among the Armenians who borrowed it from the West. Before the Council of Nicaea (325) it was only found at Rome and Carthage. In 251, Pope Cornelius, in a letter to Fabius of Antioch, mentions among the Roman clergy 42 acolytes, placing them next after the subdeacons (Eusebius, *Hist. Ecc.* vi. 43), giving no hint that the office was a new one. The *Liber Pontificalis* says that Pope Victor (186–197) made *sequentes cleros,* a term which may possibly denote acolytes. While the office was well known in Rome, it was evidently not at first an order through which, as to-day, every candidate to the priesthood must pass. St. Cyprian of Carthage (200?–258) used acolytes to carry his letters, but this seems to be the only place in Africa where they were known. The Irish Church did not know them; and in Spain the Council of Toledo (400) makes no mention of them. The *Statuta Ecclesiae Antiqua,* a Gallican collection for the province of Arles, early 6th century, mentions the acolyte, but does not give, as for the other orders, any form of ordination. The Roman books are silent, and in the *Leonine Sacramentary* and the so-called *Gelasian Mass-book* there is the same silence, though one ms. of the 10th century, given by Muratori, contains a form of ordination of an acolyte. The office is often mentioned in the *Ordines Romani,* but only in *Ordo* VIII. (not earlier than 7th century) do we find a very simple form for admitting an acolyte to his office. The evidence available, therefore, indicates that the acolyte was only a local office, not a necessary step to sacred orders. In England, acolytes first occur, both as office and order, in the Pontifical attributed to Egbert of York (732–766); and Aelfric (1006) in both his pastoral epistle and canons mentions the acolyte. It would seem, then, that the acolyte became an order in the Gallican Church first, and afterwards found its way as such into the Roman books before the fusion of the two rites under Charlemagne.

The duties of the acolyte, as given in the Roman Pontifical, are identical with those mentioned in the *Statuta Ecclesiae Antiqua* of Arles: "to carry the candlesticks, to light the lamps of the church, to administer wine and water for the Eucharist." The *Ordines Romani* divides the acolytes into *Palatini,* who served the pope at the Lateran palace, *Stationarii,* who served at churches where there was a "station," and *Regionarii,* or those attached directly to the regions; and gives us a glimpse of their duties. When the pope rode in procession to the station an acolyte walked before him, bearing the holy chrism; and at the church seven acolytes with candles went before him to the altar, while two others, bearing the vessel that contained a consecrated Host, presented it for his adoration. At the communion the acolytes received in linen bags the consecrated Hosts to carry to the assisting priests The official dress of the acolyte (*Ordo* V.) was a close-fitting linen garment (*camisia*), a napkin hanging from the left side, a white tunic, a stole (*orarium*) and a chasuble (*planeta*) which he took off when he sang on the steps of the *ambo.*

At the present day the duties of acolytes are now performed, almost everywhere, by laymen. The office has been revived unofficially in the Church of England, as a result of the Tractarian movement.

See Morin, *Commentarius in sacris Ecclesiae ordinationibus,* ii. p. 209, iii. p. 152 (Antwerp, 1685); Martène, *De Antiquis Ecclesiae ritibus,* ii. pp. 47 and 86 (Antwerp, 1739); Mabillon, *Musaeum Italicum II.* for the *Ordines Romani;* Muratori, *Liturgia Romana Vetus;* Cabrol, *Dictionnaire d'archéologie chrétienne et de liturgie,* vol. i. col. 348–536.

ACOMA, a tribe and town of the Pueblo Indians in New Mexico, forming an isolated western settlement of the Keres stock. The town is strikingly situated on a mesa rising 350ft. sheer above the surrounding plain, in which lie the Pueblo farmlands at a distance of some miles. It is reputed to be the oldest inhabited settlement in the United States, a distinction which, however, may be challenged by Zuñi and Oraibi. Discovered by Coronado's army in 1540, Acoma surprised and defeated a Spanish detachment in 1598, lost heavily in its subjugation next year, received a permanent mission early in the 17th century, rebelled with the other Pueblos in 1680, but was reconquered. The original population was perhaps 1,000, the present one is about 500.

ACOMINATUS (Akominatos), **MICHAEL** (*c.* 1140–1220), Byzantine writer and ecclesiastic, was born at Chonae (the ancient Colossae). He studied at Constantinople, and about 1175 was appointed archbishop of Athens. After the capture of Constantinople by the Franks and the establishment of the Latin empire (1204), he retired to the island of Ceos, where he died. He wrote homilies, speeches and poems which, with his correspondence, throw considerable light upon the miserable condition of Attica and Athens at the time. His memorial to Alexis III. Angelus on the abuses of Byzantine administration, the poetical lament over the degeneracy of Athens, and the monodes on his brother Nicetas and Eustathius, archbishop of Thessalonica, deserve special mention.

Bibliography.—Edition of his works by S. Lambros (1879–80); Migne, *Patrologia Graeca,* cxl.; *see* also A. Ellissen, *Michael Akominatos* (1846), containing several pieces with German translation; F. Gregorovius, *Geschichte der Stadt Athen im Mittelalter,* i. (1889); G. Finlay, *History of Greece,* iv. p. 133–134, (1877).

His younger brother, Nicetas (Niketas), sometimes called Choniates, who accompanied him to Constantinople, held several appointments under the Angelus emperors (amongst them that of "great logothete" or chancellor) and was governor of the "theme" of Philippopolis at a critical period. After the fall of Constantinople he fled to Nicaea, where he settled at the court of the emperor Theodorus Lascaris, and devoted himself to literature. He died between 1210 and 1220. His chief work is his *History,* in 21 books, of the period from 1180 to 1206. In spite of its florid style, it is of considerable value as a record (on the whole impartial) of events of which he was either an eye-witness or had heard at first hand. Its most interesting portion is the description of the capture of Constantinople. The little treatise *On the Statues* destroyed by the Latins (perhaps, as we have it, altered by a later writer), is of special interest to the archaeologist. His dogmatic work (Θησαυρὸς Ὀρθοδοξίας, *Thesaurus Orthodoxae Fidei*), extant in a complete form in ms., is one of the

chief authorities for the heresies of the 12th century.

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ACONCAGUA, a small northern province of central Chile, bounded on the north by Coquimbo, east by Argentina, south by Santiago and west by the Pacific. Its area, including Valparaiso, annexed in 1928, is 18,598sq. kilometers. Pop. (1920) including territory added in 1928, was 437,312; the 1926 estimate was 448,031. The province is very mountainous, and is traversed from east to west by the valley of the Aconcagua river. The climate is hot and dry, the rainfall being too small to influence climatic conditions. The valleys are highly fertile, and where irrigation is employed large crops are easily raised. Beyond the limits of irrigation the country is semi-barren. Alfalfa and grapes are the principal products, and considerable attention is given to the cultivation of other fruits, such as figs, peaches and melons. The Valle de Quillota, through which the railway passes between Valparaiso and Santiago, is celebrated for its gardens. The Aconcagua river rises on the southern slope of the volcano Aconcagua, the highest mountain in South America (more than 23,000ft.), first flows east down a broad valley, or bay in the mountains, and enters the Pacific 12m. N. of Valparaiso. The river has a course of about 200m., and its waters irrigate the best and most populous part of the province. Two other rivers—the Ligua and Choapa—traverse the province, the latter forming the northern boundary line. The capital is the seaport, Valparaiso, which had a population of 182,422 in 1920. Other important cities are Viña del Mar (pop. in 1920, 38,000), Santa Rosa (pop. in 1920, 29,002) and San Felipe, the former capital (pop. in 1920, 27,774). Santa Rosa is a principal station on the trans-Andine branch of the State railway. A second port is Los Vilos, whence a railway 40m. long runs north-east to the Choapa. Another line connects Cabildo, in the Ligua valley, with the State railway.

ACONCAGUA, an extinct volcano in the southern Andes with a height of about 23,000ft., usually regarded as the loftiest mountain in America. It is situated on the boundary line between Chile and Argentina in 32° 39′ S. and 70° 1′ W. On its southern slope is the source of the Aconcagua river which flows westerly to the Pacific ocean through a course of about 200 miles. The summit of Aconcagua was first scaled in 1897 by Vines and Zurbriggen of the FitzGerald expedition

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ACONCIO, GIACOMO (1492–1566?), pioneer of religious toleration, was one of the Italians, like Peter Martyr and Bernardino Ochino, who repudiated Roman Catholic doctrine and ultimately found refuge in England, where he worked as an engineer on various public works. Before reaching England he had published a treatise on the methods of investigation, *De Methodo, hoc est, de recte investigandarum tradendarumque Scientiarum ratione* (1558); and his critical spirit placed him outside all the recognized religious societies of his time.

On his arrival in London he had joined the Dutch Reformed Church in Austin Friars, but he was "infected with Anabaptistical and Arian opinions" and was excluded from the sacrament by Grindal, bishop of London. The real nature of his heterodoxy is revealed in his *Stratagemata Satanae* (1565). The "stratagems of Satan" are the dogmatic creeds which rent the Christian church. Aconcio sought to reduce dogma to a minimum in the hope of finding a common denominator for the various creeds.

BIBLIOGRAPHY.—*See* Gough's *Index to Parker Soc. Publ.*; Strype's *Grindal*, pp. 62, 66; Bayle's *Dictionnaire*; G. Tiraboschi, *Storia della lett. Italiana* (1805–13); *Österreichisches Biogr. Lexikon*; *Nouvelle biogr. générale*; *Dict. Nat. Biogr.*

ACONITE (*Aconitum*), a genus of plants belonging to the Ranunculaceae, the buttercup family, commonly known as aconite, monkshood or wolfsbane, and embracing about 60 species, chiefly natives of the mountainous parts of the northern hemisphere. They are distinguished by having one of the five blue or yellow coloured sepals (the posterior one) in the form of a helmet; hence the English name monkshood. Two of the petals placed under the hood of the calyx are supported on long stalks, and have a hollow spur at their apex, containing honey. They are handsome plants, the tall stem being crowned by racemes of showy flowers. *Aconitum napellus*, common monkshood, is a doubtful native of Britain, and is of therapeutic and toxicological importance. Its roots have occasionally been mistaken for horse-radish. The aconite has a short underground stem, from which dark-coloured tapering roots descend. The crown or upper portion of the root gives rise to new plants. When put to the lip, the juice of the aconite root produces a feeling of numbness and tingling. The horse-radish root, which belongs to the family Cruciferae, is much longer than that of the aconite, and it is not tapering; its colour is yellowish, and the top of the root has the remains of the leaves on it.

Many species of aconite are cultivated in gardens, some having blue and others yellow flowers. *Aconitum lycoctonum*, wolfsbane, is a yellow-flowered species common on the Alps of Switzerland. The roots of *Aconitum ferox* supply the famous Indian (Nepal) poison called bikh, bish or nabee It contains considerable quantities of the alkaloid pseudaconitine, which is the most deadly poison known. *Aconitum palmatum* yields another of the celebrated bikh poisons. The root of *Aconitum luridum*, of the Himalayas, is said to be as virulent as that of *A. ferox* or *A. napellus*. As garden plants the aconites are very ornamental, hardy perennials. They thrive well in any ordinary garden soil, and will grow beneath the shade of trees. They are easily propagated by divisions of the root or by seeds.

Chemistry.—The active principle of *Aconitum napellus* is the alkaloid aconitine, first examined by P. L. Geiger and Hesse (*Ann*, 1834, 7, p. 267). Alder Wright and A. P. Luff obtained apoaconitine, aconine and benzoic acid by hydrolysis; while, in 1892, C. Ehrenberg and A. Purfürst (*Journ. Prat. Chem.*, 1892, 45, p. 604) observed acetic acid as a hydrolytic product. This, and allied alkaloids, have formed the subject of many investigations by Wyndham Dunstan and his pupils in England, and by Martin Freund and Paul Beck in Berlin. But their constitution is not yet solved, there even being some divergence of opinion as to their empirical formulae. Aconitine ($C_{33}H_{45}NO_{12}$, according to Dunstan; $C_{31}H_{47}NO_{11}$, according to Freund) is a crystalline base, soluble in alcohol, but very sparingly in water; its alcoholic solution is dextrorotatory, but its salts are laevorotatory. When heated it loses water and forms pyraconitine. Hydrolysis gives acetic acid and benzaconine, the chief constituent of the alkaloids picraconitine and napelline; further hydrolysis give aconine. Pseudaconitine, obtained from *Aconitum ferox*, gives on hydrolysis acetic acid and veratryl-pseudaconine, the latter of which suffers further hydrolysis to veratric acid and pseudaconine. Japaconitine, obtained from the Japanese aconites, known locally as "kuza-uzu," hydrolyses to japbenzaconine, which further breaks down to benzoic acid and japaconine. Other related alkaloids are lycaconitine and myoctonine which occur in wolfsbane, *Aconitum lycoctonum*. The usual test for solutions of aconitine consists in slight acidulation with acetic acid and addition of potassium permanganate, which causes the formation of a red crystalline precipitate. In 1905, Dunstan and his collaborators discovered two new aconite alkaloids, indaconitine in "mohri" (*Aconitum chasmanthum*, Stapf), and bikhaconitine in "bikh" (*Aconitum spicatum*); he also proposes to classify these alkaloids according to whether they yield benzoic or veratric acid on hydrolysis (*Jour. Chem. Soc.*, 1905, 87, pp. 1620, 1650).

From the root of *Aconitum napellus* are prepared a liniment and a tincture. The dose of the latter (Brit. Pharmacop.) is of importance as being exceptionally small, for it is not advisable to give more than at most five drops at a time. The official preparation is an ointment which contains one part of the alkaloid

in fifty. It must be used with extreme care, and in small quantities, and it must not be used at all where cuts or cracks are present in the skin.

Pharmacology of Aconite and Aconitine.—Aconite first stimulates and later paralyses the nerves of pain, touch and temperature, if applied to the skin, broken or unbroken, or to a mucous membrane, the initial tingling therefore gives place to a long-continued anaesthetic action. Taken internally aconite acts very notably on the circulation, the respiration and the nervous system. The pulse is slowed, the number of beats per minute being actually reduced, under considerable doses, to 40, or even 30, per minute. The blood-pressure synchronously falls, and the heart is arrested in diastole. Immediately before arrest the heart may beat much faster than normally, though with extreme irregularity, and in the lower animals the auricles may be observed occasionally to miss a beat, as in poisoning by veratrine and colchicum. The action of aconitine on the circulation is due to an initial stimulation of the cardio-inhibitory centre in the medulla oblongata (at the root of the vagus nerves), and later to a directly toxic influence on the nerve-ganglia and muscular fibres of the heart itself. The fall in blood-pressure is not due to any direct influence on the vessels. The respiration becomes slower owing to a paralytic action on the respiratory centre and, in warm-blooded animals, death is due to this action, the respiration being arrested before the action of the heart. Aconite further depresses the activity of all nerve-terminals, the sensory being affected before the motor. In small doses it therefore tends to relieve pain, if this be present. The activity of the spinal cord is similarly depressed. The pupil is at first contracted and afterwards dilated. The cerebrum is totally unaffected by aconite, consciousness and the intelligence remaining normal to the last. The antipyretic action which considerable doses of aconite display is not specific, but is the result of its influence on the circulation and respiration and of its slight diaphoretic action.

Therapeutics.—The indications for its employment are limited, but definite. It is of undoubted value as a local anodyne in sciatica and neuralgia, especially in ordinary facial or trigeminal neuralgia The best method of application is by rubbing in a small quantity of the aconitine ointment until numbness is felt, but the costliness of this preparation causes the use of the aconite liniment to be commonly resorted to. This should be painted on the affected part with a camel's hair brush dipped in chloroform, which facilitates the absorption of the alkaloid. Aconite is indicated for internal administration whenever it is desirable to depress the action of the heart in the course of a fever. Formerly used in every fever, and even in the septic states that constantly followed surgical operation in the pre-Listerian epoch, aconite is now employed only in the earliest stage of the less serious fevers, such as acute tonsilitis, bronchitis and, notably, laryngitis. The extreme pain and rapid swelling of the vocal cords—with threatened obstruction to the respiration—that characterize acute laryngitis may often be relieved by the sedative action of this drug upon the circulation. In order to reduce the pulse to its normal rate in these cases, without at the same time lessening the power of the heart, the drug must be given in doses of about two minims of the tincture every half-hour and then every hour until the pulse falls to the normal rate. Thereafter the drug must be discontinued. It is probably never right to give aconite in doses much larger than that named. There is one condition of the heart itself in which aconite is sometimes useful. Whilst absolutely contra-indicated in all cases of valvular disease, it is of value in cases of cardiac hypertrophy with over-action. But the practitioner must be assured that neither valvular lesion nor degeneration of the myocardium is present.

Toxicology.—In a few minutes after the introduction of a poisonous dose of aconite, marked symptoms supervene. The initial signs of poisoning are referable to the alimentary canal. There is a sensation of burning, tingling and numbness in the mouth, and of burning in the abdomen. Death usually supervenes before a numbing effect on the intestine can be observed. After about an hour there is severe vomiting. Much motor weakness and cutaneous sensations similar to those above described soon follow. The pulse and respiration steadily fail, death occurring from asphyxia. As in strychnine poisoning, the patient is conscious and clear-minded to the last. The only post-mortem signs are those of asphyxia. The treatment is to empty the stomach by tube or by a non-depressant emetic. The physiological antidotes are atropine and digitalin or strophanthin, which should be injected subcutaneously in maximal doses Alcohol, strychnine and warmth must also be employed.

ACONITINE: *see* ACONITE.

ACONTIUS, in Greek legend, a beautiful youth of the island of Ceos. During the festival of Artemis, at Delos, Acontius saw and loved Cydippe, a well-born Athenian maiden. He wrote on an apple the words, "I swear to wed Acontius" and threw it at her feet. She picked it up, and mechanically read the words aloud, thus binding herself by an oath. Therefore, although she was betrothed more than once, she always fell ill before the wedding took place. The Delphic oracle at last explained the matter, and she married Acontius. (Callimachus, *Aitia,* III., 1 Mair; *see* his notes [p. 204 of the Loeb ed.] for other authorities)

ACORN, the fruit of the oak-tree (*see* OAK); a word also used, by analogy with the shape, in nautical language, for a piece of wood keeping the vane on the mast-head.

ACORN SHELLS, a name often applied to the sessile forms of barnacles (*q v*) common on rocks, piers, etc., round the coasts. (*See* also CIRRHIPEDIA.)

ACORUS CALAMUS, sweet-sedge or sweet-flag, a plant of the family Araceae, which shares with the Cuckoo Pint (*Arum*) the representation in Britain of that order of Monocotyledons. The name is derived from *acorus,* Gr. ἄκορος, the classical name for the plant. It was the *Calamus aromaticus* of the mediaeval druggists and perhaps of the ancients, though the latter has been referred by some to the Citron grass, *Andropogon Nardus* The spice "Calamus" or "Sweet-cane" of the Scriptures, one of the ingredients of the holy anointing oil of the Jews, was perhaps one of the fragrant species of *Andropogon.* The plant is a herbaceous perennial with a long, branched root-stock creeping through the mud, about ¾ inch thick, with short joints and large brownish leaf-scars. At the ends of the branches are tufts of flat, sword-like, sweet-scented leaves 3 or 4ft. long and about an inch wide, closely arranged in two rows as in the true Flag (*Iris*); the tall flowering stems (scapes), which very much resemble the leaves, bear an apparently lateral, blunt, tapering spike of densely packed, very small flowers. A long leaf (spathe) borne immediately below the spike forms an apparent continuation of the scape, though really a lateral outgrowth from it, the spike of flowers being terminal. The plant has a wide distribution, growing in wet situations in the Himalayas, North America, Siberia and various parts of Europe, including England, and has been naturalized in Scotland and Ireland.

ACOSMISM. This term was coined by Fichte and Hegel on the model of the term atheism. According to the ordinary view, reality consists of God and a world (cosmos) of finite objects usually conceived as having been created by Him and made to conform to certain laws. Now atheism is the theory which denies the existence of God, and so identifies reality with a godless world of objects and events which exist of themselves and have an inherent order of their own Acosmism is the contrary view that denies the independent reality of a world of finite objects and events, and regards God as the sole ultimate reality. In accordance with the common practice of denouncing anybody as an atheist whose conception of God was different from theirs, Spinoza was generally described as an atheist by his contemporaries and others. Hegel protested against the injustice of this. Spinoza, he said, was so far from denying the existence of God that he acknowledged no other ultimate reality—so far from being an atheist he was an acosmist. Fichte similarly applied the term to himself in reply to similar accusations. The term acosmism has since been applied also to philosophies like those of the Vedanta, of Buddhism, and of Schopenhauer. Apart from its polemical uses the term acosmism, with its suggestion of an illusory world, is not a happy equivalent of the term pantheism. Strictly speaking, a pantheism like that of Spinoza no more denies the reality of

the world than it denies the reality of God. It simply identifies the universe with God, and for that very reason regards the universe all the more as a world of order, a real *cosmos*. Moreover, there is an important sense in which pantheism is essentially *cosmic*, namely, in the sense that it regards man from the standpoint of the universe, instead of regarding the universe from the point of view of man (*see* ANTHROPOCENTRIC PHILOSOPHY). "Acosmism" is therefore not only an inadequate, but also a misleading description of pantheism.

ACOSTA, JOAQUIN (*c.* 1795–1852), Colombian historian and soldier, was an officer in Bolivar's army, and a member of Congress. He travelled in Colombia and in Spain, collecting material for his *Compendio histórico del descubrimiento y colonización de la Nueva Granada*, which was published in Paris in 1848.

ACOSTA, JOSÉ DE (1539?–1600), Spanish author, was born at Medina del Campo about the year 1539. He joined the Jesuits in 1551, and in 1571 was sent as a missionary to Peru; he acted as provincial of his Order from 1576 to 1581, was appointed theological adviser to the Council of Lima in 1582, and in 1583 published a catechism in Quichua and Aymara—the first book printed in Peru. In 1598 he became rector of the Jesuit college at Salamanca, where he died on Feb. 15, 1600. His treatise, *De natura novi orbis libri duo* (Salamanca, 1588–89), may be regarded as the preliminary draft of his celebrated *Historia natural y moral de las Indias* (Seville, 1590), which was speedily translated into Italian (1596), French (1597), Dutch (1598), German (1601), Latin (1602), and English (1604). The *Historia* is in three sections: books I and II. deal with generalities; books III. and IV. with the physical geography and natural history of Mexico and Peru; books V., VI., and VII., with the religious and political institutions of the aborigines. Apart from his sophistical defence of Spanish colonial policy, de Acosta deserves high praise as an acute and diligent observer. Among his other publications is *De procuranda salute Indorum libri sex* (Salamanca, 1588).

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ACOSTA, URIEL (d. 1647), Jewish author, was born at Oporto near the end of the 16th century. Educated in the Roman Catholic faith, he was received into the synagogue at Amsterdam and exchanged his baptismal name of Gabriel for Uriel. His wayward disposition, however, found no satisfaction in Judaism. He was twice excommunicated, and twice readmitted to the synagogue. In his autobiography, *Exemplar humanae vitae*, printed in 1687 and again in 1847, Acosta declared his hostility both to Christianity and Judaism, but spoke most bitterly of Judaism. He committed suicide in 1647. The story of Acosta's life provided K. F. Gutzkow with the material of the tragedy of *Uriel Acosta* (1847).

ACOUSTICS OF BUILDINGS, THE. The subject of the acoustics of auditoriums deals with the behaviour of sound in rooms and in halls, and the conditions which determine their fitness or unsuitability for the hearing of speech and music.

Certain characteristics of sounds emitted in a closed space require to be borne in mind. The sounds proceed outwards from the source in spherical waves until they strike the boundaries of the room. At the boundaries they are partly absorbed or transmitted to an extent depending upon the nature of the surfaces, but the remainder is reflected. Simple echoes may thus arise, and if any large portion of the surface is appropriately curved objectionable focussing of sound may occur. However, continuing the history of the reflected sound, it travels quickly, so that through numerous successive reflections its energy is very soon more or less uniformly diffused throughout the room, every element of volume being filled with waves proceeding in every direction. Again, since sound is a form of energy, when once produced in a confined space it will continue to exist until it is transmitted by the boundary walls or transformed into some other kind of energy, generally heat. Consequently if the boundaries are hard and non-absorbent, little energy is absorbed at each impact and, owing to the very many reflections which occur before the sound dies away, prolonged reverberation is noticed. With more porous wall surfaces the aerial vibrations are damped out by frictional conversion into heat within the pores of the material, and reverberation is reduced. If the source of sound is continuously maintained the loudness in the room increases rapidly until the rate of emission of sound from the source is balanced by the absorption at the surfaces. In the steady state thus reached the loudness at a given point is generally greater than it would be in open air and, apart from echo and focussing effects, more uniform in distribution. It may be mentioned further that with sustained notes interference phenomena may be observed as the ear is moved from side to side, maxima and minima of sound being perceptible at different points. In the acoustics of buildings, however, these latter effects are of subsidiary importance, partly because the use of two ears tends to obscure them, and partly because in speech—and to a lesser extent in music—the sounds are changing so rapidly that an interference system is never completely set up. Finally, resonant vibrations of columns or volumes of air in the chamber may cause distortion of sounds of appropriate pitch, and sympathetic vibration of floors in contact with the source, or of panelling close at hand, will increase the volume of sound emitted.

The chief conditions for good hearing in an auditorium are therefore: (*a*) that loudness should be adequate; (*b*) that there should be no perceptible echoes or focussing; (*c*) that there should be no undue reverberation (*i.e.*, each speech sound should die away quickly enough to be inappreciable by the time the next is uttered); (*d*) that where best music is concerned the hall should be non-resonant and as uniformly reverberant as possible for sounds of all musical pitches, in order to preserve the proper relative proportions of the components of a complex sound; and (*e*) that the boundaries be sufficiently soundproof to exclude extraneous noise.

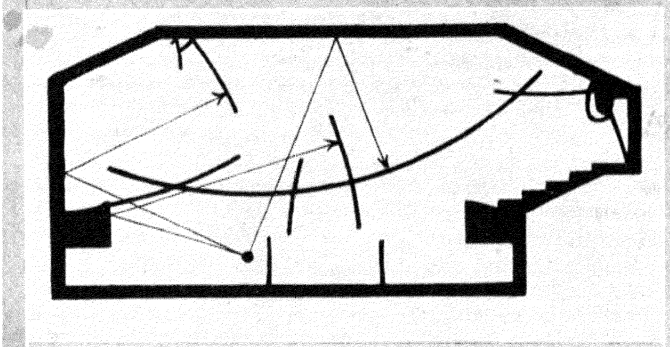
Loudness.—Voices of moderate strength and distinct pronunciation are usually loud enough to reach hearers in front of a speaker at a distance not exceeding about 50ft, provided the hearers have an uninterrupted view of the speaker. This limitation leads, in lecture halls, theatres and similar auditoriums where the hearing of speech is the primary consideration, to a size that will not usually accommodate more than about 2,000 persons, to the adoption of a raised platform or of raked seating so that a direct view of the speaker may be ensured, and to galleries for accommodating as many persons as possible within range of the voice.

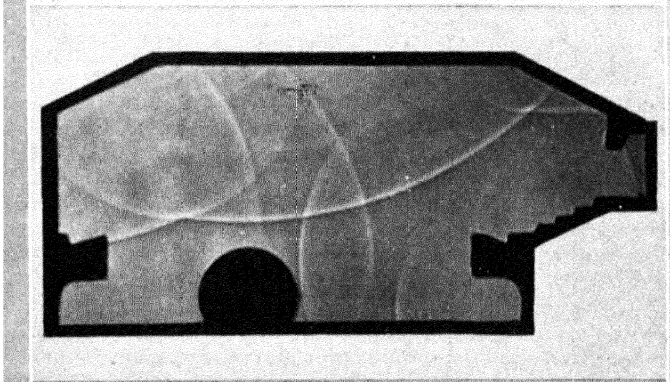
Loudness is also enhanced by keeping the ceiling of a hall low so that it may act as a reflector to strengthen sounds reaching remote seats. This device is specially valuable for Council chambers in which members speak from where they stand, for no other surface can be equally effective for all positions of the speaker. In order that the audience in galleries may benefit from the reflection, the galleries should be under the main ceiling of the hall.

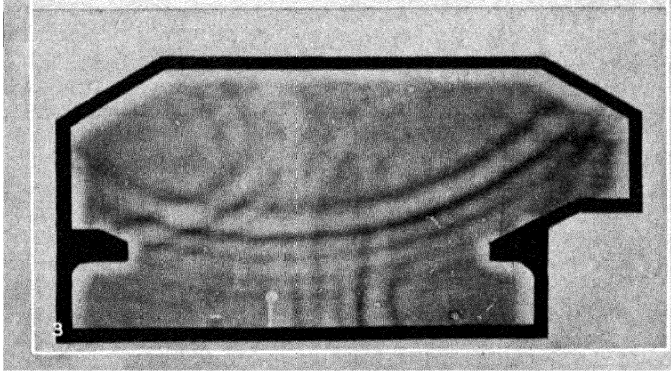
Electrical amplifying equipment, in conjunction with large loud-speakers, is now used successfully to increase the volume of sound, particularly in the case of speech. When this apparatus is used the assistance of other devices is not required. Amplification, however, must not be excessive, for excessive loudness gives undue prominence to low pitched sounds. It is necessary, therefore, to amplify only to an extent such that remote listeners can hear with comfort, to place the projectors well above the speaker's head, and so to direct them that the sound is not excessive for hearers near the platform. Loudness is then fairly uniform over the floor space and the majority of the audience has the impression of listening to only one source of sound—the speaker himself. Where a hall has a number of high galleries a double ring of projectors may be required above the speaker's head, one inclined downwards to the body of the hall, the other upwards to serve the galleries. Pl. I., fig. 1, showing two loud-speakers in position on the north side of the chancel of Liverpool cathedral, is an example of loud-speaker mounting in harmony with surroundings.

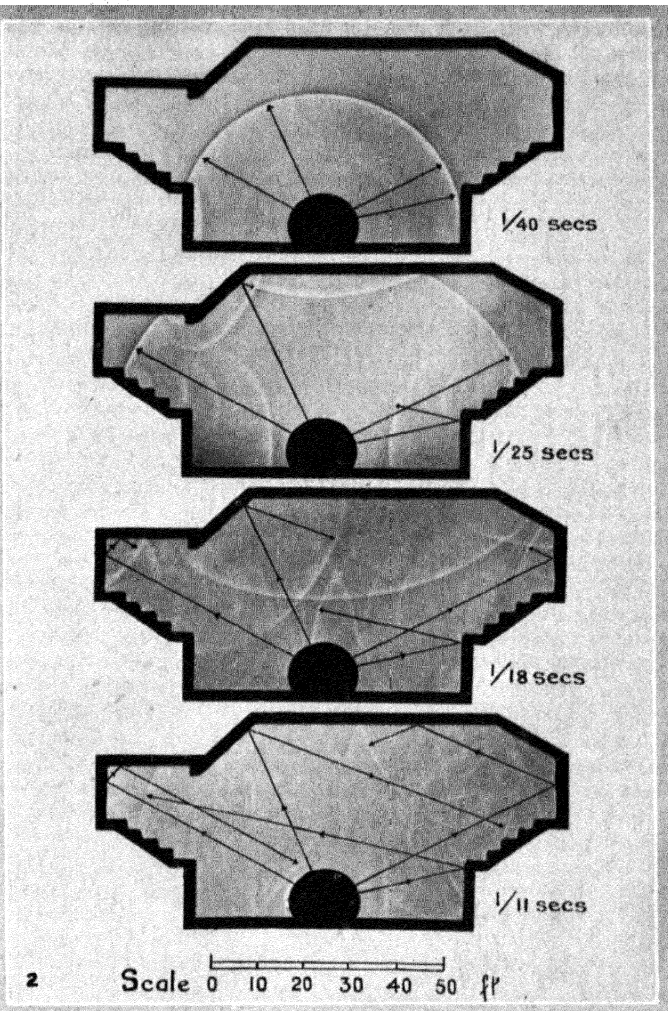
The question of loudness does not often arise in connection with orchestral and choral performances, and auditoriums for these pur-

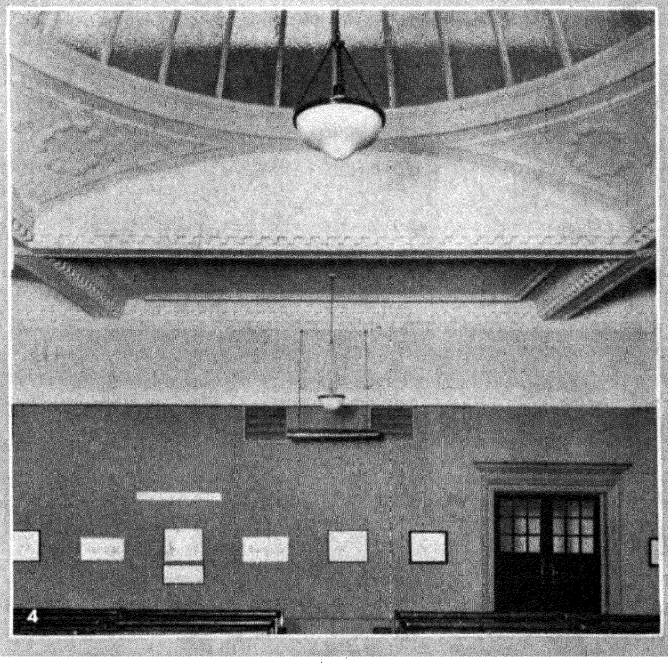












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INSTALLATIONS OF VOICE-PROJECTING EQUIPMENT AND DIAGRAMS OF THE BEHAVIOUR OF SOUND

1. Two sound-amplifiers in position on the north side of the chancel of Liverpool Cathedral so designed as to harmonize with the surroundings
2. Successive stages in the progress of a sound pulse within model outlines of an auditorium which has two types of galleries
3. Sound behaviour at the boundaries of a section of an auditorium analyzed geometrically and illustrated by water ripples
4. Rear portion of lecture hall of the Royal Institute of British Architects covered with shades of canvas for acoustic purposes

poses may be larger than those satisfactory for ordinary speech. It has been estimated by Heyl from considerations of loudness that the optimum volume of a concert hall increases from 50,000 cu.ft. for an orchestra of ten instruments to 800,000cu ft. for one of 90 instruments. For musical performances a wooden platform undoubtedly acts as a useful sounding board for instruments and performers in contact with it.

Echoes.—As a matter of general experience it appears that echoes are not noticeable when the time-interval between the arrival of the direct and reflected sounds is less than about one-fifteenth of a second or, in other words, when the path difference is less than 75 feet. According to Ernst Petzold, this time-interval should not exceed 0·05 second. In fact, it may be considered that reflected sounds arriving within this interval contribute usefully in raising the level of loudness, whereas those arriving later are undesirable and should be enfeebled as far as possible by absorption or scattering. Echo effects thus occur only in large auditoriums. They should be avoided in design, or minimized by applying absorbents to and breaking up the continuity of the surfaces which give rise to them.

For the prevention of echo it is desirable to avoid altogether ceilings of greater height than about 40 feet. Where this restriction is not acceptable, it is useful to coffer the ceiling deeply so that the echo may be scattered to some extent, and to apply highly absorbent materials in the panels. A less obvious expedient, but frequently an important one, is to apply absorbents to the upper parts of walls, and so to suppress sound which otherwise would be reflected upwards and returned to the floor of the auditorium later as an indirect echo. Frequently back walls should also be treated. In some cases, such as barrel vaulting of great height and pronounced curvature, a canopy of absorbent fabric hung near the focal region may have special value.

Echoes from high ceilings are largely eliminated when electrical amplifying equipment is used for increasing loudness, for the speech projectors are usually placed at least 25ft. above floor level.

The general direction of likely echoes and the desirable situations for absorbents may usually be inferred from an inspection of sections of the chamber For instance, on the assumption that sound obeys the laws of reflection of light, Pl. I , fig 3, upper, is an analysis of sound reflection within the vertical longitudinal section of a council chamber. Floor reflections are omitted. On the scale adopted, it shows portions of a sound wave after travelling a total distance of 60ft. from the black dot which represents a speaker on the floor of the chamber. For convenience arrows have been added to indicate the tracks of a number of the waves. In interpreting such drawings, however, it must always be borne in mind that, while for large surfaces sound tends to obey the ordinary laws of optical reflection, it usually spreads considerably beyond the limits applicable to light owing to its relatively greater wave-length.

Experimental methods of analysis have been developed in which observation is made of the progress of a sound pulse within a model or within model outlines of suitable sections of the building. This was first carried out by W. C. Sabine in America, using the technique of sound-pulse photography which had been developed by various physicists, particularly Toepler, Dvořák, Mach, Boys and Foley. The sound pulse is produced by means of an electric spark in a model section having open sides. As this pulse spreads in the model it is illuminated instantaneously by light from a distant electric spark. A silhouette of the model is thus cast upon a screen or photographic plate and, in addition, owing to refraction of light by the sound wave, the position of the sound pulse within the section is also shown. Sabine's own work contains many beautiful photographs relating to theatre acoustics. Fig. 3, middle, is a sound-pulse photograph taken in England at the National Physical Laboratory, relating to a section of a council chamber closely similar to that analyzed geometrically in fig. 3, upper, the floor being absent. General correspondence with fig. 3, upper, is marked, but the spreading of sound beyond optical limits is clearly brought out. Pl. I., fig. 2, due to A. H. Davis and N. Fleming of the Laboratory, is a series selected to show the earlier and later progress of a sound pulse in a very similar section. The first of the series shows the outgoing wave proceeding equally in all directions from the source, and later photographs show the subsequent history of the wave after reflection from the boundaries. In particular, the third photograph shows that the main ceiling reflection reaches hearers in the right-hand gallery within less than 1/18th of a second after the passage of the original sound and is thus useful to them, while hearers in the left-hand gallery—which is in an alcove—are largely denied such enhancement of the sound.

In another method of study which is simpler in technique, use is made of the approximate similarity between sound waves and water waves. A model section of the building is laid flat in a tank of shallow water. Ripples are produced at a point corresponding to a speaker's position by dipping a small object in the water, and the reflection of ripples at the boundary illustrates the reflection of sound in the actual building. To facilitate study and photography of the ripples, the tank has a glass bottom and light from an arc lamp passes upwards through the glass bottom and casts a shadow of the model and of the waves upon a screen mounted above. Pl. I , fig 3, lower, is a ripple photograph for the auditorium section already referred to in connection with the geometrical and the sound-pulse analyses.

When echoes are noticed in existing buildings they may be traced in suitable cases by ear. For the survey the hiss from an arc light placed at the focus of a reflector is a useful source of sound, first recommended by F. R. Watson The reflections of the arc hiss may be traced by ear, but the beam of light accompanying the beam of sound reduces the labour of locating the place from which reflection is taking place.

Reverberation.—It is not sufficient, however, that there be adequate loudness in an auditorium and that foci and definite echoes be avoided. Indeed, the most prevalent defect encountered is excessive reverberation, sounds being reflected to and fro without sufficient weakening It is most marked in large halls and arises from deficiency in the sound absorptive character of the surfaces.

It is frequently thought that defective acoustics in a hall can be cured by stretching wires to and fro near the ceiling Whatever may be the value of such wires—and it is very doubtful whether they have any value at all—they do not reduce reverberation. There are instances where miles of wire have been employed, with no useful effect.

Neither is the introduction of electrical amplifying equipment a universal cure for excessive reverberation Used with discrimination—say, in a case of reverberation due to a very high ceiling—it has a value which arises from the directive action of the loud-speakers and from the fact that, in projecting the sound downwards upon the audience-covered floor, the loud-speakers are directing it towards what is usually the most absorbent area in the auditorium. Apart from this directive action, however, the equipment does nothing to hasten the decay of sound which persists sufficiently to cause confusion. Indeed, in a highly reverberant hall this persistent sound affects the microphone and tends to cause the apparatus to emit a continuous note However, the reverberant condition of a hall may be measured, controlled, and even predicted in advance of construction and arranged to conform with the condition generally approved.

For purposes of measurement the rate of decay of reverberation in a hall is expressed in terms of the time which elapses after the finish of a sustained note before the general intensity of sound in the room falls to inaudibility at one millionth of its initial value. This interval is called the reverberation period of the hall. It is a convenient practical period because a source of sound such as an organ pipe ordinarily gives rise to an intensity in a room of the order of a million times the minimum audible intensity. Moreover, it is a definite acoustical constant for a given condition of the room, for it has been found that the observed duration of reverberation is almost independent of the position of the source and of the observer and, for a given amount of absorbent in the room, is largely independent of its distribution.

In order to be able to calculate the reverberant condition of an auditorium in advance of construction, it is necessary to know the

factors which determine it. The theoretical basis of the subject, due largely to W. C. Sabine and G Jaeger, is satisfactory and yields formulae which have been confirmed repeatedly by experiment. It is found that if V is the volume of a room, and if the surfaces, of total area S, absorb on an average a fraction "a" of the sound energy at each incidence, then the standard reverberation period T in which the reverberant sound decays one millionfold is given by

$$T = 0.05\ V/aS \text{ in foot second units}$$
$$\text{or } T = 0.164\ V/aS \text{ in metre second units.}$$

In the formulae the mean absorption coefficient "a" of the surfaces of the room is calculable from the absorption coefficients of the component parts. Thus if there are surfaces S_1, S_2, S_3, etc , having respectively absorption coefficients a_1, a_2, a_3, etc., then

$$aS = a_1 S_1 + a_2 S_2 + a_3 S_3 +$$

From the formulae it is seen that reverberation may be decreased by reducing the volume of the room and by increasing the absorbing power of its surfaces.

Experiments made in a number of acceptable auditoriums in various countries by W. C. Sabine, F. R. Watson, S. Lifshitz and others, show that reverberation tends to have a preferred duration for good acoustics. For halls of moderate size, up to, say, 40,000 cu ft., which are to be used both for speech and music, it is generally agreed that a standard period of about one second represents the optimum condition, the audience of course being present For a hall five times as large, *i.e.*, 200,000 cu.ft., the preferred period is apparently about 1½ sec., and for very large halls of about 1,000,000 cu.ft. a period of 2 sec. is indicated. Presumably in very large halls the persistence of sound is tolerated for the sake of increased loudness, and speakers are expected to enunciate more slowly to accommodate themselves to the conditions.

Excessive reverberation is the more serious for speech, but insufficient reverberation is unacceptable for music. In fact, acceptable halls which are used for music alone appear to have reverberation periods some 25% greater than the values given above for halls of corresponding size used for mixed purposes. Moreover, for concert halls it has been found desirable to leave the region of the stage bare so as to give the feeling of easy response desired by the artistes and, if absorbent is required by hearers to deaden reverberation, it should be placed away from the stage so that both performers and hearers may regard the acoustics as satisfactory. Incidentally, any absorbing material introduced to reduce reverberation has also a value in damping out resonances in the air of the room and thus minimizing distortion that might arise from this cause.

Generally speaking, churches and cathedrals are characterized by long reverberation owing to great size and to the very slight absorbing power of the masonry walls. The condition may well be responsible for the development of the characteristic features of church choral music and intoned liturgy. Ordinary sermons, however, cannot be satisfactorily heard, and, in churches where reading and speaking are dominant factors of the service, the acoustic condition should obviously tend to conform to the optimum reverberant period already discussed.

In connection with the materials that may be used to control reverberation, the following table presents some useful average values for the absorbing power of unit areas of various types of absorbing surface. The values relate to the note (c^{11}, 512 vibrations per second) near the middle of the musical scale, with which most reverberation measurements have been made. Almost invariably the absorbing power is less at lower frequencies, but differences at higher frequencies are not so consistent and, in general are not so marked.

It must of course be borne in mind that the absorption coefficient of a material will be dependent to some extent upon the manner in which the material is attached to the walls and that, owing to diffraction phenomena, somewhat abnormal values may be exhibited by isolated samples of which the dimensions are not great compared with the wave-length of sound.

The efficiency of a sound-absorbent material is usually due to the porosity of its surfaces, and the acoustic plasters referred to

TABLE OF ABSORPTION COEFFICIENTS.
For frequency 512 vibrations per second

Material	Absorption coefficient (a)
Walls, etc.	
Brick, marble, glass, etc.	0·01–0·03 per unit area
Varnished wood	0 03–0 08
Wood panelling	0 1 - 0 2
Porous breeze concrete blocks	0 4
Fibre board panelling, ordinary	0·2 –0 3
" " " thick, perforated	0 4 –0·7
Floors and floor coverings	
Wood floor	0·03–0·08
Linoleum, rubber carpet	0·03–0·10
Carpet	0 15
" heavy, on felt	0 2 0.35
Plasters and tiles	
Ordinary plaster	0 03
Acoustic plasters and tiles	0 2 –0·3
Miscellaneous absorbents	
Cretonne cloth	0 15
Curtains	0 2
" heavy, in folds	0 5 - 1 0
Oil paintings	0 28
Hair felt, 1" thick	0 5
Slag wool, wood wool, eelgrass, etc., 1" thick	0 55 0 8
Audience as ordinarily seated	0·96
Open window	1 0
Individual objects	
(For the case of individual objects the *absorbing power per object* is expressed below in terms of a square foot of complete absorption·—)	
Audience per person	4 7
Wood seats for auditoriums per seat	0 1–0·2
Upholstered seats for auditoriums per seat	1–2
Upholstered chairs per chair	3

(Sq ft. of complete absorption)

in the table have an aerated texture arrived at during mixing either by mechanical frothing or by the addition of a gas generating ingredient. They give a pleasing finish for ceilings and for parts of wall surfaces where roughness is not objectionable. The acoustic tiles available are similar in appearance. Fibrous boards have also been developed for sound absorption; various soft materials such as clean hair felt, jute felt, eelgrass, fireproofed woodwool, asbestos or slag wool may be applied in panels, behind a screen of canvas, net or rep. Plate I , fig. 4 is a photograph of the lecture hall of the Royal Institute of British Architects, which has been treated in this manner over the whole of the back wall and frieze, and in the spandrills of the central dome, the covering canvas being in special shades to match the decoration. The screen chosen should be as light as possible so that it does not reflect sound, but transmits it to the absorbent beneath, and is best unpainted. Paint yields a more sanitary surface, but when applied with a brush, the absorbing power of the panel is reduced by as much as 15 to 50% for one coat, with a further, but smaller, reduction for a second coat. Distemper sprayed over the screen is a usual form of decoration, but the membrane should not be previously sized If undesirable reverberation in an auditorium is considered in advance of construction, space in the hall may be suppressed. To prevent the entrance of sound to a room, it is necessary to isolate against air-borne sound and structure-borne vibration.

Air-borne sound may be excluded by having walls and partitions sufficiently massive and rigid, and avoiding openings. Usually it is found that a rigid brick wall presents adequate obstruction to the entrance of aerial sounds. In very special cases double walls are erected, preferably on separate foundations, with an air space between them. Fillers of felt or slag wool, etc., do not add to the insulation in this case, but, by bridging the air space, slightly facilitate the conduction of vibration. Transmission of sound through partitions is mainly due to flexural vibration of the parti-

tion under the action of the incident sound, so that increasing the weight and the rigidity of a partition both improve the insulation. Generally speaking, the fundamental resonant frequency of masonry constructions—brick walls, hollow tile, lath and plaster—is quite low and, in consequence, for incident sounds of ordinary pitch it is the mass of these partitions which is the most important factor. In certain experiments by P. E. Sabine, the following average figures for resistance to aerial sound of various frequencies were found for this class of partition irrespective of the actual type of construction employed:

Weight of masonry partitions	Reduction in sound intensity
*45 lb. per sq. ft.	8,000-fold
30 „	3,000 „
20 „	1,000 „
10 „	250 „

*This corresponds roughly to a 4½-inch wall of medium brickwork.

To interpret these figures, it should be realized that the usual intensity of speech is about one million times the minimum audible intensity, and one-millionth of the intensity at which sound becomes painful. The total reduction for two completely separated walls would be equal to the product of their individual values, but, in practice, resonance of the air space and incomplete isolation of foundation result in lower figures. Some quantitative information has recently become available concerning various types of stud partitions but there is not yet unanimity among observers as to the absolute magnitude of the transmitter sound.

It is important that doors and windows be in the position most conducive to quietness, and that they shut completely so as to exclude the relatively considerable amount of sound that can enter through cracks. In door construction rigidity, as well as mass, is important. Frequently, for effective insulation, doors must be double, and in extreme cases even triple, separate frames are employed. In windows heavy plate-glass is best and small well-braced or leaded panes are rather better than large panes. Double windows are most effective when they are in separate insulated frames. Particular attention must also be paid to the ventilating arrangements, which may readily facilitate transmission of sound from room to room. It appears most satisfactory for the rooms to be supplied with ventilation ducts which communicate separately with a distant supply chamber, and it is advantageous to line the interior of the ducts and of the chamber with felt-like absorbent.

To isolate a room from structure-borne sounds, such as those arising from motors, lifts, hot-water pipes and attached machinery generally, it is necessary to break up the continuity of the solid conducting path. To this end layers of felt-like material are sometimes interposed in the path of the sound. It is essential, however, that where such insulation is employed no bolts, tie-pieces or other rigid members pass from structure to structure through the layer, unless thoroughly insulated by bushing and by using insulating washers under metal ones. The simplest place to introduce absorbent is frequently at the source. Motors and machinery may be insulated from the floor by substantial layers of materials such as cork, felt or rubber, or the special combinations of cork and felt, etc., obtainable commercially for the purpose. Alternatively, machinery may be mounted upon springy supports which are themselves insulated from the structure by suitable materials. Lift shafts should be insulated from the main structure and should be surrounded with corridors or stairs. Continuous metal pipes such as air pipes, hot water pipes, etc., may carry sound to considerable distances; they should, if possible, have insulating sections and should not pass through important partition walls.

Felt-like insulation may also be introduced into the actual structure of a building. For instance, a wall may be insulated from the floor upon which it stands by means of a layer of felt, and a further layer may be used to insulate it from the ceiling. In steel constructions insulating material can be employed as a bedding for foundations, columns, girders, cross beams, etc., to counteract the transmission of sound which would otherwise occur so readily.

In the complete insulation of rooms, therefore, it is generally desirable for the boundaries of each room to be double, the inner shell with its separate door and window frames being insulated from the outer. One construction is to build the inner room upon a raft of steel framing, the raft being entirely insulated from the structural floor or girders by pads of insulation, and the walls of the inner room standing clear of the surrounding structure.

Finally, whether sounds originate within a room or are transmitted from outside, the loudness within depends upon the quantity of sound absorbent the room contains. The provision of soft carpets, of hangings and draperies, of upholstered furniture, and of specially absorbent plasters or materials for ceilings and walls, all tend to improvement, although in themselves they are not sufficient to obviate the necessity for the various special devices previously set out.

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ACQUI, city and episcopal see, province of Alessandria, Italy; from the town of that name it is 21m. S.S.W. by rail. Pop. (1921) 9,904 (town), 15,801 (commune). Its warm sulphur springs were already famous as Aquae Statiellae in Roman times. Part of the ancient bath establishment has been found; and south of the town are lofty arches of the aqueduct which supplied it. The place was connected by road with Alba Pompeia and Augusta Taurinorum. The town possesses a fine Gothic cathedral.

ACRANIATA, an obsolete term for a sub-phylum of the Chordata, including only *Amphioxus* (*q.v.*) and its allies.

ACRE. A harbour town or city of Palestine (Egypt. *'Ak* (*a*), Assyr. *Akku,* Heb. *Akko,* Gr. *Ake* [Josephus, *'Arke*], Lat. *Ac(c)e;* on Crusading coins *Ac(c)on,* Arab. *'Akka*). From the 3rd century B.C. it was known as Ptolemais, perpetuating, perhaps the name of Ptolemy II. (Philadelphus). The name St. Jean d'Acre dates from the time when it was the headquarters of the Knights Hospitallers.

Topography.—Acre is situated on a low, rocky promontory at the northern end of the Bay of Acre. A strong wall, shot pitted, girds it to seaward, and to landward a double rampart. The ancient harbour has silted up leaving now only a few feet depth of water. In the roadstead there is good anchorage for small craft. To the south of the city, broadening as it advances, stretches the marshy malaria-stricken Plain of Acre. There enters the sea not far from the city the classic river Belus (Na 'mān) which of



ACRE IS 90M. FROM JERUSALEM AND WAS THE SCENE OF MANY BATTLES

old provided, and still provides the *murex* from which the Phoenicians extracted the renowned Tyrian purple.

History.—Acre has had a most stirring and tragic history. Its strategic position on the military highway along the coast, its proximity to the western entrance to the Plain of Esdraelon, its significance as the natural port not only for Galilee, but for Damascus and the Hauran, coupled with the peculiar military value of its site, attached to it an enduring importance, both the political and commercial. The name first appears in the conquest lists of the Egyptian monarchs Thutmose III. (*c.* 1500 B.C.) and Seti I. (*c.* 1315 B.C.). From the Amarna dispatches of Amenhotep IV. (*c.* 1375 B.C.) it would appear that the caravans of Burra-Buriash II., king of Babylonia were plundered, much to his annoyance, by the king of Acre. In the Old Testament it is named (Judges i. 31) as one of the places whence the Israelites did not drive the Canaanite inhabitants. At the beginning of the 7th century B.C.

when the Assyrian was in the pride of his strength Acre appears to have been subordinate to Tyre for a time at least, since the two names are regularly coupled in inscriptions (Sinaherib, Asarhaddon). It is first mentioned apart in the records of Ashurbanipal (668–628). During the Persian period Acre is not much in evidence. It appears, however, to have been the rendezvous for Artaxerxes Mnemon in his expedition against Egypt (Strabo cvi. 2). From this time on "for Egypt, for Asia Minor, for the Greek isles and mainland, and for Italy its harbour was the most convenient on the Syrian coast, and its history till the end of the New Testament period is that of the arrival of great men from these shores, of the muster of large armies, of the winter camps of the invaders of the Syrian hinterland, and of bitter conflicts between Greeks and Jews" (G A. Smith). Josephus and the Books of the Maccabees record its varying fortunes. Within its walls the Syrian Greeks, routed by Simon Maccabaeus, sought refuge (164 B C). In the struggle for the Syrian throne, Alexander Balas wrested Acre from Demetrius (153). Jonathan was lured within its gate (Acre has only one) by Trypho and taken prisoner (143). Round about the year 104 B.C. Alexander Jannaeus laid siege to Acre but abandoned it from fear of Ptolemy Lathyrus, who besieged and took it, but was forced to yield it to his mother Cleopatra. Tigranes of Armenia stormed it (70 B C.) but relinquished it under fear of the Romans and it surrendered without a struggle to the Parthian Pacorus (Josephus, *B.J.* i. 13). Herod entertained Caesar here and here he built a gymnasium. It was established a *colonia* by Claudius. St. Paul spent a day in Ptolemais while coasting from Tyre to Caesarea (Acts xxi. 7). In the wars with the Jews the Roman leaders realized its value as main base for their armies (Varus, Vitellius, Petronius, Cestius, Vespasian).

In Christian times Ptolemais became a bishopric and its bishop attended the great councils of the Church, Caesarea (198), Nicea (325), Constantinople (381), Chalcedon (451), Jerusalem (536). The Arabs took possession of the city in 638. Baldwin I captured it with the aid of a Genoese fleet in 1104 (1st crusade). Saladin re-captured it in 1187 (2nd crusade). In 1191 after a siege by Guy de Lusignan of about two years, it was taken on the arrival of Richard Coeur de Lion (3rd crusade), and was finally lost by them in 1291. The Turks under Salim I entered into possession in 1517, after which the city fell into decay. Its revival began in 1749 with its capture by Omar ez-Zahir, and it emerged into prominence, prosperity and virtual independence under his successor "Ahmad el-Jezzar" ("the butcher"). Supported by a British fleet under Sir Sidney Smith it resisted successfully Napoleon in 1799. The year 1832 saw its capture and wreck by Ibrahim Pasha of Egypt. On Nov. 4, 1840, the city was attacked by the allied fleets (British, Austrian, Turkish) under Sir Charles Napier and after three hours' bombardment reduced Restored in the following year to Turkey it remained in Turkish hands till Sept. 23, 1918, when it was occupied by the 13th Cavalry Brigade (5th Cavalry Division) of the Egyptian Expeditionary Force with little or no opposition.

Modern.—Acre with a population of 6,500 (about 5,000 Muslims) is in British mandated territory and under the existing administrative partition of Palestine in the northern Province (Phoenicia and Galilee). Under Turkish rule it was the chief town of a governmental district. Formerly the chief port of shipment for grain brought on camel-back from the Hauran, its trade was much diminished with the opening of the Damascus-Beirut railway in 1896 and practically extinguished when the Haifa-Damascus railway in 1906 diverted what remained to Haifa. It has now a small coasting trade in locally grown grain, sesame seed and oil and a small export of oranges to Beirut. Brass and copper ware are made to a small extent. It is now a customs sub. station to Haifa. Acre is the chief seat of Baha'i religion, an offshoot of Babism, with an estimated number of adherents at 2 millions. The founder 'Abdu-l Baha died here in 1921 and was succeeded by his grandson Shauki Effendi, who has been made Life-president of the council of Nine, which regulates the affairs of the community. Few buildings of interest have survived the buffetings to which the city has been repeatedly subjected. The most notable, perhaps, is the large mosque built by El-Jezzar. Four commodious khans recall the times when 2,000 to 3,000 camels, grain laden, would arrive in a day. British administration has been responsible for the establishment of a government hospital, a forest nursery, and a large convict prison. A railway from Beirut along the coast to Acre is projected by the French.

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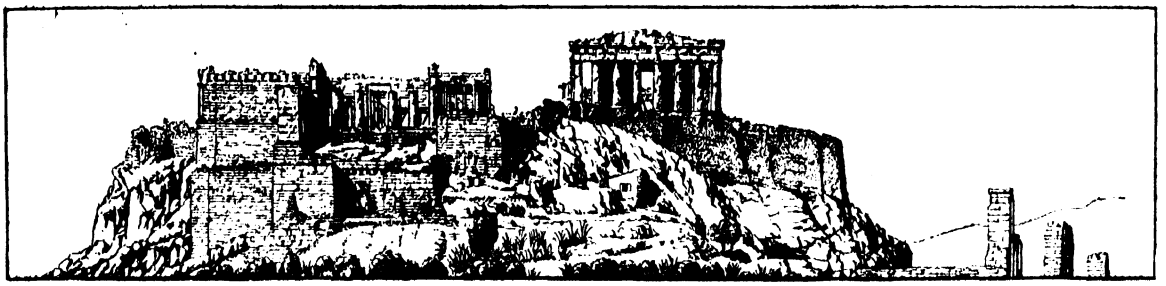
Battle of Acre.—The battle of 1189, fought on the ground to the east of Acre, affords a good example of battles of the Crusades. Saladin's victory at Tiberias in 1187 had led to the fall of Jerusalem and to that of almost all the Christian strongholds in Palestine and Syria, save Tyre, Antioch, and Tripoli. The attempt to regain Acre led to the battle described below and was in turn a prelude to the Third Crusade under Richard I of England and Philip of France. The crusading army under Guy de Lusignan, king of Jerusalem, which was besieging Acre, gave battle on Oct. 4, 1189, to the relieving army raised by Saladin. The Saracens lay in a semicircle east of the town, facing inwards towards Acre. The Christians opposed them with crossbowmen in first line and the heavy cavalry in second. At Arsuf (*q.v.*) the Christians fought coherently; here the battle began with a disjointed combat between the Templars and Saladin's right wing. The crusaders were so far successful that the enemy had to send up reinforcements from other parts of the field. Thus the steady advance of the Christian centre against Saladin's own corps, in which the crossbows prepared the way for the charge of the men-at-arms, met with no great resistance. But the victors scattered to plunder. Saladin rallied his men and, when the Christians began to retire with their booty, let loose his light horse upon them. No connected resistance was offered, and the Turks slaughtered the fugitives until checked by the fresh troops of the Christian right wing. Into this fight Guy's reserve, charged with holding back the Saracens in Acre, was also drawn, and, thus freed, 5,000 men sallied out from the town to the northward; uniting with the Saracen right wing, they fell upon the Templars, who suffered severely in their retreat. In the end the crusaders repulsed the relieving army, but only at the cost of 7,000 men.

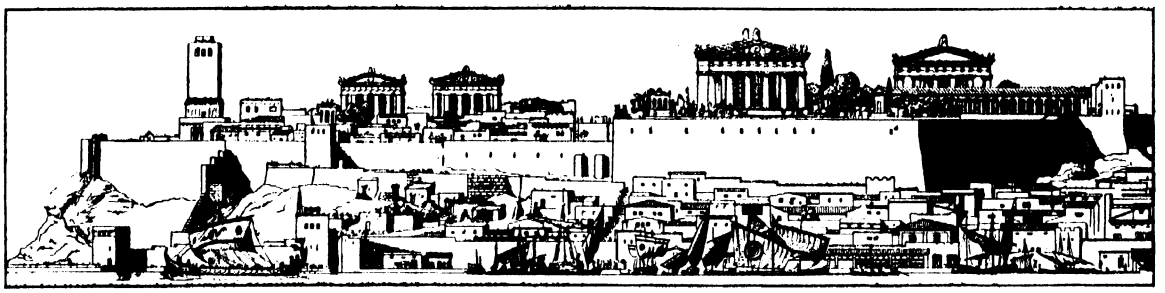
See Oman, *Hist. of the Art of War in the Middle Ages*, vol. i. 333–340 (1924).

ACRÉ or **AQUIRY,** a river of Brazil and principal tributary of the Purús, rising on the Bolivian frontier and flowing easterly and northerly to a junction with the Purús at 8° 45′ S. The name is also applied to a district situated on the same river and on the former (1867) boundary line between Bolivia and Brazil. The region, which abounds in valuable rubber forests, was settled by Bolivians between 1870 and 1878, but was invaded by Brazilian rubber collectors during the next decade and became tributary to the rubber markets of Manáos and Pará. In 1899 the Bolivian Government established a customhouse at Puerto Alonso, on the Acré river, for the collection of export duties on rubber, which precipitated a conflict with the Brazilian settlers and finally brought about a boundary dispute between the two republics. In July 1899, the Acréanos declared their independence and set up a republic of their own, but in the following March they were reduced to submission by Brazil. Various disorders followed until Brazil decided to occupy Puerto Alonso with a military force. The boundary dispute was finally settled at Petropolis on Nov. 13, 1903, through the purchase by Brazil of the rubber-producing territory south to about the 11th parallel, estimated at more than 60,000 sq.m.

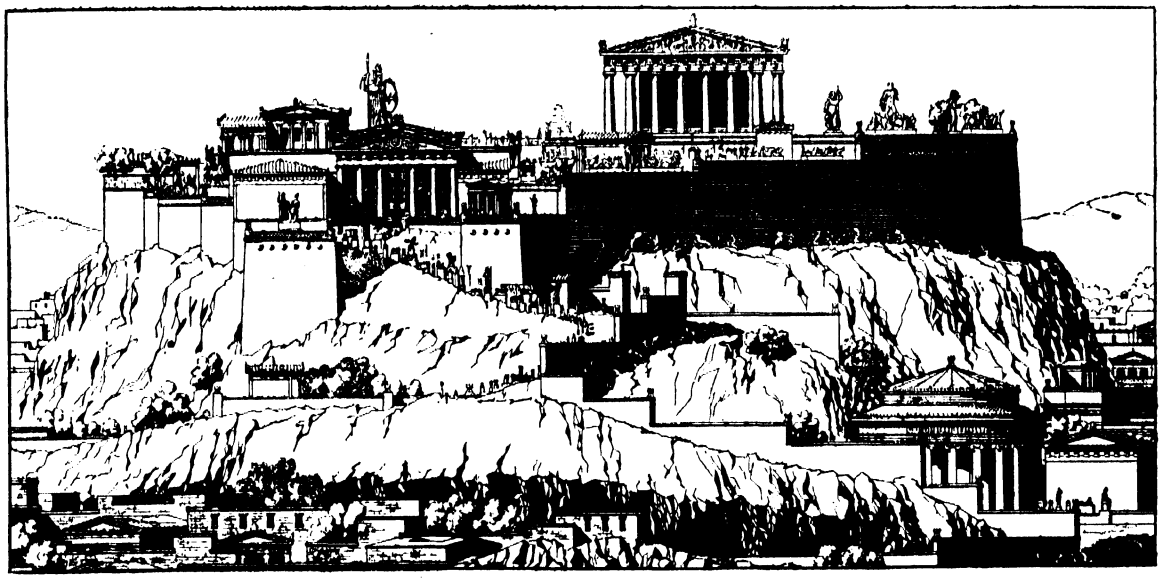
ACRE, a land measure used by English-speaking races. Derived from the O.E *acer* and cognate with the Lat. *ager*, Gr. *ἀγρός*, Sans. *ajras*, it has retained its original meaning "open country," in such phrases as "God's acre," a churchyard, or "broad acres," etc. As a measure of land, it was first defined as the amount a yoke of oxen could plow in a day; statutory values were enacted in England by acts of Edward I., Edward III., Henry VIII., and George IV., and the Weights and Measures Act 1878 now defines it as containing 4,840sq.yds. In addition to this



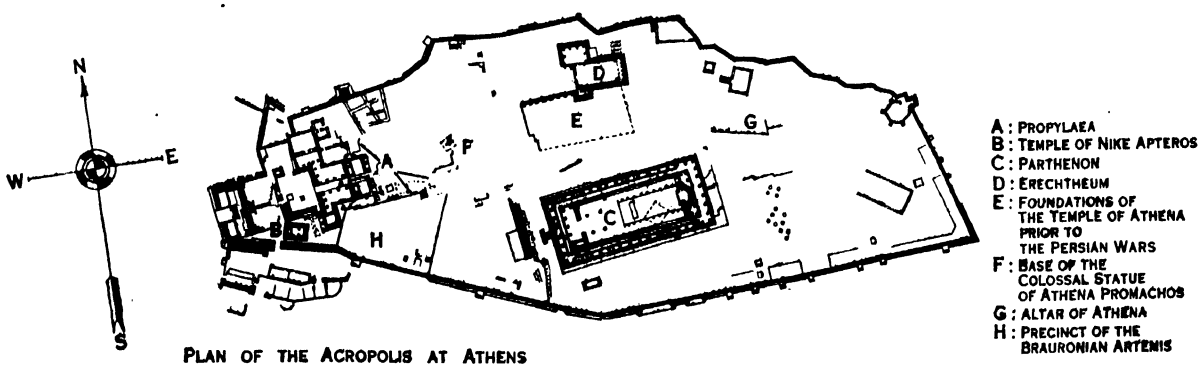
THE ACROPOLIS AT ATHENS: WEST FACE. PRESENT STATE



THE ACROPOLIS AT SELINUS, (SELINONTE IN SICILY) RESTORED



THE ACROPOLIS AT ATHENS, RESTORED



PLAN OF THE ACROPOLIS AT ATHENS

AFTER D'ESPOUY, "MONUMENTS ANTIQUES"

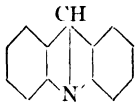
THE NAME GIVEN TO THE CITADEL IN CITIES OF GREECE AND ASIA MINOR WAS ACROPOLIS. IT WAS GENERALLY BUILT UPON A HILL OR ROCK, WAS FORTIFIED AND COMMANDED THE CITY AND SURROUNDING TERRITORY. THE ACROPOLIS CONTAINED IMPORTANT BUILDINGS. IN ATHENS THE WEIGHTS CONNECTED WITH THE COINAGE WERE KEPT IN THE ACROPOLIS

"statute" or "imperial acre," other "acres" are still, though rarely, used in Scotland, Ireland, Wales and certain English counties The Scottish acre contains 6,150·4sq yds.; the Irish acre 7,840sq. yds.; in Wales, the land measures *erw* (4,320sq yds.) *stang* (3,240 sq yds.) and *paladr* are called "acres"; the Leicestershire acre (2,308¾sq.yds), Westmorland acre (6,760sq yds) and Cheshire acre (10,240sq yds.) are examples of local values.

ACRIDINE is a solid, crystallizing in needles of melting point 110° C, found in coal-tar anthracene. It is characterized by its irritating action on the skin, and by the blue fluorescence shown by solutions of its salts. It is extracted from the crude anthracene by dilute sulphuric acid; the sulphuric acid solution is treated with potassium dichromate, and the precipitate of sparingly soluble acridine dichromate is decomposed with ammonia (C. Graebe and H. Caro, *Ann.* 1871).

Acridine and its homologues are stable compounds of feebly basic character, belonging to the general class of heterocyclic ring compounds (*see* CHEMISTRY. *Organic*). They combine readily with the alkyl iodides to form alkylacridinium iodides, which are readily transformed by the action of alkaline potassium ferricyanide to N-alkylacridones

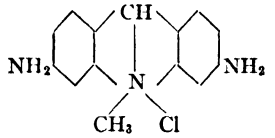
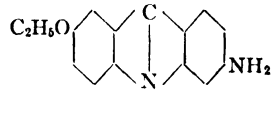
Acridine itself has the structural formula



It owes its basic properties to the presence of the tertiary nitrogen atom; it may be regarded as consisting of two benzene nuclei fused to a partially reduced pyridine nucleus, and shows characteristics both of the former (homocyclic) and the latter (heterocyclic) structure.

Phenyl-acridine is the parent base of chrysaniline, the chief constituent of the dyestuff phosphine (a by-product in the manufacture of rosaniline). The dyestuff phosphine must be distinguished from the phosphorus hydride of the same name, and from the organic derivatives of this substance, to which the general term phosphine is also given. Chrysanaline (diamino-phenylacridine) forms red salts, dyeing silk and wool a fine yellow; the solutions of the salts are characterized by their fine yellowish-green fluorescence.

Several acridine derivatives and notably acriflavine (*syn.* trypaflavine, euflavine) found extensive use during the World War as antiseptics for infected wounds (C. H Browning and others). The preparation of acriflavine (I) and of proflavine, another acridine antiseptic of similar type, was described by L. Benda (1912)

(I.)  (II.) 

Rivanol (II) also of the acridine series is recommended by J. Morgenroth (1921) as a powerful tissue antiseptic against spreading infection due to streptococcus.

ACRIFLAVINE, a coal tar derivative, in the form of a reddish-brown crystalline powder, possessed of antiseptic properties. Weak solutions are pale lemon-yellow and should be freshly made. A modification, known as neutral acriflavine, has now almost supplanted the older drug, as it is less irritant and can be used in stronger solutions Its singular advantage over other antiseptics is that it is particularly effective in the presence of serum, as in wounds. Its high cost, as compared with other local antiseptics, limits its use. It is commonly employed in solutions of $\frac{1}{1,000}$ to $\frac{1}{5,000}$ as a wash or dressing in fresh wounds and infected wounds; in cases of gonorrhoea, by instillation; and in disinfection of the skin before operation. Under certain conditions and for certain bacteria it is more effective than tincture of iodine or mercurochrome.

ACRO or **ACRON, HELENIUS,** Roman grammarian, probably flourished at the end of the 2nd century A D. He wrote commentaries on Terence and perhaps Persius. A collection of scholia on Horace was wrongly attributed to him.

See *Pseudoacronis Scholia in Horatium Vetustiora,* ed. O. Keller.

ACROLITHS, statues of a transition period in the history of plastic art, in which the trunk of the figure was of wood, and the head, hands and feet of marble. The wood was concealed either by gilding or, more commonly, by drapery, and the marble parts alone were exposed.

ACROMEGALY, the name given to a disease characterized by a true hypertrophy (an overgrowth involving both bony and soft parts) of the terminal parts of the body, especially of the face and extremities. It occurs in both sexes, usually between the ages of 25 and 40. Its causation is associated with morbid changes in the pituitary gland, and an extract of this body has been tried in the treatment, as one of the recent developments in organotherapeutics; thyroid extract has also been used, but without marked success, on the apparent analogy of acromegaly with myxoedema. (*See* ENDOCRINE GLANDS.)

ACRON, a Greek physician of the 5th century B C., born at Agrigentum in Sicily, was contemporary with Empedocles. The method of lighting large fires and purifying the air with perfumes, to put a stop to the plague in Athens (430 B.C), is said to have originated with him.

ACROPOLIS, literally the upper part of a town (Gr. ἄκρος top, πόλις city). For purposes of defence early settlers chose elevated ground, frequently a hill with precipitous sides, and these early citadels became in many parts of the world the nuclei of large cities which grew up on the surrounding lower ground. The word Acropolis, though associated primarily with Greek towns (Athens, Argos, Thebes, Corinth), is applied to all such citadels The most famous is that of Athens, which, by reason of its historical associations and the famous buildings erected upon it, is generally known as *the* Acropolis (*see* ATHENS)

ACROPOLITA (AKROPOLITES), GEORGE (1217–82), Byzantine historian and statesman, was born at Constantinople. At an early age he was sent to the court of John Ducas Batatzes (Vatatzes), emperor of Nicaea, by whom and by his successors (Theodorus II. Lascaris and Michael VIII Palaeologus) he was entrusted with important state missions The office of "great logothete" or chancellor was bestowed upon him in 1244 Acropolita's most important political task was that of effecting a reconciliation between the Greek and Latin Churches In 1273 he was sent to Pope Gregory X , and at the Council of Lyons (1274) in the emperor's name he recognized the spiritual supremacy of Rome In 1282 he was sent on an embassy to John II , emperor of Trebizond, and died in the same year.

His historical work (Χρονικὴ Συγγραφή, *Annales*) embraces the period from the capture of Constantinople by the Latins (1204) to its recovery by Michael Palaeologus (1261), thus forming a continuation of the work of Nicetas Acominatus It is valuable as written by a contemporary, whose official position gave him access to trustworthy information. He wrote several shorter works, among them being a funeral oration on John Batatzes, an epitaph on his wife Eirene and a panegyric of Theodorus II. Lascaris of Nicaea. While a prisoner at Epirus he wrote two treatises on the procession of the Holy Ghost.

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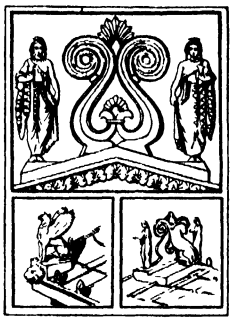
ACROSTIC, a short verse composition, so constructed that the initial letters of the lines, taken consecutively, form words (Gr. ἄκρος, at the end, and στίχος, line or verse). The fancy for writing acrostics is of great antiquity, having been common among the Greeks of the Alexandrine period, as well as with the Latin writers since Ennius and Plautus, many of the arguments of whose plays were written with acrostics on their respective titles. One of the most remarkable acrostics was contained in the verses cited by Lactantius and Eusebius in the 4th century, and attributed to the Erythraean sibyl, the initial letters of which form the words Ἰησοῦς Χριστὸς Θεοῦ υἱὸς σωτήρ "Jesus Christ, the son of

God, the Saviqur." The initials of the shorter form of this again make up the word Ἰχθύς (fish), to which a mystical meaning has been attached (Augustine, *De Civitate Dei,* 18, 23), thus constituting another kind of acrostic.

Acrostic verses have always been held in slight estimation from a literary standpoint. Dr. Samuel Butler says, in his "Character of a Small Poet," "He uses to lay the outside of his verses even, like a bricklayer, by a line of rhyme and acrostic, and fill the middle with rubbish." Addison (*Spectator,* No 60) found it impossible to decide whether the inventor of the anagram or the acrostic were the greater blockhead; and, in describing the latter, says, "I have seen some of them where the verses have not only been edged by a name at each extremity, but have the same name running down like a seam through the middle of the poem." And Dryden, in *Mac Flecknoe,* scornfully assigned Shadwell the rule of

Some peaceful province in acrostic land.



FROM BUHLMANN, "CLASSIC AND RENAISSANCE ARCHITECTURE," NEFF AND HELBURN

TWO GREEK ACROTERIA

Top and lower right, front and back of apex type. (From Fletcher, "Hist. of Arch.," Batsford.) Lower left, eaves type

The name acrostic is also applied to alphabetical or "abecedarian" verses Of these we have instances in the Hebrew psalms (*e g.,* Ps. xxv. and xxxiv), where successive verses begin with the letters of the alphabet in their order. The structure of Ps. cxix. is still more elaborate, each of the verses of each of the 22 parts commencing with the letter which stands at the head of the part in our English translation.

At one period much religious verse was written in a form imitative of this alphabetical method, possibly as an aid to the memory. The term acrostic is also applied to the formation of words, from the initial letters of other words. Ἰχθύς, referred to above, is an illustration of this. So also is the word "Cabal," which, though it was in use before, with a similar meaning, has, from the time of Charles II , been associated with a particular ministry, from the accident of its being composed of Clifford, Ashley, Buckingham, Arlington, and Lauderdale.

Double acrostics are such as are so constructed, that not only initial letters of the lines, but also the middle or last letters, form words. For example.—1 By Apollo was my first made. 2 A shoemaker's tool. 3. An Italian patriot 4 A tropical fruit. The initials and finals, read downwards, give the name of a writer and his *nom de plume.* Answer *Lamb, Elia*

1. L yr E
2. A w L
3. M azzin I
4. B anan A

A curious and clever 20th-century development of the acrostic is the quadruple acrostic. The following, taken from R. A. Knox's *Book of Acrostics,* is a good example

Uprights: Since there's no A, B, let us C and D

Lights: 1. Reverse the name a schoolboy might apply, for briefness, to his weekly subsidy.

2. A lady thus (but with an S)
   In Southern lands you might address.
3. Initials seen on many a truck
4. To cattle breeders brings bad luck.

SOLUTION

Uprights: "Since there's no help, come, let us kiss and part."

Lights: 1. HsaCteKcoP (Reverse of Pocket Cash).
2. (s) En Or It A
3. L M.S R
4. P E S T

Acrostics may be very simple and also very intricate. The modern acrostic seems to hit the happy medium and, whilst giving the reader plenty of food for thought, sends him occasionally to his Cruden, his classical dictionary or his encyclopaedia.

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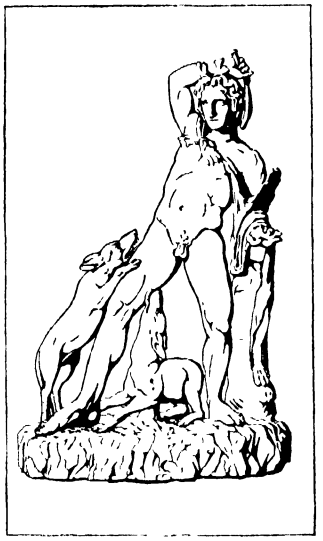
ACROTERIUM or **AKROTERION,** in architecture, a statue or ornament of any kind placed on the apex or at the lower angles of a pediment. The word is sometimes restricted to the pedestal supporting such an ornament.

ACT, a word varying in significance according to the sense in which it is employed. It is often synonymous with "statute" (*see* ACT OF PARLIAMENT). It may also refer to the result of the vote or deliberation of any legislature, the decision of a court of justice or magistrate, in which sense records, decrees, sentences, reports, certificates, etc , are called *acts.* In law act means any instrument in writing, which declares or proves the truth of a bargain or transaction, as: "I deliver this as my act and deed." The origin of the legal use of the word "act" is in the *acta* of the Roman magistrates or people, of their courts of law, or of the senate, meaning (1) what was done before the magistrates, the people or the senate; (2) the records of such public proceedings. In the sense of "document" it is used in those systems of law which are derived from the Roman.

ACTA DIURNA, called also *Acta Populi, Acta Publica* and simply *Acta* or *Diurna,* in imperial Rome a sort of daily gazette, containing an official narrative of noteworthy events at Rome. Its contents were partly official (court news, decrees, etc), partly private (notices of births, etc). Thus to some extent it filled the place of the modern newspaper (q v). The *Acta* were originated by Julius Caesar, who ordered the keeping and publishing of the acts of the people by public officers. The *Acta* were exposed daily in a public place on a whitened board (*see* ALBUM). After remaining there for a reasonable time they were taken down and preserved with other public documents, so that they might be available for reference.



AFTER A CAST IN METROPOLITAN MUSEUM OF ART

ACTAEON, MYTHICAL HERO AND HUNTER, KILLED BY HIS HOUNDS FOR HAVING ACCIDENTALLY SEEN DIANA (ARTEMIS) WHILE BATHING

The *Acta* differed from the Annals (discontinued in 133 B C) in that only the more important matters were given in the latter, while in the former things of less note were recorded Their publication continued till the transference of the seat of the empire to Constantinople.

See Gaston Boissier, *Tacitus and other Roman Studies* (Eng. trans. W. G. Hutchison, 1906), p. 197–229.

ACTAEON, son of Aristaeus and Autonoë, Boeotian hero and hunter. According to Ovid (*Metam ,* iii. 131), having accidentally seen Artemis on Mt. Cithaeron while she was bathing, he was changed by her into a stag, and pursued and killed by his 50 hounds. His statue was often set up on rocks and mountains as a protection against excessive heat, and the myth itself probably represents the destruction of vegetation during the 50 dog-days. Aeschylus and other tragic poets and artists made use of the story, which is illustrated by a noted small marble group in the British Museum.

ACTA SANCTORUM, a collection of the lives of the saints, arranged day by day according to the calendar, and compiled by the Bollandists, Belgian Jesuits The work, first conceived at the commencement of the 17th century, has been carried on ever since, save during the period of the suppression of the Society of Jesus in Belgium. In 1925 the fourth volume for November, dealing with the days Nov. 9 and Nov. 10, was published. (*See* BOLLANDISTS.)

ACTA SENATUS or **COMMENTARII SENATUS,** minutes of the discussions of the Roman senate. Before the first consulship of Julius Caesar (59 B C), minutes of the proceedings of the senate were occasionally published, unofficially; Caesar, however, ordered them to be issued authoritatively. The keeping

of them was continued by Augustus, but their publication was forbidden A young senator was chosen to draw up these Acta, which were kept in the imperial archives and public libraries. Special permission from the city praefect was necessary in order to examine them. (*See* ACTA DIURNA)

ACTING. Greek drama is usually given first consideration in connection with the origin of dramatic art, but the basic reasons for imitation, mimicry and what is now called "acting" are found in the study of the lower races of man. Make-believe, or the desire to imitate, is, perhaps, most common among children the world over, and it appears also among many animals.

Havemeyer points out (*The Drama of Savage Peoples*) that "there is a twofold purpose in this imitation characteristic of savage peoples. The first and simplest is that it gives a pleasurable sensation similar to the real experience. And, secondly, it enables man to convey his impressions to others—*i e*, it is a form of language." From the last purpose grew the gesture, or any bodily gesticulation or facial expression that serves as an aid to, or a substitute for, the spoken language of the savage. It was a common means of communication.

Development.—The evolution of acting, from its simple beginnings to modern times, is summed up by Brander Matthews (*The Development of the Drama*) "The dramaturgic faculty is evolved slowly with the growth of civilization; and play-making skill is one of the latest of human accomplishments. But the rudimentary is everywhere visible, even among the most primitive peoples. As we consider the history of human progress, we perceive that the drama is almost the very earliest of the arts, as early, perhaps, as the art of personal adornment; and we discover also that it is the very latest to attain its complete expression. But in the noblest work of the Greek dramatists, and in the most powerful plays of the Elizabethans, the same principles are applied which we discover, doubtlessly, in the rudest theatrical attempts of the lowest savages. It is out of the crude efforts, such as still may be observed among the Eskimo and the tribes of the Amazon, that the dramatic art was toilfully developed by our own predecessors as taste refined and civilization advanced. The traditions of these rude play-makers were passed down from generation to generation, and the art slowly discovered itself"

Grecian Influences.—It was not until the gods of Egypt were accepted by the Greeks that there appears any ceremony which can be truly called dramatic. The Greek drama arose through the worship of the gods of vegetation, and later developed into the form of the plays of the great dramatists. It is difficult, however, to think of the drama of the Greeks without thinking of its close connection with the dance. The myth was the subject-matter, the dance was the expression of that subject-matter, be it the idea of spring, the awakening of new life, or the representation of various objects such as trees and events by means of gestures, postures and attitudes. In the early religious history of Greece all the people took a part in the dramatic dances around the altar, but later, a certain few of the most capable actors were selected from the chorus to play outstanding *rôles*, or to play many, and sometimes all, of the parts in the play—inasmuch as the custom of wearing masks made this possible. The number of principal actors in a Greek play seldom exceeded three, and it was more common to have only one character appear at a time. Thus it was that acting became a profession, and, among the Greeks, a very noble one The profession was confined entirely to men.

Eastern Customs.—It is interesting to note, in the above connection, that in Japan men and women were forbidden on the same stage. Now and then women played parts, but never on the same stage with men, and, more often, men who had spent their lives from childhood in feminine costume and society in order to "obliterate every masculine proclivity" played the women parts Here, too, the players never appear without masks. In the No plays or dances of Japan the action is very restrained, and though the movements do, to some extent, express the story, the performers seldom alter their positions upon the stage. (*See* NO DRAMA.) The Japanese actor must make his acting conducive to the imagination of the audience. Since there are no stage properties of any kind, no scenery, the images of the places in which the action lies must be created entirely upon the minds of the audience by the descriptive passages of the play, which are largely poetic.

Italian Interests.—In Italy the dramatic instinct has been very pronounced among its people as far back as records show The dramatic literature of Italy has emerged from centuries of political and religious strife, but through all these troubled days the genius of the Italian people has led it to love the drama, and more—the art of acting. Before the writing of plays, and even after, as in the *Commedia dell'arte*, it has not been uncommon for a group of people to dramatize impromptu. Given a theme on which to bring out some feeling or desire, they express this spontaneously in the form of a play. The love of music, dance and spectacle did more, perhaps, to preserve this interest in the dramatic art through the political and religious struggles—the periods that provided no dramatic literature—than any other influence.

The Elizabethan Drama.—The art of acting was emphasized more by Shakespeare than by any other dramatist of his day. His plays show a remarkable interest in characterization, in which he brought forth every known type of humanity that would fit into the tragic or comic *rôles* that he created. And Shakespeare's own convictions as to the importance of acting, shown in Hamlet's speech to his players, cannot be over-estimated, for here he incorporates the fundamentals of good acting, the important factors in the better use of the voice and body:

"Speak the speech, I pray you, as I pronounced it to you, trippingly on the tongue; but if you mouth it, as many of your players do, I had as lief the town-crier spoke my lines. Nor do not saw the air too much with your hands, thus; but use all gently; for in the very torrent, tempest, and, as I may say, whirlwind of your passion, you must acquire and beget a temperance that may give it smoothness. Oh, it offends me to the soul to hear a robustious, periwig-pated fellow tear a passion to tatters, to very rags, to split the ears of the groundlings who, for the most part, are capable of nothing but inexplicable dumb-show and noise; I would have such a fellow whipped for o'erdoing Termagant; it out-Herods Herod; pray you, avoid it"

"Be not too tame, neither, but let your own discretion be your tutor; suit the action to the word, the word to the action . . ."

Views of Diderot.—It was not until about the 18th century that the different theories, or definite systems, of acting began to appear to any extent. Denis Diderot, the French encyclopaedist, grew weary of the classical French drama, with its conventional acting, and advanced as its opposite the theory of a drama of real life, which was, among other things, to be a truer reflection of the bourgeois of France. Diderot said (*Paradoxe sur le comédien*) that "The possibilities of a good actor lie in the complete absence of sensibility," and recommended to the actor that he should watch himself during the performance, that he should listen to his voice, and give only "recollections of his emotions."

Theodore Komisarjevsky, formerly producer and art director of the Moscow State and Imperial theatre, wrote of this theory: "It is proved now that an actor cannot move the audience, or be in any way creative on the stage, if he watches himself acting. Instead of being concentrated on the images he has to create, on his inner self, he becomes concentrated on his outer self, becomes self-conscious and loses the power of imagination The better way is to act only with the help of the imagination; to create, and not to imitate or reproduce one's own life experiences. When the actor playing a part is living in a world of images created by his own phantasy, he cannot and need not watch and control himself. The images created by the actor's phantasy, and obedient to his call, control, guide and direct his emotions and actions during the performance."

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MODERN TENDENCIES

The 20th century has seen several new and distinct theories of acting. Different schools, academies of acting and theatres, mostly repertory, have done a great deal towards improving the

standard of acting and team work or ensemble acting, on the stage. Of such are, in England, the Repertory theatre in Birmingham, and the Liverpool Repertory theatre; in Ireland the Abbey theatre, Dublin. Such English producers as Gordon Craig, Granville Barker, J. B. Fagan, Lewis Casson, Nigel Playfair and others, have done very important work in improving the quality of acting, and creating stage ensembles, not only directly by their stage work, but also by their writings on the subject. In the United States, David Belasco, the Theatre Guild of New York, the Washington Square Players, the Provincetown Playhouse and such producers as Hopkins, R. E. Jones, the Reichens and others contributed to this improvement. Moreover, the Little Theatre movement (*q.v.*) in America must not be overlooked.

In reviewing the general style of acting during this period, it will be noticed that everywhere on the stages of the theatres where there is no leading producer who has a definite theory or system of acting, and who trains his company without having a definite system or theory, there is a mixture, not only of modern, but of very many different styles of acting. In the so-called commercial theatre, with star actors, the typical style of acting is generally not an art of creation of imaginary characters, but a kind of repetition of themselves by the actors in every part and in every play. These stars are not really acting, but merely showing themselves off to the public, using their personality and certain peculiarities of that personality, and trying to please and to obtain the sympathy of the audience.

Producers such as Max Reinhardt in Germany and Firmin Gémier in Paris use, for the most part, the methods of acting created by the naturalists, André Antoine in France, and Kronig, the producer of the Meininger in Germany developed by Otto Brahm and by Stanislavsky in Moscow. Sometimes these producers introduce, in this naturalistic acting, ideas of the formalists, Georg Fuchs in Germany, Meyerhold and Tairof in Russia, Gordon Craig in England and others Sometimes they introduce touches of the synthetic theories of acting advocated by Komisarjevsky since 1910. The majority of the French actors trained in the Conservatoire in Paris remain still under the influence, not only of the old romantic school, but also of the pseudo-classical school of acting of the 18th century.

Naturalism.—The best known of all the new theories of acting which have appeared since 1910 is the system of Stanislavsky, the leading producer and director of the Moscow Art theatre His system is founded on the principle that an actor, having to be natural and sincere on the stage, could be so only by means of reproducing emotions experienced at some time or other in his life. That form of "psychical naturalism" became part of Stanislavsky's system as a result of "outer naturalism," which he advocated before he turned to psychology in the endeavour to find out a scientific system of acting.

The "inner naturalism" in acting is not a new feature in Stanislavsky's theory. Some French theatrical theorists had already, in the 18th century, founded their systems of acting on the same ideas. They held that an actor can represent himself on the stage only if it is desired that he should be sincere; that "love scenes are much better played by actors who are in love in real life." Like the followers of Racine, Stanislavsky believes that contemporary actors living in their own time, and each one in his special atmosphere, are unable to produce other emotions than those that are applicable to the time and to the surroundings in which they lead their every-day life. To be sincere, they must place, beneath the lines and stage directions of the author, their own emotions already experienced in real life.

It is quite clear that this type of acting destroys the form created by the author of the play and the rhythm of his lines, which express the inner content and the inner movements of the play. The actor who acts by the power of his imagination passes from the form and the rhythm of the play to the inner content of it. The idealistic and emotional content of the play, which he obtains through the form and rhythm of the play, exists in his imagination, and produces the necessary working of his intellect to create a stage character with all its peculiarities. The pupil of Stanislavsky neglects the form and rhythm of the play and substitutes his own remembered, intellectual states in place of those of the author.

The Formalists.—Another system, opposed to Stanislavsky's ideas, has been advocated by the symbolists, the formalists and the expressionists. Here we have a complete negation of sincerity and life-likeness; the less the acting is sincere and life-like the better. The actor must not try to create any definite characters; he must represent abstract ideas, and convey these through his speeches delivered in a formal way, and through his movements and gestures, again produced in a formal, unlife-like and "picturesque" or marionette-like style. The Russian formalists, Meyerhold and Tairof, after the Revolution for instance, became very much interested in acrobatics and circus business; the movements of the actors in their productions became something akin to a *perpetuum mobile,* dominating both the psychology of the play and the meaning of the lines. Thus the acting on their stages resembled a mixture of circus and cubistic ballet performance Later, Meyerhold returned to the more or less naturalistic style. The German impressionists, such as Jessner, use formal methods interspersed with psychological touches The actors on the French *avant-garde* stages work on somewhat similar lines, for instance, at the Atelier directed by Dulain, in the productions of Pitoef and Jouvet In the *Vieux Colombier,* now closed, they used the same methods of acting. Copeau, the director of that theatre, must be considered as a pioneer, in France, in the fight against naturalism and the old fashioned Conservatoire acting He definitely introduced such new methods of acting as the psychological and the formal on the French stage

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See also THEATRICAL PRODUCTION. *Directing and Acting*

ACTINIC RAYS, ultra-violet rays which produce chemical changes. The term is sometimes popularly applied to the ultra-violet rays which are invisible, but can be detected by their action on a photographic plate and by rendering certain substances fluorescent (*see* FLUORESCENCE and PHOSPHORESCENCE) They are, to a certain extent, absorbed by the atmosphere, and, in moderate doses, have a beneficial effect on man (*See* SPECTROSCOPY; LIGHT AND RADIATION IN RELATION TO HEALTH.)

ACTINIUM is one of the radioactive elements giving rise to a series of other elements. Its symbol is Ac, atomic number 89, and probable atomic weight 230. (*See* RADIOACTIVITY)

ACTINOMETER, an instrument for measuring the heating and chemical effects of light It is derived from the Greek, ἀκτίς ray, μέτρον measure. The name was first given by Sir John Herschel to an apparatus for measuring the heating effect of solar rays (*Edin. Journ. Science,* 1825); Herschel's instrument has since been discarded in favour of the pyrheliometer (Gr. πῦρ fire, ἥλιος sun). (*See* RADIATION.) The word actinometer is now usually applied to instruments for measuring the *actinic* or chemical effect of luminous rays; their action generally depends upon photochemical changes. A type of actinometer is used in photography under the name of exposure-meter. In this instrument a section of sensitized bromide is exposed for a measured period of time. Certain practical forms are described in the article PHOTOGRAPHY.

ACTINOMYCOSIS (STREPTOTRICHOSIS), a chronic infective disease occurring in both cattle and man In both these groups it presents the same clinical course, being characterized by chronic inflammation with the formation of granulomatous tumours, which tend to undergo suppuration, fibrosis or calcification. It used to be believed that this disease was caused by a single vegetable parasite, the Ray-Fungus, but there is now an overwhelming mass of observations to show that the clinical features may be produced by a number of different species of parasites, for which the generic name Streptothrix is adopted

Pathological Anatomy.—The naked-eye appearance of the different organs affected by Streptothrix infection varies according to the duration and acuteness of the disease. In some tissues the appearance is that of a simple inflammation, whereas in others

it may be characteristic. The liver when affected shows scattered foci of suppuration, which may become aggregated into spheroidal masses, surrounded by a zone of inflammation. In the lungs the changes may be any that are produced by the following conditions: (1) An acute bronchitis. (2) A phthisical lung, grey nodules being scattered here and there almost exactly simulating tuberculous nodules. (3) An acute broncho-pneumonia with some interstitial fibrosis, and a tendency to abscess formation. The most characteristic lesions are in the skin

The disease is more common in males than in females, and more prevalent in Germany and Russia than in England. The infection is probably spread by grain (corn or barley), on which the fungus may often be found. In a great number of recorded cases the patient has been following agricultural pursuits. The disease can only be transmitted from one individual to another with considerable difficulty, and no case of direct transmission from animal to man has yet been noted.

Clinical History.—The course of actinomycosis is usually a chronic one, but occasionally the fungus gets into the blood, when the course is that of an acute infective disease or even pyaemia. The symptoms are entirely dependent on the organ attacked, and are in no way specially characteristic. During life a diagnosis of phthisis is continually made, and only a microscopic examination after death renders the true nature of the disease apparent. The nature of the skin lesion is the most evident, and here the parasite may be detected early in the illness The only drug which appears to have any beneficial influence on the course of the disease is potassium iodide, and this has occasionally been used with great benefit. Surgical interference is usually needed.

ACTINOTHERAPY: *see* LIGHT AND RADIATION IN RELATION TO HEALTH.

ACTINOZOA, an old technical name for Sea Anemones, now usually known as Actiniaria (*See* ANTHOZOA.)

ACTION: *see* PRACTICE AND PROCEDURE.

ACTIUM (mod. PUNTA), the ancient name of a promontory in the north of Acarnania (Greece) at the mouth of the Sinus Ambracius (Gulf of Arta) opposite Nicopolis, built by Augustus on the north side of the strait. On the promontory was an ancient temple of Apollo Actius, which was enlarged by Augustus, who also, in memory of the battle, instituted or renewed the quinquennial games called *Actia* or *Ludi Actiaci.* Actiaca Aera was a computation of time from the battle of Actium. There was on the promontory a small town, or rather village, also called Actium.

History.—Actium belonged originally to the Corinthian colonists of Anactorium, who probably founded the worship of Apollo Actius and the *Actia.* In the 3rd century it fell to the Acarnanians, who subsequently held their synods there. Actium is chiefly famous as the site of Octavian's decisive victory over Mark Antony (Sept. 2, 31 B.C). This battle ended a long series of ineffectual operations. The final conflict was provoked by Antony, who is said to have been persuaded by Cleopatra to retire to Egypt and give battle to mask his retreat; but lack of provisions and the growing demoralization of his army would sufficiently account for his decision. The fleets met outside the gulf, each over 200 strong (the totals given by ancient authorities are very conflicting). Antony's heavy fighting craft endeavoured to close and crush the enemy with their artillery; Octavian's light and mobile craft made skilful use of skirmishing tactics. During the engagement Cleopatra suddenly withdrew her squadron and Antony slipped away behind her. His flight escaped notice, and the conflict remained undecided until Antony's fleet was set on fire and thus annihilated.

ACTIVISM denotes any view that lays stress on action and its requirements. In *Psychology* it means the view that stresses the importance of conation rather than cognition (*see* ATTENTION, CONATION, PSYCHOLOGY). In *Philosophy* it denotes the view which makes utility the test of truth (*see* PRAGMATISM), or allows moral claims to justify certain theoretical assumptions (*see* KANT), or conceives of the ultimate principle of reality as some kind of will or activity (*see* ACTUALITY THEORY, SCHOPENHAUER, SPINOZA). In *Science* it means the view which emphasizes the importance of the practical application of scientific discoveries—"knowledge is power" (*see* BACON).

ACT OF PARLIAMENT. An act of parliament may be regarded as a declaration of the legislature, enforcing certain rules of conduct, or defining rights and conferring them upon or withholding them from certain persons or classes of persons. Acts of Parliament fall into two classes—"Public" and "Private." The former are officially defined in the Commons' Manual of Procedure as having for their object "to alter the general law," the latter, "to alter the law relating to some particular locality, or to confer rights on or relieve from liability some particular person or body of persons " The collective body of such declarations constitutes the statutes of the realm or written law of the British nation, in the widest sense, from Anglo-Saxon times to the present day. It is not, however, till the earlier half of the 13th century that, in a more limited constitutional sense, the statute-book is generally held to open, and the parliamentary records only begin to assume distinct outlines late in the reign of Edward I. It gradually became a fixed constitutional principle that an act of parliament, to be valid, must express concurrently the will of the entire legislature It was not, however, till the reign of Henry VI. that it became customary, as now, to introduce bills into parliament in the form of finished acts; and the enacting clause, regarded by constitutionalists as the first perfect assertion, in words, of popular right, came into general use as late as the reign of Charles II. It is thus expressed in the case of all acts other than those granting money to the Crown.—"Be it enacted by the King's most excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal and Commons in this present Parliament assembled, and by the authority of the same." In the rare cases where bills have been enacted under the Parliament Act (*q v.*) in opposition to the will of the Lords, the formula is varied, the words "Lords Spiritual and Temporal" being omitted, and the word "Commons" being followed by "in accordance with the provisions of the Parliament Act." Where the act is a money grant the enacting clause is prefaced by the words, "Most Gracious Sovereign, we, Your Majesty's most dutiful and loyal subjects, the Commons of the United Kingdom of Great Britain and Northern Ireland, in Parliament assembled, towards making good the supply which we have cheerfully granted to Your Majesty in this session of Parliament, have resolved to grant unto Your Majesty the sums hereinafter mentioned; and do therefore most humbly beseech Your Majesty that it may be enacted, etc." Originally the collective acts of each session formed but one statute, to which a general title was attached, and for this reason an act of parliament was up to 1892 generally cited as the chapter of a particular statute, *e g ,* 24 and 25 Vict. c. 101. Titles were, however, prefixed to individual acts as early as 1488. Now, by the Short Titles Act 1892, it is optional to cite the most important acts to that date by their short titles, either individually or collectively. Most modern acts have borne short titles independently of the Act of 1892. (*See* PARLIAMENT; STATUTE)

ACT OF STATE, a term in law which may be generically described as an act of the Crown, or of some officer whose act is ratified by the Crown, which the courts will treat as conclusive and binding on them in any litigation before them. Such a defence or plea in bar can never be raised by the Crown against the subject except in respect of the exercise of the prerogative in international relations. For a full exposition of the subject, *see* STATE, ACT OF; and STATE SUCCESSION.

ACTON, JOHN EMERICH EDWARD DALBERG ACTON, 1ST BARON (1834–1902), English historian, only son of Sir Richard Acton, 7th baronet, and grandson of the Neapolitan admiral, Sir J. F. E. Acton, 6th baronet (*q.v.*), was born at Naples on Jan. 10, 1834. Coming of a Roman Catholic family, young Acton was educated at Oscott till 1848, under Dr. (afterwards Cardinal) Wiseman, and then at Edinburgh, and at Munich under Döllinger, whose lifelong friend he became. He had wished to go to Cambridge, but for a Roman Catholic this was then impossible. By Döllinger he was inspired with a deep love of historical research and a profound conception of its functions as a critical instrument. He began at an early age to

collect a magnificent historical library, with the object, never in fact realized, of writing a great "History of Liberty." In politics he was always an ardent Liberal. He spent much time in the chief intellectual centres of Europe and in the United States, and numbered among his friends Montalembert, De Tocqueville, Fustel de Coulanges, Bluntschli, von Sybel and Ranke. In 1859 Sir John Acton was returned to the House of Commons for Carlow and became a devoted admirer and adherent of Mr. Gladstone; but he was practically a silent member, and his parliamentary career came to an end in 1865. Meanwhile he had become editor of the Roman Catholic monthly paper, the *Rambler*, in 1859, on J. H. Newman's retirement from the editorship; and in 1862 he merged this periodical in the *Home and Foreign Review*.

Though a sincere Roman Catholic, his whole spirit as a historian was hostile to ultramontane pretensions, and his independence of thought and liberalism of view brought him into conflict with the Roman Catholic hierarchy. As early as Aug. 1862 Cardinal Wiseman publicly censured the *Review;* and when in 1864, after Döllinger's appeal at the Munich Congress for a less hostile attitude towards historical criticism, the pope issued a declaration that the opinions of Catholic writers were subject to the authority of the Roman congregations, Acton stopped the publication of his monthly periodical. He continued, however, to contribute articles to the *North British Review*. In 1865 he married the Countess Marie, daughter of the Bavarian Count Arco-Valley, by whom he had one son and three daughters. In 1869 he was raised to the peerage by Gladstone as Baron Acton; he was an intimate friend and constant correspondent of the Liberal leader, and the two men had the very highest regard for each other. Matthew Arnold used to say that "Gladstone influences all round him but Acton; it is Acton who influences Gladstone."

In the great crisis in the Roman Catholic world in 1870, over the promulgation by Pius IX of the dogma of papal infallibility, Lord Acton was in complete sympathy on this subject with Dollinger (*q.v.*). Acton did not personally join the Old Catholic seceders. In 1874, when Gladstone published his pamphlet on *The Vatican Decrees*, Lord Acton wrote during Nov. and Dec. a series of letters to *The Times*, illustrating Gladstone's main theme by numerous historical examples of papal inconsistency, but demurring nevertheless to Gladstone's conclusion. In spite of his reservations, he regarded "communion with Rome as dearer than life" Thenceforth he devoted himself to persistent reading and study, combined with social life. Little indeed came from his pen, his only notable publication being a masterly essay in the *Quarterly Review* of Jan. 1878 on "Democracy in Europe"; two lectures delivered at Bridgnorth in 1877 on "The History of Freedom in Antiquity" and "The History of Freedom in Christianity"—these last the only tangible portions put together by him of his long-projected "History of Liberty"—and an essay on modern German historians in the first number of the *English Historical Review*, which he helped to found (1886). After 1879 he divided his time between London, Cannes, and Tegernsee in Bavaria. Gladstone found him a valuable political adviser, and in 1892, when the Liberal Government came in, Lord Acton was made a lord-in-waiting. Finally, in 1895, on the death of Sir John Seeley, Lord Rosebery appointed him to the Regius Professorship of Modern History at Cambridge. His inaugural lecture on "The Study of History," afterwards published with notes displaying a vast erudition, made a great impression in the university, and the new professor's influence on historical study was felt in many important directions. He delivered two valuable courses of lectures, on the French Revolution and on Modern History; but it was in private that the effects of his teaching were most marked. The great *Cambridge Modern History*, though he did not live to see it, was planned under his editorship, and all who came in contact with him testified to his stimulating powers and his extraordinary range of knowledge. He died on June 19, 1902, being succeeded in the title by his son, Richard Maximilian Dalberg Acton, 2nd baron Acton (b. 1870).

Lord Acton left too little completed original work to rank among the great historians. But he was one of the most deeply learned men of his time, and he is remembered for his influence on others. His extensive library, composed largely of books full of his own annotations, was bought immediately after his death by Andrew Carnegie and presented to John Morley, by whom it was forthwith given to the University of Cambridge.

See Herbert Paul's excellent Introductory Memoir to the interesting volume of *Lord Acton's Letters to Mrs. Drew* (1904), and the authorities cited there; also Dom Gasquet's *Lord Acton and his Circle* (1906) and a selection from his correspondence, ed by J. N. Figgis and R. V. Laurence, with introduction (1917 *seq*). *A Bibliography of the Works of Lord Acton*, by W. A. Shaw, was published by the Royal Historical Society in 1903. The *Edinburgh Review* of April 1903 contains a luminous essay; and a chapter on Acton appears in Bryce's *Studies of Contemporary Biography* (1903) Lord Acton's *Lectures on Modern History*, ed. by J. N. Figgis and R. V. Laurence, appeared in 1906; and his *History of Freedom and other Essays* and *Historical Essays and Studies* (by the same editors) in 1907.

ACTON, SIR JOHN FRANCIS EDWARD, BART. (1736–1811), prime minister of Naples under Ferdinand IV., was the son of Edward Acton, a physician at Besançon, and was born there in 1736, succeeding to the English title and estates in 1791, on the death of his cousin in the third degree, Sir Richard Acton of Aldenham hall, Shropshire. He served in the navy of Tuscany, and in 1775 commanded a frigate in the joint expedition of Spain and Tuscany against Algiers. In 1779 Queen Maria Carolina of Naples persuaded her brother the grand-duke Leopold of Tuscany to allow Acton to reorganize the Neapolitan navy. He became commander-in-chief of both services, minister of finance, and finally prime minister. His policy was devised in concert with the English ambassador, Sir William Hamilton, and aimed at substituting the influence of Austria and Great Britain for that of Spain, at Naples, and consequently involved open opposition to France and the French party in Italy. In Dec. 1798 he shared the flight of the king and queen. For the reign of terror which followed the downfall of the Parthenopean republic, five months later, Acton has been held responsible In 1804 he was for a short time deprived of the reins of government at the demand of France; but he was soon restored to his former position, which he held till, in Feb 1806, on the entry of the French into Naples, he had to flee with the royal family into Sicily. He died at Palermo on Aug. 12, 1811.

He left three children, the elder son, Sir Richard, being the father of the first Lord Acton. The second son CHARLES JANUARIUS EDWARD (1803–1847), after being educated in England and taking his degree at Magdalene college, Cambridge, in 1823, entered the Academia Ecclesiastica at Rome. He became the secretary of the congregation of the Disciplina Regolare, and auditor of the Apostolic Chamber under Gregory XVI, by whom he was made a cardinal in 1842. Cardinal Acton helped to secure the increase, in 1840, of the English vicariates-general to eight, which paved the way for the restoration of the hierarchy by Pius IX. in 1850. He died on June 23, 1847.

ACTON, municipal borough, Middlesex, England, suburban to London, 9m. W. of St. Paul's cathedral. Population (1861) 3,151; (1901) 37,744; (1921) 61,299 The best derivation offered for its name is from Oak-town; in reference to the extensive forest which formerly covered the locality. The land belonged from early times to the See of London, a grant being recorded in 1220. Henry III. had a residence here. At the time of the Commonwealth Acton was a centre of Puritanism. Philip Nye (d. 1672) was rector; Richard Baxter, Sir Matthew Hale (Lord Chief Justice), Henry Fielding the novelist and John Lindley the botanist (d. 1865) are famous names among residents here. Acton Wells, of saline waters, had considerable reputation in the 18th century. There are stations on the G W.R., the L M.S R., the District and the C L R. Acton is governed by a mayor and corporation of 32 members. It was made a municipal borough in 1921. Area, 2,305 acres. It forms the Acton division of the parliamentary county of Middlesex (*q.v.*).

ACT ON PETITION, the term for a part of the procedure in the British Probate, Divorce and Admiralty Division, now of infrequent occurrence. It was more freely used in the old Admiralty and Divorce courts before the Judicature Acts. (*See* DIVORCE.)

ACTS OF THE APOSTLES. This book of the Bible was originally the sequel of the Gospel of Luke. Its separation was due to a growing view of the Gospels as a unit of sacred records, to which *Acts* stood as appendix. Historically it is of unique interest and value The Apocryphal Acts of certain apostles, witnessing to the impression produced by our *Acts*, only emphasize this. It is the one really primitive Church history, primitive in spirit as in substance; apart from it a real picture of the Apostolic age would be impossible. With it, the Pauline Epistles are of priceless historical value; without it, they would remain bafflingly fragmentary, often even misleading owing to their "occasional" nature and emphasis.

Plan and Aim.—All agree that *Acts* is the work of an author of high literary skill, and that he exercised careful selection in the use of his materials, in keeping with a definite purpose and plan. It is of moment, then, to discover what these were. Here it is not needful to go farther back than F. C. Baur and the Tübingen school, with its theory of sharp antitheses between Judaic and Gentile Christianity, of which they took the original apostles and Paul to be typical. Gradually this position underwent modifications, as it became realized that neither Jewish nor Gentile Christianity was a uniform genus, and that the apostolic leaders from the first stood for mutual understanding and unity. The Tübingen school put the needful question, but did not return the correct answer because, as Ritschl showed (*Altkath Kirche*, 2nd ed., 1857), their premises were inadequate. Still the attitude created by the theory persists in much that is written about *Acts*. On the whole, however, scholars now look at the book more objectively and follow up the hints as to its aim given by the author in his opening paragraph (i. 1–11). Thus (1) his second narrative is the natural sequel to his first. As the earlier book set forth in orderly sequence (*καθεξῆς*) the providential stages by which Jesus was led, "in the power of the Spirit," to begin the establishment of the Kingdom of God, so the later sets forth its extension by means of His chosen representatives or apostles. (2) This involves emphasis on the identity of the power, Divine and not merely human, visible in the great series of facts from first to last; God's Spirit appears as active throughout. But further (3), the Divine energy in the disciples is conditioned by the continued influence and volition of their "Lord" at His Father's right hand in heaven: "Holy Spirit" (without the article), the holy power of His personality (*see* xvi. 7 "the Spirit of Jesus"), is the living link between His action and theirs (i. 2, 4 *seq.*, 8, ii. 1 *seq.*, *cf* Luke xxiv. 49). And (4) the scope of this action is nothing less than all mankind (ii. 5 *seq.*), especially within the Roman empire. (5) Finally, as we see from the parallel in Luke xxiv. 46–48, the divinely appointed method of victory is through suffering (Acts xiv. 22), as it was for Messiah himself. This explains the space devoted to the tribulations of His witnesses, and their constancy amid them. It forms part of the virtual *apologia* for the absence of that earthly prosperity in which the ancient mind was apt to look for Divine approval. Moreover the Church's foes were chiefly Jews, whose opposition our author regards as due to blindness to the wider reading of their own religion—to which the Holy Spirit had from of old been pointing (*cf.* Stephen's speech)—and to jealousy of those who, by preaching the wider Messianic Evangel, were winning the Gentiles, and particularly proselytes, in such numbers.

These, then, seem to be the author's main *motifs*:—the *universality of the Gospel*, the *jealousy of national Judaism*, and the *Divine initiative*, manifest particularly in the gradual stages by which men of Jewish birth were led in spite of their own prejudices, to recognize the Divine will in the setting aside of national restrictions, alien to the universal destiny of Messiah's Church. The practical moral is *the Divine character of the Christian religion*, as evinced by the manner of its extension in the empire, no less than by its original expression in the Founder's life and death. Thus both parts of the author's work alike tend to produce assured conviction of Christianity as of Divine origin (Luke i. 1, 4; Acts i. 1 *seq*.).

This view gives the book a practical religious aim—a *sine qua non* to any theory of an early Christian writing. In spite of all difficulties, this religion is worthy of belief, even though it mean opposition and suffering. To meet this source of doubt the author holds up the picture of earlier days, when the great Apostle of the Gentiles enjoyed protection at the hands of Roman justice. It is implied that the present distress is but a passing phase, resting on misunderstanding; for Christianity, as the true fulfilment of Israel's religion, had once been (and might again be) treated as a recognized or lawful (*licita*) religion, the more so that it had deep kinship with non-Jewish philosophic monotheism. Meantime the example of apostolic constancy should inspire like fidelity. *Acts* is in fact an Apology for the Church as distinct from Judaism, the breach with which is accordingly traced with fulness and care.

From this standpoint *Acts* no longer seems to end abruptly. Whether as exhibiting the Divine leading and aid, or as recording the normal attitude of the Roman State, the writer has reached a climax, "Paulus Romae, apex Evangelii" (Bengel). In keeping with this, verses 26–28 of chap. xxviii. are the solemn close of the work, while verses 30, 31 are an appended observation. Yet even here, by the final word of all "unmolested," the writer ends most fitly on one of his keynotes.

The full force of this is missed by those who, rightly rejecting the idea that he had in reserve enough history to furnish another work, hold that Paul was freed from the imprisonment in which *Acts* leaves him (*see* PAUL). For those, on the other hand, who see in the writer's own comment in xx 38, uncontradicted by what follows, a broad hint that Paul never saw his Ephesian friends again, the view is open that his end was too well known to call for explicit record. Nor would such silence be disingenuous, any more than on the theory that martyrdom overtook him later (The view that *Acts* was written before Paul's death is excluded by the date of Luke's Gospel) To the writer Paul's death (like the horrors of Nero's Vatican Gardens in 64) was a monstrous exception to the rule of Roman policy heretofore illustrated. Not even by the Romans themselves were all Nero's acts regarded as precedents.

Authorship.—External evidence, which is early and widespread (*e.g.*, Irenaeus, Muratorian Canon, Tertullian, Clement), all points to Luke, Paul's companion, probably his physician (Col. iv. 14). Evidence for his authorship of the third Gospel counts also for *Acts*. This carries us back at least to the second quarter of the 2nd century (Justin, *Dial.* 103, and Marcion). Nor was Luke prominent enough as an associate of Paul for the belief to be a mere guess. If, then, the Lucan authorship is to be doubted, it must be on internal evidence. The form of the book, however, favours Luke, who was of non-Jewish birth (*see* Col. iv 12–14 with 10 *seq.*), and as a physician presumably a man of culture. The medical cast of some of its language points the same way. This argument, first worked out by Dr. W. K. Hobart, *The Medical Language of St. Luke* (Dublin, 1882), has been urged afresh in Harnack's *Luke the Physician* (1907), to which reference may be made for all matters connected with Lucan authorship. The early tradition that this Luke was born in the Syrian Antioch suits the way in which the origin of the Antiochene Church and its place in the extension of the Gospel are described (*see* LUKE). Again, the attitude of *Acts* towards the Roman empire is just what would be expected from a comrade of Paul, but hardly from a man who belonged to the next generation. Finally, the book itself seems to claim to be by a companion of Paul. In chap xvi. 10 without any previous warning it passes from the third person to the first. "But when he saw the vision, straightway *we* sought to go forth into Macedonia." Thenceforth "we" reemerges at certain points in the narrative until Rome is reached. These parts at least are generally held to imply the narrative of an eye-witness. If so, this eye-witness was probably also the author of the work; for the style of the "we" passages is the same as that of the book as a whole (*see* Sir J. C. Hawkins in *Horae Synopticae*, 1899, pp. 143–147). In a word, the author of Acts was Luke, Paul's companion during most of his later ministry, and also his "counterpart," "as a Hellene who yet had personal sympathy with Jewish primitive Christianity" (Harnack, *op. cit.* p. 145; *see* also LUKE).

Sources.—So far from such a plan and such an author being inimical to the quest after the materials used in *Acts* one may say

that it points the way thereto, while it keeps literary analysis within scientific limits. In their light one feels that the speeches in its first part (*e.g.*, that of Stephen)—and indeed elsewhere, too—are not "free compositions" of our author, the outcome of dramatic idealization such as ancient historians like Thucydides or Polybius allowed themselves. The Christology, for instance, of the early Petrine speeches is such as a Gentile Christian writing *c.* A.D. 80 simply could not have imagined. We are forced to assume the use of early Judaeo-Christian material, akin to that implied also in the special parts of the Third Gospel. P. Feine (*Eine vorkanonische Ueberlieferung des Lukas*, 1891) suggested that a single document explains this material in both works, as far as Acts xii. Others maintain that at any rate two sources underlie Acts i.–xii., or even i.–xv. (*see* A. Harnack, *The Acts of the Apostles*, 162 *seq.* and Foakes Jackson and Kirsopp Lake, *The Beginning of Christianity*, pt. i. vol. ii. 122 *seq.*). Certainly we can discern the presence of traditions of the Jerusalem Church and of the largely Hellenistic Church of Antioch. But it remains a question whether they reached our author in written form. If he was a careful inquirer (Luke i. 3), especially if he was in the habit of taking down in writing what he heard from different witnesses, this may explain the phenomena (including the alleged traces of "Aramaisms"). Luke would have rare facilities for collecting Palestinian materials, varying no doubt in accuracy but all relatively primitive, whether in Antioch or in Caesarea, where he probably resided for some two years in contact with Philip the Evangelist and his daughters (xxi. 8). There and elsewhere he might also learn a good deal from John Mark, Peter's friend (I Pet. v. 13; Acts xxi. 12).

In the second or strictly Pauline half, two main theories of the so-called "we" passages are possible. (1) that which sees in them traces of an earlier document—whether a travel-diary or a more consecutive narrative written later; and (2) that which regards the "we" as due to the author's breaking instinctively into the first person plural where he felt himself specially identified with the history. On the former hypothesis, it is still in debate whether the "we" document lies behind more of the narrative than is definitely indicated by the formula in question (*e.g.*, chaps. xiii.–xv., xxi. 19–xxvi.). On the latter, the presence or absence of "we" may well be due to psychological causes, rather than to the writer's mere presence or absence. Sometimes, he may be writing as a member of Paul's mission at the critical stages of onward advance (xvi. 10 *seq.*, xx. 5 *seq.*, xxvii. 1 *seq.*); sometimes rather as a witness absorbed in his hero's words and deeds (so "we" ceases between xx 15 and xxi. 1). In the former cases the whole "mission" was on the move.

Historical Value.—Questions of authorship and sources are of moment mainly as bearing on the contents as history (see *Beginnings of Christianity*, as above, pp. 265–348). *Acts* falls into two distinct parts. The first (i.–xii.) deals with the church in Jerusalem and Judaea, and with Peter as central figure—at any rate in chaps. i.–v. The difficulty here is that we have but few external means of testing the narrative (*see* further, *Date*). Some of it may have suffered partial transformation in oral tradition before reaching our author; *e.g.*, the nature of the Tongues at Pentecost does not accord with what we know of the gift of "tongues" generally. The second part pursues the history of the apostle Paul; and here we can compare it with his Epistles. The result is a general harmony, without any trace of direct use of these letters; and there are many minute coincidences. But there are also two remarkable exceptions. These are, the account given by Paul of his visits to Jerusalem in *Galatians* as compared with *Acts;* and the nature of his mission, as it appears in his letters and in *Acts*.

In regard to the first point, differences as to Paul's movements before his return to his native province of Syria-Cilicia (*see* PAUL) can be explained by the different interests of Paul and our author respectively. But what of the visits of Gal. ii. 1–10 and Acts xv.? If they refer to the same occasion, as is usually assumed, it is hard to see why Paul should omit reference to the public occasion of the visit and to the public vindication of his policy. But in fact the issues of the visits, as given in Gal. ii. 9 *seq.* and Acts xv. 20 *seq.*, are not at all the same (Harnack [*op. cit.* pp. 245 *seq.*] and others vainly argue that the Abstinences defined for Gentiles were in the original text of Acts xv. 20 purely moral, and had no reference to Jewish scruples as to eating blood) Nay more, if Gal. ii. 1–10 = Acts xv., the historicity of the "Relief visit" of Acts xi. 30, xii. 25, seems excluded by Paul's narrative before the visit of Gal. ii. 1 *seq.* Accordingly, Sir W. M. Ramsay and others argue that the latter visit itself coincided with the Relief visit, and see in Gal. ii. 10 witness thereto. But why, then, does not Paul refer to the *public* charitable object of his visit? It seems easier therefore to admit that the visit of Gal. ii. 1 *seq.* is one unrecorded in *Acts*, owing to its private nature as preparing the way for public developments—with which *Acts* is mainly concerned. In that case it would fall shortly before the Relief visit, to which there may be indirect explanatory allusion in Gal. ii. 10 (*see* further PAUL); and it will be shown below that such a conference of leaders in Gal. ii. 1 *seq.* leads up excellently both to the First Mission Journey and to Acts xv. (For other views *see The Beginnings of Christianity*, 273 *seq.*, 321 *seq*)

We pass next to the Paul of *Acts*. In his epistles Paul insists that he was the apostle to the Gentiles, as Peter was to the Circumcision, and that circumcision and the observance of the Jewish law were of no importance to the Christian as such. But in *Acts* it is Peter who first opens up the way for the Gentiles. It is Peter who used the strongest language in regard to the intolerable burden of the Law as a means of salvation (xv. 10 *seq. cf.* 1.). Not a word is said of difference between Peter and Paul at Antioch (Gal ii. 11 *seq*). The brethren in Antioch send Paul and Barnabas up to Jerusalem to ask the opinion of the apostles and elders; they state their case, and carry back the decision to Antioch. Throughout Acts Paul never stands forth as the unbending champion of the Gentiles. He seems anxious to reconcile the Jewish Christians by personally observing the law of Moses. He circumcises the semi-Jew, Timothy; and he performs his vows in the temple. He is particularly careful in his speeches to show how deep is his respect for the law of Moses. In all this the letters of Paul are very different from *Acts*. In *Galatians* he claims perfect freedom in principle, for himself as for the Gentiles, from the obligatory observance of the Law; and neither in it nor in *Corinthians* does he take any notice of a decision reached at Jerusalem. The narrative of *Acts*, too, itself implies something other than what it sets in relief; for why should the Jews hate Paul so much, if he was not in some sense disloyal to their Law?

There is, nevertheless, no essential contradiction here, only such a difference of emphasis as belongs to the standpoints and aims of the two writers and to different historical conditions. Peter's function in relation to the Gentiles belongs to early Palestinian conditions, before Paul's distinctive mission had taken shape. Once Paul's apostolate—parallel with the more collective apostolate "the Twelve"—has proved itself by tokens of Divine approval, Peter and his colleagues frankly recognize the distinction of the two missions, and are anxious only that the two shall not fall apart by religiously and morally incompatible usages (Gal. ii. 10, *cf.* Acts xv.). Paul, on his side, clearly implies that Peter felt that the Law could not justify (Gal. ii. 15 *seq.*), and argues that it could not now be made obligatory in principle (*cf.* "a yoke," Acts xv. 10), yet for Jews it might continue for the time (pending the Parousia) to be seemly and expedient, especially for the sake of non-believing Judaism. To this he conformed his own conduct as a Jew, so far as his Gentile apostolate was not involved (I Cor. ix. 19 *seq.*). There is no reason to doubt that Peter largely agreed with him, since he acted in this spirit in Gal. ii. 11 *seq.*, until coerced by Jerusalem sentiment to draw back for expediency's sake This incident it did not fall within the scope of *Acts* (*see* above) to narrate, since it had no abiding effect on the Church's extension. As to Paul's submission of the issue in Acts xv. to the Jerusalem conference, *Acts* does not imply that Paul would have accepted a decision in favour of the Judaizers, though he saw the value of getting a decision for his own policy in the quarter to which they were most likely to defer. If the view that he already had an understanding with the "Pillar" Apostles, as recorded in Gal. ii. 1–10 (*see* further PAUL), be correct, it gives

the best of reasons why he was ready to enter the later public Conference of Acts xv. Paul's own "free" attitude to the Law, when on Gentile soil, is just what is implied by the hostile rumours as to his conduct in Acts xxi. 21, which he was glad to disprove as at least exaggerated (*ib.* 24 and 26). What is clear is that such lack of formal accord as here exists between *Acts* and the Epistles tells against its author's dependence on the latter, and so favours his having been a comrade of Paul himself.

Speeches.—The speeches in *Acts* deserve special notice. Ancient historians (like many of modern times) used the liberty of working up in their own language the speeches recorded by them They did not dream of verbal fidelity; they preferred to mould a speaker's thoughts to their own methods of presentation. Besides this, some did not hesitate, for vividness' sake, to give to their characters speeches which were never uttered Now how far has the author of *Acts* followed these practices? Some of its speeches are evidently bare summaries. Others claim to be reports of speeches really delivered. But all have been passed through one mind, and some mutual assimilation in phraseology and idea may well have resulted They are, moreover, all of them, mere abstracts. Yet these circumstances, while inconsistent with verbal accuracy, do not destroy authenticity; and in most cases (*e g* xiv. 15–17) there is a varied appropriateness, as well as an allusiveness, pointing to good information (*see* under *Sources*). There is no evidence that any speech in *Acts* is the free composition of its author, without either written or oral basis; and in general he seems nearer than most ancient historians to the essentials of historical accuracy.

Miracles.—Objections to the trustworthiness of *Acts* on the ground of its miracles require to be stated more carefully than has usually been the case especially as bearing on authorship. For the idea of the "miraculous" or supernormal is hardly if at all, less marked in the "we" sections (where efforts to dissect it out are fruitless) than in the rest of the work The scientific method, then, is to consider each "miracle" on its own merits, according as we may suppose that it has reached our author more or less directly. But even the form in which the gift of Tongues at Pentecost is conceived does not exclude Luke's authorship, since it may have stood in his source; and the first outpouring of the Messianic Spirit may soon have come to be thought of as unique by some Jewish Christians, parallel in form to the Rabbinic tradition as to the inauguration of the Old Covenant at Sinai (*cf.* Philo, *De decem oraculis,* 9, 11, and the Midrash on Ps lxviii 11)

As to such historical difficulties in *Acts* as still remain, there are various possibilities of mistake intervening between the facts and the accounts which reached its author, at second or even third hand (*see* further under *Date*). Also recent research in antiquity has tended to verify such parts of the narrative as can be tested, as Sir W. M. Ramsay in particular has shown The proofs of trustworthiness extend also to the theological sphere What was said of the Christology of the Petrine speeches applies to the whole conception of Messianic salvation, the eschatology, the idea of Jesus as equipped by (the) Holy Spirit for His Messianic work. These and other forms of very primitive witness in *Acts* have not indeed the value of shorthand notes or even of abstracts based thereon But they suggest that our author gave a faithful account of such words and deeds as had come to his knowledge. The perspective of the whole is no doubt his own; and as his materials furnished but few hints for a continuous narrative, this perspective, especially in things chronological, may sometimes be faulty. Yet when one remembers that by A.D. 70–80 it must have been a matter of small interest by what *tentative* stages the Messianic salvation was first extended to the Gentiles, it is surely surprising that *Acts* enters into any detail on the subject, and is not content with a summary account such as the mere logic of the matter would naturally suggest

"Study of Sources" (*Quellenkritik*), then, solves many difficulties in the way of treating *Acts* as an honest narrative by a companion of Paul. In addition, we may also count among recent gains a juster method of judging such a book. For among the results of the Tübingen criticism was what Dr. W. Sanday called "an unreal and artificial standard, the standard of the 19th century rather than the 1st, of Germany rather than Palestine, of the lamp and the study rather than of active life." This has a bearing, for instance, on the differences between the three accounts of Paul's conversion in *Acts*. In the recovery of a more real standard, we owe much to men like Mommsen, Ramsay, Blass and Harnack, trained amid methods and traditions other than those which had brought the constructive study of *Acts* almost to a deadlock. Nor have the results of recent similarly jealous suspicion (of which Loisy is the type) won any wide consensus among scholars.

Date.—External evidence points to the existence of *Acts* at least as early as the opening years of the 2nd century. The traces of it in Polycarp and Ignatius, when taken together, are highly probable; and the resemblance of Acts xiii. 22, and I Clem. xviii. 1, in features not found in the Psalm (lxxxix 20) quoted by each, can hardly be accidental (see *The N T. with Apostolic Fathers,* 48 *seq.*). That is, *Acts* was probably current in Rome as early as *c:* A.D 95. With this view internal evidence agrees In spite of some advocacy of a date prior to A.D 70, the bulk of critical opinion is against it. The prologue to Luke's Gospel implies the dying out of eye-witnesses as a class. Many support a date about A.D. 80; some prefer 75 to 80; while a date even before 75 seems possible Of the reasons for a date in one of the earlier decades of the 2nd century, as argued by the Tubingen school, most are now untenable Among these are the supposed traces of 2nd-century Gnosticism and "hierarchical" ideas of organization; while the argument from the relation of the Roman state to the Christians has been turned by Ramsay into proof of an origin prior to Pliny's correspondence with Trajan, *c.* 112. Another fact tells against a 2nd-century date, *viz* the failure of a writer devoted to Paul's memory to avoid seeming conflict with his Epistles. If, indeed, *Acts* uses the later works of Josephus, we should have to place it about A.D 100. But this is far from proved.

Three points of contact with Josephus in particular are cited (1) The circumstances attending the death of Herod Agrippa I. in A.D 44 Here Acts xii. 21–23 is largely parallel to Jos. *Antt* xix 8 2; but the latter adds an omen of coming doom, while *Acts* alone gives a circumstantial account of the occasion of Herod's public appearance. Hence the parallel, when analysed, tells against dependence So also with (2) the case of the Egyptian pseudo-prophet in Acts xxi. 37 *seq*, Jos. *Jewish War,* ii. 13 5, *Antt* xx. 8. 6; for the numbers do not agree with either of Josephus's rather divergent accounts, while *Acts* alone speaks of *Sicarii* With these instances in mind, it is best to regard (3) the curious resemblance in v. 36 *seq* and Jos. *Antt.* xx. 5. 1 as to the order in which Theudas and Judas of Galilee are referred to in both as accidental, the more so that again there is difference as to numbers. There may well have been another Theudas, in the period of many tumults after the death of Herod the Great to which Josephus refers in *Antt* xvii. 10 4, whom as a pseudo-Messiah on so small scale he might not think worth while mentioning after A.D. 70; whereas to Gamaliel the case was not long before his own time ("before these days") Further, to make out a case for dependence, one must assume the mistaken order in Gamaliel's speech as due to gross carelessness in the author of *Acts*. Such a mistake, if really there, was far more likely to arise in oral transmission of the speech, before it reached Luke at all.

Place.—The place of composition is still an open question. Rome and Antioch have been in favour; and Blass combined both views in his theory of two editions (*see* further, *Text*). But internal evidence points to the Roman province of Asia, and the neighbourhood of Ephesus. Note the confident local allusion in xix. 9 to "the school of Tyrannus"—not "a certain Tyrannus," as in the inferior text—and in xix. 33 to "Alexander"; also the very minute topography in xx. 13–15. Affairs in that region, including the future of the church of Ephesus (xx. 28–30), are treated as though they would specially interest "Theophilus" and his circle: also an early tradition makes Luke die in the adjacent Bithynia. An *apologia* for the Church against the Synagogue's attempts to influence Roman policy to its harm would be much to the point in "Asia" (*cf.* Rev. ii. 9, iii. 9, and Sir W. M. Ramsay, *The Letters to the Seven Churches,* ch. xii.).

Text.—The *apparatus criticus* of *Acts* has grown considerably of recent years; mainly in one direction, that of the so-called "Western text." This misleading term really stands for a glossing or paraphrastic text, comparable to a Targum on an Old Testament book, which became very widespread, in both east and west, for some 200 years or more from early in the 2nd century. The sifting, however, of the readings in all our witnesses (mss., versions, Fathers) has not yet gone far enough to yield final results as to the history of this text—what in its extant forms is primary, secondary, and so on. Beginnings only have been made towards grouping our authorities (*see* J. H. Ropes' fine study in *Beginnings of Christianity*, pt. i., vol. iii. pp. ccxv). Assuming, however, that the original form of the "Western" text had been reached, the question of its historical value, *i e.* its relation to the original text of *Acts*, would remain On this point the highest claims were made by Blass (1894 and later), who held that both the "Western" text of *Acts* (styled the β text) and its rival, the text of the great uncials (the α text), are due to the author's own hand; and that the former (Roman) is more original than the latter (Antiochene); but the theory (as Ropes shows) is untenable. Sir W. M. Ramsay pointed the way to sounder views. Already in *The Church in the Roman Empire* (1893) he held that the "Western" text in the *Codex Bezae* rested on a recension made not later than about the middle of the 2nd century. Though "some at least of the alterations in *Codex Bezae* arose through a gradual process," the revision as a whole was the work of a single reviser His aim, in suiting the text to the views of his place and time, was to make it at once more intelligible and more complete In his later work, *St. Paul the Traveller and the Roman Citizen* (1895), Ramsay's views gained in breadth by looking beyond the Bezan text to the "Western" text as a whole

But all earlier work on the text of *Acts* is summed up and improved in Ropes' monumental edition (as above). Generally speaking, the text as printed by Westcott and Hort, on the basis of the earliest mss (ℵB), seems in *Acts*, as elsewhere, to be nearest to the autograph. the "Western" text, even in its earliest form, was a deliberate revision. This does not mean that it has no historical value of its own. Certain of its readings (*e g* xi 28, xii 10) may even date from the end of the 1st century and preserve living memories But their value is mainly that of an early commentary, and lies in the light cast on ecclesiastical thought in certain quarters and epochs *Acts*, from its very scope, was least likely to be viewed as sacrosanct in its text. Indeed there are signs that its undogmatic nature caused it to be comparatively neglected at certain times and places, as, *e.g.*, Chrysostom explicitly witnesses

BIBLIOGRAPHY.—An account of the extensive literature that has gathered round *Acts* may be found in R. J. Knowling's ed in *The Expositor's Greek Testament* vol ii (1900), and in his *Testimony of St. Paul to Christ* (1905); C Clemen, *Die Apostelgesch. im Lichte der neueren Forschungen* (Giessen, 1905), A. Harnack, *Acts of the Apostles* (1909), J. Moffatt's *Introduction to the N T.* (1911 and later); and particularly, Foakes Jackson and Kirsopp Lake, *The Beginnings of Christianity* pt. i. (1920–28); H. J. Cadbury, *The Making of Luke-Acts* (1927). (J. V. B.)

ACTUALITY THEORY is the view that the real is not a thing or a state at rest, but an activity or a process

In philosophy the theory is as old as Heraclitus who conceived ultimate reality as an incessant becoming, not as static being In modern philosophy Spinozism may be regarded as a form of this theory. For, notwithstanding the important place which the conception of "substance" holds in the philosophy of Spinoza, Spinozism when correctly interpreted is essentially dynamic, not static, in character. Of subsequent philosophers the following (among others) may be regarded as upholders of the actuality theory in some form or other. Fichte conceived of the real as the infinite activity of the absolute ego. Hegel regarded it as an absolute process, a kind of dialectical evolution. Schopenhauer described it as volitional activity or striving. Wundt likewise thought of reality as a complex of volitional activities or processes. For Bergson "there are no things, only activities" (*Creative Evolution*). Of philosophical men of science Mach, Ostwald, and Whitehead (among others) may be claimed as supporters of the actuality theory. Indeed the whole drift of present day science is to regard "events" rather than "things" as the ultimate components of the world of reality.

In psychology the actuality theory is mainly concerned with the nature of the soul or mind. According to the popular view, which is also supported by many psychologists, the mind or soul is a substance, an abiding something which owns the mental experiences of knowing, feeling, and willing, or which exercises these activities. As against this "substantial" view of the soul, the actuality theory in psychology treats the soul as just the complex or system of these activities, experiences, or processes, and no more. The view appears to be as old as Protagoras and Aristotle It is quite explicit in Spinoza, for whom the human soul is just a complex of ideas, and ideas are not dead, static pictures on a canvas, but living activities. Hume likewise stated that his introspective attempt to catch a glimpse of his soul revealed to him nothing but "a bundle" of sensations, etc. Of modern psychologists, Fechner, Höffding, James, Baldwin, Ebbinghaus, Sully, and Wundt (among others) may be classed among the supporters of the actuality theory, while other psychologists are more or less in sympathy with it, though they regard the whole question as pertaining to philosophy rather than to psychology. On one point, however, all modern psychologists are agreed, namely, that mental experiences are essentially events, activities, or processes, not states. And this agreement is largely the result of the contention of the upholders of the activity theory.

ACTUARY. The name of *actuarius*, sc. *scriba*, in ancient Rome, was given to the clerks who recorded the *Acta Publica* of the senate, and also to the officers who kept the military accounts and enforced the due fulfilment of contracts for military supplies In its English form the word has undergone a gradual limitation of meaning At first it seems to have denoted any clerk or registrar; then more particularly the secretary and adviser of any joint-stock company, but especially of an insurance company; and it is now applied specifically to one who makes those calculations as to the probabilities of human life, on which the practice of life assurance and the valuation of reversionary interests, deferred annuities, etc , are based. The first mention of the word in law is in the Friendly Societies Act of 1819, where it is used in the vague sense, "actuaries, or persons skilled in calculation," but it has been defined and is used with precision since the establishment of the Institute of Actuaries in 1848 and the Faculty of Actuaries in Scotland in 1856.

The Institute of Actuaries (Staple Inn hall, London) and the Faculty of Actuaries, in Scotland (Edinburgh) are incorporated by royal charter. The membership of the respective bodies was 1,046 (March 1928) and 247 (June 1928). Their objects are identical, namely, to promote the efficiency of actuaries, whose function, briefly stated, is to apply the doctrine of probabilities to practical affairs The examinations are very similar and embrace advanced algebra, finite differences, the differential calculus and statistics. The practical part covers the theory of compound interest and annuities-certain and of life and other contingencies, the compilation of tables of mortality, sickness, accident, etc , the calculation of premium rates and all rates of contribution for life assurances, annuities, sickness funds, widows' and orphans' funds, and friendly societies, as well as to a limited extent, investments and law.

The registrar in the Lower House of Convocation is also called the Actuary.

ACUMINATE, sharpened or pointed, a word used principally in botany and ornithology to denote the narrowing or lance-shaping of a leaf or of a bird's feather into a point The poet Cowper used the word to denote sharp and keen despair, but other authors, Sir T. Browne, Bacon, etc., use it to explain a material pointed shape.

ACUÑA, CHRISTOVAL DE (1597–*c* 1676), Spanish Jesuit missionary and explorer, was born at Burgos in 1597. He was sent on mission work to Chile and Peru, where he became rector of the college of Cuenca. In 1639 he accompanied Pedro Texiera in his second exploration of the Amazon, in order to take scientific observations, and draw up a report for the Spanish Government. The journey lasted ten months; on the explorer's

arrival in Peru, Acuña prepared his narrative, while awaiting a ship for Europe. The king of Spain, Philip IV., received the author coldly, and it is said even tried to suppress his book, fearing that the Portuguese, who had just revolted from Spain (1640), would profit by its information. Eventually Acuña returned to South America, where he died, probably soon after 1675. His *Nuevo Descubrimiento del Gran Rio de las Amazonas* was published at Madrid in 1641; French and English translations (the latter from the French), appeared in 1682 and 1698.

ACUPRESSURE, the name given to a method of restraining haemorrhage, introduced by Sir J. Y. Simpson, the direct pressure of a metallic needle, either alone or assisted by a loop of wire, being used to close the vessel near the bleeding point.

ACUPUNCTURE, a form of surgical operation, performed by pricking the part affected with a needle. It has long been used by the Chinese in cases of headaches, lethargies, convulsions, colics, etc.

ADA, a city of Oklahoma, 85m. S.E. of Oklahoma City; served by the Santa Fe, the Frisco and the Oklahoma City-Ada-Atoka railways. The population, nearly all native whites, increased from 4,349 in 1910 to 8,012 in 1920. Ada is the county seat of Pontotoc county, which produces natural gas and petroleum, cotton, grain, live stock, sweet potatoes, peanuts and alfalfa; and has deposits of rock asphalt, glass sand, pottery clay, lead, zinc and other minerals. The city has cotton gins and compresses; feed and corn-mills; cement, stone-crushing, pottery and glass works; brick-yards and grain elevators. It is the seat of the East Central State teachers college (1909), which in 1926–27 had an enrolment of about 2,400 students. The city was incorporated in 1901. It has a commission form of government.

ADA, a village of Hardin county, O., U.S.A., on the Pennsylvania railroad, 15m E of Lima, with a population of 2,321 in 1920. It lies on the watershed between the Ohio river and the Great Lakes, in a rich agricultural district. Natural gas is available. The village has canning and packing plants, and manufactures stoves and tiles. It is the seat of the Ohio Northern university (Methodist) which in 1926–27 had an enrolment of about 1,700 students.

ADAB (modern Bismaya), an ancient town in Mesopotamia, in 32° N, 45° 30′ E, 25m. S. of Nippur. It was supplied by a canal which passed through the city and irrigated the country, eventually falling into the Shatt al Hai. In the centre of the city the canal divided to form an island on which stood the temple of the mother Goddess Aruru, to whose cult the city was devoted. There are a succession of periods on the mound which rises 50ft. above the plain: 2 to 3ft. below the platform of Ur Engur are the buildings of the kings of Akkad; 10ft. below are the plano-convex bricks of Unnina; 10ft. lower are buildings made of limestone blocks, which were used before the days of brickmaking. At a depth of 48ft. the excavators found thin unpainted wheel-made pots. The Ziggurat or temple tower is pre-Sargonic and one of the oldest in Sumer. One of the most remarkable finds was the head of a Semite in white marble.

The city appears to have enjoyed a restricted independence at the time of the kings and patesis of Lagash. The kings of Akkad and Ur certainly devoted a good deal of attention to the city, probably owing to its religious cults.

See E. J. Banks, *Bismaya or the Lost City of Adab* (1912); S. Langdon, in *Cambridge Ancient History,* vol. i. 1923.

ADABAZÁR, an important commercial town in the Khoja Ili sanjak of Asia Minor, situated on the old military road from Constantinople to the East, and connected by a branch line with the Anatolian railway. Pop. (1927), 83,523. There are silk and linen industries and an export of tobacco, walnut-wood, cocoons and vegetables for the Constantinople market.

See V. Cuinet, *Turquie d'Asie* (Paris, 1890–1900).

ADAD, the name of the storm-god in the Babylonian-Assyrian pantheon, who is also known as Ramman ("the thunderer"). It seems that Ramman was the name current in Babylonia, whereas Adad was more common in Assyria. A god Hadad, a prominent deity in ancient Syria, is identical with Adad, whose name is therefore, an importation into Assyria from Aramaic districts. Ramman is identical with Rimmon, known to us from the Old Testament as the chief deity of Damascus. The cult of a specific storm-god in ancient Babylonia is vouched for by the occurrence of the sign Im—the "Sumerian" for Adad-Ramman—as an element in proper names of the old Babylonian period. Through Aramaic influences in Babylonia and Assyria he was identified with the storm-god of the western Semites. The designation Amurru is also given to this god in the religious literature of Babylonia, which describes him as belonging to the Amorite district.

On the one hand he brings on the rain in due season, and causes the land to become fertile; on the other hand, by the storms that he sends, he brings havoc and destruction. He is pictured on monuments and seal cylinders with the lightning and the thunderbolt, and in the hymns the sombre aspects of the god on the whole predominate. His association with the sun-god, Shamash, imbues him with some of the traits belonging to a solar deity. In the theological lists he follows Shamash. At Erech in the south and Assur in the north Adad is intimately associated with Anu, the sky god. In Syria Hadad is hardly to be distinguished from a solar deity. In Babylonia and Assyria Shamash and Adad became in combination the gods of oracles and of divination in general. In the annals and votive inscriptions of the kings, when oracles are referred to, Shamash and Adad are always named as the gods addressed, and their ordinary designation in such instances is *bēlē biri,* "lords of divination." The consort of Adad-Ramman is Shala, while as Amurru his consort is called Ashratum.

In magic rituals the symbol of Ramman is the cypress, and his sacred number is "six," consequently the sixth day of each month was sacred to him The principal seat of the old Sumero-Babylonian cult of the thunder god was *Muru* (ki), which has not been located, and the cult is mentioned in connection with the cities Padda, Akus, Simurri and Halbaba, all unknown and certainly unimportant places; but a great temple to him and Anu has been excavated at Assur.

See the special study on this deity by Hans Schlobies, *Das akkadische Wettergott in Mesopotamien* (1925); also the article Babylonian and Assyrian Religion.

ADAEV, a province of the autonomous Kazak (Kirghiz) S.S.R. Area 303,325sq.km. Pop. (1926) 136,000 (urban 3,012). The area includes the Ust Urt plateau (700ft.) in the south, and the low plain to the north of it which apparently once linked the Caspian and Aral seas, and which is studded with salt lakes with fauna bearing evidence of this link. The soil is either gravelly and stony desert or alkaline and gypsiferous grey soil, so that vegetation is sparse. The nomad Kirghiz tribes are mainly herdsmen. The administrative centre is Fort Alexandrovsk on the Mangishlak peninsula, which has a fishing industry (including seal fishery) and exports Glauber salts obtained from the shores of Kara Bugaz bay. On Mangishlak peninsula there is evidence of naphtha, ozokerite and bitumen deposits, as yet unworked (1928). In the north-west the province extends northward in a narrow strip nearly to lat. 50° N, and thus includes the naphtha area round Uilsk, where the population is mainly Russian and Tatar. Apart from this strip, the province is semi-desert; there is no railway.

ADAGIO, a term in music to indicate slow time; also a slow movement in a symphony, sonata, etc., or an independent piece, such as Mozart's pianoforte, "Adagio in B minor." The diminutive form *adagietto* means somewhat less slow than *adagio.*

ADAIR, JOHN (d. 1722), Scottish surveyor and map-maker of the 17th century. In 1703 he published the first part of his *Description of the Sea-coasts and Islands of Scotland,* for the use of seamen. The second part never appeared. Some of his work is preserved in the Advocates' Library (now the National Library of Scotland) at Edinburgh and in the King's Library of the British Museum, London.

ADALBERON or **ASCELIN** (d. 1030 or 1031), French bishop and poet, studied at Reims and became Bishop of Laon in 977. When Laon was taken by Charles, Duke of Lorraine, in 988, he was put into prison, whence he escaped and sought the

protection of Hugh Capet, King of France. Winning the confidence of Charles of Lorraine and of Arnulf, Archbishop of Reims, he was restored to his see; but he betrayed Laon, together with Charles and Arnulf, into the hands of Hugh Capet. He died on July 19, 1030 or 1031. Adalberon wrote a satirical poem in the form of a dialogue dedicated to Robert, King of France, in which he showed his dislike of Odilo, Abbot of Cluny, and his followers, and his objection to persons of humble birth being made bishops. The poem was first published by H. Valois in the *Carmen panegyricum in laudem Berengarii* (Paris, 1663), and in modern times by J. P. Migne in the *Patrologia Latina*, tome cxli. (Paris, 1844). Adalberon must not be confounded with his namesake, Adalberon, Archbishop of Reims (d. 988 or 989).

BIBLIOGRAPHY.—*See* Richer, *Historiarum libri iii. et iv.* which appears in the *Monumenta Germaniae historica, Scriptores.* Band iii. (Hanover and Berlin, 1826–92). A. Olleris, *Oeuvres de Gerbert pape sous le nom de Sylvestre II.* (Paris, 1867); *Histoire littéraire de la France*, tome vii. (Paris, 1865–69).

ADALBERT (*c.* 700), English saint, possibly a grandson of Oswald, king of Deira, was sent with St. Willibrord on a mission to the Frisians, and is said to have been the first archdeacon of Utrecht. In about 702 he went to preach in north Holland, where he built a church at Egmont. He is supposed to have died in 705, on June 25, and until the early 18th century that day was still kept sacred to his memory, as patron saint, in the village of Egmont. A life of Adalbert was compiled in the 10th century, by some monks in the diocese of Treves, and one by a monk at Egmont in the 12th century.

ADALBERT or **ADELBERT** (*c.* 1000–1072), German archbishop, was the son of Frederick, count of Goseck, a member of a noble Saxon family. Adalbert stood high in the favour of Henry III., whom he accompanied on many expeditions into Hungary, Italy, Slavonia and elsewhere. It is said that he might have been made Pope but that he saw greater possibilities of power and influence in northern Germany. In 1045 he was appointed archbishop of Hamburg-Bremen, his province including the Scandinavian countries, as well as the larger part of North Germany. He moved the seat of the bishopric from Bremen to Hamburg, sent missionaries to Finland, Greenland and the Orkney Islands, and aimed at making Bremen a patriarchal see for northern Europe, with 12 suffragan bishoprics.

He consolidated and increased the estates of the church, exercised the powers of a count, denounced simony, and initiated financial reforms. The presence of this powerful and active personality was greatly resented by the Saxon duke of the north, Bernard II., who regarded him as a spy sent by Henry. Adalbert gave substantial help to the emperor in the struggle with Baldwin, count of Flanders, by concluding a treaty (1049) with Sweyn of Norway and Denmark, who sent a fleet to the Netherlands coast. The archbishop's ambition to secure ecclesiastical control of northern Europe was furthered in 1052 by a papal brief which put all the Christians of the north, from the Icelanders in the west to the Finns in the east, under the see of Bremen. Adalbert himself became papal legate for the north. For a time his ecclesiastical pretensions estranged Sweyn, but in the end the Norwegian king acquiesced.

Adalbert, who wished to free his lands entirely from the authority of the duke, Bernard II., aroused hostility by an attack on the privileges of the great abbeys, and after the emperor's death in 1056 his lands were ravaged by Bernard. He took a leading part in the government of Germany during the minority of Henry IV., and was styled *patronus* of the young king, over whom he exercised considerable influence. Having accompanied him on a campaign into Hungary in 1063, he received large gifts of crown estates and obtained the office of count palatine in Saxony. His power aroused so much opposition that in 1066 the king was compelled to assent to his removal from court. In 1069 he was recalled by Henry, when he made a further attempt to consolidate a northern patriarchate, which failed owing to the hostility of the papacy and the condition of affairs in the Scandinavian kingdoms. He died at Goslar, and was buried in the cathedral which he had built at Bremen. Adalbert was a man of large ideas and a strong, energetic character. He fortified and improved Bremen, and it was called the *New Rome* by his biographer, Adam of Bremen.

See Adam of Bremen, *Gesta Hammenburgensis ecclesiae pontificum*, edited by J. M. Lappenberg, in the *Monumenta Germaniae historica, Scriptores*, Band vii. (1826–92); C. Gruenhagen, *Adalbert Erzbischof von Hamburg und die Idee eines Nordischen Patriarchats* (1854).

ADALBERT, originally VOJTECH (*c.* 950–997), known as the apostle of the Prussians, the son of a Bohemian prince, was born at Libice (Lobnik, Lubik). He was educated at the monastery of Magdeburg; and in 983 was chosen bishop of Prague. The extreme severity of his rule repelled the Bohemians, whom he vainly strove to wean from their national customs and pagan rites. Discouraged by ill success, he withdrew to Rome until 993, when, in obedience to the Pope, he returned to his own people. Finding little amendment, however, in their course of living, he returned to Rome, and obtained permission from the Pope to devote himself to missionary labours in N. Germany and Poland. While preaching in Pomerania he was assassinated by a heathen priest.

See U. Chevalier, *Répertoire des sources historiques du moyen âge*, Bio.-Bibl. (1905); Bolland, *Acta Sanctorum*, April 23; H. G. Voigt, *Adalbert von Prag* (1898), a thoroughly exhaustive monograph.

ADALIA, the ancient *Attaleia* (*q.v.*) (med. *Antaliyah;* the crusaders' *Satalia*), the largest seaport on the south coast of Asia Minor, though in point of trade it is now second to Mersina. The unsuitability of the harbour for modern steamers, the bad anchorage outside and the extension of railways from Smyrna have greatly lessened its former importance as an emporium for west central Anatolia, although it retains considerable importance as the administrative capital of a rich and isolated vilayet. Adalia played a considerable part in the mediaeval history of the Levant. Kilij Arslan had a palace there. The army of Louis VII. sailed thence for Syria in 1148, and the fleet of Richard of England rallied there before the conquest of Cyprus. Conquered by the Seljuks of Konia, and made the capital of the province of Tekké, it passed after their fall through many hands, including those of the Venetians and Genoese, before its final occupation by the Ottoman Turks under Murad II. (1432). The port is served by coasting steamers of the local companies only. Adalia is an extremely picturesque, but ill-built and backward place. Pop. (1927) 38,780.

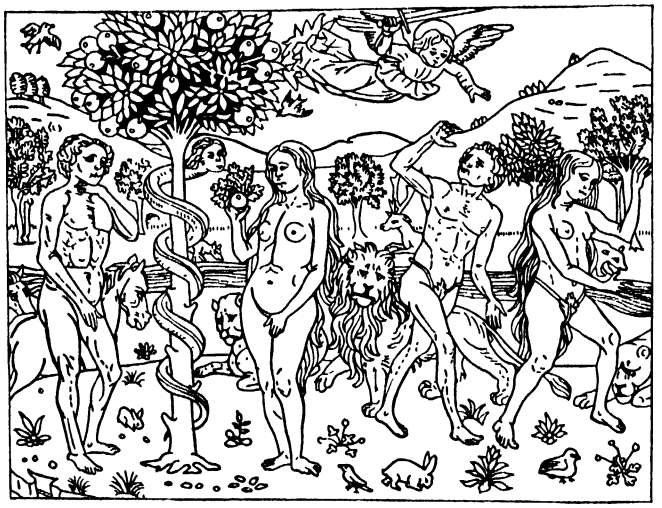
See C. Lanckoronski, *Villes de la Pamphylie et de la Pisidie*, i. (1890).

ADAM, the Hebrew word for "man"; when used without the article implying the human species (*e.g.*, Gen. i. 26 and the familiar phrase "son" or "sons of man," *i.e.*, a human being or human beings), with the article a human individual, corresponding generally to the Latin *homo* and the Greek ἄνθρωπος. (The absence of the article in Gen. ii. 20b and iii. 17 is probably accidental, being due to the vocalization of the Hebrew text, not to its original consonants.) But in Gen. ii. 25 and v. 1 it *may* be a proper name, applied to the first man created. It is certainly in this sense that the word is employed in Gen. v. 2–6, and so it has been generally used, in the popular language both of Jews and of Christians.

The narrative of Gen. i. in giving an account of the "creation" of man does not necessarily imply that a single pair only was thus formed at the first. Throughout that chapter the impression the reader receives is that a large number of individuals in each species come into being at once. This, however, in its present form, is the later of the two narratives of creation, though it is probably a revision of a very ancient tradition, going far back behind the earliest appearance of Israel as a nation, and based on that common stock of thought which spread from Mesopotamia over western Asia before the middle of the 2nd millennium B.C.

With the narrative in Gen. ii. 4–25—the earlier in its present form—the case is different. Here we have most certainly the theory that all humanity is sprung from a single pair, a "man" and his "woman." The narrative is naïve in its detail and elementary in its theology. There is no account of the creation of the earth, or speculation as to how it came into being; it is

assumed. There is, however, no life, whether animal or vegetable, and the ordinary processes of the weather have not yet begun. The clayey soil is moistened by "mist," and from this material "Yahweh," afterwards to be the God of Israel, models the figure of a man. Then He breathes into his nostrils, and so—breath being regarded as one of the primary "givers of life"—brings to life this earthen model. The next problem is what to do with this living toy, and Yahweh makes a proper home for him by planting a garden and making all kinds of useful trees grow in it. There is



AFTER A WOODCUT FROM "BERGOMENSIS, SUPPLEMENTUM CHRONICARUM," VENICE, 1492

EVE TEMPTING ADAM TO EAT THE FORBIDDEN FRUIT AND THEIR EXPULSION FROM THE GARDEN OF EDEN

more to be done; the man's needs are far from being satisfied, for he will require suitable companionship. It is not enough that he should exist alone, and experiment alone can show what will satisfy him.

Yahweh's first attempt at providing a suitable companion follows the method by which the man himself has been made. All kinds of forms are modelled from the wet clay, and brought before the man At the sight of each he makes some sound, and the sound, expressing as it does the man's attitude towards the creature, becomes its name. But in no case does the name thus spontaneously given suggest that the problem is solved; the experiment has failed. Another method must be tried. Yahweh throws the man into an anaesthetic slumber and takes a rib from his side, carefully mending the place afterwards. Then He "builds" the rib into a form, and brings that to the man Now he exclaims "wo-man," and the terms in which he greets the new figure show that at last the experiment is successful. Ultimately from this pair the whole human race descends.

Here, then, we have certain theories about human nature, held by the Israelite of the middle monarchy. Though the view of God is crude and anthropomorphic, yet it is clear that He is the author of man's being Man's nature is bipartite—it is assumed that what is true of the common ancestor will be true of all his descendants. He consists of a body, made of the same kind of material as the soil from which all things spring, together with another element, a life-soul, which does not come from the ground, but is imparted by God Himself. The difference between the sexes is recognized, as also the fact that they are mutually complementary, but the sex instinct is at present undeveloped.

Other familiar features of human life are thus left unexplained. Man no longer lives in the garden, nor finds that the soil always yields a generous response to his efforts. The sex life is strongly developed and the subordination of woman is generally recognized. The hostility between man and other creatures, especially the snake tribe, needs explanation, and all these facts are accounted for in the second narrative, that of Gen. iii., commonly described as the story of the Fall.

Such is the Biblical story of the first man, and, apart from genealogies in Gen. iv. 25, v. 1–6, Chron. i. 1, he is never mentioned again by name in the Old Testament. The narrative has affinities with others known to the ancient world, and the story of the Fall, at least, has a parallel in Ez. xxviii. Mesopotamians told of the formation of man from clay mingled with the blood of Bel, of Adapa, who narrowly missed attaining immortality, and of Ea-bani, made by Ishtar from clay, and seduced from his wild and primitive ways by a harlot If all these have a common source with the Biblical narrative (which is quite possible), then we are more than ever impressed with the way in which the Hebrew genius for religion transmuted them, and, in spite of the crudities of language and thought, adapted them to universal religious experience.

Later thinkers and writers greatly expanded the story, and drew from it conclusions which were originally foreign to it. Rabbinic thought ascribed to Adam before the Fall a superhuman grandeur. One legend indeed, followed in the Koran, relates that all the angels were ordered to fall down and worship Adam, and that Satan refused, on the ground that he was made of fire and the man of clay. Others ascribed to Adam's fall the mortality of the human race, though in the original story there is no suggestion that man was originally created immortal The doctrine of hereditary guilt appeared, and has formed the basis of much Christian theology. Apart from a single reference in Jude 14 and the mention of the name in the Lucan genealogy of Christ, St. Paul is the only New Testament writer who mentions Adam. He regards him as a type or summary of the whole human race in its natural state, and contrasts him and his kind with the new order of being that came into existence with Christ—"the second Adam," the originator of the higher spiritual plane To him the "natural" man is, as to the old Hebrew, bipartite, consisting of "flesh" and "life"; the man who is in Christ has received a third element, the "Spirit." And to Pauline thought Christ is the starting point at which this third element first enters, just as the "Adam" of Gen. i.–v. is the starting point of the lower human order. (T. H. R.)

ADAM, the name of a family of French sculptors. LAMBERT SIGISMUND (1700–1759) executed many pieces for the French royal residences and for Frederick the Great of Prussia. NICOLAS SÉBASTIEN, his brother (1705–1778), was responsible for the tomb of Catherine Opalinska at Nancy. Another brother, FRANÇOIS GASPARD BALTHASAR, executed many of the monuments at Sans Souci and Potsdam.

See Dussieux, *Artistes français à l'étranger* (1855); Lady Dilke, *French Architects and Sculptors of the 18th century* (1900).

ADAM, ADOLPHE CHARLES (1803–1856), French composer of light operas which enjoyed great favour, was born in Paris July 24, 1803, and died there May 3, 1856. Boieldieu taught and encouraged him and he became in due course one of the most prolific and popular composers of his time. Of his 53 stage works *Le Postillon de Longjumeau* merits particular mention, while his ballet *Giselle* is still performed.

ADAM, ALEXANDER (1741–1809), Scottish teacher and antiquarian, was born on June 24, 1741 near Forres, Morayshire, and died in Edinburgh on Dec. 18, 1809. He became rector of Edinburgh High School in 1768, and had among his pupils many boys who afterwards became famous, among them Sir Walter Scott, Lord Brougham, and Jeffrey. He introduced Greek into the school curriculum, and defied tradition by publishing a *Principles of Latin and English Grammar* in English instead of Latin. His best-known work is his *Roman Antiquities* (1791).

See A. Henderson, *An Account of the Life and Character of A. A.* (1810).

ADAM, SIR FREDERICK (1781–1853), British general, fought during the Napoleonic wars from Egypt, in 1801, to Waterloo; afterwards he was high Commissioner of the Ionian Isles and governor of Madras.

ADAM, JULIETTE (1836–), French writer, known also by her maiden name of Juliette Lamber, was born at Verberie (Oise) Oct. 4, 1836. She has given an account of her childhood, rendered unhappy by the dissensions of her parents, in *Le Roman de mon enfance et de ma jeunesse* (Eng. trans., 1902). In 1852 she married a doctor named La Messine, and published in 1858 her *Idées antiproudhoniennes sur l'amour, la femme et le mariage,*

in defence of Daniel Stern (Mme. d'Agoult) and Georges Sand. On her husband's death she married, in 1868, Antoine Edmond Adam (1816–1877), prefect of police in 1870, and subsequently life-senator; and she established a salon which was frequented by Gambetta and the other republican leaders against the conservative reaction of the 'seventies In the same interest she founded in 1879 the *Nouvelle Revue,* which she edited for the first eight years, and in the administration of which she retained a preponderating influencé until 1899. She wrote the notes on foreign politics, and was unremitting in her attacks on Bismarck and in her advocacy of a policy of *revanche.* The famous *Lettres sur la politique extérieure* in this review are from her pen. Mme. Adam was also generally credited with a share in the authorship of papers on various European capitals signed "Paul Vasili." The most famous of her numerous novels is *Paienne* (1883). Her reminiscences, *Mes premières armes littéraires et politiques* (1904), *Mes sentiments et nos idées avant 1870* (1905), and later volumes in 1907, 1909 and 1910, contain much interesting gossip about her distinguished contemporaries. Mme. Adam saw the revolution of '48, the Second Empire, the Siege of Paris, the Treaty of Versailles, and lived to see the *revanche* she had fought and prayed for when the second Treaty of Versailles was signed in 1919 In her youth she had belonged to the anti-clerical Liberal Party, but in the disillusionments of her later days she moved with her time, and just as *Païenne* had reflected a free-thinking age, *Chrétienne* (1913) was a glorification of the Catholic tradition

See W. Stephens, *Madame Adam, la grande française* (1917).

ADAM, MELCHIOR (d. 1622), German divine and biographer, wrote *Vitae Germanorum philosophorum* (Heidelberg-Frankfurt, 1615–20). Pierre Bayle acknowledges his debt to this work, which deals principally with German scholars of the 16th century.

ADAM, PAUL (1862–1920), French novelist, was born in Paris on Dec. 7, 1862, and died there on Jan 2, 1920. He was prosecuted for his first novel, *Chair molle* (1885), but was acquitted. He collaborated with Jean Moréas in *Le thé chez Miranda* (1886), and with Moréas and Gustave Kahn he founded the *Symboliste,* coming forward as one of the earliest defenders of symbolism. Among his numerous novels should be noted *Le mystère des foules* (1895), a study in Boulangism, *Lettres de Malaisie* (1897), a fantastic romance of imaginary future politics. In 1899 he began a novel-sequence, giving the history of the Napoleonic campaigns, the restoration, and the government of Louis Philippe, comprising *La force* (1899), *L'enfant d'Austerlitz* (1901), *La ruse* (1902), and *Au soleil de Juillet* (1903). In 1900 he wrote a Byzantine romance, *Basile et Sophia.*

He was an indefatigable traveller, and in his later years much occupied with economic theory. *Le Trust* (1910) was the fruit of one of his journeys to America Later books were *Stéphanie* (1918) and during the World War *Reims devastée* and *Le Lion d'Arras.*

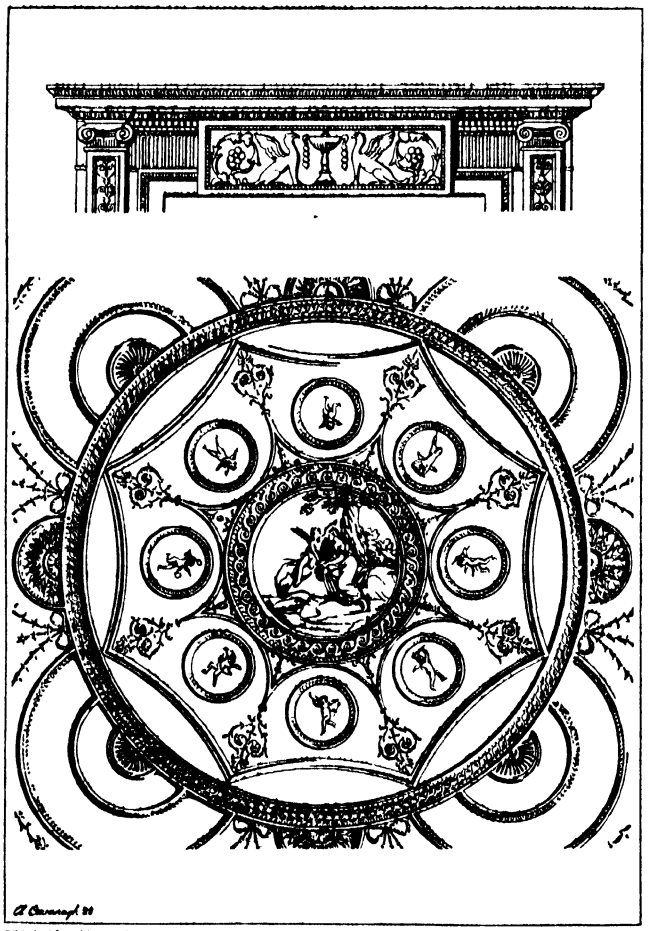
ADAM, ROBERT (1728–1792), British architect, the second son of William Adam of Maryburgh, in Fife, and the most celebrated of four brothers, John, Robert, James, and William Adam, was born at Kirkcaldy in 1728. He studied at the University of Edinburgh, and probably received his first instruction in architecture from his father, who gave proofs of his own skill and taste in the Edinburgh Royal Infirmary (now demolished). Somewhere between 1750 and 1754 he visited Italy, where he spent three years studying the remains of Roman architecture. There he was struck with the circumstance that practically nothing had survived of the Greek and Roman masterpieces except public buildings, and that the private palaces, which Vitruvius and Pliny esteemed so highly, had practically vanished. One example of such work, however, was extant in the ruins of Diocletian's palace at Spalato, in Dalmatia, and this he visited in July 1757, taking with him the famous French architect and antiquary, C. L. Clérisseau, and two experienced draughtsmen, with whose assistance, after being arrested as a spy, he managed in five weeks to accumulate a sufficient number of measurements and careful plans and surveys to produce a restoration of the entire building in a fine work which he published in 1764, *The Ruins of the Palace of Diocletian, etc.* Adam regarded this as the last great achievement of Roman architecture, whereas to later students it appears to mark the beginning of the decadence The influence of these studies was apparent directly and indirectly in much of his subsequent work, which, indeed, was in great measure founded upon them.

After his return to England he came rapidly to the front, and in 1762 he was appointed sole architect to the king and the Board of Works. Six years later he resigned this office, in which he was succeeded by his brother James—who, however, held the office jointly with another—and entered parliament for the county of Kinross. In 1768 he and his three brothers leased the ground fronting the Thames, upon which the magnificent terrace of the Adelphi, one of their greatest achievements, was built for £1,200 on a 99 years' lease. The Adelphi was still standing in 1928, though imminently in danger from rebuilding proposals. The site presented attractive possibilities. A steep hill led down Buckingham street to the river-side, and the plan was to raise against it, upon a terrace formed of massive arches and vaults and facing the river, a dignified quarter, of fine streets and stately buildings, suggestive of the Spalato ruins. Splendid, however, as the terrace and its houses are, both in conception and execution, the underground work which upholds them is perhaps more remarkable still. Between 1773 and 1778 the brothers issued a fine series of folio engravings and descriptions of the designs for many of their most important works, which included several great public buildings and numberless large private houses; a fine volume was published in 1822. For the remaining years of Robert's life the practice of the firm was the most extensive in the country; his position was unquestioned, and when he died in 1792 he was laid to rest in Westminster Abbey almost as a matter of course.

As an architect, Adam was strongly under Roman and Italian influences, and his style and aims were exotic rather than native. It was the signal triumph of his genius that he was able so to mould and adapt classical models as to create a new manner of the highest charm and distinction. Out of simple curvilinear forms, of which he principally preferred the oval, he evolved combinations of extraordinary grace and variety, and these entered into every detail of his work. In his view the architect was intimately concerned with the furniture and the decorations of a building as well as with its form and construction, and this view he carried rigorously into practice, and with astonishing success. But whatever care he might have expended upon the flowing curves of a moulding or a decoration, it was strictly kept in its place; it contributed its share and no more to the total effect. He imparted the unity of a single imposing structure to a number of private houses grouped in a block which is so characteristic a feature of modern town building. A delightful but theoretically undesirable characteristic of his work is the use of stucco Upon it he moulded delicate forms in subtle and beautiful proportions His "compo" was used so successfully that the patent was infringed; many of his moulds still exist and are in constant use. That most difficult feature, the column, he handled with enthusiasm and perfect mastery; he studied and wrote of it with minute pains, while his practice showed his grasp of the subject by all avoidance of bare imitation of the classic masters who first brought it to perfection. His work might be classic in form but it was independently developed by himself. It would be impossible here to give a list of the innumerable works which he executed In London, of course, the Adelphi stands pre-eminent; the screen and gate of the Admiralty and part of Fitzroy square are by him, and much of the older portion of Finsbury circus, besides whole streets of houses in the west end There are the famous country houses of Lord Mansfield at Kenwood (Highgate) and Luton Hoo, and decorations and additions to many more.

Robert Adam—with, there is reason to suspect, some help from his brother James—has left as deep and enduring a mark upon English furniture as upon English architecture. Robert Adam was no doubt at first led to turn his thoughts towards furniture by his desire to see his light, delicate, graceful interiors, with their large

sense of atmosphere and their refined and finished detail, filled with plenishings which fitted naturally into his scheme. His own taste developed as he went on, but he was usually extremely successful, and cabinet-makers are still reproducing his most effective designs. In his furniture he made lavish use of his favourite decorative motives—wreaths and paterae, the honeysuckle, and that fan ornament which he used so constantly. Thus an Adam



FROM BOLTON, "ARCHITECTURE OF R AND J ADAM," COURTESY OF "COUNTRY LIFE"

A CHARACTERISTIC MANTELPIECE BY ROBERT ADAM IN THE ADELPHI DETAIL OF ADAM DRAWING-ROOM CEILING IN GARRICK'S HOUSE, ADELPHI

house is a unique product of English art. From façade to fire-irons, from the chimneys to the carpets, everything originated in the same order of ideas, and to this day an Adam drawing-room is to English what a Louis Seize room is to French art. In nothing were the Adams more successful than in the fine proportions of their mantelpieces and doors. The former, by reason of their simplicity and the readiness with which the "compo" ornaments can be applied and painted, are still made in cheap forms in great number.

John Adam succeeded to his father's practice as an architect in Edinburgh. James Adam studied in Rome, and eventually was closely associated with Robert; William is variously said to have been a banker and an architect.

See John Swarbrick, *Robert Adam and his brothers* (1916); Arthur T. Bolton, *Architecture of Robert and James Adam* (1922). Both are illustrated. Mr. Bolton's book contains photographs of many Adam houses, and of many Adam interiors. Among country houses, Hatchlands, Shardeloes, Harewood House, Bowood, Kedleston, Syon House and Kenwood; among the great houses of London, Lansdowne House, and of many public and private buildings in Scotland.

ADAM, WILLIAM (1751–1839), British lawyer and politician, was a Whig and a supporter of the policy of Fox At the English bar he obtained a very considerable practice. He was successively attorney and solicitor-general to the Prince of Wales, one of the managers of the impeachment of Warren Hastings, and one of the counsel who defended the first Lord Melville when impeached.

ADAMANT, the modern diamond (*q.v.*), but also a name given to any very hard substance (Gr. ἀδάμας, untameable). The word is used by Homer as a personal epithet, and by Hesiod for the hard metal in armour. By confusion with the Lat. *adamare,* to have an attraction for, it came to be associated with the loadstone; but since the term was displaced by "diamond" it has had only a figurative and poetical use.

ADAMAWA, a country of West Africa, which lies roughly between 6° and 11° N., and 11° and 15° E., about midway between the Bight of Biafra and Lake Chad. The region is watered by the Benue, a tributary of the Niger. Another stream, the Yedseram, flows north-east of Lake Chad. The most fertile parts of the country are the plains near the Benue, about 800ft. above the sea. South and east of the river a much dissected plateau rises to an elevation of 1,600ft. Mount Alantika (6,000ft.), about 25m. south-south-east of Yola, is a conspicuous granite mass. The country, which is very fertile and covered with luxuriant vegetation, has many villages and a considerable population Durra, groundnuts, yams and cotton are the principal products, and the palm and banana abound Elephants are numerous and ivory is exported. In the eastern part of the country the rhinoceros is met with, and the rivers swarm with crocodiles.

Adamawa is named after a Fula emir, Adama, who in the early years of the 19th century conquered the country. To the Hausa and Bornuese it was previously known as Fumbina (or Southland). The inhabitants are mainly pure negroes such as the Durra, Batta and Dekka, speaking different languages, and all fetish-worshippers. Slave-trading was still active among them in the early years of the 20th century The Fula (*q.v.*), who first came into the country about the 15th century as nomad herdsmen, are found chiefly in the valleys, the pagan tribes holding the mountainous districts. There are also in the country numbers of Hausa, who are chiefly traders, as well as Arabs and Kanuri from Bornu. The exploration of the region during the 19th century was mostly in the hands of the Germans The emir of Yola, in the period of Fula lordship, claimed rights of suzerainty over the whole of Adamawa, but the country, since the subjection of the Fula (*c.* 1900), has consisted of a number of small states under the control of the British, Germans and French It is now administered, partly under French Equatorial Africa, and partly under the British Protectorate of Nigeria. Garua on the Upper Benue and Ngaundere are the chief towns

See Heinrich Barth, *Travels in North and Central Africa* (new edit., 1890); S. Passarge, *Adamawa* (Berlin, 1895). *See* also FRENCH EQUATORIAL AFRICA and NIGERIA.

ADAM (or ADAN) DE LE HALE (*c* 1238–1288), French troubadour, was born at Arras. His patronymic is generally modernized to La Halle, and he was commonly known to his contemporaries as Adam d'Arras or Adam le Bossu, sometimes simply as Le Bossu d'Arras. Adam studied grammar, theology and music at the Cistercian abbey of Vaucelles, near Cambrai. He joined the household of Robert II, count of Artois in 1272; and from 1283 was attached to Charles of Anjou, brother of Charles IX., whose fortunes he followed in Egypt, Syria, Palestine and Italy. At the court of Charles, after he became king of Naples, Adam wrote his *Jeu de Robin et Marion,* the most famous of his works. He died between 1285 and 1288. Adam's shorter pieces are accompanied by music, of which a transcript in modern notation, with the original score, is given in Coussemaker's edition.

His *Jeu de Robin et Marion* is cited as the earliest French play with music on a secular subject, and on the strength of it he has been dubbed by some the father of opéra-comique. It takes the form of a dramatic pastoral introducing a number of characters and consists of a dialogue varied by refrains already current in popular song. The melodies to which these are set have the character of folk-music, and are more spontaneous and melodious than the more elaborate music of his songs and motets. A modern adaptation, by Julien Tiersot, is occasionally performed. Another of his plays, *Le jeu Adan* or *Le jeu de la Feuillée* (*c.* 1262), was a satirical drama in which he introduced himself, his father and the citizens of Arras, with their peculiarities. His works include further a *Congé,* or satirical farewell to the city of Arras, and an

unfinished *chanson de geste* in honour of Charles of Anjou, *Le roi de Sicile*, begun in 1282.

BIBLIOGRAPHY.—The only MS. which contains the whole of Adam's work is the La Vallière MS. (No. 25, 566) in the Bibliothèque Nationale, Paris, dating from the latter half of the 13th century. Many of his pieces are also contained in Douce MS. 308, in the Bodleian Library, Oxford. His *Oeuvres complètes* (1872), were edited by E. de Coussemaker. *See* J. Tiersot, *Sur le jeu Robin et Marion* (1898); L. Nicod, *Les Partures Adan, Les Jeux partis d'Adam de la Halle* (1917); and, for full bibliography of works on the subject, No. 6, of the *Bibliothèque de bibliographies critiques*, by Henri Guy.

ADAMITES or **ADAMIANS**, a sect of heretics that flourished in North Africa in the 2nd and 3rd centuries. Basing itself probably on a union of certain gnostic and ascetic doctrines, this sect pretended that its members were re-established in Adam's state of original innocency.

ADAMNAN or **ADOMNAN** (*c.* 624–704), Irish saint and historian, was born at Raphoe, Donegal, Ireland In 679 he was elected abbot of Hy or Iona, being ninth in succession from the founder, St Columba. In 686, while on a visit to King Aldfrith of Northumbria he was led to adopt the Roman rules on the date of Easter and on the tonsure, but failed to enforce the change upon his monks.

We owe to Adamnan two valuable works, the anecdotic *Life of St Columba*, preserving the authentic traits of the saint, and the *De locis sanctis*, an account of Arculf's travels in the Holy Land, which, in the longer version of Bede, was a kind of guide-book to the holy places in Palestine throughout the middle ages.

Adamnan is sometimes credited with *Adamnan's Vision*, the Irish version of which is in a 12th century MS. in Dublin

BIBLIOGRAPHY.—Thirteen MSS. of the original Arculf-Adamnan narrative exist, and fully 100 of Bede's abridgment of the former, the most important, containing all the plans, are (1) Berne, Canton Library, 582, of 9th century; (2) Paris, National Library, Lat. 13,048, of 9th century, a third ms, London, Brit Mus, Cotton, Tib. D.V., of 8th–9th centuries, though damaged by fire and lacking the illustrations, is of value for the text, being the oldest of all The best edition is that of Tobler in *Itinera et Descriptiones Terrae Sanctae* (1877); we may also mention that of 1870, by Delpit, in his *Essai sur les anciens pèlerinages à Jérusalem*. *See* further Delpit's remarks upon Arculf in the same work, 260–304; Beazley, *Dawn of Modern Geography*, 1 131–41 (1897), and J L. Macpherson, *Arculfus' Pilgrimage to the Holy Land* (1899). The *Life of St. Columba* was edited by J. T. Fowler (1894).

ADAM OF BREMEN (died *c.* 1076), historian and geographer, was, according to one tradition, born at Meissen (Saxony) before 1045 In 1069 he appears as a canon of Bremen and master of the cathedral school On the death of Adalbert, archbishop of Bremen, in 1072, he began the *Historia Hammaburgensis Ecclesiae*, which he finished about 1075. Adam's *Historia*—known also as *Gesta Hammaburgensis Ecclesiae Pontificum, Bremensium praesulum Historia*, and *Historia ecclesiastica*—is a primary authority, not only for the great diocese of Hamburg-and-Bremen, but for all North German and Baltic lands (down to 1072), and for the Scandinavian colonies as far as America.

Here occurs the earliest mention of Vinland, and here are also references of great interest to Russia and Kiev, to the heathen Prussians, the Wends and other Slav races of the South Baltic coast, as well as to Finland, Thule or Iceland, Greenland and the Polar seas, which Harald Hardrada and the nobles of Frisia had attempted to explore in Adam's own day (before 1066). Adam's account of North European trade at this time, and especially of the great markets of Jumne at the mouth of the Oder, of Birka in Sweden and of Ostrogard (Old Novgorod?) in Russia, is also of much value.

His work, which places him among the first and best of German annalists, consists of four books or parts, and is compiled partly from written records, and partly from oral information mainly gathered from experience or at the courts of Adalbert and Sweyn Estrithson, king of Denmark. Of his minor informants he names several, such as Adelward, dean of Bremen, and William the Englishman, "bishop of Zealand," formerly chancellor of Canute the Great, and an intimate of Sweyn Estrithson. The fourth (perhaps the most important) book of Adam's *History*, variously entitled *Libellus de Situ Daniae et reliquarum quae trans Daniam sunt regionum, Descriptio Insularum Aquilonis*, etc., has often been considered, but wrongly, as a separate work.

BIBLIOGRAPHY.—Ten MSS. exist, of which the chief are (1–2) Copenhagen, Royal Library, Old Royal Collection, No. 2296, of 12th to 13th cents.; No. 718, of 15th cent.; (3) Leyden University, Voss. Lat. 123, of 11th cent.; (4) Rome, Vatican Library, 2010; (5) Vienna, Hof-u. Staatsbibliothek, 413, of 13th cent; (6) Wolfenbüttel, Ducal Library, Gud. 83, of 15th cent. There are 15 editions of the *Historia*, in whole or part; the first published at Copenhagen, 1579 (the first of the *Libellus* or *Descriptio Ins. Aquil* appeared at Stockholm in 1615), the best at Hanover (1846, by Lappenberg, in *Scriptores Rerum Germanicarum*; re-issued by L. Weiland, 1876), and at Paris, 1884 (in Migne's *Patrologia Latina*, cxlvi.). *See* also Beazley, *Dawn of Modern Geography*, ii. 514–48 (1901).

ADAMS, ABIGAIL SMITH (1744–1818), wife of John Adams (*q v.*), second President of the United States, was born in Weymouth, Mass, on Nov. 23, 1744 She was the daughter of William Smith, a Congregational minister, and was descended through her mother, Elizabeth Quincy, from Thomas Shepard of Cambridge, a noted Puritan divine Despite scanty education and delicate health, she became a terse and vigorous writer and exercised much influence on the social and political life of her time. In 1764 she was married to John Adams, then practising law in Boston. During the first ten years of this union she lived in peace and quiet, though always ardently sharing her husband's interests in the growing disputes that culminated in war In this period she became the mother of a daughter and three sons, one of whom, John Quincy Adams, rose to the presidency of the United States. But during the second ten years of married life she was practically separated from her husband, who was absent attending Congress and serving on diplomatic missions in Europe She resolutely supported him in his insistence upon the Declaration of Independence and aided him and his cause with loyal zeal during the many dark days that followed In 1784 she rejoined her husband in France and in 1785 accompanied him to England, where, as the wife of the first minister of the United States, the then but newly lost American colonies, to the court of George III, she met with social discourtesies which she long resented From 1789 to 1801, when her husband was successively vice president and president, she lived in a simple manner in Washington. Since the publication by C F Adams in 1876 of *The Familiar Letters of John Adams and his Wife* increased interest has centred in the career of the stout-hearted Puritan woman who was both the wife and the mother of a President of the United States She died at Braintree, now Quincy, Mass, on Oct. 28, 1818.

BIBLIOGRAPHY.—Laura Elizabeth Richards, *Abigail Adams and Her Times* (1917), Gamaliel Bradford, *Portraits of American Women* (1919).

ADAMS, ANDREW LEITH (1827–1882), Scottish naturalist and palaeontologist. An army surgeon, he studied natural history in India and Kashmir, in Egypt, Malta, Gibraltar and Canada; and his observations on the fossil vertebrata of the Maltese Islands made him a recognized authority on fossil elephants.

See his *Notes of a Naturalist in the Nile Valley and Malta* (London, 1870), and *Monograph on the British Fossil Elephants* (Palaeontographical Soc.) (London, 1877–81).

ADAMS, CHARLES CHRISTOPHER (1873–), American zoologist, born in Clinton, Ill., July 23, 1873. He graduated from Illinois Wesleyan university in 1895, received the degree of master of science from Harvard university in 1899 and of doctor of philosophy from the University of Chicago in 1908. He was assistant in biology at Illinois Wesleyan university in 1895–96, assistant entomologist in the Illinois State Laboratory of Natural History in 1896–98, curator of the museum, University of Michigan, in 1903–06, and director of the Cincinnati Society of Natural History in 1906–07. From 1908 to 1914 he was associate in animal oecology in the University of Illinois, and from 1914 to 1926 assistant professor and professor of forest zoology in the New York college of forestry, and from 1919 to 1926 director of the Roosevelt Wild Life Experiment station, both at Syracuse, New York. In 1926 he was appointed director of the New York State museum, Albany, New York. His published writings

include *Guide to the Study of Animal Ecology* (1914) and numerous articles on faunas, habitats and associations, especially of prairies, lakes and forests, migration, geographical distribution and the relation of animal oecology to state and national parks.

ADAMS, CHARLES FOLLEN (1842–1918), American humorous poet, was born in Dorchester, Mass., April 21, 1842. He received a common school education. Early in the Civil War he entered the Union army and at Gettysburg was wounded and taken prisoner. In 1872 he began writing verses in German dialect, chiefly humorous, for juvenile periodicals. Collections of his verse were published under the title *Leedle Yawcob Strauss, and Other Poems* (1877) and *Dialect Ballads* (1887). His complete poetical writings under the title *Yawcob Strauss, and Other Poems,* with illustrations by "Boz," were published in 1910. He died in Boston, Mass , March 15, 1918.

ADAMS, CHARLES FRANCIS (1807–1886), American diplomatist, son of John Quincy Adams, and grandson of John Adams, was born in Boston (Mass) Aug. 18, 1807. His father, having been appointed minister to Russia, took him in 1809 to St. Petersburg, where he acquired a perfect familiarity with French, learning it as his native tongue. After eight years spent in Russia and England, he attended the Boston Latin school for four years, and in 1825 graduated at Harvard. He lived for two years in the executive mansion, Washington, during his father's presidential term, studying law and moving in a society where he met Webster, Clay, Jackson and Randolph. Returning to Boston, he devoted ten years to business and study, and wrote for the *North American Review.* He also undertook the management of his father's pecuniary affairs, and actively supported him in his contest in the House of Representatives for the right of petition and the anti-slavery cause. In 1835 he wrote an effective and widely read political pamphlet, entitled, after Edmund Burke's more famous work, *An Appeal from the New to the Old Whigs.* He was a member of the Massachusetts general court from 1840 to 1845, sitting for three years in the House of Representatives and for two years in the Senate; and in 1846–48 he edited a party journal, the *Boston Whig.* In 1848 he was prominent in politics as a "Conscience Whig," presiding over the Buffalo convention which formed the Free Soil party and nominated Martin Van Buren for president and himself for vice-president. He was a Republican member of the 36th Congress, which assembled Dec. 5, 1859, and during the second session (Dec. 3, 1860–March 4, 1861) he represented Massachusetts in the Congressional Committee of 33 at the time of the secession of seven of the Southern states His selection by the chairman of this committee, Thomas Corwin, to present to the full committee certain propositions agreed upon by two-thirds of the Republican members and his calm and able speech of Jan. 31, 1861, in the House served to make him conspicuous before Congress and the country. Together with William H Seward, he stood for the Republican policy of concession; and, while he was criticized severely and charged with inconsistency in view of his record as a "Conscience Whig," he was of the same mind as President Lincoln, willing to concede non-essentials, but holding rigidly to the principle, properly understood, that there must be no extension of slavery. He believed that as the Republicans were the victors they ought to show a spirit of conciliation, and that the policy of righteousness was likewise one of expediency, since it would have for its result the holding of the border slave states with the North until March 4, when the Republicans could take possession of the government at Washington. With the incoming of the new administration, Secretary Seward secured for Adams the appointment of minister to Great Britain. So much sympathy was shown in England for the South that his path was beset with difficulties; but his mission was to prevent the interference of Great Britain in the struggle; and while the work of Lincoln, Seward and Sumner, and the cause of emancipation, tended to this end, the American minister was insistent and unyielding, and knew how to present his case forcibly and with dignity. He laboured with energy and discretion to prevent the sailing of the "Alabama"; and, when unsuccessful in this, he persistently urged upon the British Government its responsibility for the destruction of American merchant vessels by the privateer. In his own diary he shows that underneath his calm exterior was serious trouble and keen anxiety; and, in fact, the strain which he underwent during the Civil War made itself felt in later years. Adams was instrumental in getting Lord John Russell to stop the "Alexandra," and it was his industry and pertinacity in argument and remonstrance that induced Russell to order the detention in Sept. 1863 of the two ironclad rams intended for the Confederate States. Adams remained in England until May 1868. His last important work was as a member, in 1871–72, of the tribunal of arbitration at Geneva which disposed of the "Alabama" claims. His knowledge of the subject and his fairness of mind enabled him to render his country and the cause of international arbitration valuable service. He died at Boston, Nov. 21, 1886.

He edited the works of *John Adams* (1850–56), and the *Memoirs of John Quincy Adams* (1874–77). *See* the excellent biography (Boston, 1900), in the "American Statesmen Series," by his son, Charles Francis Adams, Jr., and E. W. Adams, *Great Britain and the American Civil War* (1925).

ADAMS, CHARLES KENDALL (1835–1902), American educator and historian, was born in Derby, Vt , on Jan. 24, 1835 He graduated in 1861 at the University of Michigan, where he was instructor of history in 1862, assistant professor of history in 1863–67 and professor of history in 1868–85. From 1885 to 1892 he was president of Cornell university, succeeding A D. White (*q v.*), and from 1892 to 1902 he was president of the University of Wisconsin. He edited *Representative British Orations* (1884) and was editor-in-chief of Johnson's *Universal Cyclopaedia* in 1892–95. His published works include *Democracy and Monarchy in France* (1874), *Manual of Historical Literature* (1882), *Christopher Columbus, his Life and Work* (1892) and, with W P Trent, *A History of the United States,* rev. ed. (1913). He died in Redlands, Calif., on July 26, 1902.

See Charles Foster Smith, *Charles Kendall Adams, a Life Sketch* (1924).

ADAMS, CLEMENT (1519?–1587), English author. He is supposed to have been tutor to the royal pages at Greenwich. His *Anglorum Navigatio ad Moscovitas* is an account of the journey to Moscow made by Chancellor and Willoughby in 1553, and an English translation was printed by Hakluyt in his *Principal Navigations,* vol. i. (1598).

ADAMS, EPHRAIM DOUGLASS (1865–), American educator and historian, brother of Henry Carter Adams (*q v*), was born in Decorah, Ia , Dec 18, 1865 He graduated in 1887 from the University of Michigan from which in 1890 he received the degree of doctor of philosophy. From 1891 to 1899 he was assistant and associate professor of history and sociology, and from 1899 to 1902 professor of European history in the University of Kansas. He was associate professor of history in Leland Stanford university from 1902 until 1906, when he was made professor.

His published writings include *Control of the Purse in the United States Government* (1894), *The Influence of Grenville on Pitt's Foreign Policy* (1904), *British Interests and Activities in Texas* (1910), *The Power of Ideals in United States History* (1913), *Great Britain, America and Democracy* (1919), *Great Britain and the American Civil War* (1925) and numerous papers and reviews in historical journals.

ADAMS, FREDERICK UPHAM (1859–1921), American author and industrial engineer, was born in Boston, Mass., on Dec. 10, 1859. He removed to Elgin, Ill , and graduated at the high school there in 1876. He then studied mechanical engineering, which he practised from 1882 to 1890. In 1886 he invented an electric lamp-post, and in 1887 devised a form of electric light tower. He wrote books on engineering and on social subjects and also novels. He died in Larchmont, N Y , on Aug 28, 1921.

Among his works are: *Atmospheric Resistance and its Relation to the Speed of Railway Trains* (1893); *President John Smith* (1896); *The Kidnapped Millionaires* (1901); *John Burt* (1903); *How Cities are Governed in Great Britain* (1904); *John Henry Smith* (1905); *The Bottom of the Well* (1905); *The Revolt* (1907); *The Vegetarians,* a drama (1911); *Ramley,* a drama (1911); *The Conquest of the Tropics* (1914); *The Romance of Big Business* (1915); *The Open Shop* (1919).

ADAMS, GEORGE BURTON (1851–1925), American educator and historian, was born in Fairfield, Vt., June 3, 1851.

He graduated from Beloit college, Beloit, Wis., in 1873, and received the degree of doctor of philosophy from the University of Leipzig, Germany, in 1886. He was professor of history in Drury college, Springfield, Mo., from 1877 to 1888, when he became professor of history at Yale. From 1895 to 1913 he was editor of the *American Historical Review*. He edited Duruy's *Middle Ages*, Bémont and Monod's *Mediaeval Europe*, and *Select Documents of English Constitutional History*. He died in New Haven, Conn., May 26, 1925.

His published works include *Civilization During the Middle Ages* (1894), *The Growth of the French Nation* (1896), *European History* (1899), *The Origin of the English Constitution* (1912), *Outline Sketch of English Constitutional History* (1918), *The British Empire* (1919) and *The Constitutional History of England* (1921).

ADAMS, HANNAH (1755–1832), American writer, was born in Medfield, Mass., in 1755. She is said to be the first woman in America to have made literature a profession. By private study, which she began at an early age, she acquired much varied learning, including some acquaintance with Latin and Greek. Through family reverses she was compelled from her 17th year to provide for herself. Her writings, though they brought reputation and friends, yielded but little pecuniary profit. Among her chief works were *Views of Religious Opinions* (1784), *History of New England* (1799), *Evidences of Christianity* (1801) and *History of the Jews* (1812). Her *Autobiography*, with additions by Hannah F. Adams, was published in 1832. She died in Brookline, Mass., Nov. 15, 1832.

ADAMS, HENRY (1838–1918), American historian, son of Charles Francis Adams and grandson of John Quincy Adams, was born in Boston, Mass., on Feb. 16, 1838. He graduated at Harvard in 1858, studied abroad, and was private secretary to his father when the latter was a congressman and minister to England. Thereafter for a brief time he did political writing in Washington; and from 1870 to 1877 he was assistant professor of history at Harvard, for most of the period also acting as editor of the *North American Review*. He is considered to have been the first to conduct historical seminary work in the United States. His *History of the United States from 1801 to 1817* (9 vols. 1889–91, new ed. 1909) took its place as the best work on the administrations of Presidents Jefferson and Madison, being specially notable for its account of the diplomatic relations of the United States during this period, and for its essential impartiality. This, like his other historical and biographical works such as the *Life of Albert Gallatin* (1879), *John Randolph* (1882), *Historical Essays* (1891), and *Chapters of Erie and Other Essays* (1871, with Charles Francis Adams, Jr.), won him a reputation among scholars. His *Mont Saint Michel and Chartres* (1913, privately printed 1904) and *The Education of Henry Adams* (1918, privately printed 1906) revealed him to a much wider audience as a writer of delicate sensibilities and refined taste. *Mont Saint Michel and Chartres* is one of the most valuable studies of mediaevalism yet produced in America, not only for the aid which it affords in the appreciation of the literary and architectural monuments of the past, but for the conception which it gives of the animating forces which produced these monuments. The autobiography which attempted to show how ill-adapted eighteenth-century man and education were for the needs of the twentieth century was one of the most widely discussed books of its decade in America. Correlating with these books to a certain extent was Adams's *Letter to American Teachers of History* (1910). He died in Washington on May 27, 1918. Posthumous publications were *The Degradation of the Democratic Dogma* (1919, with an introduction by Brooks Adams) and *Letters to a Niece and Prayer to the Virgin of Chartres* by Henry Adams, with *A Niece's Memories* by Mabel La Farge (1920). After his death he was named by Henry Holt as the author of *Democracy*, an anonymous novel of 1880.

His elder brother, JOHN QUINCY ADAMS (1833–1894), a graduate of Harvard (1853), practised law, and was for several terms a Democratic member of the Massachusetts general court. In 1872 he was nominated for vice president by the Democratic faction that refused to support Horace Greeley.

Another brother, CHARLES FRANCIS ADAMS, JR. (1835–1915), born in Boston, on May 27, 1835, graduated at Harvard in 1856, and was admitted to the bar in 1858. During the Civil War he served on the Union side, receiving, in 1865, the brevet of brigadier general. He was president of the Union Pacific railroad from 1884–90, having previously become widely known as an authority on the management of railways. In 1900–01 he was president of the American Historical Association. He died in Washington, D.C., on March 20, 1915. His autobiography was published in 1916 with a memorial address by Henry Cabot Lodge.

Among his writings are: *Railroads, Their Origin and Problems* (rev. ed. 1887); *Three Episodes of Massachusetts History* (1892); a biography of his father, *Charles Francis Adams* (1900); *Lee at Appomattox and Other Papers* (1902); *Three Phi Beta Kappa Addresses* (1907); *Studies Military and Diplomatic 1775–1865* (1911); and *Atlantic Historical Solidarity* (1913), lectures delivered at Oxford.

Another brother, BROOKS ADAMS (1848–1927), was born in Quincy, Mass., on June 24, 1848, graduated at Harvard in 1870, and until 1881 practised law. He died in Boston, Feb. 13, 1927.

His writings include: *The Emancipation of Massachusetts: The Dream and the Reality* (rev. ed. 1919); *The Law of Civilization and Decay* (1895); *America's Economic Supremacy* (1900); and *The New Empire* (1902).

ADAMS, HENRY CARTER (1852–1921), American economist, was born at Davenport, Ia., Dec. 31, 1852. He was educated at Iowa college and Johns Hopkins university, where he was a fellow 1876–78, and in French and German universities. He afterwards taught at Cornell university, and in 1887 became professor of political economy and finance in the University of Michigan. He also became statistician to the Interstate Commerce Committee and was in charge of the transport department in the 1900 census. His principal works include *The State in Relation to Industrial Action* (1887); *Public Debts* (1887); *The Science of Finance* (1888); *Economics and Jurisprudence* (1897); *Description of Industry* (1918) and *American Railway Accounting* (1918). He died Aug. 11, 1921.

ADAMS, HERBERT (1858–), American sculptor, was born at West Concord (Vt.) on Jan. 28, 1858. He was educated at the Worcester Institute of Technology and at the Massachusetts normal art school, and in 1885–90 he was a pupil of Antonin Mercié in Paris. In 1890–98 he was an instructor in the art school of Pratt institute, Brooklyn, New York. In 1906 he was elected vice-president of the National Academy of Design, New York, and from 1917–20 served as president. He experimented successfully with some polychrome busts and tinted marbles, notably in the "Rabbi's Daughter" and a portrait of Julia Marlowe, the actress. He was at his best in his portrait busts of women, the finest example being the study, completed in 1887, of Miss A. V. Pond, whom he afterwards married. Among his other productions are a fountain for Fitchburg (Mass., 1888); a number of works for the Congressional library, Washington, including the bronze doors ("Writing") begun by Olin Warner, and the statue of Prof. Joseph Henry; memorial tablets for the Boston State House; a memorial of Jonathan Edwards at Northampton (Mass.); statues of Richard Smith, the type-founder, in Philadelphia, and of William Ellery Channing, in Boston (1902); the Vanderbilt memorial bronze doors for St. Bartholomew's church, New York; the group of figures for McMillan fountain in McMillan park, Washington (D.C.); and the reliefs for the tomb of Ellen Axson Wilson (Mrs. Woodrow Wilson).



BY COURTESY OF GRAND CENTRAL GALLERIES

ADAMS'S POLYCHROME BUST "PRIMAVERA" SHOWS A LEANING TOWARD THE ITALIAN "QUATTROCENTO" AND THE WORK OF THE DELLA ROBBIAS

ADAMS, HERBERT BAXTER (1850–1901), American historian and educationalist, was born at Shutesbury (Mass.) on April 16, 1850. He graduated at Amherst, at the head of his class,

in 1872; and after studying at Göttingen and Berlin he received the degree of Ph.D. at Heidelberg in 1876, with the highest honours. Thereafter almost until his death he was connected with the Johns Hopkins university, Baltimore (Md.), becoming professor of American and institutional history in 1891. He was one of the founders of the American Historical Association, of which he was secretary until 1900. In 1882 he founded the "Johns Hopkins University Studies in Historical and Political Science," of which he became editor. It was as a teacher, however, that Adams rendered his most valuable services, and many American historical scholars owe their training, and to a considerable extent their enthusiasm, to him. He died at Amherst (Mass.) on July 30, 1901. Among his writings are. *Maryland's Influence in Founding a National Commonwealth* (1877); *Methods of Historical Study* (1884); *Maryland's Influence upon Land Cessions to the United States* (1885); and the *Life and Writings of Jared Sparks* (1893)

See *Herbert B. Adams: Tributes of Friends* (1902); extra vol. (xxlii) of "Studies in Historical and Political Science."

ADAMS, JOHN (1735–1826), second president of the United States of America, was born Oct. 30, 1735, in what is now the town of Quincy (Mass). His father, a farmer, also named John, was of the fourth generation in descent from Henry Adams, who emigrated from Devonshire, England, to Massachusetts about 1636; his mother was Susanna Boylston Adams Young Adams graduated from Harvard college in 1755, and for a time taught in school at Worcester and studied law in the office of Rufus Putnam. In 1758 he was admitted to the bar. From an early age he developed the habit of writing descriptions of events and impressions of men. The earliest of these is his report of the argument of James Otis in the superior court of Massachusetts as to the constitutionality of writs of assistance This was in 1761, and the argument inspired him with zeal for the cause of the American colonies Years afterwards, when an old man, Adams undertook to write out at length his recollections of this scene; it is instructive to compare the two accounts John Adams had none of the qualities of popular leadership which were so marked a characteristic of his second cousin, Samuel Adams; it was rather as a constitutional lawyer that he influenced the course of events. He was impetuous, intense and often vehement, unflinchingly courageous, devoted with his whole soul to the cause he had espoused, but his vanity, his pride of opinion and his inborn contentiousness were serious handicaps to him in his political career. These qualities were particularly manifested at a later period—as, for example, during his term as president. He first made his influence widely felt and became conspicuous as a leader of the Massachusetts Whigs during the discussions with regard to the Stamp Act of 1765. In that year he drafted the instructions which were sent by the town of Braintree to its representatives in the Massachusetts legislature, and which served as a model for other towns in drawing up instructions to their representatives; in Aug. 1765 he contributed anonymously four notable articles to the *Boston Gazette* (republished separately in London in 1768 as *A Dissertation on the Canon and Feudal Law*), in which he argued that the opposition of the colonies to the Stamp Act was a part of the never-ending struggle between individualism and corporate authority; and in Dec. 1765 he delivered a speech before the governor and council in which he pronounced the Stamp Act invalid on the ground that Massachusetts, being without representation in parliament, had not assented to it. In 1768 he removed to Boston. Two years later, with that degree of moral courage which was one of his distinguishing characteristics, as it has been of his descendants, he, aided by Josiah Quincy, Jr., defended the British soldiers who were arrested after the "Boston Massacre," charged with causing the death of four persons, inhabitants of the colony. The trial resulted in an acquittal of the officer who commanded the detachment, and most of the soldiers; but two soldiers were found guilty of manslaughter. These claimed benefit of clergy and were branded in the hand and released. Adams's upright and patriotic conduct in taking the unpopular side in this case met with its just reward in the following year, in the shape of his election to the Massachusetts House of Representatives by a vote of 418 to 118.



BIRTHPLACE OF JOHN ADAMS, SECOND PRESIDENT OF THE UNITED STATES OF AMERICA, AT QUINCY, MASS

John Adams was a member of the Continental Congress from 1774 to 1778. In June 1775, with a view to promoting the union of the colonies, he seconded the nomination of Washington as commander-in-chief of the army. His influence in congress was great, and almost from the beginning he was impatient for a separation of the colonies from Great Britain. On June 7, 1776, he seconded the famous resolution introduced by Richard Henry Lee (*q.v.*) that "these colonies are, and of a right ought to be, free and independent states," and no man championed these resolutions (adopted on July 2) so eloquently and effectively before the congress. On June 8 he was appointed on a committee with Jefferson, Franklin, Livingston and Sherman to draft a Declaration of Independence, and although that document was by the request of the committee written by Thomas Jefferson, it was John Adams who occupied the foremost place in the debate on its adoption. Before this question had been disposed of, Adams was placed at the head of the board of war and ordnance, and he also served on many other important committees

In 1778 John Adams sailed for France to supersede Silas Deane in the American commission there But just as he embarked that commission concluded the desired treaty of alliance, and soon after his arrival he advised that the number of commissioners be reduced to one His advice was followed and he returned home in time to be elected a member of the convention which framed the Massachusetts constitution of 1780, still the organic law of that commonwealth. With James Bowdoin and Samuel Adams, he formed a sub-committee which drew up the first draft of that instrument, and most of it probably came from John Adams's pen

Before this work had been completed he was again sent to Europe, having been chosen, Sept. 27, 1779, as minister plenipotentiary for negotiating a treaty of peace and a treaty of commerce with Great Britain. Conditions were not then favourable for peace, however; the French Government, moreover, did not approve of the choice, inasmuch as Adams was not sufficiently pliant and tractable and was from the first suspicious of Vergennes; and subsequently Benjamin Franklin, Thomas Jefferson, John Jay and Henry Laurens were appointed to co-operate with Adams. Jefferson, however, did not cross the Atlantic, and Laurens took little part in the negotiations. This left the management of the business to the other three. Jay and Adams distrusted the good faith of the French Government. Outvoting Franklin, they decided to break their instructions, which required them to "make the most candid confidential communications on all subjects to the ministers of our generous ally, the king of France, to undertake nothing in the negotiations for peace or truce without their knowledge or concurrence; and ultimately to govern yourself by their advice and opinion"; and, instead, they dealt directly with the British commissioners, without consulting the French ministers. Throughout the negotiations Adams was especially determined that the right of the United States to the fisheries along the British-American coast should be recognized. Political conditions in Great Britain, at the moment made the conclusion of peace almost a necessity with the British ministry, and eventually the American negotiators were able to secure a peculiarly favourable treaty. This preliminary treaty was signed Nov. 30, 1782. Before these negotiations began, Adams had spent some time in the Netherlands. In July 1780 he had been authorized to execute the duties previously assigned to Henry Laurens, and at The Hague was eminently successful, securing there recognition of the United States as an independent government (April 19, 1782), and negotiating both a loan and, in Oct. 1782, a treaty of amity and commerce, the first of such

treaties between the United States and foreign powers after that of Feb. 1778 with France.

In 1785 John Adams was appointed the first of a long line of able and distinguished American ministers to the court of St. James's. When he was presented to his former sovereign, George III. intimated that he was aware of Adams's lack of confidence in the French Government. Replying, Adams admitted it, closing with the outspoken sentiment: "I must avow to your Majesty that I have no attachment but to my own country"—a phrase which must have jarred upon the monarch's sensibilities. While in London Adams published a work entitled *A Defence of the Constitution of Government of the United States* (1787). In this work he ably combated the views of Turgot and other European writers as to the viciousness of the framework of the state governments. Unfortunately, in so doing, he used phrases savouring of aristocracy which offended many of his countrymen—as in the sentence in which he suggested that "the rich, the well-born and the able" should be set apart from other men in a senate. Partly for this reason, while Washington had the vote of every elector in the first presidential election of 1789, Adams received only 34 out of 69. As this was the second largest number he was declared vice-president, but he began his eight years in that office (1789–97) with a sense of grievance and of suspicion of many of the leading men. Differences of opinion with regard to the policies to be pursued by the new government gradually led to the formation of two well-defined political groups—the Federalists and the Democratic-Republicans—and Adams became recognized as one of the leaders, second only to Alexander Hamilton, of the Federalists.

In 1796, on the refusal of Washington to accept another election, Adams was chosen president, defeating Thomas Jefferson; though Alexander Hamilton and other Federalists had asked that an equal vote should be cast for Adams and Thomas Pinckney, the other Federalist in the contest, partly in order that Jefferson, who was elected vice president, might be excluded altogether, and partly, it seems, in the hope that Pinckney should in fact receive more votes than Adams, and thus, in accordance with the system then obtaining, be elected president, though he was intended for the second place on the Federalist ticket. Adams's four years as chief magistrate (1797–1801) were marked by a succession of intrigues which embittered all his later life; they were marked, also, by events such as the passage of the Alien and Sedition acts, which brought discredit on the Federalist party. Moreover, factional strife broke out within the party itself; Adams and Hamilton became alienated, and members of Adams's own cabinet virtually looked to Hamilton rather than to the president as their political chief. The United States was, at this time, drawn into the vortex of European complications, and Adams, instead of taking advantage of the militant spirit which was aroused, patriotically devoted himself to securing peace with France, much against the wishes of Hamilton and of Hamilton's adherents in the cabinet. In 1800, Adams was again the Federalist candidate for the presidency, but the distrust of him in his own party, the popular disapproval of the Alien and Sedition acts and the popularity of his opponent, Thomas Jefferson, combined to cause his defeat. He then retired into private life. On July 4, 1826, on the 50th anniversary of the adoption of the Declaration of Independence, he died at Quincy. Jefferson died on the same day. In 1764 Adams had married Abigail Smith (1744–1818), the daughter of a Congregational minister at Weymouth (Mass.). She was a woman of much ability, and her letters, written in an excellent English style, are of great value to students of the period in which she lived. President John Quincy Adams was their eldest son.

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ADAMS, JOHN COUCH (1819–1892), British astronomer, was born at Lidcot farmhouse, Laneast, Cornwall, on June 5, 1819. He was educated at St. John's College, Cambridge, and was senior wrangler and first Smith's prizeman of his year, 1843. While still an undergraduate he read of certain unexplained irregularities in the motion of the planet Uranus and determined to investigate them, with a view to ascertaining whether they might not be due to the action of a remote undiscovered planet. Elected fellow of his college in 1843, he at once attacked the problem. It was this: from the observed perturbations of a known planet to deduce by calculation, assuming only Newton's law of gravitation, the mass and orbit of an unknown disturbing body. By Sept. 1845 he obtained his first solution, and handed to Prof. Challis, the director of the Cambridge Observatory, a paper giving the elements of what he described as "the new planet."

It was not until July 1846 that the search for the new planet was begun at Cambridge. Meanwhile the French astronomer Leverrier had been working along similar lines with equally successful results, and a controversy arose as to whether the discovery of the new planet, Neptune, should be ascribed to the English or the French astronomer. As the facts became known the world recognized that the two astronomers had independently solved the problem of Uranus. The new planet, at first called *Leverrier* by F. Arago, received by general consent the neutral name of *Neptune*. Its mathematical prediction was an unsurpassed intellectual feat.

In 1851 Adams became president of the Royal Astronomical Society. His lay fellowship of St John's College came to an end in 1852, but Pembroke College elected him in the following year to a lay fellowship which he held for the rest of his life In 1858 he became professor of mathematics at St Andrews, but lectured only for a session, when he vacated the chair for the Lowndean professorship of astronomy and geometry at Cambridge. Two years later he succeeded Challis as director of the Observatory, where he resided until his death.

Although Adams's researches on Neptune were those which attracted widest notice, his subsequent work on gravitational astronomy and terrestrial magnetism was not less remarkable In 1852 he published new and accurate tables of the moon's parallax, which superseded J. K Burckhardt's, and supplied corrections to the theories of M. C T. Damoiseau, G A A Plana and P G D. de Pontécoulant. In the following year his memoir on the secular acceleration of the moon's mean motion partially invalidated Laplace's famous explanation, which had held its place unchallenged for 60 years. For these researches the Royal Astronomical Society awarded him its gold medal in 1866. The great meteor shower of 1866 turned his attention to the Leonids, whose probable path and period had already been discussed by Prof. H A. Newton. Adams ascertained that this cluster of meteors, which belongs to the solar system, traverses an elongated ellipse in 33 years and three months, and is subject to definite perturbations from the larger planets, Jupiter, Saturn and Uranus. These results were published in 1867. Ten years later, when G. W Hill of Washington expounded a new method for dealing with the problem of the lunar motions, Adams briefly announced his own unpublished work in the same field, which, following a parallel course, had confirmed and supplemented Hill's.

The determination of the constants in Gauss's theory of terrestrial magnetism occupied him at intervals for more than 40 years. The calculations involved great labour, and were not published during his lifetime They were edited by his brother, Prof. W. Grylls Adams, and appear in the second volume of the collected *Scientific Papers* Numerical computations of this kind might almost be described as his pastime The value of the constant known as Euler's, and the Bernoullian numbers up to the 62nd, he worked out to an incredible degree of accuracy. For Newton and his writings he had a boundless admiration; many of his papers, indeed, bear the cast of Newton's thought. He laboured for many years at the task of arranging and cataloguing the great collection of Newton's unpublished mathematical writings, presented in 1872 to the University by Lord Portsmouth, and wrote the account of them issued in a volume by the University Press in 1888.

The post of astronomer-royal was offered him in 1881, but he

preferred to pursue his peaceful course of teaching and research in Cambridge. After a long illness he died at the Cambridge Observatory on Jan. 21, 1892, and was buried in St. Giles's cemetery, near his home.

BIBLIOGRAPHY.—*The Scientific Papers of John Couch Adams,* 4to vol. i. (1896), and vol. ii. (1900), edited by William Grylls Adams and Ralph Allen Sampson, with a memoir by Dr. J W. L. Glaisher, were published by the Cambridge University Press. The first volume contains his previously published writings; the second those left in manuscript, including the substance of his lectures on the Lunar Theory. A collection, virtually complete, of Adams's papers regarding the discovery of Neptune was presented by Mrs. Adams to the library of St. John's College. A description of them by Prof. Sampson was inserted in the *Memoirs* of the Royal Astronomical Society (vol. liv. p. 143).

ADAMS, JOHN QUINCY (1767–1848), eldest son of President John Adams, sixth president of the United States, was born on July 11, 1767, in that part of Braintree that is now Quincy (Mass.), and was named after John Quincy (1689–1767), his mother's grandfather, who was for many years a prominent member of the Massachusetts legislature In 1778 and again in 1780, young Adams accompanied his father to Europe; studying in Paris in 1778–79 and at the University of Leyden in 1780. In 1780, also, he began to keep that diary which forms so conspicuous a record of the doings of himself and his contemporaries. In 1781, at the age of 14, he accompanied Francis Dana (1743–1811), American envoy to Russia, as his private secretary; but Dana was not received by the Russian Government, and in 1782 Adams joined his father at Paris, where he acted as "additional secretary" to the American commissioners in the negotiation of the treaty of peace which concluded the War of Independence. Instead of accompanying his father to London, he, of his own choice, returned to Massachusetts, graduated at Harvard college in 1787, three years later was admitted to practice at the bar and at once opened an office in Boston. A series of papers written by him in which he controverted some of Thomas Paine's doctrines in the *Rights of Man,* and later another series in which he ably supported the neutral policy of the Administration toward France and England, led to his appointment by Washington as minister to the Netherlands in May 1794. There was little for him to do at The Hague, but in the absence of a minister at London, he transacted certain public business with the English foreign secretary. In 1796 Washington appointed him minister to Portugal, but before his departure thither his father John Adams became president and changed his destination to Berlin (1797). While there, he negotiated (1799) a treaty of amity and commerce with Prussia. On Thomas Jefferson's election to the presidency in 1800, the elder Adams recalled his son, who returned home in 1801. The next year, he was elected to the Massachusetts senate, and in 1803 was sent to Washington as a member of the Senate of the United States.

Up to this time, John Quincy Adams was regarded as belonging to the Federalist Party, but he now found its general policy displeasing to him, was frowned upon, as the son of his father, by the followers of Alexander Hamilton, and found himself practically powerless as an unpopular member of an unpopular minority. He was not, and indeed never was, a strict party man. On the first important question that came before him in the Senate, the acquisition of Louisiana, he voted with the Republicans, regardless of the opposition of his own section. In Dec. 1807 he warmly seconded Jefferson's suggestion of an embargo and vigorously urged instant action, saying: "The president has recommended the measure on his high responsibility. I would not consider, I would not deliberate; I would act!" Within five hours the Senate had passed the Embargo bill and sent it to the House. The support of a measure so unpopular in New England caused him to be hated by the Federalists there, and cost him his seat in the Senate; his successor was chosen on June 3, 1808, several months before the usual time of filling the vacancy, and five days later Adams resigned. In the same year he attended the Republican congressional caucus which nominated Madison for the presidency, and thus definitely joined the Republicans. From 1806 to 1809 Adams was professor of rhetoric and oratory at Harvard.

In 1809 President Madison sent Adams to Russia to represent the United States. He arrived at St. Petersburg (Leningrad) at the psychological moment when the tsar had made up his mind to break with Napoleon. Adams therefore met with a favourable reception and a disposition to further the interests of American commerce in every possible way. On the outbreak of the war between the United States and England in 1812, he was still at St. Petersburg. In September of that year, the Russian Government suggested that the tsar was willing to act as mediator between the two belligerents. Madison precipitately accepted this proposition and sent Albert Gallatin and James Bayard to act as commissioners with Adams; but England would have nothing to do with it. In Aug. 1814, however, these gentlemen, with Henry Clay and Jonathan Russell, began negotiations with English commissioners which resulted in the signature of the Treaty of Ghent on Dec. 24 of that year. After this Adams visited Paris, where he witnessed the return of Napoleon from Elba, and then went to London, where, with Henry Clay and Albert Gallatin, he negotiated (1815) a "Convention to Regulate Commerce and Navigation." Soon afterwards he became U S minister to Great Britain, as his father had been before him, and as his son, Charles Francis Adams, was after him. After accomplishing little in London, he returned to the United States in the summer of 1817 to become secretary of State in the cabinet of President Monroe.

Later Career.—As secretary of State, Adams played the leading part in the acquisition of Florida and the promulgation of the Monroe Doctrine. Ever since the acquisition of Louisiana successive administrations had sought to include a part at least of Florida in that purchase. In 1819, after long negotiations, Adams succeeded in bringing the Spanish minister to the point of signing a treaty in which the Spaniards abandoned all claims to territory east of the Mississippi, and the United States relinquished all claim to what is now known as Texas Before the Spanish Government ratified the treaty in 1820, Mexico, including Texas, had thrown off allegiance to the mother country, and the United States had occupied Florida by force of arms. The Monroe Doctrine (*q.v.*) rightly bears the name of the president who in 1823 assumed the responsibility for its promulgation; but it was primarily the work of John Quincy Adams. The eight years of Monroe's presidency (1817–25) are known as the "Era of Good Feeling." As his second term drew to a close, there was a great lack of good feeling among his official advisers, three of whom—Adams, secretary of State, Calhoun, secretary of War, and Crawford, secretary of the Treasury—aspired to succeed him in his high office. In addition Henry Clay and Andrew Jackson were also candidates. Calhoun was nominated for the vice-presidency. Of the other four, Jackson received 99 electoral votes, Adams 84, Crawford 41, and Clay 37; as no one had a majority, the decision was made by the House of Representatives, which was confined in its choice to the three candidates who had received the largest number of votes. Clay, who was speaker of the House of Representatives, and had for years assumed a censorious attitude toward Jackson, cast his influence for Adams and thereby secured his election on the first ballot. A few days later Adams offered Clay the secretaryship of State, which was accepted. The wholly unjust and baseless charge of "bargain and corruption" followed, and the feud thus created between Adams and Jackson greatly influenced the history of the United States.

Up to this point Adams's career had been almost uniformly successful, but his presidency (1825–29) was in most respects a failure, owing to the virulent opposition of the Jacksonians; in 1828 Jackson was elected president over Adams. It was during his administration that irreconcilable differences developed between the followers of Adams and the followers of Jackson, the former becoming known as the National Republicans, who with the Anti-Masons were the precursors of the Whigs. In 1829 Adams retired to private life in the town of Quincy; but only for a brief period, for in 1830, largely by Anti-Masonic votes, he was elected a member of the national House of Representatives. On its being suggested to him that his acceptance of this position would degrade an ex-president, Adams replied that no person could be degraded by serving the people as a representative in Congress or, he added, as a selectman of his town. His service in Congress from 1831

until his death is, in some respects, the most noteworthy part of his career.

Throughout he was conspicuous as an opponent of the extension of slavery, though he was never technically an abolitionist, and in particular he was the champion in the House of Representatives of the right of petition at a time when, through the influence of the Southern members, this right was, in practice, denied by that body. His prolonged fight for the repeal of the so-called "gag laws" is one of the most dramatic contests in the history of Congress. The agitation for the abolition of slavery, which really began in earnest with the establishment of the *Liberator* by William Lloyd Garrison in 1831, soon led to the sending of innumerable petitions to Congress for the abolition of slavery in the District of Columbia, over which the Federal Government had jurisdiction, and for other action by Congress with respect to that institution. These petitions were generally sent to Adams for presentation. They aroused the anger of the pro-slavery members of Congress, who, in 1836, brought about the passage of the first "gag rule," the Pinckney resolution, presented by Henry L. Pinckney, of South Carolina. It provided that all petitions relating to slavery should be laid on the table without being referred to committee or printed; and, in substance, this resolution was readopted at the beginning of each of the immediately succeeding sessions of Congress, the Patton resolution being adopted in 1837, the Atherton resolution, or "Atherton gag," in 1838, and the Twenty-first rule in 1840 and subsequently until repealed. Adams contended that these "gag rules" were a direct violation of the First amendment to the Federal Constitution, and refused to be silenced on the question, fighting for repeal with indomitable courage, in spite of the bitter denunciation of his opponents. Each year the number of anti-slavery petitions received and presented by him increased; perhaps the climax was in 1837, when Adams presented a petition from 22 slaves, and, when threatened by his opponents with censure, defended himself with remarkable keenness and ability. At each session, also, the majority against him decreased until in 1844 his motion to repeal the Twenty-first rule was carried by a vote of 108 to 80 and his battle was won. On Feb. 21, 1848, after having suffered a previous stroke of apoplexy, he fell insensible on the floor of the Representatives' chamber, and two days later died. Few men in American public life have possessed more intrinsic worth, more independence, more public spirit and more ability than Adams; but throughout his political career he was handicapped by a certain reserve, a certain austerity and coolness of manner, and by his consequent inability to appeal to the imaginations and affections of the people as a whole. He had, indeed, few intimate political or personal friends, and few men in American history have, during their lifetime, been regarded with so much hostility and attacked with so much rancour by their political opponents.

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ADAMS, MAUDE (1872–), American actress, was born in Salt Lake City, Utah, on Nov. 11, 1872. The family name was Kiskadden, but she adopted the maiden name, Adams, of her mother, an actress. From an early age she played juvenile parts, and at the age of 16 went to New York. From her appearance in Hoyt's *A Midnight Bell,* in 1889, her popularity grew steadily. In 1897 Charles Frohman gave her her first leading part as Lady Babbie in *The Little Minister;* and in *Peter Pan* she achieved a great success. She introduced Rostand to the American stage, taking the title-rôle in *L'Aiglon* in 1901, and in *Chantecler* in 1911. Other plays in her repertory were *Romeo and Juliet, The Pretty Sister of José, The Jesters* and *As You Like It.*

ADAMS, OSCAR FAY (1855–1919), American author and editor, was born in Worcester, Mass., in 1855. He was educated in the New Jersey State Normal school. He became a teacher of English literature and a frequent contributor to periodicals. In 1886 he edited *Through the Year with the Poets,* in 12 volumes. His published writings include *The Story of Jane Austen's Life* (1891, 2nd ed. 1897); *The Archbishop's Unguarded Moment and Other Stories* (1899); *A Brief Handbook of English Authors* (1884, 7th ed. 1893); *Dear Old Story Tellers* (1889, new ed. 1911); *A Dictionary of American Authors* (1897, 5th ed. 1905); and *A Motley Jest—Shakespearean Diversions* (1909). He was also American editor for *The Henry Irving Shakespeare.* He died in North Truro, Mass., April 30, 1919.

ADAMS, ROGER (1889–), American chemist, was born in Boston, Mass., on Jan. 2, 1889. He was educated at Harvard university from which he graduated in 1909 and received the degree of Ph.D. in 1912. Following two years' study in the University of Berlin and the Kaiser Wilhelm institute, 1912–13, he returned to Harvard where he was instructor in organic chemistry for three years. In 1916 he was made assistant professor, in 1919 professor, and in 1926 head of the department of organic chemistry, in the University of Illinois. He has made important researches on catalysts, local anaesthetics, platinum oxide, alkali-insoluble phenols, chaulmoogric acid derivatives and other organic compounds, in recognition of which he was awarded the Nichols medal (1927). His writings include *Organic Syntheses* (1921) and many articles on chemical subjects.

ADAMS, SAMUEL (1722–1803), American statesman, born in Boston (Mass.), on Sept. 27, 1722, a second cousin to the elder John Adams. He graduated at Harvard college in 1740 and began the study of law. Though he repeatedly failed in business and was sued because of his easy methods as tax-collector, he became so influential in local politics as to be called the "Man of the Town Meeting."

He first came into wider prominence at the beginning of the Stamp Act episode, when as author of Boston's instructions to its representatives in the general court of Massachusetts he urged strenuous opposition to taxation by act of parliament. At about the same time he was elected to the lower house of the general court, in which he served until 1774, after 1766 as clerk. As James Otis's vigour and influence declined, Adams took a more prominent position in the revolutionary councils, in which he advised against any form of compromise. Many of the Massachusetts revolutionary documents, including the famous "Massachusetts Resolves" and the circular letter to the legislatures of the other colonies, are from his pen. Indeed, there can be no question that he was one of the first American political leaders to deny the legislative power of parliament and to desire and advocate separation from the mother country.



HOUSE AT LEXINGTON, MASS., FROM WHICH ADAMS AND HANCOCK ESCAPED WHEN AROUSED BY PAUL REVERE

To promote the ends he had in view Adams suggested non-importation, instituted the Boston committees of correspondence, urged that a Continental Congress be called, and wrote a vast number of articles for the newspapers, especially the Boston *Gazette,* over a multitude of signatures. He was, in fact, one of the most voluminous and influential political writers of his time. His style is clear, vigorous and epigrammatic; his arguments are characterized by strength of logic and appeals to passion, and are based not so much on precedent and documentary authority as on "natural right." Although he lacked oratorical fluency, his short speeches, like his writings, were forceful; and he was an eminently successful manager of men, shrewd, wily, adroit, an adept in all the arts of the politician. He is considered to have done more than any other one man, in the years immediately preceding the War of Independence, to mould and direct public opinion in his community; and by his contemporaries he was credited with equally successful management of the delegates to the first Continental Congress.

During the intense excitement which followed the "Boston Massacre," Adams skilfully secured the removal of the soldiers from the town to a fort in the harbour. He also managed the

proceedings of the "Boston Tea Party," and later he was leader in the opposition to the Boston Port bill. One of the objects of the expedition sent by the governor, Gen. Thomas Gage, to Lexington (*q.v.*) and Concord on April 18–19, 1775, was the capture of Adams and John Hancock, temporarily staying in Lexington, and when Gage issued his proclamation of pardon on June 12 he excepted these two, whose offences, he said, were "of too flagitious a nature to admit of any other consideration than that of condign punishment."

As a delegate to the Continental Congress, from 1774 to 1781, Adams vigorously opposed any concession to the British Government; strove for harmony among the several Colonies in the common cause; served on the committee to prepare a plan of confederation and signed the Declaration of Independence. His most important service was in organizing the forces of revolution before 1775. In 1779 he was a member of the convention which framed the constitution of Massachusetts adopted in 1780, and in 1788 a member of the Massachusetts convention to ratify the Constitution of the United States. From 1789 to 1794 Adams was lieutenant-governor of his State, and from 1794 to 1797 governor. After the formation of parties he became allied with the Democratic-Republicans rather than with the Federalists. He died in Boston on Oct 2, 1803.

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ADAMS, SAMUEL HOPKINS (1871–), American author, was born in Dunkirk, N Y., on Jan 26, 1871. He graduated at Hamilton college in 1891 and entered journalism. From 1891 to 1900 he was engaged as a reporter and special writer for the New York *Sun*. He was managing editor of McClure's syndicate in 1900–01, advertising manager of McClure, Phillips and Company in 1901–02, and from 1903 to 1905 member of the editorial staff of *McClure's Magazine* In 1905 he contributed to *Collier's Weekly* a noteworthy series of articles exposing fraudulent quack medicines, and in 1915–16, in the New York *Tribune*, he similarly exposed dishonourable practices in advertising.

Among his published writings are: *The Mystery*, with Stewart Edward White (1905); *The Great American Fraud* (1905); *The Flying Death* (1906); *Average Jones* (1911), *The Secret of Lonesome Cove* (1913); *The Health Master* (1913); *The Clarion* (1914); *Little Miss Grouch* (1915); *The Unspeakable Perk* (1916); *Our Square and the People in It* (1917); *Common Cause* (1918); *Wanted, a Husband* (1919); *Success* (1921); *From a Bench in Our Square* (1922); *Siege* (1924); and *Revelry* (1926).

ADAMS, SARAH FLOWER (1805–1848), English poet, was born at Great Harlow, Essex, Feb. 22, 1805. She was the daughter of Benjamin Flower and in 1834 married William Bridges Adams, inventor and pamphleteer. She was a Unitarian and her writings are chiefly religious. Her longest work, *Vivia Perpetua* (1841), a dramatic poem having for its subject the life of the early Christians, contains impressive passages. Besides various other poems, she wrote several beautiful hymns, the best known of which is "Nearer, My God, to Thee" (1840). She died in Aug. 1848.

ADAMS, THOMAS (d. *c.* 1655), English Puritan divine, held churches at Willington in Bedfordshire, Wingrave in Bucks, and then in London. His "occasionally" printed sermons, collected in 1629, show him to have been a brilliant and witty preacher. Southey, indeed, calls him "the prose Shakespeare of Puritan theologians." His numerous works show great learning in the classics and the fathers of the church, and abound in all kinds of stories and aphorisms.

See the edition of his works in J. P. Nichol's *Puritan Divines*, by J. Angus and T. Smith (1862).

ADAMS, WALTER SYDNEY (1876–), American astronomer, was born in Antioch, Northern Syria, on Dec. 20, 1876. He graduated from Dartmouth college, Hanover, N.H., in 1898, studied at the University of Chicago in 1899–1900 and at the University of Munich in 1901. For the ensuing three years he was an assistant and instructor in the Yerkes observatory at Lake Geneva, Wis. He was assistant astronomer at the Mt. Wilson observatory of the Carnegie Institution, Pasadena, Calif., from 1904 to 1909, when he was made astronomer. He served also as acting or assistant director from 1910 until 1923, at which time he was appointed director of the observatory. His writings include a memoir on the rotation of the sun and numerous papers on stellar motions, solar and stellar spectroscopy, and other astronomical subjects.

ADAMS, WILLIAM (d. 1620), English navigator, the first Englishman in Japan, was born at Gillingham, near Chatham, England. When 12 years old he was apprenticed in the mercantile marine, afterwards entering the British navy, and later serving the company of Barbary merchants as master and pilot. Attracted by the Dutch trade with India, he shipped as pilot major with a little fleet of five ships despatched from the Texel in 1598 by a company of Rotterdam merchants. The vessels, boats ranging from 75 to 250 tons and crowded with men, were driven to the coast of Guinea, where the adventurers attacked the island of Annabon for supplies, and finally reached the straits of Magellan. Scattered by stress of weather the following spring the "Charity," with Adams on board, and the "Hope," met at length off the coast of Chile, where the captains of both vessels lost their lives in an encounter with the Indians. In fear of the Spaniards, the remaining crews determined to sail across the Pacific. On this voyage the "Hope" was lost, but in April 1600 the "Charity," with a crew of sick and dying men, was brought to anchor off the island of Kiushiu, Japan.

Adams was summoned to Osaka and there examined by Iyeyasu, the guardian of the young son of Taiko Sama, the ruler, who had just died. His knowledge of ships and shipbuilding, and his nautical smattering of mathematics, raised him in the estimation of the shogun, and he was presented with an estate at Hémi near Yokosuka; but was refused permission to return to England. In 1611 news came to him of an English settlement in Bantam, and he wrote asking for help. In 1613 Captain John Saris arrived at Hirado in the ship "Clove" with the object of establishing a trading factory for the East India Company, and after obtaining the necessary concessions from the shogun, Adams postponed his voyage home (permission for which had now been given him) in order to take a leading part, under Richard Cocks, in the organization of this new English settlement.

He had already married a Japanese woman, by whom he had a family, and the latter part of his life was spent in the service of the English trading company, for whom he undertook a number of voyages to Siam in 1616, and Cochin-China in 1617 and 1618. He died May 16, 1620, some three years before the dissolution of the English factory. His Japanese title was Anjin Sama, and his memory was preserved in the naming of a street in Yedo, Anjin Cho (Pilot Street), and by an annual celebration on June 15 in his honour.

See *England's Earliest Intercourse with Japan*, by C. W. Hillary (1905); *Letters written by the English Residents in Japan*, ed. by N. Murakami (1900, containing Adams's Letters reprinted from *Memorials of the Empire of Japan*, ed. by T. Rundall, Hakluyt Society, 1850); *Diary of Richard Cocks*, with preface by N. Murakami (1899, reprinted from the Hakluyt Society ed. 1883); R. Hildreth's *Japan* (1855); J. Harris's *Navigantium atque Itinerantium Bibliotheca* (1764), i. 856; *Voyage of John Saris*, ed. by Sir E. M. Satow (Hakluyt Society, 1900); *Asiatic Society of Japan Transactions*, xxvi. (sec. 1898) pp. 1 and 194, where four more hitherto unpublished letters of Adams are given; *Collection of State Papers; East Indies, China and Japan*. The ms. of his logs written during his voyages to Siam and China is in the Bodleian Library at Oxford.

ADAMS, WILLIAM TAYLOR (1822–1897), American juvenile writer, popularly known under the pseudonym of "Oliver Optic," was born in Medway, Mass., on July 30, 1822. For 20 years he was a teacher in the public schools of Boston, and he served for a term in the State legislature. He wrote more than 100 books, chiefly juvenile fiction, which appeared in several series. In large part these were contributed to *Oliver Optic's*

Magazine, of which he was founder and editor. Among the best known are "Boat Club" series (1854), "Riverdale Story Books" (1858), "Woodville Stories" (1863–67), "Army and Navy" series (1865–1894), "Starry Flag" series (1867–69), "Young America Abroad" series (1867–69), "Great Western" series (1875–82), "Yacht Club" series (1900–03). He wrote also two novels, *The Way of the World* (1867) and *Living Too Fast* (1876). He died in Boston on March 27, 1897.

ADAMS, a town of Berkshire county, Mass., U.S.A., near the north-western corner of the State; including part of the valley of the Hoosac river, and extending from the Hoosac mountains on the east to Mt. Williams (3,040ft.) and Mt. Greylock (3,505ft.) on the west. It has an area of 23sq.m., and a population of 12,967 in 1920, of whom 3,949 were foreign-born whites; and 13,525 in 1925 (State census). The principal village, Adams, is on a branch of the Boston and Albany railroad, and is the nearest railway station for an ascent of Mt. Greylock. It is a busy industrial centre, with cotton, woollen, silk and paper mills. The town (originally East Hoosuck) was surveyed in 1749 and incorporated in 1778. It was named after Samuel Adams, the revolutionary leader. North Adams was made a separate township in 1878.

ADAM'S APPLE, the movable projection (more prominent in males) in the front of the throat formed by the thyroid cartilage of the larynx. The "Adam's apple" is one of the particular points of attack in the Japanese system of self-defence known as ju-jutsu (*q.v.*).

ADAM'S BRIDGE or **RAMA'S BRIDGE,** a chain of sandbanks between the Island of Manaar, near the north-west coast of Ceylon and the Island of Rameswaram, off the Indian coast, and lying between the Gulf of Manaar on the south-west and Palk Strait on the north-east. More than 30m. long, it seriously hinders navigation. Some of the sandbanks are dry, and no part of the shoal has a greater depth than 3ft. or 4ft. at high water. Though dredging operations were begun as early as 1838 they never succeeded in maintaining a channel for any save vessels of light draught and have now been abandoned. Geological evidence shows that this gap was once bridged by a continuous isthmus, which, according to temple records, was breached by storm in 1480. These banks and shoals are traditionally supposed to be the remains of a huge causeway constructed by Rama, the hero of the *Ramayana*, to facilitate passage of his army from India to Ceylon for the rescue of his abducted wife Sita.

ADAM SCOTUS (*c.* 1180), theological writer, sometimes called Adam Anglicus or Anglo-Scotus, was born in the south of Scotland in the first half of the 12th century. About 1150 he was a Premonstratensian canon at St. Andrews, and about 20 years later was perhaps abbot and bishop of Candida Casa (Whithorn) in Galloway. He gained a European reputation for his writings, which are of mystico-ascetic type, and include an account of the Premonstratensian order, a collection of festival sermons, and a *Soliloquia de instructione discipuli*, formerly attributed to his contemporary, Adam of St. Victor.

ADAMSEN, AMANDUS HEINRICH (1855–), Estonian sculptor, studied in St. Petersburg (Leningrad). In 1887 he produced a portrait in relief of Tsar Alexander III.; he then went to Paris, where he lived for several years. In 1891 he returned to his native land and lived alternately in Port Baltic and St. Petersburg.

Adamsen's technique in marble and wood has been moulded on classical lines. His small wood carvings are incomparable. His most important works are an allegory, shown at the Paris Exhibition in 1889, entitled "Liebe, Tod und Wissenschaft"; "Die Welle," and "Hunger"; also "Befreiter Genius" and "Sieg der Arbeit," which were executed for the Nijni-Novgorod Exhibition.

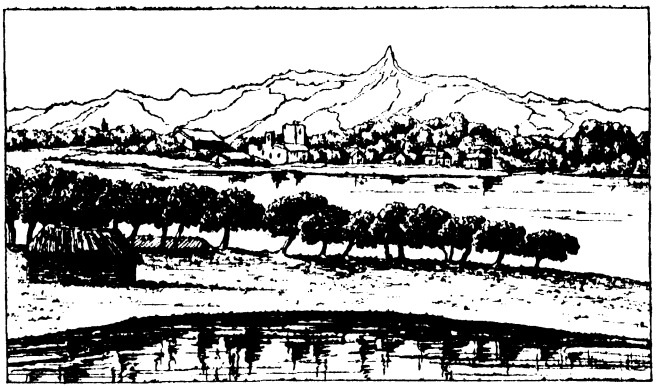
ADAMSON, PATRICK (1537–92), Scottish divine, Archbishop of St. Andrews, was born at Perth and educated at St. Andrews. He then spent some years in Paris, and was in hiding for seven months after the massacre of St. Bartholomew. He returned to Scotland in 1572, and in 1576 was appointed Archbishop of St. Andrews. He came into acute conflict with the General Assembly, and was twice excommunicated, though in each case the sentence was remitted. The last years of his life were spent in poverty. His collected works, which include Latin verse translations of the books of Job and Revelation, were printed in 1614.

ADAMSON, ROBERT (1852–1902), Scottish philosopher, was born in Edinburgh on Jan. 19, 1852. After a distinguished career at Edinburgh university he spent some time at Heidelberg (1871), where he began his study of German philosophy. He then returned to Edinburgh as assistant, first to Henry Calderwood and later to A. Campbell Fraser; he joined the staff of the *Encyclopædia Britannica* (9th ed.) (1874). In 1876 he succeeded W. S. Jevons in the chair of logic and philosophy at Owens college, Manchester. In 1893 he went to Aberdeen, and finally, in 1895, to the chair of logic at Glasgow, which he held till his death on Feb. 5, 1902. At Glasgow university he accomplished a great deal of useful administrative work and left a substantial impress on its constitution.

In 1903, under the title *The Development of Modern Philosophy and Other Essays*, his more important lectures were published with a short biographical introduction by Prof. W. R. Sorley of Cambridge university (see *Mind*, xiii. p. 73 *seq.*) (1904). Most of the matter is taken verbatim from the notebook of one of his students. Under the same editorship there appeared, three years later, his *Development of Greek Philosophy*.

Throughout his lectures Adamson pursued the critical and historical method without formulating a constructive theory of his own. He felt that any philosophical advance must be based on the Kantian methods. As he grew older his metaphysical optimism waned. He felt that the increase of knowledge must come in the domains of physical science. Adamson represented an empiricism which, so far from refuting, was actually based on, idealism, and yet was alert to expose the fallacies of a particular idealist construction (*see* his essay in *Ethical Democracy*, edited by Dr. Stanton Coit).

ADAM'S PEAK, a mountain in Ceylon, about 45m. E. of Colombo, in 6° 55′ N., 80° 30′ E. It rises steeply to a height of 7,352ft. and commands a magnificent prospect. Its conical summit terminates in an oblong platform, 74ft. by 24, on which there is a hollow, resembling the form of a human foot, 5ft. 4in. by 2ft. 6in. It is held in high veneration by Buddhists, Mohammedans and Hindus alike, and by them is respectively ascribed to Gautama, to Adam and to Siva. It is in charge of Buddhist monks, and is the resort of large numbers of pilgrims. At dawn the peak frequently casts a very well-defined shadow upon the clouds. It can be reached from Hatton on the railway or from Ratnapura.



ADAM'S PEAK, CEYLON, AS SEEN FROM GALLE FACE, COLOMBO, VENERATED BY THE SINHALESE. PILGRIMS ASCEND TO THE SACRED SPOT

ADANA. (1) A vilayet in south-east Asia Minor, including the ancient Cilicia. Pop. (1927) 227,652. The mountain districts are rich in unexploited mineral wealth, and the fertile coast-plain, watered by streams from the Taurus, produces cotton, rice, cereals, sugar and much fruit, and affords abundant pasturage. Imports and exports pass through Mersina (*q.v.*). (2) The chief town of the vilayet, in the alluvial plain about 30m. from the sea in 37° 1′ N., 35° 18′ E., on the right bank of the Seihan (Sihun, anc. Sarus), navigable by small craft as far as the town. Adana is connected with Tarsus and Mersina by a railway

built in 1887, and has a magnificent stone bridge, carrying the road to Missis and the East, and dating in parts from the time of Justinian, but restored first in A.D. 743 and called Jisr al-Walid after the Omayyad caliph of that name, and again in 840 by Caliph Mutasim. There are, also, a ruined castle founded by Harun al-Rashid in 782, fine fountains, good buildings, river-side quays and cotton mills. Adana, which retains its ancient name, was a station on the Roman military road to the East, and at one time a rival of Tarsus. It was largely rebuilt by Mansur in 758. Its position, commanding the passage of the mountains to the north of Syria, led to many vicissitudes. In the contest between Egyptians and Turks in 1832, after the defeat of the Turkish army at Konia, it was granted to Ibrahim Pasha, and though the firman named him only *muhassil,* or collector of the Crown revenue, it continued to be held by the Egyptians till the treaty of July 1840 restored it to the Porte. The chief productions of the province are cotton, corn, sesame and wool, which are largely exported. In 1927 the population was given as 108,957.

ADANSON, MICHEL (1727–1806), French naturalist of Scottish descent, was born at Aix-en-Provence. He travelled in Senegal and published an *Histoire naturelle du Sénégal* (Paris, 1757). Adanson's chief work was done as a botanist. In his *Familles naturelles des plantes* (1763) he opened the way for the natural classification of plants developed later by A. L. de Jussieu in his *Genera Plantarum* (1780). He also left a vast unfinished encyclopaedia on all known beings and substances, which has never been published.

ADAPA, MYTH OF. Adapa was a legendary sage, a citizen of Eridu, a city of Babylonia. Endowed with vast intelligence by the God Ea, he became the hero of the Eridu myth of the Fall of Man. Adapa, in spite of his possession of all wisdom was denied immortality, and one day, while fishing, the south wind blew so violently that he was thrown into the sea. In his rage he broke the wings of the south wind which then ceased to blow. Anu, the god of heaven, summoned him before his gates to receive punishment, but jealous Ea (god of wisdom) cautioned him not to touch the bread and water which would be offered him. When Adapa came before Anu, Tammuz and Gishzida interceded for him and explained to the god of heaven that as Adapa had been endowed with omniscience he needed only immortality to become a god; Anu then offered Adapa the bread and water of eternal life, which he refused to take. Thus mankind became mortal. (See *The Cambridge Ancient History,* vol. i. [1924].)

ADAPTATION, a process of fitting, or modifying, a thing to other uses, and so altering its form or original purpose. In literature there may be, *e g.,* an adaptation of a novel for a drama, or in music an arrangement of a piece for two hands into one for four, etc. In biology, adaptation plays a prominent part as the process by which an organism or species becomes modified to suit the conditions of its life. Every change in a living organism involves adaptation; for in all cases life consists in a continuous adjustment of internal to external relations. Some adaptations are produced afresh in each generation, others are transmitted by heredity, having been probably fixed by natural selection. (*See* EVOLUTION, VARIATION AND SELECTION.)

ADDA (anc. *Addua*), a river of North Italy. It rises in small lakes of the Fraele glen, and unites with several smaller streams near Bormio, in the Rhaetian Alps. Thence it flows south-west and west through the fertile Valtellina (*q.v.*) passing Tirano; the Poschiavino joins it at Tirano and the Malero at Sondrio. It falls into the northern end of the Lake of Como. On issuing from the south-east or Lecco arm, it crosses the plain of Lombardy, and, after a course of about 150m., joins the Po 8m. above Cremona. The lower Adda once bounded the territories of Venice and of Milan. At Trezzo, 20m. N.E. of Milan, there is an important hydro-electric power plant.

ADDAMS, JANE (1860–), American sociologist, was born at Cedarville (Ill.), on Sept. 6, 1860. After graduating at Rockford (Ill.) female seminary (now Rockford college) in 1881, she spent several years in the study of economic and sociological questions in both Europe and America, and in 1889, with Miss Ellen Gates Starr, established in Chicago (Ill.) the social settlement known as Hull House, of which she became the head worker. The success of this settlement, which became a great factor for good in the city, was principally due to Miss Addams's rare executive skill. Her personal participation in the life of the community is exemplified in her acceptance of the office of inspector of streets and alleys under the municipal government. She became widely known as a lecturer and writer on social problems and published *Democracy and Social Ethics* (1902); *Newer Ideals of Peace* (1907), and *The Spirit of Youth and the City Streets* (1909). She was chairman of the International Congress of Women held at The Hague in 1915. A permanent organization was then established, the Women's International League for Peace and Freedom, of which she became president. She presided over the international congresses at Zurich, 1919, Vienna, 1921, Washington, 1924, and Dublin, 1926. Her books include *Twenty Years at Hull House* (1910); *A new Conscience and an Ancient Evil* (1912); *The Long Road of Woman's Memory* (1916); *Peace and Bread in Time of War* (1922).

ADDAX, a genus of antelopes, with one species (*A nasomaculatus*) from North Africa and Arabia. It is 3 ft. high, yellowish white in colour, with a brown mane and fringe on the throat. Both sexes carry horns, which are ringed and form an open spiral. The addax is a desert antelope. It is hunted by the Arabs for its flesh and to test the speed of their horses and greyhounds.

ADDER, a name for the common viper (*q v.*), ranging from Wales to Saghalien island, and from Caithness to the north of Spain. The puff-adder (*Bitis arietans*) of nearly the whole of Africa, and the death-adder (*Acanthophis antarcticus*) from Australia to the Moluccas, are both very poisonous (*see* VIPER).

ADDICT, DRUG: *see* DRUG ADDICTION.

ADDING MACHINE: *see* OFFICE APPLIANCES.

ADDIS ABABA (the new flower), capital of Abyssinia since 1896, about 8,000ft. above sea level on the southern slopes of the Entoto Mts. in 9° 1′ N., 38° 56′ E. It is linked by a single railway line (784km) with Jibuti, the principal town of French Somaliland on the Gulf of Aden, and since the completion of the line in 1918 Addis Ababa has undergone much change. It is embowered in woods of eucalyptus planted by Emperor Menelek to repair the ravages caused in neighbouring forests by his army and followers; and is watered by small tributaries of the Hawash river, notably the Akaki and the Kabana. The population in normal times consists of some 70,000 people, but at feast times many thousands of the followers of the chiefs and provincial governors attend the court. The increasing number of foreign legations are quartered in well-built houses in large grounds some 4m. out of the town. Since the visit of the regent and some of the chiefs to Europe in 1924 many motor cars have been imported into the town and roads made. Shops, stores and offices have been built around the vast central market place, until recently a bare space dotted with piles of stones used as booths, the daily rendezvous of immense numbers of peasants and traders dealing in local and imported cotton and other goods. The Gebbi or imperial palace is a rambling collection of buildings of every kind enclosed by high stone walls, but the King's dwelling is a modern and well equipped house, and quite recently large stone buildings have been erected for government use.

No sanitary, water, or lighting arrangements exist, but there is a telephone service and a bi-weekly postal service to and from the coast. Addis Ababa is the seat of government and the centre of trade, and £1,750,000 worth of goods were transported in and out of the town by rail in 1926.

ADDISON, JOSEPH (1672–1719), English essayist, poet and man of letters, eldest son of Lancelot Addison, later Dean of Lichfield, was born at his father's rectory of Milston in Wiltshire, on May 1, 1672. After having attended several schools, the last Charterhouse, he was entered a commoner of Queen's College, Oxford, at the age of 15; but after two years was elected to a demyship of Magdalen College for his skill in Latin versification. He took his master's degree in 1693, and subsequently obtained a fellowship which he held until 1711. Much of his early Latin verse is preserved in the *Musae Anglicanae* (1691–99). A

poem in the third volume of Dryden's *Miscellanies* followed in the next series by a translation of the fourth *Georgic,* brought about his introduction to Tonson the bookseller, and (probably through Tonson) to Lord Somers and Charles Montagu. To both of these persons he commended himself by *An Account of the Greatest English Poets* (1694), *An Address to King William* (1695), after Namur, and a Latin poem entitled *Pax Gulielmi* (1697), on the Peace of Ryswick, with the result that in 1699 he obtained a pension of £300 a year to enable him (as he afterwards said in a memorial addressed to the Crown) "to travel and qualify himself to serve his Majesty." In the summer of 1699 he crossed into France, where chiefly for the purpose of learning the language, he remained till the end of 1700; and after that he spent a year in Italy. In Switzerland, on his way home, he was stopped by receiving notice that he was to attend the army under Prince Eugene, then engaged in the war in Italy, as secretary from the King But in March 1702 the death of King William at once drove his Whig friends from power and Addison's pension ceased. He was able, however, to visit a great part of Germany, and did not reach Holland till the spring of 1703. In the autumn of the same year Addison returned to England



AFTER THE STATUE IN WESTMINSTER ABBEY

ADDISON WHO, WITH STEELE, DELIGHTED THE TOWN WITH THE "SPECTATOR"

During his residence abroad he wrote the rhymed *Letter from Italy* to Charles Montagu, the *Dialogues on the Usefulness of Medals,* not published until after his death, and the *Remarks on several parts of Italy,* printed in 1705. After his return to England he was asked by Lord Halifax to write a poem celebrating Marlborough's victory at Blenheim. This, *The Campaign* (1704), won for its author a post in the excise, which was practically a sinecure. The next ten years of his life were spent in government service as an under-secretary of State, secretary to Lord Halifax on a mission to the Elector of Hanover (1708), and secretary to Lord Wharton, the lord lieutenant of Ireland (1708–10). His commissionership in the excise he retained all his life, and he sat in Parliament, a silent member, from 1708 onwards, first for Lostwithiel and then for Malmesbury. During this period he wrote an anonymous pamphlet in defence of the Government entitled *The Present State of the War* (1707), and an opera libretto, *Rosamond,* complimenting the Duke of Marlborough, which was a failure at the time, but was afterwards set to music by Dr. Arne with great success. In 1711 he purchased for £10,000 the estate of Bilton near Rugby.

Soon after the fall of the ministry, he started the *Whig Examiner* in opposition to the Tory *Examiner,* then conducted by Prior, and afterwards the vehicle of Swift's most vehement invectives against the party to which he had once belonged. These are certainly the most ill-natured of Addison's writings; but they are neither lively nor vigorous, and the paper died after five numbers (Sept. 14 to Oct. 12 1710). There is more spirit in his allegorical pamphlet, *The Trial and Conviction of Count Tariff.* But meanwhile Addison found his real vocation as one of the greatest of English essayists. Richard Steele, who had been Addison's schoolfellow at the Charterhouse, remained on intimate terms with him and belonged to the same political party. Addison was in Dublin when, in April 1709, Steele published the first number of the "Tatler." He is said to have detected his friend's authorship only by recognizing in the sixth number a critical remark on Virgil, which he remembered having himself communicated to Steele. He began to furnish hints and suggestions, assisted occasionally and finally wrote regularly. According to Aitken (*Life of Steele,* i. 248), he contributed 42 out of the total of 271 numbers, and was part-author of 36 more. With the advent of Addison as a contributor the character of the "Tatler" changed. The essay began to preponderate, and the news element almost disappeared. The paper was discontinued from Jan. 2, 1711, perhaps because its semi-political character made Steele's position difficult under the Tory administration. But after a very short time it had a successor in the "Spectator," in which Addison played the leading part. The paper was to be non-political, and was to "bring philosophy out of the closets and libraries, schools and colleges, to dwell in clubs and assemblies; at tea-tables and in coffee-houses" (*Spectator* No. 10).

The first number appeared on March 1, 1711; the paper was issued daily until Dec. 6, 1712. In the "Tatler" the papers on different subjects had been dated from various clubs; in the "Spectator" the framework is supplied by an imaginary club grouped round the "Spectator" Mr Spectator himself, whose character is portrayed in the first number, represents a new and more sober England, very different from the court circles of the time. He is learned, thoughtful, serious, yet with a pleasant humour; he frequents the coffee-houses, and his observant eye notes the new spirit growing up under the older forms of society. His fellow club members represent different types. Sir Roger de Coverley is the old English country gentleman; Sir Andrew Freeport represents the great London merchant class; Captain Sentry is the good-humoured soldier discharged in civil life; Will Honeycomb the man of fashion, while the Templar stands for learning and wit, and so on

For nearly two years the "Spectator" delighted the town The "Spectator" stood for reason and moderation in an age of bitter party strife, for clean living in an age when the English upper classes had not yet recovered from the licence of the Restoration, and in criticism for the best standards of its time. Addison and Steele were for a reconciliation of the harsh austerities of Puritanism with the careless profligacy of the Restoration. They were, in fact, great moralists Samuel Johnson, whose political sympathies did not make him too friendly to Addison, paid his tribute to the lucidity and purity of his English style. "Whoever wishes to attain an English style," he said, "must give his days and nights to the volumes of Addison" And Macaulay speaks justly of Addison as the "consummate painter of life and manners," and of "the great satirist who alone knew how to use ridicule without abusing it; who, without inflicting a wound, effected a great social reform, and who reconciled wit and virtue, after a long and disastrous separation, during which wit had been led astray by profligacy and virtue by fanaticism." The "Spectator" includes the famous Saturday papers on Milton in which Addison applied the principles of Aristotelian criticism to Milton's work However excessive his praise of Milton may seem (he placed him above Homer and Virgil), these papers had a great influence on criticism for a long period, and were translated into French and German

Of the 555 papers in the "Spectator" Addison's numbered 274 against 236 written by Steele. W J Courthope estimated the circulation of the "Spectator" at 10,000—a very large number for those days—and the bound annual volumes had a further sale of 9,000. After the "Spectator," Steele projected the "Guardian," which was also to be non-political, but did not maintain its aloofness Addison also contributed a few papers

It is astonishing to some readers that Addison's tragedy of *Cato,* produced on April 13, 1713, should have been counted one of his best achievements. But the artificiality and frigidity of the piece, and its glaring faults even after the emendations of Pope and others, counted for very little against the political interest imported into the play. It was dedicated to the Duchess of Marlborough, and the liberal sentiments put into the mouths of Roman orators were taken as a glorification of Whig sentiments. It was interpreted as a defence of the Whigs and Marlborough against the Tories who were suspected of trying to undo the act of Settlement. *Cato* ran for 35 nights. It was translated into French and German, and Addison was praised by Voltaire as "the first Englishman who composed a regular tragedy and infused a spirit of elegance into every part of it" Voltaire's praise was partly due to Addison's strict adherence to the unity of place which his English contemporaries found unnatural and artificial.

From the cessation of the "Spectator" onwards, Addison's life, though outwardly increasingly prosperous, was clouded by various misunderstandings and quarrels. The rights and wrongs of Pope's quarrel with him (*see* POPE, ALEXANDER) are difficult to disentangle, and cannot be dealt with here. But Addison, who had established Button in a coffee-house in Covent Garden, held a little literary court there of which Budgell, Tickell, Carey and Phillips were members. Pope was not a member of the coterie, though it appears that he made a brief appearance there. In any case there was a complete breach. Pope wrote the famous lines on Atticus in the *Epistle to Dr. Arbuthnot* in which Addison is mercilessly attacked as "willing to wound, and yet afraid to strike," who "like Cato, gives his little senate laws, and sits attentive to his own applause." The *Epistle* was not published until after Addison's death, though he must have seen the lines.

On the accession of George I, Addison was appointed secretary to the lords justices entrusted provisionally with the conduct of the Government until the new King's arrival. He then became once more chief secretary for Ireland. He defended the Hanoverian succession against the Jacobite partisans in a new paper called the "Freeholder" which appeared bi-weekly between Dec. 23, 1715 and June 9, 1716. Probably in return for this service he was made one of the commissioners for trade and the colonies. In Aug. 1716 he married Charlotte, Countess dowager of Warwick, who brought her husband the occupancy of Holland House, Kensington The common report that the marriage was a very unhappy one is based mainly on the evidence of Addison's enemies. The allegations that he was incompetent in the public service are derived from similar sources; but as one of the secretaries of State in the Sunderland cabinet (1717) he seems to have been a failure. He resigned on the plea of failing health in March 1718. In the same month he found himself ranged as a pamphleteer against his old friend Dick Steele. The contest was still proceeding when Addison died of dropsy, June 17, 1719 Steele's real love for his friend was shown in the letter to Congreve prefixed to Addison's anonymous comedy *The Drummer,* acted in 1716.

Addison's life was written in 1843 by Lucy Aikin. This was reviewed by Macaulay in July of the same year. A more modern study is that in the "Men of Letters" series by W. J. Courthope (1884). The *Spectator* (seven vols. 1712–13, the 8th being added in 1715), was frequently reprinted. There is a good modern edition, in eight vols. (1897–98) by G. Gregory Smith. Of the *Tatler* there is an edition by G. A. Aitken in eight vols. (1898). A complete edition of Addison's works (based upon Hurd) is included in Bohn's *British Classics;* Bonamy Dobree, *Essays in Biography* (1925).

ADDISON'S DISEASE, an affection manifesting itself in an exaggeration of the normal pigment of the skin, asthenia, irritability of the gastro-intestinal tract, and weakness and irregularity of the heart's action: these symptoms being due to loss of function of the suprarenal glands. It is important to note, however, that Addison's disease may occur without pigmentation, and pigmentation without Addison's disease. The condition was first recognized by Dr. Thomas Addison of Guy's Hospital, London, in 1855. But it remained for Schafer and Oliver of University college, London, to demonstrate that the suprarenal glands contain a very powerful extract which produces toxic effects when administered to animals, and that an active principle "adrenalin" can be separated, which excites contraction of the small blood vessels and thus raises blood pressure. The latest views of this disease thus stand: (1) that it is entirely dependent on suprarenal disease, being the result of a diminution or absence of their internal secretion, or else of a perversion of their secretion; or (2) that it is of nervous origin, being the result of changes in or irritation of the large sympathetic plexuses in the abdomen; or else (3) that it is a combination of glandular inadequacy and sympathetic irritation.

The morbid anatomy shows (1) that in over 80% of the cases the changes in the suprarenals are tuberculous, usually beginning in the medulla and resulting in caseation; and that this lesion is bilateral and usually secondary to tuberculous disease elsewhere, especially of the spinal column. In the remaining cases (2) simple atrophy has been noted, or (3) chronic interstitial inflammation leading to atrophy; and finally (4) an apparently normal condition of the glands, but the neighbouring sympathetic ganglia diseased or involved in a mass of fibrous tissue.

The onset of the disease is insidious and consists in a slow but increasing condition of weakness. There is a feeble and irregular action of the heart, resulting in attacks of syncope which may prove fatal. Blood pressure is low and anaemia may be great. From time to time there may be severe attacks of nausea, vomiting or diarrhoea. The best known, though a late, symptom is a gradually increasing pigmentation of the skin, ranging from a bronzy-yellow to brown or even occasionally black. This pigmentation shows itself (1) over exposed parts, as face and hands; (2) wherever pigment appears normally, as in the axillae and round the nipples; (3) wherever pressure is applied, as round the waist; and (4) occasionally on mucous membranes, as in the mouth.

The patient's temperature is usually sub-normal. The disease is commoner in males than in females, and among the lower classes than the upper. But this latter fact may be due to poor nourishment and bad hygienic conditions rendering the poorer classes more susceptible to tuberculosis.

The diagnosis is by no means easy. Pigmentation of the skin occurs in many conditions, but the presence of a low blood pressure with weakness and irritability of the heart and some of the preceding symptoms render the diagnosis fairly certain. The latest researches on the subject tend to indicate a more certain diagnosis in the effect on the blood pressure of administering suprarenal extract, the blood pressure of the normal subject being unaffected thereby, that of the man suffering from suprarenal inadequacy being markedly raised. The disease is treated by promoting the general health in every possible way: by diet; by tonics, especially arsenic and strychnine; by attention to the hygienic conditions; and always by the administration of one of the many preparations of the suprarenal gland extract.

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"ADDLED PARLIAMENT," the name usually given to the English parliament which met on April 6, 1614, sat for two months of violent debate, and was finally dissolved by James I. without having passed a single bill. Seven years passed before another parliament was summoned.

"ADDRESS, THE," an English parliamentary term for the reply of the Houses of Parliament (and particularly of the House of Commons) to the speech of the sovereign at the opening of a new parliament or session. There are certain formalities which distinguish this stage of parliamentary proceedings. The "King's Speech" itself is divided into three sections. the first, addressed to "My Lords and Gentlemen," touches on foreign affairs; the second, to the "Gentlemen of the House of Commons," has reference to the estimates; the third, to "My Lords and Gentlemen," outlines the proposed legislation for the session. Should the sovereign in person open parliament, he does so in the House of Lords in full state, and the Speaker and members of the House of Commons are summoned there into the royal presence. The sovereign then reads his speech. If the sovereign is not present in person, the speech is read by commission. The Commons then return to their House, and an address in answer is moved in both Houses. But before this motion a bill is read *pro forma,* a survival of an ancient claim of the Commons to assert their right of deliberation on subjects other than the Crown's immediate cause of summons. The Government of the day selects two of its supporters in each House to move and second the address, and when carrying out this honourable task they appear in levee dress. Previous to the session of 1890–91, the royal speech was answered paragraph by paragraph, but "the address" is now moved in the form of a single resolution, thanking the sovereign for his most gracious speech. The debate on the address is used as a means of ranging over the whole Government policy, amendments being introduced by the Opposition. A defeat on an amendment to the address is generally regarded by the Government as a vote of no-confidence. After the address is agreed to it is ordered to be presented to the sovereign. The thanks of the sovereign for the address are then conveyed to the Lords by the lord steward of the household and to the Commons by the comptroller of the household.

ADDRESSING MACHINE: *see* OFFICE APPLIANCES.

ADE, GEORGE (1866–), American author, was born at Kentland, Ind., on Feb 9, 1866. After graduating from Purdue University in 1887, he took up newspaper work in Lafayette, Ind., and Chicago (1887–1900). Although he belongs to the school of American vernacular humorists, he is definitely an urban product. Many of his early books, such as *Artie* (1896) and *Doc' Horne* (1899) were designated as stories "of the streets and town" and were adapted from his newspaper contributions. His best-known book, *Fables in Slang* (1899), is clever and sophisticated Ade has written a number of musical comedy librettos, film scenarios, including *Back Home and Broke* (1922), and plays, the best known of which are *The County Chairman* (1903), *The College Widow* (1904) and *Father and the Boys* (1908).

ADELAER or ADELER, the surname given to KURT SIVERTSEN (1622–75), Norwegian-Danish sailor. Born at Brevig, in Norway, he entered the Dutch navy and then the Venetian service, where he was known as Curzio Suffrido Adelborst (*i.e.*, Dutch for "naval cadet") He commanded the Venetian squadron at the battle of the Dardanelles (May 13, 1654) when his ship alone sank 15 Turkish galleys and burned others. Next day he compelled the surrender of the Turks at Tenedos.

In 1660 he became admiral-lieutenant in the Venetian service, but in 1662 he was induced to take command of the Danish fleet. Under Christian V. he took command of the combined Danish fleets against Sweden, but he died suddenly before the expedition set out

ADELAIDE (ADELHEID) (931–999), queen of Italy and empress, was the daughter of Rudolph II of Burgundy, and married, in 947, Lothair, who succeeded his father Hugh as king of Italy. Lothair died in 950 and Adelaide was imprisoned at Como by his successor, Berengar II, marquis of Ivrea, who wished to compel her to marry his son Adalbert. After four months (August 951), she escaped, and took refuge at Canossa with Atto, count of Modena-Reggio Meanwhile Otto I, the German king, whose English wife, Edgitha, had died in 946, came to Italy. Adelaide met him at Pavia, and at the close of the year the marriage took place On Feb 2, 962, she was crowned empress at Rome by Pope John XII. immediately after her husband, and she accompanied Otto in 960 on his third expedition to Italy, where she remained with him for six years

After Otto I's death (May 7, 973), Adelaide exercised for some years a controlling influence over her son, the new emperor, Otto II. The causes of their subsequent estrangement are obscure, but it was possibly due to the empress's lavish expenditure in charity and church building, which was a serious drain on the imperial finances In 978 she left the court and lived partly in Italy, partly with her brother Conrad, king of Burgundy, by whose mediation she was ultimately reconciled to her son. In 983, shortly before his death, she was appointed his viceroy in Italy, and, in concert with the Empress Theophano, widow of Otto II, and Archbishop Willigis of Mainz, defended the right of her infant grandson, Otto III, to the German crown against the pretensions of Henry the Quarrelsome, duke of Bavaria.

In June 984 the infant king was handed over by Henry to the care of the two empresses; but the masterful will of Theophano soon obtained the upper hand, and until the death of the Greek empress, on June 15, 991, Adelaide had no voice in German affairs. She assumed the regency, in concert with Archbishop Willigis and a council of princes of the Empire, and held it until in 995 Otto was declared of age. In 996 the young king went to Italy to receive the imperial crown; and from this date Adelaide devoted herself to pious exercises, to correspondence with the abbots Majolus and Odilo of Cluny, and to the foundation of churches and religious houses. She died on Dec. 17, 999, and was buried in the convent of Saints Peter and Paul, her favourite foundation, at Salz in Alsace By the Emperor Otto I she had four children: Otto II. (d 983), Mathilda, abbess of Quedlinburg (d. 999), Adelheid (Adelaide), abbess of Essen (d. 974) and Liutgard, who married Conrad II., duke of Franconia, and died in 955.

BIBLIOGRAPHY.—Adelaide's life (*Vita* or *Epitaphium Adalheidae imperatricis*) was written by St. Odilo of Cluny. It is valuable only for her later years, the rest of her life being merely outlined, though her adventures in escaping from Berengar are treated in more detail. The best edition is in Duchesne, *Bibliotheca Cluniacensis*, pp. 353–362 *See* Giov. Batt. Semeria, *Vita politico-religiosa di s. Adeleida, etc.* (Turin, 1842); Jul. Bentzinger, *Das Leben der Kaiserin Adelheid . . . während der Regierung Ottos III.*, Inaug Dissertation (Breslau, 1883); J. J. Dey, *Hist. de s. Adelaide, etc.* (Geneva, 1862), F. P. Wimmer, *Kaiserin Adelheid, Gemahlin Ottos I. des Grossen* (Regensb, 1889); Wattenbach, *Deutschlands Geschichtsquellen* (Stuttgart and Berlin, 1904). *See* Chevalier, *Répertoire des sources historiques* (1903).

ADELAIDE, capital of South Australia, in the county to which it gives its name, is situated near the middle of the eastern side of St. Vincent gulf where the coast line curves farthest inland (eastwards). The genius of Sturt, and then of Light, the first surveyor-general, selected (1836) a site upon fertile plains which here sweep up very gently from the coast to a curving line of hills some 9m inland (Mt Lofty, *c* 7m [air-line] E S E of Adelaide, 2,334 feet) Light chose, not without opposition, a spot on rising ground, close to the Torrens stream, the chief early source of water-supply, and within easy reach of a fair open roadstead (Holdfast bay, *c.* 6m) Within 8m also was the only considerable sheltered inlet along this recently elevated coast, the Port Adelaide "river," a deflected tidal estuary. This water—shallow, muddy, but improved by dredging—became the site of Adelaide's port until the construction of the outer harbour provided a more accessible anchorage for larger vessels near the mouth of the estuary and facing the open gulf Southwards the hills close in upon the plain and meet the coast line, but northwards the lowlands stretch, broadening, up to and beyond the head of the gulf Easy movement was possible also by various gaps and saddles to the Murray lowlands in the east and south-east, and Adelaide thus soon became an important nodal point for lines of movement by land and sea The fertility of the plains—deep alluvium washed down from the torrent-scarred hills—the presence of minerals (though in relatively small quantities) in the hills, and the genial climate formed the basis of Adelaide's prosperity. A fairly regular rainfall of *c.* 21in falling largely in the winter months (April–November); temperatures hot in summer (Jan mean: 73°; highest recorded [shade] maximum 116°, with fairly frequent heat spells), but cool and bracing in winter (June mean. 52° with occasional frosts); land and sea breezes along the coast and much sunshine make up a typical Mediterranean climate.

The town was laid out by Light in the form of a square, divided into rectangular blocks with gardens and parks at the points of intersection Around the square a mile-broad belt of park-land was reserved, and beyond these stretch the suburbs. The park-lands have been to some extent encroached upon for public buildings, but the remainder form the great playground and "lungs" of the city which claims to have no slums The climate and the presence of the river Torrens, now artificially dammed and converted into a lake, lend Adelaide the peculiar charm of diversified vegetation, north-western European, southern European and sub-tropical

After a somewhat chequered early history Adelaide, in virtue of its commanding situation in relation to all the more important southern parts of the State, steadily grew in prosperity and size until, with 316,865 inhabitants, it had a decidedly alarming proportion (nearly 56%) of the total population of the State (1926), 566,394 Its commercially central position and good communications, ready supplies of raw materials and of imported coal, and a protective tariff have built up in the metropolitan area (particularly along the main lines to Port Adelaide) a number of flourishing young industries, manufacturing woollens, machinery, pottery, etc. To Adelaide gravitate the products of the agricultural and pastoral areas of the surrounding fertile districts, and thither also, for lack of a river-mouth port, come the bulk of the products—wool, wheat, fruit—of the lower Murray valley (*see* ALEXANDRINA LAKE) The trade of Port Adelaide (1924–25 £25·9 million; 2,074 million tons) is five to six times as valuable as that of any other South Australian port, and fourth as regards value and tonnage amongst the ports of Australia.

The city possesses many fine buildings, including the

University, School of Mines, an Anglican and a Roman Catholic Cathedral, Exhibition Building and others. It was the birthplace of municipal government in Australia and gained a Lord Mayoralty in 1919.

ADELARD or **AETHELARD** of Bath (12th century), English scholastic philosopher. He studied in France and travelled in Spain, Italy, North Africa and Asia Minor, where he became acquainted with Arabian scholarship. He returned to England in the time of Henry I., and received an annual grant from the revenues of Wiltshire. Adelard translated Euclid's *Elements*, probably from an Arabic version The work, which was published in Venice in 1482 under the name of *Campanus de Novara*, at once began to be used as a text-book in the schools. Adelard's special contribution to scholastic philosophy was the treatise *De eodem et diverso*, in which he enunciated the theory of "indifference." *See* SCHOLASTICISM.

It is in the form of a dialogue between himself and his favourite nephew, and was dedicated to Richard, bishop of Bayeux from 1113 to 1133. He wrote also a group of treatises on the astrolabe (a copy of which is in the British Museum), on the abacus (three copies exist in the Vatican Library, the library of Leyden University and the Bibliothèque Nationale in Paris), translations of the Kharismian Tables and an Arabic *Introduction to Astronomy*.

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ADELIE LAND, Antarctic land situated on the polar circle in longitude 140° E, discovered by the Frenchman Dumont d'Urville in 1840 The steep coasts, rising to heights of from 3,250 to 4,000ft are almost unapproachable. Although covered with snow and ice and completely uninhabited, it has possibilities of utilization for whale-fishing. (*See* also ANTARCTIC REGIONS)

ADELSBERG: *see* POSTUMIA GROTTE.

ADELUNG, JOHANN CHRISTOPH (1732–1806), German grammarian and philologist, was born at Spantekow, in Pomerania, on Aug. 8, 1732. In 1787 he was made principal librarian to the elector of Saxony at Dresden, where he lived until his death on Sept. 10, 1806.

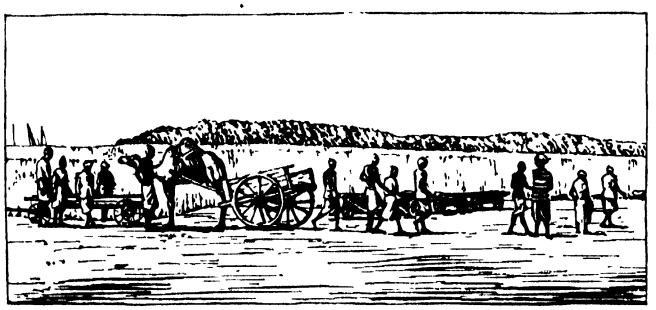
By his grammars, dictionary, and various works on German style, Adelung helped to rectify the orthography, refine the idiom, and fix the standard of his native tongue. His German dictionary—*Grammatisch-kritisches Worterbuch der hochdeutschen Mundart* (1774–86)—bears witness to his intimate knowledge of the history of the different dialects on which modern German is based. No man before Jakob Grimm (*q v*) did so much for the language of Germany. At the time of his death Adelung was engaged on a work on general philology, entitled *Mithridates, oder allgemeine Sprachenkunde*. Unfortunately he did not live to complete it. The first volume, which deals with the Asiatic languages, was published immediately after his death; the other two were issued under the superintendence of Johann Severin Vater (1771–1826).

ADEMPTION, a taking away; in law, a revocation of a grant or bequest (*see* LEGACY).

ADEN, seaport and territory in Arabia, situated in 12° 45′ N, and 45° 4′ E, on a peninsula near the entrance to the Red sea, 100m. east of the Strait of Bab-el-Mandeb. The peninsula of Aden has barren and desolate volcanic rocks, rising to 1776ft. and extending 5m. from east to west, and 3m. from its northern shore to Ras Sanailah or Cape Aden, its most southerly point; it is connected with the mainland by a neck of low sandy ground. The town is built on the eastern coast, in what is probably the crater of an extinct volcano, and is surrounded by precipitous rocks forming an admirable natural defence There are two harbours, an outer, facing the town, protected by the island of Sirah, but now partially choked with mud; and an inner, called Aden Back-bay, or, by the Arabs, Bandar Tawayih, on the western side of the peninsula, which at all periods of the year admits vessels drawing less than 20 feet. Aden suffers considerably from the want of good water, and the heat is often intense. A little water is obtained from wells, and some from an aqueduct 7m. long, built in 1867.

Aden early became the chief entrepôt of trade between Europe and Asia. It is the Ἀραβία εὐδαίμων of the Periplus. It was known to the Romans as *Arabia Felix* and *Attanae*, and was captured by them, probably in the year 24 B.C. In 1513 it was unsuccessfully attacked by the Portuguese under Albuquerque, but subsequently fell into the hands of the Turks in 1538. In the following century the Turks themselves relinquished their conquests in Yemen, and the sultan of Sana established a supremacy over Aden, which was maintained until 1735, when the sheikh of Lahej, throwing off his allegiance, founded a line of independent sultans.

From the 16th to the 19th century traffic between Europe and the East had mostly gone via the Cape of Good Hope. The annexation of Aden to British India in 1839 renewed trade between India and the Red sea and this developed enormously after the cutting of the Suez canal. Aden was made a free port and a coaling station and its territory has been extended by cession or purchase. The island of Perim in the Strait of Bab-el-Mandeb was occupied in 1857. In addition to its east and west trade Aden has many commercial relations with the interior and with the coast of Africa opposite.



A CAMEL-CART IN ADEN THIS CHARACTERISTIC VEHICLE FORMS THE USUAL MEANS OF CONVEYANCE AND IS DETERMINED BY THE NATURE OF THE TERRAIN WHERE IT IS IMPASSABLE TO MODERN TRANSPORT

The chief imports are coffee, cotton-piece goods, grain, hides, coal, sugar and tobacco. The exports are, in the main, the same as the imports Aden itself produces salt and cigarettes. The trade is largely a transhipment trade. In 1925–26 the total value of imports was Rs 8,98,19,456, of which Rs 28,20,660 was land-borne; and of exports Rs 7,52,67,613, of which Rs 29,00,581 was land-borne, as compared with imports valued at Rs.6,56,62,230 and exports at Rs.6,62,36,935 in 1913–14. In 1925–26, 1,315 merchant vessels of 4,356,326 tons (net) entered the port of Aden besides 1,029 local craft. The submarine cables of the Eastern Telegraph Company here diverge—on the one hand to India, the Far East and Australia, and on the other hand to Zanzibar and the Cape. During the war of 1914–18 a metre-gauge railway was constructed for military purposes from Aden to Lahej, 26 miles. Later it was extended to Habil, a further eight miles. The total population of the settlement in 1921 including Perim island was 54,923 (including about 500 Europeans) as compared with less than 1,000 in 1839.

Boundaries and Administration.—The frontier of the protectorate was demarcated in 1902–04, and in 1905 a convention was signed by the British and Ottoman commissioners determining the boundary from Sheikh Murad on the Red sea coast to the Bana river, and thence in a north-easterly direction into the desert. By an Anglo-Turkish Convention of 1914 the boundary was prolonged to a point on the shores of the Persian gulf opposite Bahrein island. During the World War, the Turkish forces encroached on Aden territory and approached to within a short distance of the town; they occupied Lahej and Sheikh Othman. At the end of the war the Turks withdrew from the Yemen. The neighbouring territories of the Iman of San'ā conform, theoretically, with the 1905 line, though encroachments had been made at some points which, in 1925, were the subject of dispute.

For internal administrative purpose Aden is under the control of the Government of Bombay and, ultimately, of the Government of India. The political relations of Aden with the rest of Arabia and with the tribes of the protectorate were taken charge of during the World War by the high commissioner of Egypt. In

1920 political control was transferred to the political resident, who was directly responsible to the British Foreign Office. In 1921 this responsibility was taken over by the Colonial Office. It has been further agreed that for the future London shall be entirely responsible for the political and military administration, the Government of India remaining responsible for the internal administration. It was also decided that from 1927 the Government of India should contribute a fixed sum for three years towards military and political charges and thenceforward one-third of these charges, subject to a fixed maximum

ADENÈS, ADENEZ or **ADANS,** surnamed Le Roi, French trouvère, was born in Brabant about 1240 He owed his education to the kindness of Henry III., duke of Brabant, and he remained in favour at court for some time after the death (1261) of his patron In 1269 he entered the service of Guy de Dampierre, afterwards count of Flanders, probably as *roi des ménéstrels,* and followed him in the next year on the abortive crusade in Tunis. The expedition returned by way of Sicily and Italy, and Adenès left in his poems some very exact descriptions of the places through which he passed.

The poems written by Adenès are four: the *Enfances Ogier, Berte aus grans piés, Bueves de Comarchis,* and a long *roman d'aventures, Cléomadès,* borrowed from Spanish and Moorish traditions brought into France by Blanche, daughter of Louis IX. Adenès probably died before the end of the 13th century

Bibliography —The romances of Adenès were edited for the Académie Impériale et Royale of Brussels by A. Scheler and A van Hasselt in 1874; *Berte* was rendered into modern French by G. Hecq (1897) and by R. Périé (1900), *Cléomadès,* by Le Chevalier de Chatelain (1850) *See* also the edition of *Berte* by Paulin Paris (1832); an article by the same writer in the *Hist. Litt de la France,* vol. xx. p. 679–718, Léon Gautier, *Les épopées françaises,* vol iii. etc.

ADENINE occurs in the pancreas and widely elsewhere in the animal kingdom, as well as in beer yeast and tea leaves. It has been prepared synthetically and also by decomposition of nucleic acids and other complex animal substances It is a colourless solid, crystallizing with three molecules of water, and melting, with decomposition, at 360–365° C. It is a purine base, 6-amino purine ($C_5H_5N_5$)

(*See* Purines)

ADENOIDS, or adenoid growths, masses of soft, spongy tissue between the back of the nose and throat, occurring mostly in young children, blocking the air-way, they prevent the due inflation of the lungs and the proper development of the chest. The growths are apt to keep up a constant catarrh near the orifice of the ventilating tubes which pass from the throat to the ear, and so render the child dull of hearing or even deaf They also give rise to asthma, and like enlarged tonsils—with which they are often associated—they impart to the child a vacant, stupid expression, and hinder his physical and intellectual development They cause him to snore at night, his voice is "stuffy," thick, and unmusical. Though, except in the case of a cleft palate, they cannot be seen with the naked eye, they are often accompanied by a visible and suggestive granular condition of the wall at the back of the throat.

If the child continues to breathe with his mouth open and to snore at night, if he remains deaf and dull, and is troubled with a chronic "cold in his head," the question of thorough exploration of the naso-pharynx and of a surgical operation should most certainly be considered. The comparatively simple operation for their removal results, as a rule, in marked benefit, but this treatment should always be followed by a course of instruction in respiratory exercises.

ADEPT (if used as a substantive pronounced *ad*ept, if as an adjective ad*ept*), completely and fully acquainted with one's subject, an expert. (Lat. *adeptus,* one who has attained.) The word implies more than acquired proficiency, a natural inborn aptitude. In olden times an adept was one who was versed in magic, an alchemist.

ADERNO, town of the province of Catania, Sicily, 22m. by rail N.W. of the town of that name. Pop. (1921) 39,765. Anciently Adranon (the original Siculan settlement was perhaps some 5m. away), it took its name from Adranos, an indigenous deity, in Roman times identified with Vulcan, to whom was dedicated a temple guarded by 1,000 huge dogs. Substructures of the temple may persist outside the town. The town, founded by Dionysius I. (*c.* 400 B.C.), has fine remains of its walls (*see* P. Orsi in *Not. Scavi,* 1915, p. 227). For a time it was the headquarters of Timoleon, and it was the first town taken by the Romans in the First Punic War (263 B C). In the centre of the modern town rises the castle, built by Roger I.

ADES are non-alcoholic beverages made from the juice of lemons, oranges or limes, powdered sugar or syrup and plain, mineral or carbonated water. Usually a maraschino cherry and cracked ice are added, and a straw through which to sip the drink. They are sold in the United States chiefly at soda fountains and drug stores. A departure of the last decade that grows in popular favour is that of serving "orange drinks" at street stands and corner shops. Pineapple "drinks" have more recently come to be handled in the same way and give promise of similar success. A still later innovation is that of extracting the juices of the orange or the lemon through electrical machines installed at soda fountains. The advantage in this method lies in the fact that the customer sees with his own eyes the fresh fruit and the resulting unadulterated juice. It has been estimated that through the California and Florida fruit exchanges 56,000 of these extracting machines have already been distributed, and that in this way the United States used 3,000,000 boxes of the fresh fruit annually

ADEVISM, a term introduced by Max Muller to imply the denial of gods (Skt *deva*), on the analogy of Atheism, the denial of God (*see* Gifford Lectures, 1892, c ix)

ADHÃN: *see* Azān

ADHÉMAR DE CHABANNES (*c* 988–*c.* 1030), mediaeval historian, was born at Chabannes, France He was a monk of the monastery of St Cybard, Angoulême, and died, probably at Jerusalem, where he was on pilgrimage Adhémar's principal work, *Chronicon Aquitanicum et Francicum* or *Historia Francorum,* is in three books and deals with Frankish history from the fabulous reign of Pharamond, king of the Franks, to A.D. 1028. The two earlier books are scarcely more than a copy of the *Gesta regum Francorum,* but the third, dealing with the period from 814 to 1028, is of considerable historical importance, and is published in the *Monumenta Germaniae historica, Scriptores,* iv. (Hanover and Berlin, 1826–92) Other writings of Adhémar's are published by J. P. Migne in the *Patrologia Latina,* tome cxli. (Paris, 1844–55).

See F. Arbellot, *Étude historique et littéraire sur Adémar de Chabannes* (Limoges, 1873); J F E. Castaigne, *Dissertation sur le lieu de naissance et sur la famille du chroniqueur Adémar moine de l'abbaye de St. Cybard d'Angoulême* (Angoulême, 1850).

ADHEMAR (ADEMAR, AIMAR, AELARZ) DE MONTEIL (died 1098), crusader, was bishop of Puy en Velay from before 1087, and accompanied Raymond IV, count of Toulouse, to the East as apostolic legate. He negotiated with Alexis Comnenus at Constantinople, re-established at Nicaea some discipline among the crusaders, caused the siege of Antioch to be raised, and died in that city of the plague

Bibliography —*See* the article by C. Kohler in *La Grande Encyclopédie; Bibliographie du Velay* (1902), 640–50.

ADHESIVE CEMENTS: *see* Cement.

ADIABATIC CHANGE, a change in the physical state of a body, whether this change be one of volume, strain, electric charge, etc., which involves no passage of heat to or from the body. (*See* Thermodynamics)

ADIABATIC LAPSE of temperature of the atmosphere, the limiting rate of decrease of temperature with increasing height consistent with convective (or neutral, or adiabatic) equilibrium In temperate regions the state of the atmosphere is in convective equilibrium and the adiabatic lapse corresponds to a fall of 1° C for each increase in height of 100 metres. (*See* Thermodynamics and Meteorology.)

ADIAPHORISTS, the name of a party in the religious controversies of the 16th century in Germany. The Adiaphorist controversy among Lutherans was an issue of the provisional scheme of compromise between religious parties, drawn up by

Charles V., sanctioned at the Diet of Augsburg, May 1548, and known as the Augsburg Interim. It satisfied neither Catholics nor Protestants. As head of the Protestant party the young elector Maurice of Saxony negotiated with Melanchthon and others, and at Leipzig, Dec. 1548, secured their acceptance of the Interim as regards *adiaphora* (things indifferent), points neither enjoined nor forbidden in Scripture. This sanctioned jurisdiction of Roman Catholic bishops and observance of certain rites, while all were to accept justification by faith (relegating the words "by faith *alone*" to the *adiaphora*). Passionate opposition was led by Melanchthon's colleague, Matthias Flacius, on the grounds that the imperial power was not the judge of *adiaphora*, and that the measure was a trick to bring back popery. From Wittenberg he fled, April 1549, to Magdeburg, making it the headquarters of rigid Lutheranism. Practically, the controversy was concluded by the religious peace ratified at Augsburg (Sept. 1555), which left princes a free choice between the rival confessions with the right to impose either on their subjects; but much bitter internal strife was kept up by Protestants on the theoretical question of *adiaphora;* to appease this was one object of the Formula Concordiae, 1577. Another *Adiaphorist* controversy between Pietists and their opponents, respecting the lawfulness of amusements, arose in 1681, when Anton Reiser (1628–86) denounced the opera as anti-Christian.

See Herzog-Hauck, *Realencyklopädie* (3rd ed); and Hastings, *Encyclopaedia of Religion and Ethics*, art. "Adiaphorism," where the connection of this historic question with the fundamental question of what is vital or essential is shown. For an earlier study, on rigorist lines, *see* E Schmid, *Adiaphora, wissenschaftlich u. historisch untersucht* (1809).

ADIGE, river, North Italy. The Adige rises in small lakes on The Resia (Reschen Scheideck) Pass (4,902ft.), and near Glorenza is joined by tributaries where roads over the Ofen and Stelvio Passes fall in. It flows E. to Merano, and S E to Bolzano, where it receives the Isarco (6ft), and becomes navigable. Turning S W., and receiving the Noce (right) and the Avisio (left), it enters Lombardy, 13m. S. of Rovereto. It falls into the Adriatic at Porto Fossone, a few miles N. of the Po. The most considerable towns on its banks (south of Bolzano) are Trento, Rovereto, Verona and Legnago. It is very rapid, with sudden floods which do great damage. In Lombardy it is 200yds. wide, and 10 to 16ft, deep, but the strong current impedes navigation. The Adige is 220m long and, after the Po, the most important river in Italy In Roman times its lower course lay much farther north than now, along the base of the Euganean hills, and it entered the sea at Brondolo. In A D. 587 the river broke its banks and took its present course, but new streams opened repeatedly to the south, until now the Adige and Po form one delta.

ADIGEI, CHERKESS, autonomous area in the north Caucasian region of the R.S.F.S.R., created July, 1922. It is a narrow strip of territory lying north and south of lat. 45° and curving south at about long. 41° E, forming an autonomous island in the north Caucasian area, mainly along the south banks of the Kuban river and Laba river, from west of Krasnodar to south of Labinsk. It was formerly part of the Kuban province. The Kuban river is navigable to its confluence with the Laba river but is malarial and swampy and frequently floods its banks. The population 114,176 (1926) is entirely rural and is administered from Krasnodar, for which purpose it is divided into the following sections.—Dzhidzhikhablsk (18,064), Natyrbovsk (22,229), Preobrazhensk (27,608), Takhtamykaevsk (20,228), Khakyrino-Khabalsk (30,055). The Adigei or Adyghei (their own name) or Cherkess (their Russian name) are Circassians who formerly occupied the mountain valleys but were compelled by Russia in 1861 either to settle on the flat land or to emigrate (200,000 settled in Turkey, as the Bashi-Bazouks). They are mainly Alpine in physical type and speak a non-Aryan language related to Abkhasian and Kabard. Their religion was Mohammedan, mingled with old heathen and modern Christian rites. Cattle and sheep-rearing were their chief occupations, and great respect to seniority and hospitality, and fierce vendettas, were characteristic. Their present habitat is on the southern limit of the black earth steppe region where it merges into the broad-leaved, deciduous forest and they are now mainly agricultural, with wheat, maize and sunflower seed as the chief crops, and consequently their old customs are rapidly dying out.

ADIPOCERE, a substance into which animal matter is sometimes converted (from the Lat. *adeps*, fat, and *cera*, wax), and so named by A. F. Fourcroy, from its resemblance to both fat and wax. When the Cimetière des Innocens at Paris was removed in 1786–87, great masses of this substance were found where the coffins containing the dead bodies had been placed very closely together. Chemically, adipocere consists principally of a mixture of palmitic, margaric and oxymargaric acids combined with a little ammonia; glycerine appears to be absent (*see* also under GLYCERIDES). Lime, derived from the tissues, is present with other substances as an inorganic residue. It appears that it is not formed from protein, but from the body fats which collect together and undergo decomposition.

ADIPOSE TISSUE is composed of specialized connective tissue cells which contain large globules of fat The chief chemical constituents of this fat are the neutral glycerol esters of stearic, oleic and palmitic acids. The fat stored in these cells comes in part directly from the fats eaten, and in part is manufactured within the body from fats and carbohydrates in the food and sometimes from protein. The main reservoir of fat in the body is the adipose tissue beneath the skin, called the *panniculus adiposus*. There are also deposits of fat between the muscles, among the intestines and in their mesentery, around the heart, and elsewhere Beside acting as a fuel reserve against times of starvation or great exertion the *panniculus adiposus* conserves the heat of the body. Fat also seems to be a factor in resistance to disease, since undernourished people are more prone to infections than those in a good state of nutrition.

ADIRONDACKS, a group of mountains in north-eastern New York, U S.A., in Clinton, Essex, Franklin and Hamilton counties, often included by geographers in the Appalachian system, but pertaining geologically to the Laurentian highlands of Canada. Unlike the Appalachians, the Adirondacks do not form a connected range, but consist of many summits, isolated or in groups, arranged with little appearance of system. There are about 100 peaks, ranging from 1,200 to more than 5,000ft. in height, and 42 more than 4,000ft.; the highest peak, Mt. Marcy (called by the Indians Tahawus or "cloud-splitter"), is near the eastern part of the group and attains an elevation of 5,344ft. Other high peaks are McIntyre, 5,112ft; Skylight, 4,920; Haystack, 4,918; and Whiteface, 4,872. These mountains, consisting of various sorts of gneiss, intrusive granite and gabbro, have been formed partly by faulting but mainly by erosion, the lines of which have been determined by the presence of faults or the presence of relatively soft rocks. The mountains form the water-parting between the Hudson and the St. Lawrence rivers. On the south and south-west the waters flow either directly into the Hudson, which rises in the centre of the group, or else reach it through the Mohawk. On the north and east the waters reach the St. Lawrence by way of Lakes George and Champlain, and on the west they flow directly into that stream or reach it through Lake Ontario. The most important rivers within the area are the Hudson, Black, Oswegatchie, Grass, Raquette, Saranac and Ausable. Among the larger lakes are the Upper and Lower Saranac, Big and Little Tupper, Schroon, Placid, Long, Raquette and Blue Mountain. The surface of most of the lakes lies at an elevation of over 1,500ft. above the sea; their shores are usually rocky and irregular, and the wild scenery within their vicinity has made them very attractive to the tourist.

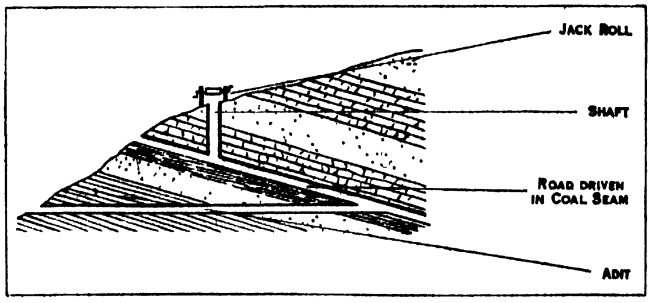
The region known as the Adirondack Wilderness, or the Great North Woods, embraces between 5,000 and 6,000 sq. m. of mountain, lake, plateau and forest, which for scenic grandeur is almost unequalled in any other part of the United States. Railways and highways penetrate the heart of the region and small boats ply upon the larger lakes. Well-marked trails lead to the crests of the better-known peaks. The mountains are easily reached from Plattsburg, Port Kent, Herkimer, Malone and Saratoga Springs. Every year thousands spend the summer

months in the wilderness, where cabins, hunting lodges, villas and hotels are numerous. The resorts most frequented are in the vicinity of the Saranac and St. Regis lakes and Lake Placid.

In the Adirondacks are some of the best hunting and fishing grounds in the eastern United States. At the head of Lake Placid stands Whiteface mountain, from whose summit one of the finest views of the Adirondacks may be obtained. Two miles south-east of this lake, at North Elba, is the old farm of the abolitionist John Brown, which contains his grave and is much frequented by visitors. Lake Placid is the principal source of the Ausable river, which for a part of its course flows through a rocky chasm from 100 to 175ft. deep and rarely over 30ft. wide. At the head of the Ausable chasm are the Rainbow falls. Another impressive feature of the Adirondacks is Indian pass, a gorge about 11m. long, between Mt. McIntyre and Wallface mountain, a majestic cliff rising vertically from the pass to a height of 1,300 feet. Keene valley, in the centre of Essex county, is another picturesque region, presenting a pleasing combination of peaceful valley and rugged hills. Though the climate during the winter months is very severe—the temperature sometimes falling as low as −42°—it is beneficial to persons suffering from pulmonary troubles and a number of sanatoria have been established. The region is heavily wooded with spruce, hemlock, pine and hardwood trees. Lumbering has been much restricted by the creation of a State forest preserve, containing in 1927, 1,884,643 ac, and by the purchase of large tracts for game preserves and recreation grounds by private clubs. The so-called Adirondack park, containing over 3,000,000 ac., includes most of the State preserve and large areas held in private ownership.

See S R. Stoddard, *The Adirondacks Illustrated* (1894); T. M. Longstreth, *The Adirondacks* (1917), and the *Reports of the New York State Geologist* and the *Bulletins of the New York State Museum*

ADIT. An adit is the name given to a horizontal working made from the surface to strike a seam of coal or a mineral vein. Other names for an adit are "day drift," "day hole" surf (Forest of Dean), "sough" (lead mines of Derbyshire), "water-gates" (north of England), "sorre" (Yorkshire), "aridod" and "audit" as well as adit. Mining by means of adits is very ancient, and was practised in hilly country where the seams were cut by valleys. It was perhaps the earliest method of mining. The adits were driven at such a level as to drain off the water from the workings The figure shows a seam coal outcropping on the side of a hill with ventilating shaft and adit level.



THE LOWER TUNNEL, WHICH IS HORIZONTAL, REPRESENTS AN ADIT CUT ACROSS THE STRATA, TO "WIN" AND DRAIN A COAL SEAM

Sometimes the coal was carried up the shaft on the backs of men or women climbing up ladders, or by means of a jack-roll worked by manual labour. The coal was worked by means of narrow passages driven in the coal, small pillars being left for the support of the roof. The extent to which working was possible was limited by three factors: lack of ventilation, crush of pillars and water difficulties. Mechanical ventilation was not practised. A fire was placed in the shaft to heat the air and so increase the air current. The pillars were made very small with a view to getting as much coal as possible, and as the area worked extended, a point was reached at which the support offered by the pillars of coal became insufficient and a crush of the superincumbent strata supervened, inducing a "creep" or heaving up of the floor, if the floor were a soft fireclay. If the floor was hard, a "thrust" took place and the pillars were crushed. The methods of raising the water from the dip workings to the water level or adit being by means of pumps worked by manual labour, it was not possible to proceed far to the dip from beyond the point where the adit struck the seam of coal, or as it was termed beyond "the line of free drainage."

Where the ground was flat, working by adits was not possible, so that it was usual, in very early times, to get the coal by means of bell pits (*q.v.*) sunk near the outcrop. (R R.)

ADJECTIVE, a word used chiefly in its grammatical sense of limiting or defining the noun to which it refers (Lat. *ad-jacio,* to throw to). Grammarians used to speak of a noun and its adjective together as a noun-adjective. In the art of dyeing, adjective colours are those which require mixing with some basis to render them permanent.

ADJECTIVE LAW. This term means the law of procedure and distinguishes it from the substantive law which it is designed to enforce, the former being viewed as the machinery by means of which the latter is brought into operation.

ADJOURNMENT, the act of postponing a meeting of any private or public body, particularly of parliament, or any business, until another time, or indefinitely (in which case it is an adjournment *sine die*). The word applies also to the period during which the meeting or business stands adjourned.

ADJUDICATION, generally a trying or determining of a case by the exercise of judicial power; a judgment. In a more technical sense, in English and American law, an adjudication is an order of the bankruptcy courts by which a debtor is adjudged bankrupt and his property vested in a trustee. It usually proceeds from a resolution of the creditors or where no composition or scheme of arrangement has been proposed by the debtor. It may be said to consummate bankruptcy, for not till then does a debtor's property actually vest in a trustee for division among the creditors, though from the first act of bankruptcy till adjudication it is protected by a *receiving order.* As to the effect which adjudication has on the bankrupt, *see* under BANKRUPTCY. The same process in Scots law is called sequestration. In Scots law the term "adjudication" has a technical meaning, being the name of that diligence by which a creditor adjudges the heritable estate of his debtor, in order to appropriate it to himself either in payment or security of his debt. The term is also applied to an action of the same nature by which the person beneficially entitled to a right may obtain a legal title to it.

In some foreign legal systems, adjudication means the judicial decision which determines the ownership of a disputed thing, or the shares therein, or the extent of ownership, as in the case of disputed boundaries, following in this the usual meaning of *adjudicatio* in Roman law.

ADJUNCT, that which is joined on to another, not an essential part, and inferior to it in mind or function, but nevertheless amplifying or modifying it. (Lat. *ad,* to, *jungere,* to join) Adverbs and adjectives are adjuncts to the words they qualify Twelve members of the Royal Academy of Sciences in Paris are called "adjuncts."

ADJUSTMENT: *see* AVERAGE; BONDS.

ADJUTANT, a helper or junior in command, one who assists his superior, especially an officer who acts as an assistant to the officer commanding a battalion or unit of similar scale In the British army the appointment of adjutant is usually held by a captain or lieutenant. The adjutant acts as staff officer to the commanding officer, issues his orders, superintends the work of the orderly room and the general administration of the corps, and is responsible for the training of recruits. Regular officers are appointed as adjutants to units of the Territorial army. In the French army, however, the title is given to senior under-officers of superior grade to sergeant. On the European Continent the word is not restricted to the lower units of organization; for example, in Germany the *Adjutantur* includes all "routine" as distinct from "General" staff officers in the higher units, and the aides-de-camp of royal persons and of the higher commanders are also styled adjutant-generals, flügel-adjutanten, etc.

ADJUTANT BIRD, the name given to large storks of the genus *Leptoptilus,* distinguished by their dull plumage, black scabrous head and enormous pouch, of doubtful function, connected with the respiratory system. The largest is *L. dubius* of India. It feeds on offal, frogs and fish, and is a most efficient scavenger, for which reason it is usually protected. Other species are *L javanicus* of south-east Asia and *L. crumenifer,* the marabou stork of Africa; the "marabout" feathers of commerce were originally the under-tail coverts of this bird, but the name is now applied to a large number of kinds of downy feathers.

ADJUTANT-GENERAL, an army official, originally (as indicated by the word) the chief assistant (Lat. *adjuvare*) staff-officer to a general in command, but now a distinct high functionary at the head of a special office in the British and American war departments. In England the second military member of the Army Council is styled adjutant-general to the forces He is a general officer and at the head of his department of the War Office, which is charged with all duties relative to personnel. The adjutant-general of the United States Army is one of the principal officers in the war department, the head of the bureau for army correspondence, with the charge of the records, recruiting, issue of commissions, etc. Individual American states also have their own adjutant-general, with cognate duties regarding the state militia In many countries, such as Germany and Russia, the term has retained its original meaning of an officer on the personal staff, and is the designation of personal *aides-de-camp* to the sovereign.

ADLER, CYRUS (1863–), American scholar and educator, was born in Van Buren, Ark., on Sept. 13, 1863. He graduated at the University of Pennsylvania in 1883 and received the degree of doctor of philosophy in 1887 from Johns Hopkins university, in which, from 1884 to 1893, he was an instructor and associate professor of Semitic languages. He was librarian in 1892–1905 and assistant secretary in 1905–08, of the Smithsonian Institution, Washington From 1889 to 1908 he was curator of historic archaeology and historic religions in the U S. National Museum. He became president of Dropsie college, Philadelphia, in 1908, and was acting president of the Jewish theological seminary of America, New York city, from 1916 until 1924, when he was made president. In 1892 he founded the Jewish Historical Society of America. He was one of the editors of the *Jewish Encyclopaedia* and in 1899 was made editor of the *Jewish Year Book.* His writings include numerous articles on Assyriology, oriental archaeology, Semitic philology, comparative religion, bibliography and American Jewish history.

Among his published works are *The Shofar, Its Use and Origin* (1893); *Told in the Coffee House,* with Allen Ramsay (1898), *International Catalogue of Scientific Literature* (1905); *Jews in the Diplomatic Correspondence of the United States* (1906); *Jacob Henry Schiff* (1921); and "The Beginnings of Semitic Studies in America" in *Oriental Studies* (Baltimore, 1926).

ADLER, FELIX (1851–), American educationalist, was born at Alzey, Germany, Aug. 13, 1851. His father, a Jewish rabbi, emigrated to the United States in 1857, and the son graduated at Columbia college in 1870. After completing his studies at Berlin and Heidelberg, he became, in 1874, professor of Hebrew and Oriental literature at Cornell university In 1876 he established in New York city the Society for Ethical Culture, to the development and extension of which he devoted a great deal of time and energy, and before which he delivered a regular Sunday lecture. In 1902 he became professor of political and social ethics at Columbia university. He also acted as one of the editors of the *International Journal of Ethics.* Under his direction the Society for Ethical Culture became an important factor in educational reform in New York city, exercising through its technical training school and kindergarten (established in Jan. 1878) a wide influence. Dr. Adler also took a prominent part in philanthropic and social reform movements, such as the erection of model tenement houses and the abolition of child labour. He published *Creed and Deed* (1877), *The Moral Instruction of Children* (1892), *Marriage and Divorce* (1905), *The Religion of Duty* (1905), *The World Crisis and Its Meaning* (1915), *An Ethical Philosophy of Life* (1918), and *The Reconstruction of the Spiritual Ideal* (Hibbert lectures at Oxford, 1923).

ADLER, FRIEDRICH (1879–), Austrian politician, was born in Vienna July 9, 1879, the son of Viktor Adler (*q.v.*). From 1907 to 1911 he was lecturer in physics at the University of Zürich, but he was soon immersed in politics. From 1911 to 1916 he was secretary of the Austrian Social Democratic Party and editor of the monthly *Kampf.* During the World War he was in close sympathy with the Socialists of the Left. In despair over the break-up of the International, as a protest against war and a sign of proletarian feeling against it, he shot the Austrian prime minister, Count Sturgkh, on Oct. 21, 1916. On May 19, 1917 a special tribunal condemned him to death, but his sentence later was commuted to 18 years' imprisonment He was, however, amnestied on Nov. 1, 1918. In 1919 he was elected to the National Assembly, and became vice-president of the committee of the Social Democratic Party and of the Union of the Social Democratic deputies. He became secretary of the International Working Union of Socialist Parties (the "2½" International), and after its absorption in the Second International (which changed its name to "Labour and Socialist International" at Hamburg in 1923) became secretary of the latter body also

Adler's chief works are: *Die Erneuerung der Internationale* (1918); *Ernst Mach's Ueberwindung des mechanischen Materialismus* (1918); *Ortszeit, Systemszeit, Zonenzeit und das ausgezeichnete Bezugssystem der Electrodynamik, eine Untersuchung uber die Lorentzische und die Einsteinsche Kinematik* (1920).

See *Friedrich Adler vor dem Ausnahmegericht* (1923).

ADLER, HERMANN (1839–1911), British chief rabbi, born at Hanover on May 30, 1839, the son of N. M. Adler, was educated at University College school and University college, London, and then at Prague under Dr Rapoport After receiving the rabbinical diploma at Prague, he returned to England, to become temporary principal of the Jewish theological college in London for two years With this college he was associated in one capacity or another all his life. He began his ministry at the Bayswater synagogue in 1864, and continued to preach there until 1891, when he became chief rabbi on the death of his father Dr Adler was a prominent figure in English public life, and served on many Mansion House committees and on various bodies concerned with the improvement of social conditions in London. He died on July 18, 1911. A collection of his sermons, entitled *Anglo-Jewish Memories and Other Sermons,* was published in 1909

His daughter, NETTY, sat on the London County Council for Central Hackney from 1910–25, and was deputy chairman of the council in 1922–23. She served on many committees in connection with social questions, but her principal work was done in education. She began her social work as a school manager under the local school board, was then co-opted a member of the London Education Committee 1905–10, and in the County Council was closely connected with the administration of the schools. Apart from education, she was interested in the welfare of children from all points of view, having been for many years joint honorary secretary on the committee for the protection of wage earning children, and a member of the London Advisory Council for Juvenile Employment.

ADLER, NATHAN MARCUS (1803–1890), British chief rabbi, was born at Hanover, Jan 15, 1803, and died at Brighton, England on Jan. 21, 1890. He took his degree of Ph D. at Erlangen in 1828. He was ordained in the same year, was chief rabbi of Oldenburg (1829), and of Hanover in 1830, and on Oct. 13, 1844, was elected chief rabbi in London Here he originated and carried out his scheme for a Jew's college for the training of teachers, which was founded in London on Nov. 11, 1855, with himself as its first president. In 1860 Adler suggested the establishment of a United Synagogue which should bring all the British congregations under one central administration; this idea was realized in 1870, when the United Synagogue bill was passed in parliament. Adler's writings include sermons and commentaries on Hebrew texts, the best known of which is *Nethinah la-ger,* a commentary on the Aramaic paraphrase of Onkelos on the Pentateuch (1874).

ADLER, VIKTOR (1852–1918), Austrian politician, was born at Prague, June 24, 1852. He began to occupy himself early with political and social questions. In 1883 he went to study in

Switzerland and in London, where he came into close touch with Engels. On his return to Vienna, however, he turned entirely to politics. The Workmen's party had sunk into political insignificance and Adler's task was to restore unity in the ranks of labour. In 1886 appeared his paper *Gleichheit,* eventually succeeded by *Die Arbeiterzeitung,* the principal organ of the Social Democratic party, which Adler continued to conduct till his death. In July 1889 he appeared at the first congress of the Second International, of which he became an official, as the representative of the united Austrian Labour party. From that time he was the acknowledged leader of the party.

Adler regarded it as his first task to secure for the workers representation in Parliament, but it was not until 1907 that he was able to secure universal and equal suffrage. The Social Democratic party increased their representation from 11 deputies to 87. Adler himself entered the Diet of Lower Austria in 1902, and in 1905 was elected to the Reichsrat, where, until his death, he played an important part

In the congress and in the secretariat of the International, Adler, with Jaurès and Bebel, played the most prominent part, whether as leader, adviser, or mediator. After the collapse of Austria in 1918 at the constituent session of the provisional German-Austrian National Assembly, he read the declaration of the Social Democrats, in which they expressed their willingness, in association with the other German-Austrian parties, to build the new State on the basis of democracy and self-determination, without prejudice to a possible association with the German Empire. He held for a few days the office of foreign minister, but he broke down and died Nov. 12, 1918, the day on which the State council had decided to proclaim German Austria a democratic republic, and an integral part of the German Reich.

BIBLIOGRAPHY—His works include articles scattered in various newspapers, in the *Neue Zeit; Kampf; Deutsche Worte* (Vienna), in addition to those in the *Arbeiterzeitung;* pamphlets, among which are *Die Fabrikinspektion, insbesondere in England und der Schweiz* (1884), *Die Arbeiterkammern und die Arbeiter* (1886); *Die Gleichheit vor dem Ausnahmegericht* (1889), *Das allgemeine, gleiche und direkte Wahlrecht und das Wahlunrecht in Oesterreich* (1893); *Schwurgerichtsprozess gegen Doktor Viktor Adler wegen Verbrechens der Storung der offentlichen Ruhe* (1894), *Alcoholismus und Gewerkschaft* (many editions) (1907).

AD LIBITUM (Lat., at pleasure), in music, a direction signifying that the performance of the passage in question is left to the unfettered discretion of the performer; also that a given portion of a composition, such as the accompaniment of a choral piece, may be omitted if desired

ADMETUS, in Greek legend, son of Pheres, king of Pherae, in Thessaly. By the aid of Apollo, who served him as a slave—either as a punishment for having slain the Cyclops, or out of affection for his mortal master—he won the hand of Alcestis, the most beautiful of the daughters of Pelias, king of Iolcus. Finding that Admetus was soon to die, Apollo persuaded the Fates to prolong his life, provided any one could be found to die in his place. His parents refused, but Alcestis consented She was rescued by Heracles, who wrestled with Death and made him give her back.

BIBLIOGRAPHY.—*See* A. Lesky, *Alkestis: der Mythus und das Drama* (Vienna, 1925); Roscher's *Lexikon,* arts. Admetos, Alkestis.

ADMINISTRATION, the performance or management of affairs, a term specifically used in law for the administration or disposal of the estate of a deceased person. (*See* WILL OR TESTAMENT.) It is also used generally for "government," and specifically for "the Government" or the executive ministry, and in such connections as the administration (administering or tendering) of the sacraments, justice, oaths, medicines, etc.

Letters of Administration.—Upon the death of a person intestate or leaving a will to which no executors are appointed, or when the executors appointed by the will cannot or will not act, the probate division of the High Court is obliged to appoint an administrator who performs the duties of an executor. This is done by the court granting letters of administration to the person entitled Grants of administration may be either general or limited. A general grant is made where the deceased has died intestate. Formerly, on the death of the owner of realty and personalty intestate, the realty vested in the deceased's heir and the personalty in the court of probate until administrators were appointed. Now, since the rights of heirs as such are abolished by the Administration of Estates Act 1925, all the property, real and personal, vests in the court Moreover, formerly the right to be appointed administrator was more or less defined. Now by the same act the court is given an absolute discretion as to whom it shall appoint, subject to these limitations: that where there is no special reason to the contrary some person interested in the residuary estate should be appointed, and that where the estate passing on the deceased's death includes land settled otherwise than by his will the trustees of the settlement should be appointed (s. 10). Not more than four persons are to be appointed administrators (Judicature Act 1925, s. 160); and separate administrators may be appointed to the real and to the personal estate of the deceased (Administration of Estates Act 1925, s. 13). In the absence of statutory next-of-kin the Crown, on the death intestate of an owner of land and personalty, is now entitled to both as *bona vacantia,* escheat both to the intermediate lord and to the Crown being abolished. If a creditor claims and obtains a grant he is compelled by the court to enter into a bond with two sureties that he will not prefer his own debt to those of other creditors. The more important cases of grants of special letters of administration are the following.—

Administration *cum testamento annexo,* where the deceased has left a will but has appointed no executor to it, or the executor appointed has died or refuses to act. In this case the court will make the grant to the person (usually the residuary legatee) with the largest beneficial interest in the estate.

Administration *de bonis non administratis:* this occurs in two cases—(*a*) where the executor dies intestate after probate without having completely administered the estate; (*b*) where an administrator dies. In the first case the principle of administration *cum testamento* is followed, in the second that of general grants in the selection of the person to whom letters are granted.

Administration *durante minore aetate,* when the person nominated by the will as executor is under age.

Administration *durante absentia,* when the executor or administrator is out of the jurisdiction for more than a year.

Administration *pendente lite,* where there is a dispute as to the person entitled to probate or a general grant of letters the court appoints an administrator till the question has been decided.

BIBLIOGRAPHY—*Woerner, American Law of Administration,* 3rd edition, 3 volumes, Boston, 1923. *Williams, Executors and Administrators,* 11th edition, 2 volumes, London, 1921.

ADMINISTRATOR: *see* ADMINISTRATION, PROPERTY: DEVOLUTION ON DEATH.

ADMIRABLE CRICHTON: *see* CRICHTON, JAMES.

ADMIRAL, the rank and title of the naval officer who commands a fleet or sub-division of a fleet. In the British navy there are four grades of admiral; *i.e.,* admiral of the fleet, admiral, vice-admiral and rear-admiral, in descending order of seniority. These titles superseded those in vogue in the Stuart navy of admiral of the red, white and blue. The term "yellow admiral" was applied familiarly to captains promoted to rear-admiral and placed on the retired list

The rank of admiral essentially applies to flag officers of the military branch who have commanded, or who have qualified to command, a fleet or squadron at sea. The equivalent rank of admiral is granted to certain officers of the non-military branches of the royal navy; *e.g.,* engineer rear-admiral, paymaster rear-admiral, but they are not flag officers and should not be addressed without the appropriate prefix.

The corresponding ranks in the three services are:

NAVY	ARMY	AIR FORCE
Admiral of the Fleet	Field Marshal	Marshal of the Royal Air Force.
Admiral	General	Air Chief Marshal.
Vice-Admiral	Lieut.-General	Air Marshal.
Rear-Admiral.	Major-General	Air Vice-Marshal.

"Admiral of the fleet" is the senior rank in the navy. An officer of this rank retires from the active list at the age of 65, but retains his rank on the retired list. It is exceptional for an

admiral of the fleet to fly his flag at sea in peace time, but in the World War the commander-in-chief of the grand fleet held this rank. Commanders-in-chief of the main fleet; *i.e.*, Mediterranean, and of the premier home ports—Portsmouth and Plymouth—are generally full admirals. The lesser independent commands and seconds-in-command are vice-admirals or rear-admirals.

The political and administrative head of the navy up to the year 1546 was known as "The Lord High Admiral," which office is now executed by the lords commissioners of the Admiralty. There still remain the honorary titles of "Vice- and Rear-Admiral of Great Britain," in compliment on selected senior flag officers.

The origin of the title is undoubtedly Arabic, the derivation being amīr or emīr, which, in combination with other words, signified "men in authority." As a naval title it was first taken by the French from the Genoese during the Crusade of 1249 By the end of the 13th century it had come to be used in England as the title of the officer who commanded the Cinque Port ships.

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ADMIRALTY. The department of State which regulates, controls, and maintains the Navy on behalf of the British Government is the Admiralty. The term "Admiralty" is used (to quote the old official definition) to mean "The Lord High Admiral for the time being . . . and when there shall be no such Lord High Admiral in office, any two or more of the Commissioners for executing the office of Lord High Admiral of the United Kingdom." Actually, the system whereby responsibility centred in a Lord High Admiral of the United Kingdom was terminated in the reign of Henry VIII. and since then the office has been executed by a board, which, varying somewhat in its constituency, has been the forerunner of the Admiralty of to-day.

Before that time there was no recognized organization to supply the wants of the Navy, which were dealt with spasmodically as they arose. Then, with the increase in the strength of the Navy, it became more and more obvious that change was imperative This brought about the formation of a board of principal officers, subordinate to the lord high admiral, whose duty it was to supply the needs of the fleet, and established the sound principle that political and executive control should be superior to, but separate from, administration. The new system also did much to relieve those responsible for the conduct of warlike operations from details of supplies, design, and so forth.

The political and executive authority passed at one time to the king and council and again to a parliamentary committee and yet again to a lord high admiral to the king, but finally it came to be vested in the Board of Admiralty, with whom it remained throughout the great maritime wars from the end of the 17th century to the downfall of Napoleon. This authority, in practice, was not exercised in full by the board of principal officers or the navy board, whose energies were mainly devoted to the administration of supplies. In principle, the several commissioners were, from early days, intended to keep in direct and constant communication with the first lord and with each other, and also with the civil departments working under their control. James I. enjoined that the principal officers and commissioners of the Navy should be in constant communication among themselves, consulting and advising "by common counsel and argument of most voices" and live as near together as could conveniently be arranged, and should meet at the Navy office at least twice a week.

Originally there existed an ordnance board instituted specially for the Navy, but this eventually passed into military hands—very much to the detriment of the Navy's ordnance requirements. It was for long a byword in inefficiency and sloth. There is now a joint board with naval, military, and air force representatives to deal with design but not with supplies, which are the concern of the several departments.

The Navy Board in its early form continued to function for nearly three centuries, but by 1832 the various departments had become so inefficient and unwieldy that reform again became essential. This was undertaken by Sir James Graham, who abolished the Navy office and brought all civil departments directly under the Admiralty board, organizing them under five principal officers; viz : surveyor of the Navy, storekeeper-general, controller of victualling, medical director-general, and accountant-general. Each of these was under a superintending lord of the Admiralty who represented their various charges on the board. This system had the defect that all the lords of the Admiralty were responsible for, and therefore their attention was largely engaged in, questions of supply, and there was no body of senior officers who could devote their time specially to the conduct of war. The reforms were probably dictated in some measure by the fact that the period was one of peace and prospective peace and that the naval estimates had been reduced to the small amount of £4,500,000 per annum. Eventually the system was put to the test by the Crimean War; but it did not bear the strain well and by the end of the 'sixties it had broken down seriously At this time the Navy was expanding considerably and the mechanical era was rapidly developing. The introduction of "ironclads," improvements to ordnance, the gradual ousting of sails by steam, all resulted in efforts centring very largely on material details This and the growing numbers of personnel meant that the members of the board were largely taken up with their departmental duties and had little time to give to matters of policy, much less to war plans.

In 1868 H. C. Eardley Childers, on becoming first lord, endeavoured to rectify the shortcomings of the system, but it cannot be said that his reforms were very successful, since they resulted in the several lords being restricted more than ever to the business assigned to them, whereby board meetings became the exception rather than the rule and much passed into the unprofessional hands of the civil first lord The disaster to the low freeboard masted turret-ship "Captain" brought matters to a head. Childers retired and was succeeded by Goschen in 1871.

The new first lord reverted to the principles of the original system, which made for more collective responsibility. We see the naval staff in embryo in a foreign intelligence committee, inaugurated in 1884. This was developed into the intelligence committee in 1887. It was largely due to the efforts of Lord Charles Beresford that these committees came about and from then onwards the more enlightened sections of the Navy never ceased to press for the formation of a proper war staff.

In 1886 Lord Charles resigned from his appointment as fourth sea lord on the ground that the organization provided for an intelligence department and, for the conduct of war, was inadequate. Various changes in the responsibilities of the First Sea Lord were made by an Order-in-Council of 1904, one of the principal of these being that the senior naval lord was given virtual supremacy over all his colleagues. He was also given considerable responsibility connected with material.

In 1911 Mr. Churchill. as first lord, established a naval war staff. In theory this step was admirable, but in practice the staff was not given the necessary standing or authority in the Admiralty machine. As a result, proper use was not made of its services during the earlier years of the World War, especially in analysing and preparing plans before embarking upon such enterprises as the Dardanelles campaign. The individual influence of the most forceful personality on the board still dominated naval policy to the exclusion of proper staff work and even, on occasion, to considered and well-informed judgment.

In May 1917 we see a new development, whereby the First Sea Lord was made chief of the naval staff, and two naval members were added to the board, with titles of "deputy chief of the naval staff" and "assistant chief of the naval staff " For a short time there was also a third addition, with the title of "deputy first sea lord"; but responsibility continued to rest on all the members of the board.

As the war developed, it became more and more evident that those naval lords who were chiefly engaged in matters of adminis-

tration and supply could not, at the same time, devote adequate attention to the control of the naval side of the war. In point of fact, the position was that they were held responsible in matters with which it was humanly impossible for them to take any very active part. In the autumn of that year the naval staff system was put upon a new and altogether sounder basis and it was separated, so far as was practicable, from administration. Under the presidency of the first lord two committees were formed—one (consisting of the four staff lords) to deal with operations, and the other (consisting of the remaining sea lords and the civil lords) to deal with maintenance. The operations committee dealt with such matters as the provision, equipment, efficiency, organization, and utilisation of the Navy as a fighting force: the maintenance committee devoted their efforts to personnel, material, supplies, works, and the maintenance of the fleet generally, in accordance with the requirements of the operations committee. Questions of great importance were still referred to the board as a whole.

Under this system the first sea lord, as chief of the naval staff, was responsible for movements of ships, the general conduct of naval warfare, the fighting and sea-going efficiency of the fleet, and other matters connected with its active employment. The second sea lord remained chief of naval personnel; the third sea lord, as controller, continued to deal with material matters such as ship construction, design of guns, mountings, torpedoes, and machinery; the fourth sea lord was chief of supplies and transport; the deputy chief of the naval staff was head of the operations, plans, intelligence, and trade divisions; the assistant chief of the naval staff was head of the gunnery, torpedo, training, and staff duties divisions, and the naval air and tactical sections. There continued to be a civil lord, a parliamentary and financial secretary, and the permanent secretary to the board, and, at the head, the minister of State, the first lord.

This organization remained substantially the same after the war and may be said to meet well the peace-time requirements of the Navy, while it provides the essential personnel for the higher conduct of any future war at sea.

BIBLIOGRAPHY.—*Admiralty Administration—Its Faults and Defects* (1861); M. Oppenheim, *Administration of the Royal Navy 1509–1660* (1869); Admiral Viscount Jellicoe of Scapa, *The Crisis of the Naval War* (1920); The Rt. Hon. Winston Churchill, *The World Crisis 1911–14* (1923). (E. A.)

ADMIRALTY, HIGH COURT OF. The High Court of Admiralty of England was the court of the deputy or lieutenant of the admiral. It is supposed in the *Black Book of the Admiralty* to have been founded in the reign of Edward I; but it would appear, from the learned discussion of R. G. Marsden, that it was established as a civil court by Edward III. in the year 1360; the power of the admiral to determine matters of discipline in the fleet, and possibly questions of piracy and prize, being somewhat earlier. At first there were separate admirals or rear-admirals of the north, south and west, each with deputies and courts A list of them was collected by Sir H. Spelman. These were merged in or absorbed by one high court early in the 15th century. Sir Thomas Beaufort, afterwards earl of Dorset and duke of Exeter (appointed admiral of the fleet 1407, and admiral of England, Ireland and Aquitaine 1412, which latter office he held till his death in 1426), certainly had a court, with a marshal and other officers, and forms of legal process—mandates, warrants, citations, compulsories, proxies, etc. Complaints of encroachment of jurisdiction by the admiralty courts led to the restraining acts, 13 Ric. II c. 5 (1389), 15 Ric. II. c. 3 (1391) and 2 Hen. IV. c. 11 (1400).

Jurisdiction.—The original object of the institution of the courts or court seems to have been to prevent or punish piracy and other crimes upon the narrow seas and to deal with questions of prize; but civil jurisdiction soon followed. The jurisdiction in criminal matters was transferred by the Offences at Sea Act, 1536, to the admiral or his deputy and three or four other substantial persons appointed by the lord chancellor, who were to proceed according to the course of the common law. By the Central Criminal Court Act, 1834, cognizance of crimes committed within the jurisdiction of the admiralty was given to the central criminal court. By an act of 1844 it has been also given to the justices of assize; and crimes done within the jurisdiction of the admiralty are now tried as crimes committed within the body of a county. *See* also the Criminal Law Consolidation Acts of 1861.

From the time of Henry IV. the only legislation affecting the civil jurisdiction of the High Court of Admiralty till the time of Queen Victoria is to be found in an act of 1540, enabling the admiral or his lieutenant to decide on certain complaints of freighters against shipmasters for delay in sailing, and one of 1562, giving the lord high admiral of England, the lord warden of the Cinque Ports, their lieutenants and judges, co-ordinate power with other judges to enforce forfeitures under that act—a very curious and miscellaneous statute called "An Act for the Maintenance of the Navy."

In an act of 1534, with regard to ecclesiastical appeals from the courts of the archbishops to the Crown, it is provided that the appeal shall be to the king in Chancery, "and that upon every such appeal a commission shall be directed under the great seal to such persons as shall be named by the king's highness, his heirs or successors, like as in cases of appeal from the Admiralty Court." It is only in this incidental recognition that recorded authority for appeals from the admiralty to persons commissioned under the great seal is to be found. The appeal to these "persons," called delegates, continued until it was transferred first to the Privy Council and then to the judicial committee of the Privy Council by acts of 1832 and 1833.

The early jurisdiction of the court appears to have been exercised very much under the same procedure as that used by the courts of common law. Juries are mentioned, sometimes of the county and sometimes of the county and merchants. But the connection with foreign parts led to the gradual introduction of a procedure resembling that coming into use on the Continent and based on the Roman civil law.

Restraining Acts.—The material enactments of the restraining statutes were as follows:—An act of 1389 (13 Ric. II. c 5) provided that "the admirals and their deputies shall not meddle from henceforth of anything done within the realm, but only of a thing done upon the sea, as it hath been used in the time of the noble prince king Edward, grandfather of our lord the king that now is." The Act of 1391 (15 Ric. II. c. 3) provided that "of all manner of contracts, pleas and quarrels, and other things rising within the bodies of the counties as well by land as by water, and also of wreck of the sea, the admiral's court shall have no manner of cognizance, power, nor jurisdiction; but all such manner of contracts, pleas and quarrels, and all other things rising within the bodies of counties, as well by land as by water, as afore, and also wreck of the sea, shall be tried, determined, discussed and remedied by the laws of the land, and not before nor by the admiral, nor his lieutenant in any wise. Nevertheless, of the death of a man, and of a mayhem done in great ships, being and hovering in the main stream of great rivers, only beneath the (bridges) of the same rivers (nigh) to the sea, and in none other places of the same rivers, the admiral shall have cognizance, and also to arrest ships in the great flotes for the great voyages of the king and of the realm; saving always to the king all manner of forfeitures and profits thereof coming; and he shall have also jurisdiction upon the said flotes, during the said voyage only; saving always to the lords, cities, and boroughs, their liberties and franchises." The statutes of Richard, except the enabling part of the second, were repealed by the Civil Procedure Acts Repeal Act, 1879. The formation of a High Court of Justice rendered them obsolete.

In the reign of James I. the chronic controversies between the courts of common law and the admiralty court as to the limits of their respective jurisdictions reached an acute stage. We find the records of it in the second volume of Marsden's *Select Pleas in the Court of Admiralty*, and in Lord Coke's writings: *Reports*, part xiii. 51; *Institutes*, part iv. chap. 22. In this latter passage Lord Coke records how, notwithstanding an agreement asserted to have been made in 1575 between the justices of the King's Bench and the judge of the admiralty, the judges of the common law courts successfully maintained their right to prohibit suits in admiralty upon contracts made on shore, or within havens, or creeks, or tidal rivers, if the waters were within the body of

any county, wheresoever such contracts were broken, for torts committed within the body of a county, whether on land or water, and for contracts made in parts beyond the seas. It is due to the memory of the judges of Lord Coke's time to say that, at any rate as regards contracts made *in partibus transmarinis*, the same rule appears to have been applied at least as early as 1544, the judges then holding that "for actions transitory abroad, action may lie at common law."

Judge's Patent.—All the while, however, the patents of the admiralty judge purported to confer on him a far ampler jurisdiction than the jealousy of the other courts would concede to him. The patent of the last judge of the court, Sir Robert Joseph Phillimore, dated Aug. 23, 1867, styles him "Lieut Offl Princl and Commissary Genl and Special in our High Court of Admiralty of Eng and President and Judge of the same," and gives to him power to take cognizance of "all causes, civil and maritime, also all contracts, complaints, offences or suspected offences, crimes, pleas, debts, exchanges, accounts, policies of assurance, loading of ships, and all other matters and contracts which relate to freight due for the use of ships, transportation, money or bottomry; also all suits civil and maritime between merchants or between proprietors of ships and other vessels for matters in, upon, or by the sea, or public streams, or fresh-water ports, rivers, nooks and places overflown whatsoever within the ebbing and flowing of the sea, and high-water mark, or upon any of the shores or banks adjacent from any of the first bridges towards the sea through England and Ireland and the dominions thereof, or elsewhere beyond the seas." Power is also given to hear appeals from vice-admirals; also "to arrest . . . according to the civil laws and ancient customs of our high court . . . all ships, persons, things, goods, wares and merchandise"; also "to enquire by the oaths of honest and lawful men . . . of all . . . things which . . . ought to be enquired after, and to mulct, arrest, punish, chastise, and reform"; also "to preserve the public streams of our admiralty as well for the preservation of our royal navy, and of the fleets and vessels of our kingdom . . . as of whatsoever fishes increasing in the rivers"; also "to reform nets too straight and other unlawful engines and instruments whatsoever for the catching of fishes"; also to take cognizance "of the wreck of the sea . . . and of the death, drowning and view of dead bodies," and the conservation of the statutes concerning wreck of the sea and the office of coroner (1276), and concerning pillages (1353), and "the cognizance of mayhem" within the ebb and flow of the tide; all in as ample manner and form as they were enjoyed by Dr. David Lewis (judge from 1558 to 1584), Sir Julius Caesar, and the other judges in order (22 in all) before Sir Robert Phillimore. This form of patent differs in but few respects from the earlier Latin patents—*tempore* Henry VIII.—except that they have a clause *non obstantibus statutis*.

Modern Progress.—As has been said, however, the contention of the common law judges prevailed, and the admiralty court (except for a temporary revival under Cromwell) sank into comparative insignificance during the 17th century. The great maritime wars of the 18th century gave scope to the exercise of its prize jurisdiction; and its international importance as a prize court in the latter half of the 18th and the first part of the 19th centuries is a matter of common historical knowledge. There were upwards of 1,000 prize causes each year between 1803 and 1811, in some years upwards of 2,000.

There were other great judges; but Sir William Scott, afterwards Lord Stowell, is the most famous. Before his time there were no reports of admiralty cases, except Hay and Marriott's prize decisions. But from his time onwards there has been a continuous stream of admiralty reports, and we begin to find important cases decided on the instance as well as on the prize side.

In the reign of Queen Victoria, two enabling statutes, 1840 and 1861, were passed and greatly enlarged the jurisdiction of the court. The manner in which these statutes were administered by Dr. Stephen Lushington and Sir R. J. Phillimore, whose tenure of office covered the whole period of the queen's reign till the creation of the High Court of Justice, the valuable assistance rendered by the nautical assessors from the Trinity House, the great increase of shipping, especially of steam shipping, and the number and gravity of cases of collision, salvage and damage to cargo, restored the activity of the court and made it one of the most important tribunals of the country. In 1875, by the operation of the Judicature Acts of 1873 and 1875, the High Court of Admiralty was with the other great courts of England formed into the High Court of Justice. The principal officers of the court in subordination to the judge were the registrar (an office which always points to a connection with canon or civil law), and the marshal, who acted as the maritime sheriff, having for his baton of office a silver oar. The assistance of the Trinity Masters, which has been already mentioned, was provided for in the charter of incorporation of the Trinity House. These officers and their assistance have been preserved in the High Court of Justice.

Practitioners in the Court.—Till the year 1859 the practitioners in the High Court of Admiralty were the same as those in the ecclesiastical courts and distinct from those who practised in the ordinary courts. Advocates took the place of barristers, and proctors of solicitors. The place of the attorney-general was taken by the king's or queen's advocate-general, and that of the treasury solicitor by the king's or queen's procurator or proctor. There were also an admiralty advocate and an admiralty proctor.

In an act of 1859 the practice was thrown open to barristers and to attorneys and solicitors.

Upon the next vacancy after the courts were thrown open, the Crown altered the precedence and placed the queen's advocate after the attorney- and solicitor-general. There were two holders of the office under these conditions, Sir R. J. Phillimore and Sir Travers Twiss. The office was not filled up after the resignation of the latter, nor was the office of admiralty advocate filled up when next it became vacant.

Ireland.—The High Court of Admiralty of Ireland, being formed on the same pattern as the High Court in England, sat in the Four Courts, Dublin, having a judge, a registrar, a marshal and a king's or queen's advocate. In peace time and war time alike it exercised only an instance jurisdiction, though in 1793 it claimed to exercise prize jurisdiction (*see* ADMIRALTY JURISDICTION). No prize commission ever issued to it. By the Irish Judicature Act of 1877 it was directed that it should be amalgamated with the Irish High Court of Justice upon the next vacancy in the office of judge, and this subsequently took place. There was no separate lord high admiral for Ireland.

Scotland.—At the Union, while the national functions of the lord high admiral were merged in the English office it was provided by the Act of Union that the Court of Admiralty in Scotland should be continued "for determination of all maritime cases relating to private rights in Scotland competent to the jurisdiction of the Admiralty Court." This court continued till 1831, when its civil jurisdiction was given to the Court of Session and the Sheriffs' Courts (*see* ADMIRALTY JURISDICTION).

See J. Godolphin, *View of the Admiral Jurisdiction* (1661); Sir Travers Twiss, *Black Book of the Admiralty*, Rolls' series (1871); R. G. Marsden, *Select Pleas in the Court of Admiralty*, published by the Selden Society (1894). (P.)

ADMIRALTY ISLANDS, about 40 islands of the Bismarck archipelago, north of New Guinea, between 1° and 3° S. and 146° and 148° E. Area 600 sq. miles. Manus, the largest island, has a length of 60 miles; it is sometimes termed Great Admiralty island, its chief town being Lorengai. There are cultivations of coco-nuts for copra and valuable pearl and shell fisheries. Manus has hills of 3,000ft., but the other islands are low, small and mostly of coral formation. They were discovered by the Dutch in 1616, and Philip Carteret visited them in 1767, but the first landing seems to have been from the "Challenger," in 1875. They were part of a German protectorate from 1885–1914. In Nov. 1914 they were occupied by Australian troops, and in 1919, under the Treaty of Versailles, they were made part of the Mandated Territory of New Guinea, under the Commonwealth of Australia. Estimated pop. 13,750. The natives are Papuan, with some mixture of blood, and are cannibals, not well-disposed to strangers, but they are becoming more tractable under European supervision. The language is Papuan in

type and displays many dialectical variations, every district having its own particular patois (*see* PAPUAN LANGUAGE).

BIBLIOGRAPHY.—E. von Warteg, *Samoa, Bismarck-Archipel und Neu Guinea* (1902); H. Schnee, *Bilder aus der Sudsee* (Bismarck Archipelago) (1904); R. Parkinson, *Dreizig Jahre in der Sudsee, Land und Leute, Sitten und Gebrucke, auf dem Bismarck-Archipel* (1909).

ADMIRALTY JURISDICTION. The courts by which, as far as we know, admiralty jurisdiction in civil matters was first exercised were the following. In and throughout England the courts of the several admirals soon combined into one High Court of Admiralty (*see* ADMIRALTY, HIGH COURT OF). Within the territories of the Cinque Ports the Court of Admiralty of the Cinque Ports exercised a co-ordinate jurisdiction. In certain towns and places there were local courts of vice-admiralty. In Scotland there existed the Scottish High Court of Admiralty, in Ireland the Irish High Court of Admiralty. Of these courts that of the Cinque Ports alone remains untouched. The Scottish Court was abolished, and its civil jurisdiction given to the Court of Session and to the courts of the sheriffs by the Court of Session Act, 1830—not, however, till a decision given by it and the appeal therefrom to the House of Lords had established a remarkable rule of admiralty law in cases of collision (*Hay* v. *le Neve*, 1824, 2 Shaw, Sc App. Cas. 395). The act states that the Court of Justiciary held cumulative jurisdiction with the Court of Admiralty in criminal matters The local vice-admiralty courts in England had ceased to do much work when they were abolished by the Municipal Corporations Act, 1835. The High Court became, with the other superior courts, a component part of the High Court of Justice by virtue of the Judicature Acts, 1873 and 1875. And the Irish Court in like manner became a part of the High Court of Justice in Ireland by virtue of the Judicature Act passed in 1877.

Vice-Admiralty Courts.—As England first, and Great Britain afterwards, acquired colonies and possessions beyond seas, vice-admiralty courts were established. The earliest known was that in Jamaica, established in the year 1662 Some vice-admiralty courts created for prize purposes in the eighteenth century were suffered to expire after 1815. In the year 1863, when the act regulating the vice-admiralty courts was passed, there were vice-admiralty courts established in 45 several portions of the King's dominions; to which by an act of 1867 one for the Straits Settlements was added These courts have been regulated from time to time by the following statutes: 2 and 3 Will. IV. c 51, 26 and 27 Vict. c. 24 (Vice-Admiralty Courts Act, 1863), already cited, and 30 and 31 Vict. c. 45 (Vice-Admiralty Courts Act Amendment Act, 1867); and by the slave trade acts, of which the last and consolidating act was that of 1873.

In 1890 the Colonial Courts of Admiralty Act provided that, except in the colonies of New South Wales, Victoria, St. Helena and British Honduras, vice-admiralty courts should be abolished and colonial courts of admiralty substituted. There is power, however, reserved to the Crown to erect through the admiralty in any British possession any vice-admiralty court, except in India or any British possession having a representative legislature. No vice-admiralty court so established can exercise any jurisdiction except for some purpose relating to prize, the royal navy, the slave trade, foreign enlistment, Pacific Islanders' protection, and questions relating to treaties or conventions on international law.

Colonial Courts of Admiralty.—By the Colonial Courts of Admiralty Act, 1890, already referred to, every court of law in a British possession which is declared by its legislature to be such, or if there be no such declaration, which has original unlimited civil jurisdiction, shall be a court of admiralty.

There used to be vice-admiralty courts for Calcutta, Madras and Bombay; but by the India High Courts Act, 1861, s. 9, the admiralty jurisdiction was given to the High Courts of these places.

Consular Courts.—Admiralty jurisdiction was given to the consular courts in China, Japan and Turkey (those in Japan and Turkey have disappeared with the capitulations), and by s. 12 of the Colonial Admiralty Courts Act any court established by H.M. for the exercise of jurisdiction in any place outside H.M.'s dominion may have admiralty jurisdiction granted to it.

Australia.—By the Commonwealth of Australia Constitution Act, 1900, a federal supreme court, to be called the High Court of Australia, is created, and the parliament of the Commonwealth may make laws conferring original jurisdiction on the High Court in matters of admiralty and maritime jurisdiction.

Isle of Man.—There is a court of admiralty in the Isle of Man of which the water-bailiff is judge. He is also styled admiral. It is said to have jurisdiction in salvage and over other maritime matters occurring within three leagues from the shore.

County and Local Courts.—Modern statutes have given admiralty jurisdiction to the City of London Court, Court of Passage and to county courts in the following matters Salvage, where the value of the salved property does not exceed £1,000, or the claim for reward £300; towage, necessaries and wages, where the claim does not exceed £150; claims for damage to cargo, or by collision, up to £300 (and for sums above these prescribed limits by agreement between the parties); and claims arising out of breaches of charter parties and other contracts for carriage of goods in foreign ships, or torts in respect thereof, up to £300 This jurisdiction is restricted to subjects over which jurisdiction was possessed by the High Court of Admiralty at the time when the first of these acts was passed, except as regards the last branch of it (the *Aline*, 1880, 5 Ex Div 227; *R* v. *Judge of City of London Court* [1892] 1 Q B 272) In analogy with the county court admiralty jurisdiction created in England, a limited admiralty jurisdiction was given in Ireland to the recorders of certain boroughs and the chairmen of certain quarter sessions; in salvage cases, where a county court in England would have jurisdiction, magistrates, recorders and chairmen of quarter sessions may have jurisdiction as official arbitrators (Merchant Shipping Act, 1894, s 547). In Scotland, admiralty suits in cases not exceeding the value of £25 are exclusively tried in the sheriff's court; while over that limit the sheriff's court and the court of session have concurrent jurisdiction The sheriff has also criminal admiralty jurisdiction, but only as to crimes which he would be competent to try if committed on land (The Court of Session Act, 1830, ss. 21 and 22).

By an act of 1821 an arbitral jurisdiction in cases of salvage was given to certain commissioners of the Cinque Ports.

The appeal from county courts and commissioners is to the High Court of Justice, and is exercised by a divisional court of the Probate, Divorce and Admiralty Division. In cases arising within the Cinque Ports there is an optional appeal to the Admiralty Court of the Cinque Ports The appeal from the High Court of Justice is in ordinary admiralty matters, as in others, to the Court of Appeal, and from thence to the House of Lords.

Civil Jurisdiction.—In the high courts, whether in England, Scotland or Ireland, it is not now necessary to distinguish their civil admiralty jurisdiction, from their ordinary civil jurisdiction, except for the purpose of seeing whether there can or cannot be process *in rem*. Not that every admiralty action can of right be brought *in rem*, but that no process *in rem* lies at the suit of a subject unless it be for a matter of admiralty jurisdiction—one, for instance, that could in England have been tried in the High Court of Admiralty. Now these matters of admiralty jurisdiction with process *in rem* range themselves under four primary and four supplementary heads. The four primary are damage, salvage, bottomry, wages; and the four supplementary are extensions due to one or other of the statutes of 1840 (Admiralty Court) and 1861 (Admiralty Court Act). They are damage to cargo carried in a ship, necessaries supplied to a ship, mortgage of ship, and master's claim for wages and disbursements on account of a ship. In all these cases, primary and secondary, the process of which a plaintiff can avail himself for redress, may be either *in personam* as in other civil suits, or by arrest of the ship, and, in cases of salvage and bottomry, the cargo. Whenever, also, the ship can be arrested, any freight due can also be attached, by arrest of the cargo to the extent only of the freight which it has to pay. For the purpose of ascertaining whether or not process *in rem* would lie, there have been distinctions as nice, and the line of admiralty jurisdiction has been drawn as carefully, as in the cases of the admiralty jurisdiction of the county courts (the

Theta, [1894] P. 280; the *Gas Float Whitton* [1897] App. Cas. 337). Similar questions have been raised in the United States, from *De Lovio* v. *Boit* (1815, 2 Gall. 398), and *Ramsay* v. *Allegre* (1827, 12 Wheat 611), down to the more modern cases which will be found quoted in the arguments and judgments in the *Gas Float Whitton*.

The disciplinary jurisdiction at one time exercised by the Admiralty Court, over both the royal navy and merchant vessels, may be said to be obsolete in time of peace, the last remnant of it being suits against merchantmen for flying flags appropriate to men-of-war (the *Minerva*, 1800 3, C Rob 34), a matter now more effectively provided against by the Merchant Shipping Act, 1894. In time of war, however, it was exercised in some instances as long as the Admiralty Court lasted, and is now in consequence exercisable by the High Court of Justice (*see* PRIZE). It was, perhaps, in consequence of its ancient disciplinary jurisdiction that the Admiralty Court was made the court to enforce certain portions of the Foreign Enlistment Act, 1870.

Finally, appeals from decisions of courts of inquiry, under the Merchant Shipping Act, cancelling or suspending the certificates of officers in the merchant service, may be made to the Probate, Divorce and Admiralty Division of the High Court of Justice.

Criminal Cases.—The Admiralty jurisdiction in criminal matters extends over all crimes committed on board British ships at sea or in tidal waters, even though such tidal waters be well within foreign territory (*R.* v. *Anderson*, 1868, L R. 1 C.C R. 161), but not over crimes committed on board foreign vessels upon the high seas (*R.* v. *Serva*, 1845, 1 Denison C C. 104). Whether it extended over crimes committed on foreign ships within territorial waters of the United Kingdom, and whether a zone of three miles round the shores of the United Kingdom was for such purpose territorial water, were the great questions raised in *R.* v. *Keyn* (the *Franconia*, L R 2 Ex. Div. 126), and decided in the negative by the majority of the judges. Since then, however, the legislature has brought these waters within the jurisdiction of the admiralty by the Territorial Waters Jurisdiction Act, 1878. Section 2 runs as follows: "An offence committed by a person, whether he is or is not a British subject, on the open sea within the territorial waters of British dominions, is an offence within the jurisdiction of the admiral, although it may have been committed on board or by means of a foreign ship." By s. 7 the "jurisdiction of the admiral" is defined as "including the jurisdiction of the admiralty of England or Ireland, or either of such jurisdictions as used in any act of parliament" (*see* TERRITORIAL WATERS). But where portions of the sea and tidal waters, by reason of their partially land-locked positions, are deemed to be in the body of a county, there is no admiralty jurisdiction. Crimes are tried as if they were committed on land within the same county.

Pirates, whatever flag they pretended to fly, were, from 1360 onwards, wherever their crimes were committed, subject to the admiralty jurisdiction. The criminal jurisdiction of the admiralty was first exercised by the High Court of Admiralty; and then, by virtue of the Offences at Sea Act, 1536, transferred to commissioners appointed under the great seal, among whom were to be the admiral or admirals, his or their deputies. Admiralty sessions were held for this purpose till 1834. Admiralty criminal jurisdiction is now, by virtue of the series of statutes, the Offences at Sea Act, 1709, the Central Criminal Court Act, 1834, Offences at Sea Act, 1844, and the criminal law consolidation acts passed in 1861, exercised by the Central Criminal Court and by the ordinary courts of assize. Special provision for trial in the colonies of offences committed at sea has been made by an act of William III. (1698–99), the Offences at Sea Act, 1806, and the Admiralty Offences (Colonial) Act, 1849.

See Clunet, *Journal du droit international privé*, cited shortly as Clunet; De Pistoye et Duverdy, *Traité des prises maritimes* (1855) vol. ii., tit. viii.; Phillimore, *International Law*, vol i, vol. iii., part xi.; v. Holzendorff, *Rechtslexicon* (Leipzig, 1881); Raikes, *The Maritime Codes of Spain and Portugal* (1896), *of Holland and Belgium* (1898), *of Italy* (1900); Autran, *Code international de l'abordage, de l'assistance, et du sauvetage maritimes* (1902). (P.)

United States.—Admiralty jurisdiction was exercised in the colonies by vice-admiralty courts until 1776, then by the State admiralty courts until 1789. The Constitution, Art, III., s. 2, provides that the judicial power of the United States "shall extend to all cases of admiralty and maritime jurisdiction."

The Judiciary Act of 1789 (1 U.S.S L. 76) granted original jurisdiction to United States district courts. The circuit courts were given concurrent original jurisdiction over seizures for slave trading, condemnations of property used by persons in insurrection (R S. 629, 2nd ed.), and in the coolie trade (R S 2159, 2nd ed). The supreme court of the District of Columbia was given the same jurisdiction as that of the United States district courts in 1901 (31 U.S.S.L. 1199). Formerly the Judiciary Act authorized appeals from the district court to the circuit court and thence to the Supreme Court. This practice was abolished in 1891, and nine circuit courts of appeals were created (Judicial Code, s. 116). These were the final courts of appeal in admiralty, except that there was the right of a direct appeal to the Supreme Court on questions of jurisdiction (Judicial Code, s. 238), and that the Supreme Court might in its discretion review the judgments of the circuit court of appeals by writs of certiorari (Judicial Code, s. 240).

The circuit courts were abolished in 1911 (Judicial Code, s. 289). Direct appeals to the Supreme Court were abolished in 1925 (43 U S.S.L. 938). Since then the district courts alone have original jurisdiction in all admiralty cases. Appeals lie to the circuit courts of appeal which may certify questions to the Supreme Court for opinion, and the Supreme Court may review the judgments of the circuit courts of appeal on writs of certiorari.

The district courts have jurisdiction in admiralty of suits against the United States in contract and in tort arising out of the operation of merchant vessels (41 U.S S.L. 525), in tort, towage and salvage arising out of the operation of public vessels (43 U S S.L. 1112), and in certain cases concurrent jurisdiction with the court of claims in contract cases (24 U.S.S L. 505; *Cornell S S. Co.* v. *U S*, 202 U S. 184). The district courts have jurisdiction over crimes and offences committed upon vessels of the United States wherever they may be afloat upon navigable waters, but they are tried according to common law criminal procedure (*U.S.* v. *Rodgers*, 150 U S. 249; *Hamilton* v. *U S*, 268 Fed. 15).

Actions in admiralty may be either *in rem* with the arrest of the ship, or other maritime property, to enforce a maritime lien (a *jus in re*) or *in personam* against a person. Actions *in rem* are limited to courts of admiralty. Under s. 24 of the Judicial Code, "saving to suitors the right of a common law remedy where the common law is competent to give it," a right *in personam* may be enforced in a common law court, but the substantive rights of the parties are determined by the maritime law (*Southern Pacific* v. *Jensen*, 244 U S. 205; *Knickerbocker Ice Co.* v. *Stewart*, 253 U.S 149). Admiralty jurisdiction extends to all navigable waters, including rivers, lakes and canals connected with the sea (*The Hine*, 4 Wall, 555; *Robert W. Parson*, 191 U.S. 17). Admiralty jurisdiction extends to prize cases (*Jecker* v. *Montgomery*, 13 How. 498), to possessory and petitory suits (*The Schooner Tilton*, Fed. Cas. No. 14054; *Ward* v. *Peck*, 18 How. 267), to maritime contracts and torts. Maritime contracts are determined by their subject matter and in general they relate to ships as such, or to transportation of goods or passengers. They include charter-parties, contracts of affreightment, bills of lading, bottomry and respondentia bonds, salvage, towage, pilotage, stevedoring, supplies and repairs, advances, marine insurance policies, wages, preferred mortgages (41 U.S S.L. 988, 1000; *ex parte Easton*, 95 U.S. 68). A contract to build a ship or furnish material for its completion is non-maritime (*Peoples Ferry Co.* v. *Beers*, 20 How. 393; *the Thames Co.* v. *Francis McDonald*, 254 U.S. 242). A tort is maritime if the injury is inflicted on navigable waters (*Atlantic Transport Co.* v. *Imbrovek*, 234 U.S. 52). If a vessel collides with a pier the damage to the pier is a non-maritime tort because the injury occurs on land (*Cleveland Terminal & Valley R.R. Co.* v. *Cleveland S.S. Co.*, 208 U.S. 316), but the damage to the vessel is a maritime tort because that injury occurs on navigable waters (*P.W. & B.R.R. Co.* v. *Phila. etc. S.S. Co.*, 23 How. 209; *Hill* v. *Board of Freeholders*, 45 Fed. 260). (A. M. B.)

ADMISSION: *see* EVIDENCE, also ESTOPPEL.

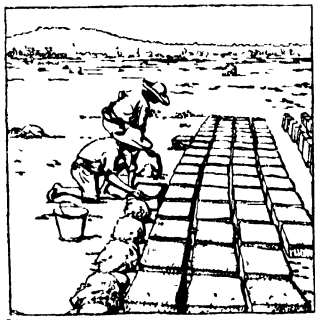
ADMITTANCE, in alternating current electricity, the reciprocal of the reactance. (*See* ELECTRICITY.)

ADO (died 874), archbishop of Vienne in Lotharingia, held his archiepiscopal see from 859 till his death Dec. 16, 874. His extant letters reveal their writer as an energetic man of wide sympathies. Ado's principal works are a *Martyrologium* (printed *inter al.* in Migne, *Patrolog. lat.* cxxiii. pp. 181–420; append. pp. 419–436), and chronicle, *Chronicon sive Breviarium chronicorum de sex mundi aetatibus de Adamo usque ad ann.* 869 (in Migne, cxxiii. pp. 20–138, and Pertz, *Monumenta Germ.* ii. pp. 315–323).

Ado's chronicle is based on that of Bede, with which he combines extracts from the ordinary sources, forming the whole into a consecutive narrative founded on the conception of the unity of the Roman Empire, which he traces in the succession of the emperors, Charlemagne and his heirs following immediately after Constantine and Irene.

BIBLIOGRAPHY.—Ado wrote also a book on the miracles (*Miracula*) of St. Bernard, archbishop of Vienne (9th century), published in the Bollandist *Acta Sanctorum;* a life or *Martyrium* of St. Desiderius, bishop of Vienne (died 608), written about 870 and published in Migne, cxxiii. pp. 435–442; and a life of St. Theudericus, abbot of Vienne (563), published in Mabillon, *Acta Sanct.,* i pp. 678–681, Migne, cxxiii. pp. 443–450, and revised in Bollandist *Acta Sanct.,* Oct. 29, xii. pp 840–843. *See* W. Wattenbach, *Deutschlands Geschichtsquellen,* vol. i. (Stuttgart, 1904).

ADOBE (ą-dō'bę), a Spanish-American word (often corrupted to *dobie*) for the sun-dried clay used for building by the Indians in the arid regions of the south-western United States and northern Mexico (from Spanish *adobar,* to plaster). The use of such building material is said to have been anciently introduced into Spain from northern Africa Soon after the discovery of America the method was imported into Peru, Mexico and other dry countries of the New World by the Spanish conquerors, who brought it as early as the 16th century to the Indians of New Mexico and Arizona. Most of the buildings connected with the Spanish missions in California, established in 1770–1823 were constructed of adobe. In Mexico and the south-western United States the name is not only applied to the bricks but also to the clay from which they are made, and, likewise, to structures built of this material. The usual method of making adobe is very simple. It consists of wetting a quantity of suitable clay, adding a small amount of chopped straw, hay, grass roots or other fibrous litter, mixing the materials with a hoe or a similar implement, and then trampling the mass with the bare feet. When brought to the proper consistency, the adobe is shaped with simple wooden moulds into bricks. These vary greatly in size, in accordance with intended use, ranging from small forms about 8in. square and 2in. thick to large slabs 1 or 2yd. long, 1ft. wide and 6 to 8in thick. A common form for structural use is about 12in. wide, 16in. long and from 4 to 8in. thick. After being properly dried, adobes are laid in walls, like ordinary bricks, and joined with a mortar of the same material. Often the walls are smoothly finished inside and out with this mortar and given an outer coating of lime wash, which is frequently tinted with yellow or other colours.



MEXICAN PEONS MOULDING AND DRYING ADOBE, A COMMON BUILDING MATERIAL IN ARID PARTS OF MEXICO AND THE SOUTHWEST

In regions of scant rainfall adobe is serviceable in structures of one storey or other low buildings, having well-drained foundations and non-leaking roofs with wide cornices and eaves. When protected against the action of water adobe walls will endure for many decades and sometimes for centuries. As adobe is a very poor conductor of heat and as walls made of it do not become frosty in cold weather or damp in a short rainy season, adobe structures are warm in winter and cool in summer, the interior temperature of the walls remaining remarkably constant. Since 1900 there has been a revival of adobe construction in the south-western United States, particularly in California. In a modified form adobe is utilized also in Colorado and other States of the Rocky Mountain plateau, where, instead of being first made into bricks, the adobe is moulded directly into the wall, being applied and dried in successive layers. In the plateau region adobe is used chiefly for walls of stables, cattle sheds and chicken houses. In southern California substantial city homes have been constructed with adobe walls, made from materials available on the premises, and finished with waterproof plaster or stucco, thus making it possible, when so desired, to dispense with the wide cornices and eaves otherwise required in adobe structures. For the artistic adaptation of adobe to building construction *see* ARCHITECTURE.

Recent scientific researches have shown that seeds that have been embedded with the barnyard refuse used in making adobe are preserved indefinitely. Consequently, by dissolving out seeds contained in adobes from the walls of old buildings whose date of erection is known, the approximate date of introduction of various cultivated plants in the region may be ascertained.

See J. W. Adams, "Adobe as a Building Material for the Plains," *Colorado Agric. Expt. Sta. Bull. 174* (1910); Lee McCrae, "The Revival of the Adobe," *Keith's Magazine,* vol. xlv, p 45–47 (1921); Torrey Connor, "The Art and Uses of Adobe," *House Beautiful,* vol. li, p 78–79 (1922); and Roy M Singer, "Adobe House Construction," *National Builder,* vol. lxvii, pp. 74–76 (1924).

ADOBE SOIL, a term used in the western United States, particularly in California, to designate the structural quality of various clay soils, referring usually to the characteristic breakage of such soil material into small angular blocks when it dries. These soils are very heavy in texture, being composed of extremely fine-grained material, a large part of which is colloidal. Sands and loose sandy loams, for example, never display an adobe soil structure. By many, however, adobe soils are often thought of as constituting the material from which adobe or sun-dried bricks are made; but, as in the case of ordinary brick, adobe building materials are derived from a great variety of clayey soils. Under proper conditions of moisture soils of adobe structure are readily worked, but when too dry their hardness and coherence make tillage extremely difficult. When placed under irrigation soils of this type usually display great fertility.

ADOLESCENCE, the term now commonly adopted for the period between childhood and maturity, during which the characteristics (mental, physical and moral) that are to make or mar the individual disclose themselves, and then mature, in some cases by leaps and bounds, in others by more gradual evolution The annual rate of growth, in height, weight and strength, increases to a marked extent and may even be doubled. The development in the man takes place in the direction of a greater strength, in the woman towards a fitter form for maternity. The sex sense develops, the love of nature and religion, and an overmastering curiosity both individual and general This period of life, so fraught with its power for good and ill, is accordingly the most important and by far the most difficult for parents and educationists to deal with efficiently. The chief points for attention may be briefly indicated. Health depends mainly on two factors, heredity and environment In an ideal system of training these two factors will be so fitted in and adapted to one another, that what is weak or unprovided for in the first will be amply compensated for in the second

In an ideal condition children should be brought up in the country as much as possible. An abundance of simple well-cooked food in sufficient variety, ample time at table, where an atmosphere of light gaiety should be cultivated, and a period free from restraint both before and after meals, should be considered fundamental essentials

The exercise of the body must be attended to in the shape of games.

But severe exercise should only be allowed under adequate medical control, and should be increased very gradually. In the case of girls, let them run, leap and climb with their brothers for the first 12 years or so of life. But as puberty approaches, with all the change, stress and strain dependent thereon, their lives may need appropriate modification. Rest may be necessary during the

menstrual periods of these earlier years, and perhaps, milder, more graduated exercise should be taken at other times. In the same way all mental strain should be diminished. Instead of pressure being put on a girl's intellectual education at about this time, as is too often the case, the time devoted to school and books should be diminished. Education should be on broader, more fundamental lines, and much time should be passed in the open air. With regard to the mental training of both sexes two points must be borne in mind. First, that an ample number of hours should be set on one side for sleep, up to ten years of age not less than 11, and up to 20 years not less than nine. Secondly, that the time devoted to "bookwork" should be broken up into a number of short periods, very carefully graduated to the individual child.

In every case where there is a family tendency towards any certain disease or weakness, that tendency must determine the whole circumstances of the child's life That diathesis which is most serious and usually least regarded, the nervous excitable one, is by far the most important and the most difficult to deal with. Every effort should be made to avoid the conditions in which the hereditary predisposition would be aroused into mischievous action, and to encourage development on simple unexciting lines. The child should be confined to the schoolroom but little, and receive most of his training in wood and field. Other diatheses (the tuberculous, rheumatic, etc) must be dealt with in appropriate ways.

The adolescent is prone to special weaknesses and moral perversions. The emotions are unstable, and any stress put on them may lead to undesirable results. Warm climates, tight-fitting clothes, corsets, rich foods, soft mattresses or indulgences of any kind, and also mental over-stimulation, are especially to be guarded against. The day should be filled with interests of an objective (in contradistinction to subjective) kind, and the child should retire to bed at night healthily fatigued in mind and body. Let there be confidence between mother and daughter, father and son, and, as the years bring the bodily changes, those in whom the children trust can choose the fitting moments for explaining their meaning and effect, and warning against abuses of the natural functions. (For bibliography *see* CHILD)

ADOLPH OF NASSAU (*c* 1255–1298), German king, son of Walram, count of Nassau. On May 5, 1292 he was chosen German king, in succession to Rudolph I , an election due rather to the political conditions of the time than to his personal qualities. His position was unstable, and the allegiance of many of the princes, among them Albert I , duke of Austria, son of the late King Rudolph, was merely nominal. He claimed Meissen as a vacant fief of the empire, and in 1294 allied himself with Edward I , King of England, against France. Edward granted him a subsidy, but Adolph turned his arms against Thuringia, which he had purchased from the landgrave Albert II. This bargain was resisted by the sons of Albert, and from 1294 to 1296 Adolph was campaigning in Meissen and Thuringia. Meissen was conquered, but he was not equally successful in Thuringia. He had been unable to fulfil the promises made at his election, and the princes began to look with suspicion upon his designs Wenceslaus II , king of Bohemia, fell away from his allegiance, and Adolph was deposed at Mainz, on May 23, 1298, when Albert of Austria was elected his successor. At the battle of Goellheim on July 2, 1298 Adolph was killed, it is said by the hand of Albert.

See F. W. E. Roth, *Geschichte des Romischen Konigs Adolf I. von Nassau* (Wiesbaden, 1879); V. Domeier, *Die Absetzung Adolfs von Nassau* (Berlin, 1889); L. Ennen, *Die Wahl des Konigs Adolf von Nassau* (Cologne, 1866); L. Schmid, *Die Wahl des Grafen Adolf von Nassau zum Romischen Konig;* B. Gebhardt, *Handbuch der deutschen Geschichte,* Band i. (Berlin, 1901).

ADOLPHUS FREDERICK (1710–1771), king of Sweden, was born at Gottorp on May 14, 1710, the son of Christian Augustus (1673–1726), duke of Schleswig-Holstein-Gottorp and Albertina Frederica of Baden-Durlach. From 1727 to 1750 he was bishop of Lübeck, and administrator of Holstein-Kiel during the minority of Duke Charles Peter Ulrich, afterwards Peter III. of Russia. In 1743 he was elected heir to the throne of Sweden by the "Hat" faction in order that they might obtain better conditions of peace from the Empress Elizabeth, whose fondness for the house of Holstein was notorious. During his whole reign (1751–71) Adolphus Frederick was little more than a figurehead, the real power being lodged in the hands of an omnipotent *riksdag,* distracted by fierce party strife. Twice he endeavoured to free himself from the intolerable tutelage of the estates. The first occasion was in 1756 when, stimulated by his wife, Louisa Ulrica, sister of Frederick the Great, he tried to regain part of his prerogative, and nearly lost his throne in consequence. On the second occasion (1768), under the guidance of his eldest son, afterwards Gustavus III., he succeeded in overthrowing the tyrannous "Cap" senate, but was unable to make any use of his victory. He died at Stockholm on Feb. 12, 1771.

See R. Nisbet Bain, *Gustavus III. and his Contemporaries,* vol. i. (London, 1895).

ADOLPHUS, JOHN LEYCESTER (1795–1862), English lawyer and author, well-known London barrister. Adolphus wrote *Letters to Richard Heber, Esq.* (1821) in which he discussed the authorship of the then anonymous Waverley novels, and fixed it upon Sir Walter Scott. This conclusion was based on the resemblance of the novels in general style and method to the poems acknowledged by Scott. Scott thought at first that the letters were written by Reginald Heber, afterwards bishop of Calcutta, and the discovery of J. L. Adolphus's identity led to a warm friendship. At the time of his death (Dec. 24, 1862) he was completing the *History of England to 1783,* written by his father John Adolphus (1768–1845). This book is still valuable for the history of the first part of the reign of George III.

ADONI, a town of British India, in the Bellary district of Madras, 307m. from Madras by rail. Pop. (1921) 30,232 It has manufactures of carpets, silk and cotton goods, factories for ginning and pressing cotton and a considerable trade in cotton. The hill-fort above, now in ruins, was a seat of government frequently mentioned in 18th century wars.

ADONIJAH. A name borne by several persons in the Old Testament, of whom the best known is the fourth son of David. Shortly before the death of David, he made preparations to seize the throne, to which he was the natural heir after the death of Absalom, and received the support of Joab and Abiathar the priest. However, Bathsheba, David's favourite wife, organized a counter-intrigue in favour of her son, Solomon Shortly after his accession Solomon had Adonijah put to death on the ground that by seeking to marry David's concubine, Abishag, he was aiming at the crown (I. Kings i. *seq*).

ADONIS, in classical mythology, a youth of remarkable beauty, the favourite of Aphrodite. According to one account, he was the son of the Syrian king, Theias, by his daughter Smyrna (Myrrha), who had been inspired by Aphrodite with unnatural love. When Theias discovered the truth he would have slain his daughter, but the gods in pity changed her into a tree of the same name. After ten months the tree burst asunder, and from it came forth Adonis. Aphrodite, charmed by his beauty, hid the infant in a box and handed him over to the care of Persephone, who afterwards refused to give him up. When an appeal was made to Zeus, he decided that Adonis should spend a third of the year with Persephone and a third with Aphrodite, the remaining third being at his own disposal. In another version (*see* Ovid, *Metam.,* x. 298) he was killed by a boar, and this version was followed by Shakespeare. Apollodorus (iii. 185) clumsily combines the two; numerous other variants exist. The name is generally supposed to be of Phoenician origin (from *adon,* "lord"), Adonis himself being identified with Tammuz, although this is not certain. (*See* also ATTIS.)

Annual festivals, called Adonia, were held in his honour at Byblus, and also, from the 5th century B.C. onwards, at different places in Greece. The central feature was the mourning for Adonis, generally represented by an effigy, which was afterwards flung into the water. The very elaborate Alexandrian festival is described by Theocritus (*Idyll* xv).

It is now generally agreed that Adonis is a vegetation spirit, whose death and return to life represent the decay of nature in winter and its revival in spring. A special feature of the Athenian festival was the "Adonis gardens," small pots of seeds forced

to grow artificially, which rapidly faded. The dispute between Aphrodite and Persephone for the possession of Adonis finds a parallel in the story of Tammuz and Ishtar (*see* APHRODITE). In other words, Aphrodite is the Oriental mother-goddess, Adonis her lover; the details have been influenced by the legend of Demeter, (q.v.). The ceremony of the Adonia was intended as a charm to promote the growth of vegetation, the throwing of the gardens and images into the water being supposed to procure a supply of rain (for European parallels *see* Mannhardt). It is suggested (Frazer) that Adonis is not a god of vegetation generally, but specially a corn-spirit, and that the lamentation is not for the decay of vegetation in winter, but for the cruel treatment of the corn by the reaper and miller (*cf.* Robert Burns's *John Barleycorn*).



ADONIS, A YOUTH IN CLASSICAL MYTHOLOGY, BELOVED BY APHRODITE FOR HIS GREAT BEAUTY

An important element in the story is the connection of Adonis with the boar; possibly Adonis himself was looked upon as incarnate in the swine. For a god sacrificed to himself as his own enemy, *cf.* the sacrifice of the goat and bull to Dionysus. It has been observed that whenever sacrifices of swine occur in the ritual of Aphrodite there is reference to Adonis. In any case, the conception of Adonis as a swine-god does not contradict the idea of him as a vegetation or corn spirit, which in many parts of Europe appears in the form of a boar or sow.

BIBLIOGRAPHY—W. Mannhardt, *Wald- und Feld-kulte*, ii. (1905); M. P. Nilsson, *Griechische Feste* (Leipzig, 1906), articles in Roscher's *Lexikon* and Pauly-Wissowa's *Encyklopadie*; J. G. Frazer, *The Golden Bough*, vol. v.; L. R. Farnell, *Cults of the Greek States*, ii. p. 646; W. Robertson Smith, *Religion of the Semites*, new ed., 1894, pp. 191, 290, 411.

ADONIS, a genus of plants belonging to the family Ranunculaceae, known commonly by the name of pheasant's eye and *Flos Adonis*. They are annual or perennial herbs with much divided leaves and yellow or red flowers. *Adonis autumnalis* has become naturalized in some parts of England; the petals are scarlet with a dark spot at the base. The name is also given to the butterfly, Mazarine or Clifton Blue (*Polyommatus Adonis*).

ADOPTIANISM. As the theological doctrine of the Logos which bulks so largely in the writings of the apologists of the 2nd century came to the front, the trinitarian problem became acute. The necessity of a constant protest against polytheism led to a tenacious insistence on the divine unity, and the task was to reconcile this unity with the deity of Jesus Christ. Some thinkers fell back on the "modalistic" solution which regards "Father" and "Son" as two aspects of the same divine principle; but the "adoptianist" or humanitarian method was a simpler and more popular one. Basing their views on the synoptic Gospels, the adoptianists under Theodotus of Byzantium tried to found a school at Rome *c.* 185, asserting that Jesus was a man, imbued with the Holy Spirit's inspiration from his baptism, and so attaining such a perfection of holiness that he was adopted by God and exalted to divine dignity. Theodotus was excommunicated by the bishop of Rome, Victor, *c.* 195, but his followers lived on under a younger teacher, Artemon, while in the East similar views were expounded by Beryllus of Bostra and Paul of Samosata, who undoubtedly influenced Lucian of Antioch and his school, including Arius and, later, Nestorius.

There is thus a traceable historical connection between the early adoptian controversy and the struggle in Spain at the end of the 8th century, to which that name is usually given. It was indeed only a renewal, under new conditions, of the conflict between two types of thought, the rational and the mystical, the school of Antioch and that of Alexandria. The writings of Theodore of Mopsuestia, a typical representative of the Antiochene school, had become well known in the West, and the opposition of Islam also partly determined the form of men's views on the doctrine of Christ's person. About 780 Elipandus (born 718), archbishop of Toledo, revived and vehemently defended the expression *Christus Filius Dei adoptivus* (Christ the adopted son of God), and was aided by his much more gifted friend Felix, bishop of Urgella. They held that the duality of natures implied a distinction between two modes of sonship in Christ—the natural or proper, and the adoptive. In support of their views they appealed to scripture, and especially to Christ's fraternal relation to Christians—the brother of God's adopted sons. Christ, the firstborn among many brethren, had a natural birth at Bethlehem and also a spiritual birth begun at his baptism and consummated at his resurrection. Thus they did not teach a dual *personality*, nor the old Antiochene view that Christ's divine exaltation was due to his sinless virtue; they were less concerned with old disputes than with the problem as the Chalcedon decision had left it—the relation of Christ's one personality to his two natures.

Felix introduced adoptian views into that part of Spain which belonged to the Franks, and Charlemagne thought it necessary to assemble a synod at Regensburg (Ratisbon) in 792, before which the bishop was summoned to explain and justify the new doctrine. Instead of this he renounced it, and confirmed his renunciation by a solemn oath to Pope Adrian, to whom the synod sent him. The recantation was probably insincere, for on returning to his diocese he taught adoptianism as before. Another synod was held at Frankfort in 794, by which the new doctrine was again formally condemned, though neither Felix nor any of his followers appeared.

In this synod Alcuin of York took part. A friendly letter from Alcuin, and a controversial pamphlet, to which Felix replied, were followed by the sending of several commissions of clergy to Spain to endeavour to put down the heresy. Archbishop Leidrad (died 816) of Lyons, being on one of these commissions, persuaded Felix to appear before a synod at Aix-la-Chapelle in 799. There, after six days' disputing with Alcuin, he again recanted his heresy. The rest of his life was spent under the supervision of the Archbishop at Lyons, where he died in 816. Elipandus, secure in his see at Toledo, never swerved from the adoptian views, which, however, were almost universally abandoned after the two leaders died. Adoptianism continued to be a source of theological dispute all through the middle ages, but was no longer put forward as a serious interpretation of the person of Christ.

BIBLIOGRAPHY—*See* A. Harnack, *Hist of Dogma*, esp. vol. v., p. 279–292; R. Ottley, *The Doctrine of the Incarnation*, vol. i., p. 228 et seq., vol. ii., p. 151–61, Bethune-Baker, *Early History of Christian Doctrine*.

ADOPTION is the act of a person taking upon himself the position of parent to another who is not in fact or is not treated by law as his child, and the person so acting is recognized by the law as having the rights and duties of a parent by nature. The practice prevailed in most civilized or semi-civilized nations from the earliest times. In India it is general, based on customs or religious and social ideas which vary in different parts of the country and among different classes. "The probability is that any Hindu who has no son will contemplate adoption," and the effect that every adoption must have on the devolution of property causes endless disputes, so that the courts, including the Privy Council on appeals from Indian tribunals, are constantly occupied with the litigation of this subject. An elaborate statement with regard to the Indian laws affecting adoption will be found in Mayne's *Commentaries*.

Adoption was also common among the Greeks and Romans. The Roman law was well defined and clearly stated by the jurists and, in this as well as in other subjects, had an important influence on the law of most modern European countries except England. Important changes were made from time to time, but it is to be noticed that from the earliest to the latest times some intervention on the part of the State and official sanction was required to give legal effect to adoptions. This principle has been

generally accepted in the legislation and practice of modern States and is also the basis of the recent change in English law.

By the French code conditions are laid down under which adoption may take place. To give legal effect to it, inquiry must be made by the court (1) whether the conditions have been fulfilled, (2) whether the adopter is of good repute. The act of adoption must be published and registered. The adopted person preserves his rights in his natural family of origin and gains no rights of inheritance as regards the property of the relatives of the adopter, but in the property of the adopter himself has the same rights as a legitimate child. According to the French code, the adoptive parent must be 50 years of age, and on the other hand it is provided that *l'adoption ne pourra en aucun cas avoir lieu avant la majorité de l'adopté.* A subsequent part of the code deals with the appointment of *tuteurs officieux* for protection of the interests of persons who require such oversight or assistance

In Germany adoption is recognized and plays a most important part in the social life and conditions of the German people. It is regulated by a number of elaborate and carefully drawn provisions which are contained in the civil code A comprehensive statement of these provisions will be found in an article by Mr. Henry Happold, of Berlin, which appeared in the *Law Magazine and Review* for Aug. 1914. It shows how complicated the question is and how many points have to be provided for. As in the French code, confirmation by a competent tribunal is necessary to give legal validity to an adoption It is also to be noted that though the adopted child acquires the legal position of a legitimate child of the adopter, the adopter acquires no right of inheritance, and the person adopted acquires no rights as regards the relatives of the adopter.

Adoption is also provided for in the legislation of the British dominions. In West Australia, for example, a male may be adopted by a man 18 years his senior, or by a woman 30 years his senior, or a female by a woman 18 years her senior or a man 30 years her senior. An act on the subject has also been passed in South Africa.

In view of this widespread recognition of adoption by law both in ancient and modern States all over the world it seems strange that until 1926 "adoption" in the sense of the transfer of parental rights and duties in respect of a child to another person and their assumption by him was not recognized by the law of England (*see* Halsbury's *Commentaries*). But a relative or a stranger might put himself *in loco parentis* to a child and certain legal consequences between the parties might result from that position Where a parent has neglected a child or it would be injurious to the child to remain in his custody he could be deprived of it or of the direction of the child's education or of the right to decide in what religion it shall be brought up (*re Newton*, 1896, 1 ch 748). Under the Children's Act 1908 and other statutes the guardianship of children may be taken from parents who have ill-treated and neglected them and entrusted to some other person or institution, but this is not properly a case of adoption.

By the British Adoption of Children Act 1926 for the first time a definite system of legal adoption is introduced. Under that Act on application made by a person desirous of being authorized to adopt an infant the court may make an order authorizing the applicant to adopt that infant. In this procedure English law follows the precedent of Roman law and of most other countries, including the dominions, in requiring the sanction of a judicial or public authority for adoption of children. The welfare of the child is to be the paramount consideration. No payment or reward is to be received by the adoptive parent unless sanctioned by the court for some special reason. The adopted child does not lose rights of succession to the property of the natural parent or gain rights of succession to the adopter, but all rights and duties of parents or guardians as to future custody, maintenance and education are to vest in and be exercisable by and enforceable against the adopter as though the adopted child was born to the adopter in lawful wedlock. The applicant must not be under 25 years of age, must as a rule be 21 years older than the person adopted, and the court must see that the consent of the proper parties has been obtained. Either the high court, the county courts, or courts of summary jurisdiction, may deal with applications for adoption, and the effect of the order is registered.

Already the Act has been used in a very large number of cases and it is constantly found that between the adoptive parents and the children adopted ties of affection grow up very similar to those which exist between parents and their own children.

In the United States, Louisiana and Texas follow the civil law in relation to adoption, but the other states, where their jurisprudence is based on the common law, have had to enact statutes concerning the same. In many states it is required that adoptions be made only by married couples, but in a few states a single person may do so. Suitable age, financial solvency and substantial compliance with the requirements of the statutes are essential to make adoptions legal. Some states permit adoptions only of minors, and others forbid adoptions of relatives An adopted child stands in the position of a child by blood in the matter of inheritances if the adoptive parent dies intestate.

See W. Clarke Hall, *Law of Adoption and Guardianship of Infants* (1928). (A H.)

ADOR, GUSTAVE (1845–1928), Swiss statesman, was born at Geneva, Dec. 23, 1845, of a Vaudois family established there in 1814 He studied law at the academy and in 1868 became an advocate. He served his apprenticeship to politics in the cantonal government and was president of the cantonal executive in 1892 and 1906. From 1889 to 1917 he was a member of the Swiss National Council, of which he was president in 1901.

Ador gained an international reputation for the hard and disinterested work he did for the International Red Cross. He had become president of the committee four years before the World War, and when it broke out he founded an association at Geneva for facilitating communications between prisoners of war and their families and for alleviating their condition. A central agency for forwarding parcels and letters was established

In June 1917, after the enforced resignation of Arthur Hoffmann, Ador became a member of the executive of the Swiss Federation with the portfolio of Foreign Affairs. Toward the end of 1918 he was elected president of the Swiss Federation; he retired at the end of his year of office. He headed the Swiss delegation which visited Paris and London in Jan.-Feb. 1920 to secure a reservation of the principle of the neutrality of Switzerland when she joined the League of Nations. He did important work for the League itself, first as president of the Brussels Conference of 1920 and then as president of the Economic and Financial Commission. He represented Switzerland at the various Assemblies of the League of Nations until 1924, when he retired on the ground of advancing age, although he still continued his Red Cross work. He died at Geneva on March 31, 1928. His funeral was a national ceremony, and was held in Geneva Cathedral.

ADORATION, primarily an act of homage or worship, performed among the Romans by raising the hand to the mouth, kissing it and then waving it in the direction of the adored object (Lat. *ad*, to; *os*, mouth; *i.e.*, carrying to the mouth). Saturn and Hercules were adored with the head bare. By a natural transition the homage came to be paid to monarchs by the Greeks and Romans. The Persian method was to bend the knee and fall on the face at the prince's feet, striking the earth with the forehead and kissing the ground. This striking of the earth with the forehead is the form of adoration usually paid to Eastern potentates to-day. The Jews kissed in homage. (*See* I Kings xix. 18, Psalms ii. 12, Hosea xiii. 2.) In England the ceremony of kissing the sovereign's hand may be described as a form of adoration. Adoration is applied in the Roman Church to the ceremony of kissing the pope's foot, a custom said to have been introduced by the popes following the example of the Emperor Diocletian. In the Roman Church a distinction is made between *Latria*, a worship due to God alone, and *Dulia* or *Hyperdulia*, the adoration paid to the Virgin, saints, martyrs, crucifixes, etc.

ADORF, a town in the republic of Saxony, 3m. from the Czechoslovakian frontier, at a height of 1,400ft. above sea. Pop. (1925) 7,722. Musical instruments, objects in mother of pearl, textiles and carpets are made.

ADOUR, a river of south-west France, rising in the department of Hautes Pyrénées, south of the Pic du Midi de Bigorre, and flowing in a wide curve to the Bay of Biscay. It traverses the beautiful valley of Campan and, after passing Bagnères de Bigorre, enters the plain of Tarbes. Beyond Tarbes numerous canals are drawn from the river for irrigation purposes; the most important is the Canal d'Alaric, which follows the right bank for 36m. Within the department of Landes it flows west and later south-west, becoming navigable at St. Sever, beyond which it is joined on the left by the Larcis, Gabas, Louts and Luy, and on the right by the Midouze. After Bayonne the river enters the sea through a dangerous estuary, after a total course of 208m. The mouth of the Adour has repeatedly shifted, its old bed being represented by the series of *étangs* and lagoons extending northwards as far as the village of Vieux Boucau (22½m.), where it debouched in the 14th century. The present channel was constructed by the engineer Louis de Foix in 1579. The area of the basin of the Adour is 6,565sq.m.

ADRA (anc. *Abdera*), a seaport of southern Spain, in the province of Almería. Pop. (1920) 8,565. Adra is the port of shipment for the lead obtained in the Sierra de Gádor near Berja, 10 m. north-east, and also exports grapes, sugar and esparto grass.

ADRAR (Berber for "uplands"), the name of various districts of the Sahara, northern Africa. Adrar Sutuf is a hilly region in southern Rio de Oro (*q.v.*). Adrar el Jebli, otherwise Adghagh, a plateau north-east of Timbuktu, is the headquarters of the Awellimiden Tuareg (*see* TUAREG and SAHARA). Adrar n'Ahnet and Adrar Adhafar are smaller regions in the Ahnet country south of Insalah. Adrar Temur, the best known region of the name, is in the western Sahara, 300m. N. by E of the Senegal and separated on the north-west from Adrar Sutuf by wide valleys and sand dunes. Adrar is within the French sphere of influence. In general barren, the country, which occupies the centre of a plateau scarped steeply westwards, contains several oases, with a total population of about 10,000 The chief centres of population are Atar, Shingeti, Wadan and Ujeft, Shingeti being the chief commercial centre, whence caravans take to St. Louis gold-dust, ostrich feathers and dates. A considerable trade is also done in salt from the sebkha of Ijil, in the north-west.

Adrar or Adgar is also the name sometimes given to the chief settlement in the oasis of Tuat in the Algerian Sahara.

ADRASTUS: *see* OEDIPUS.

ADRENAL GLANDS, two flattened, yellowish brown bodies, about 2in. long which lie on the upper anterior surface of the kidneys, called also suprarenal glands. They have no ducts but pour their secretions directly into the blood stream, and are therefore called ductless or endocrine glands. Their function is closely related to that of the other ductless glands, such as the thyroid, pituitary, liver and gonads, in controlling the normal growth and development of the body and in maintaining a certain equilibrium among its various processes. Each ductless gland, besides having a special function, seems to have an effect on every other ductless gland, and these interrelated effects are so complex that it is difficult to isolate the activity of a single gland.

Removal of both adrenal glands in animals is followed by death in about 48 hours and destructive disease of these glands in man produces a symptom complex called Addison's disease, which is ultimately fatal. They therefore seem to perform some function necessary to life. Each gland consists of two distinct and originally separate layers, the yellowish cortex which covers the whole external surface and the gray central part, or medulla. The exact function of the cortex is unknown, but it seems to play a rôle in sexual development and to be the part necessary to life. The medulla, on the other hand appears in the embryo from a group of those nerve cells which migrate from the nerve layer to form ganglia or relay stations of the sympathetic nervous system. The cells of the medulla are presumed to secrete the chemical substance which has been isolated and analyzed from extracts of the whole gland.

This substance, called epinephrine or adrenalin, may be regarded, according to Cannon's theory, as an emergency messenger which supplements the activity of the sympathetic nervous system in times of emotional stress. Under the influence of such emotions as fear and anger, the adrenals, stimulated by the sympathetic nerves, mobilize the resources of the body for such exertions as struggle or flight. The actual effects of a sudden outpouring of epinephrine into the blood may be observed experimentally and consist in an increase in the blood pressure and pulse rate, inhibition of digestion, erection of the hair, dilatation of the pupil and a rise in the blood sugar. (*See* DUCTLESS GLANDS; ENDOCRINOLOGY; SUPRARENAL EXTRACT.)

ADRENALIN (Adrenine, Epinephrine or Hemieine) is obtained from the medulla of the suprarenal glands of animals, ductless glands situated immediately above each kidney. Its chief action is upon the heart and small arteries. The heart is somewhat slowed, but the force of its contractions is increased and the arteries are constricted, thus causing a considerable rise in the general blood pressure. A 1 in 1,000 aqueous solution is a very efficient haemostatic and may be used together with cocaine for painless, bloodless operations on the eyes, teeth, etc. It is one of the most efficacious drugs for stopping a paroxysm of asthma. (*See* HORMONES; SUPRARENAL EXTRACT.)

ADRIA (anc. *Atria;* the form Adria or Hadria is less correct: Atria was a town in Picenum, the modern Atri), town and episcopal see, province of Rovigo, Italy, 15m. E. by rail from the town of Rovigo. It is situated between the mouths of the Adige and the Po, about 13½m. from the sea and but 13ft. above it. Pop. (1921), 13,817 (town), 19,827 (commune). It gave its name to the Adriatic and was an important Etruscan harbour. The town was famous in Aristotle's day for a special breed of fowls. Even then river silt rendered access difficult, and the historian Philistus excavated a canal to the sea. This was still open in the imperial period, and the town possessed its own guild of sailors; but its importance gradually decreased. The remains of the ancient town lie 10–20ft below the modern level

ADRIAN or **HADRIAN** (Lat. *Hadrianus*), the name of six popes.

ADRIAN I., pope from 772 to 795, was the son of Theodore, a Roman nobleman Soon after his accession Adrian found it necessary to invoke the aid of Charlemagne against Desiderius, king of the Lombards. In his contest with the Greek empire and the Lombard princes of Benevento, Adrian remained faithful to the Frankish alliance, and the friendly relations between pope and emperor were not disturbed by the difference which arose between them on the question of veneration of images, to which Charlemagne and the Gallican Church were strongly opposed, while Adrian approved the decree of the council of Nicaea (787), confirming the practice and excommunicating the iconoclasts. The dispute remained unsettled at Adrian's death. Adrian restored the ancient aqueducts of Rome, and governed his little state with a firm and skilful hand.

ADRIAN II., pope from 867 to 872, was a member of a noble Roman family, and became pope in 867, at an advanced age. Like his predecessor, Nicholas, Adrian II. was forced to submit, at least in temporal affairs, to the tutelage of the emperor, Louis II., who placed him under the surveillance of Arsenius, bishop of Orta, his confidential adviser, and Arsenius's son Anastasius, the librarian Adrian had married in his youth, and his wife and daughter were still living. They were carried off and assassinated by Anastasius's brother, Eleutherius. Adrian died in 872.

ADRIAN III, pope, was born at Rome. He succeeded Martin II. in 884, and died in 885, on a journey to Worms.

ADRIAN IV. (Nicholas Breakspear), pope from 1154 to 1159, the only Englishman who has occupied the papal chair, was born before A.D. 1100 at Langley, near St. Albans, in Hertfordshire. Nicholas went to Paris and became a monk of the cloister of St. Rufus, near Arles. He rose to be prior, and in 1137 was unanimously elected abbot. Eugenius III. created him cardinal bishop of Albano. From 1152 to 1154 Nicholas was in Scandinavia as legate; organizing the affairs of the new Norwegian archbishopric of Trondhjem, and arranging for the recognition of Uppsala as a metropolitan see in 1164. Nicholas was elected pope on Dec. 4, 1154. He at once endeavoured to compass the overthrow of Arnold of Brescia, the leader of anti-papal sentiment in Rome.

Disorders ending with the murder of a cardinal led Adrian, shortly before Palm Sunday 1155, to put Rome under the interdict. The senate thereupon exiled Arnold, and the pope, with the co-operation of Frederick I. Barbarossa, was instrumental in procuring his execution. Adrian crowned the emperor at St. Peter's on June 18, 1155, a ceremony which so incensed the Romans that the pope had to leave the city for some months. At the diet of Besançon in Oct. 1157, the legates presented to Barbarossa a letter from Adrian which alluded to the *beneficia* conferred upon the emperor, and the German chancellor translated this *beneficia* in the feudal sense. In the storm which ensued the legates were glad to escape with their lives, and the incident at length closed with a letter from the pope, declaring that by *beneficium* he meant merely *bonum factum*. The breach subsequently widened, and Adrian was about to excommunicate the emperor when he died at Anagnia on Sept. 1, 1159.

In 1155 Henry II. of England sent an embassy to Adrian to ask for permission to invade and subjugate Ireland, in order to gain absolute ownership of that isle. Unwilling to grant a request counter to the papal claim (based on the forged Donation of Constantine) to dominion over the islands of the sea, Adrian proposed that the king should become hereditary feudal possessor of Ireland while recognizing the pope as overlord. This compromise did not satisfy Henry, so the matter dropped; Henry's subsequent title to Ireland rested on conquest, not on papal concession, and was therefore absolute. The much-discussed bull *Laudabiliter* is, however, not genuine.

See Herzog-Hauck, *Realencyklopädie*, 3rd ed. (excellent bibliography), and Wetzer and Welte, *Kirchenlexikon*, 2nd ed. under "Hadrian IV."; also Oliver J. Thatcher, *Studies concerning Adrian IV.* Chicago, 1903); R. Raby, *Pope Adrian IV.; An Historical Sketch* (London, 1849); and A. H. Tarleton, *Life of Nicholas Breakspear* (London, 1896).

ADRIAN V. (Ottobuono de' Fieschi), pope in 1276, was a Genoese who was created cardinal deacon by his uncle Innocent IV. In 1264 he was sent to England to mediate between Henry III. and his barons. He was elected pope to succeed Innocent V. on July 11, 1276, but died at Viterbo on Aug. 18, without having been ordained even to the priesthood

ADRIAN VI. (Adrian Dedel, not Boyens, probably not Rodenburgh, 1459–1523), pope from 1522 to 1523, was born at Utrecht in March 1459, and became tutor to the seven-year-old Charles V Charles secured his succession to the see of Tortosa, and on Nov. 14, 1516, commissioned him inquisitor-general of Aragon During the minority of Charles, Adrian was associated with Cardinal Ximenes in governing Spain. After the death of the latter Adrian was appointed, on March 14, 1518, general of the reunited inquisitions of Castile and Aragon, in which capacity he acted until his departure from Tarragona for Rome on Aug. 4, 1522. When Charles left for the Netherlands in 1520 he made Adrian regent of Spain. In 1517 Leo X. had created him cardinal priest *SS. Ioannis et Pauli;* on Jan. 9, 1522, he was almost unanimously elected pope. Crowned in St. Peter's on Aug. 31, at the age of 63, he entered upon the lonely path of the reformer. His programme was to attack notorious abuses one by one; but in his attempt to improve the system of granting indulgences he was hampered by his cardinals; reduction of the number of matrimonial dispensations was impossible, for the income had been farmed out for years in advance by Leo X. In dealing with the early stages of the Protestant revolt in Germany Adrian did not fully recognize the gravity of the situation At the diet which opened in Dec. 1522 at Nuremberg he was represented by Chieregati, whose instructions contain the frank admission that the whole disorder of the church had perchance proceeded from the Curia itself, and that there the reform should begin. But Adrian was stoutly opposed to doctrinal changes, and demanded the punishment of Luther for heresy. The statement in one of his works that the pope could err in matters of faith (*"haeresim per suam determinationem aut Decretalem asserendo"*) has attracted attention; but as it is a private opinion, not an *ex cathedra* pronouncement, it is held not to prejudice the dogma of papal infallibility. On Sept. 14, 1523, he died, after a pontificate too short to be effective.

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ADRIAN, SAINT, one of the praetorian guards of the Emperor Galerius Maximian, who, becoming a convert to Christianity, was martyred at Nicomedia on March 4, 303. His limbs were struck off on an anvil, and he was then beheaded. St. Adrian's festival, with that of his wife, St. Natalia, is kept on Sept. 8. He is specially a patron of soldiers, and is much reverenced in Flanders, Germany and the north of France.

ADRIAN, a city in south-eastern Michigan, U S A., about 30m N W. of Toledo. It is the county seat of Lenawee county, and is served by the New York Central, the Wabash, the Detroit, Toledo and Ironton and the Toledo and Western (electric) railways The population was 11,878 in 1920, and was estimated locally at nearly 14,000 in 1926.

The county, a rich farming land, contains beautiful lakes. Adrian's trade in grain, livestock and dairy products is extensive. Woven wire fence was first made here, and is the leading manufacture. Electrical appliances, phonographs, furniture, leather, knitted goods, automobile supplies and condensed milk are also produced. There were 44 factories in 1925, with an output valued at $11,432,215. Adrian college (established 1859, continuing Michigan Union college, which had been organized at Leoni in 1852) is a Methodist Protestant co-educational institution. It has a beautiful campus of 22ac. and an enrolment of about 300. The State training-school for girls (1879) is one mile north of the city.

Adrian was laid out in 1828; incorporated as a village in 1836; became the county seat in 1838; and was chartered as a city in 1853. Tradition says that it was named after the emperor Hadrian.

ADRIANI, GIOVANNI BATTISTA (1513–1579), Italian historian, was born of a patrician family of Florence, and was secretary to the republic. At the instance of Cosimo I. he wrote *Istoria di suoi tempi* (1583; modern ed. 1872), covering the years 1536 to 1574.

See G. M. Mazzucchelli, *Gli Scrittori d'Italia*, i. p. 151 (1753).

ADRIANOPLE, the capital of the vilayet of Adrianople, Turkey in Europe, 137m by rail W.N.W. of Constantinople. It occupies both banks of the river Tunja, at its confluence with the Maritsa, which is navigable to this point in spring and winter. The nearest seaport by rail is Dédéagatch, west of the Maritsa; Enos, at the river-mouth, is the nearest by water. Adrianople is on the railway from Belgrade and Sofia to Constantinople and Salonica. In appearance it is thoroughly oriental—a mass of mean, irregular wooden buildings, threaded by narrow tortuous streets, with a few better buildings. Earlier buildings include Eski Serai, a half-ruined palace of the sultans; the bazaar of Ali Pasha; and the fine 16th century mosque of the sultan Selim II, built by Sinan.

The war of 1877–78 impoverished Adrianople, and the creation of a customs cordon between it and Eastern Rumelia (1885) put an end to its commercial headship of Thrace, and parts of Bulgaria and Philippopolis and Burgas took most of its trade. The city manufactures silk, leather, tapestry, woollens, linen, and cotton, and has an active general trade. Besides fruits and agricultural produce, its exports include raw silk, cotton, opium, rosewater, attar of roses, wax, and the dye known as turkey red. The surrounding country is extremely fertile, and its wines are the best produced in Turkey. The city is supplied with fresh water by means of an aqueduct carried by arches over an extensive valley. There is also a fine stone bridge over the Tunja.

Adrianople was originally known as Uskadama or Uskodama, but was renamed and enlarged by the Roman emperor Hadrian

(117–138). In 378 the Romans were here defeated by the Goths. Adrianople was the residence of the Turkish sultans from 1361, when it was captured by Murad I., until 1453, when Constantinople fell. It was occupied by the Russians in 1829 and 1878 (*see* RUSSO-TURKISH WARS).

After 1913, the town changed hands repeatedly, being occupied in turn by the Belgians, Turks and Greeks. It was restored to Turkey by the Mudania Convention of October 1922, confirmed by the Treaty of Lausanne of July 24, 1923. A protocol subjected the Greek inhabitants of Karagatch to the exchange of populations, compelling them to emigrate six months after the re-establishment of peace.

The population in 1924 was given as only 56,347, as compared with about 80,000 in 1905 and 65,454 in 1911. This diminution is due to the emigration of the population, with the exception of the Jews, after the successive occupations of the city. The south-western portion of the city, burnt down in 1905, was rebuilt with comparatively broad streets. The railway station, which stands among ruins, has been rebuilt.

See *British and Foreign State Papers*, 1914, part 1 vol. cvii., p. 706 (1920); vol. cxiii., p. 652 (1917–23); *Treaty Series*, No. 16 (1923).

Adrianople, Battle of, 378.—This is one of the milestones of military history, and in only less degree of political history. As a military disaster to the Roman arms, it rivalled Cannae (*q.v.*), and unlike Cannae, was never fully redeemed. For the Empire's barriers against the tide of barbarian migration were breached so gravely that temporary repair was only effected by a hazardous employment of the forces of destruction—a wholesale enlistment of Goths and Teutons to substitute the regular imperial forces. It also marks the changing balance of power between infantry and cavalry.

The Visigoths who, for a century, had been "allies" of the Empire, asked permission in 376 to move inside the Roman border owing to the pressure which they themselves were suffering from the Huns. A year later the Visigoths broke out in revolt which the imperial forces failed to crush In 378 the Emperor Valens himself, returning from a campaign against the Persians, determined on a powerful effort to subdue the Visigoths. On Aug. 9 the Roman army moved out to attack the Goths whose main body of cavalry was away foraging at a distance. The Goths sent envoys with offers of surrender to regain time for the recall of their cavalry. When the parley broke down the Romans, with the legions in the centre and the cavalry on the wings as customarily, launched an assault on the Goths' position The fight was raging hotly around the great wagon-*laager*, when suddenly the recalled squadrons appeared on the scene and charged "like a thunderbolt" against the Roman left flank. The Roman cavalry were ridden down or swept aside, while the Gothic horse drove the left wing infantry in upon the centre and reserve, the pressure forcing the Romans into a disordered mass which was too dense to allow them to use their weapons. Surrounded on all sides, for the Gothic foot now burst out from their wagon-barricade, and forsaken by their right wing cavalry and foot which quitted the field, the Roman main body was progressively massacred. Only after two-thirds of the Roman army had fallen, were the ranks sufficiently thinned for the survivors to break a way through and follow the earlier retreat of the right wing.

When the sun went down that evening on the corpse-piled battlefield of Adrianople, it set for all time on the glory of the legions, the infantry who had been the foundation of Roman world-power, and a thousand years' era of cavalry supremacy was ushered in. Henceforth cavalry became the predominant arm of the Roman army, as reorganized by Theodosius, and 150 years later, during Justinian's great revival of Roman power, we find Belisarius risking battle and winning victory without even waiting for his infantry to arrive on the battlefield. (*See* ROMAN ARMY.)

ADRIATIC SEA (ancient *Adria* or *Hadria*), an arm of the Mediterranean sea separating Italy from the Balkan peninsula, occupying a structural depression between the New Fold mountain systems of the Apennines and the Dinaric Alps. The sea extends from north-west to south-east between lat. 40° and 45° 45′ N., a length of nearly 500 miles. Its average width is *c.* 110m.; but the Strait of Otranto is only 45 miles. The Italian shore, except where the Apennines fall steeply to a narrow coastal ledge between Rimini and Mt. Gargano, is low, merging in the north-west into the marshes and lagoons about the delta of the Po, the basin of which is structurally a continuation of the Adriatic. The sediment brought by the river has pushed forward the coast-line for several miles within historic times. The east coast is generally rugged, and south of the Istrian peninsula, placed between the Gulf of Trieste and the Strait of Quarnero, is fringed with islands (*e.g.*, Veglia, Cherso, Brazza and Curzola) and with many small islets and rocks which represent submerged parallel deviations of the longitudinal mountain folds. Opposite the islands of the Dalmatian coast the sea is shallow, and in the extreme north rarely exceeds 25 fathoms. But between Sebenico and the Abruzzi a well marked depression occurs, with depths exceeding 100 fathoms. South of this shallower water continues, but beyond Mt. Gargano and south of Ragusa depths of over 500 fathoms are reached, and a small area of this basin falls below 800 fathoms. Opposite this deeper water, at the 100 fathom line, the islands of the Balkan coast disappear. The absence of good harbours on the Italian side contrasts with the excellent inlets of the Dalmatian coast. Here the rocks are mainly cretaceous and have characteristic features of dry barren soil and poor vegetation despite the fairly heavy rainfall Some of the islands, however, are luxuriant with dark vegetation. The *bora* (north-east wind), and the prevalence of sudden squalls, are dangers to navigation in winter. Tidal movement is slight. (*See* also MEDITERRANEAN.)

For the "Marriage of the Adriatic," or more properly "of the sea," a ceremony formerly performed by the doge of Venice, *see* the article BUCENTAUR. (X)

Political Question.—Before the World War the Adriatic littoral belonged to four States, Italy, Austria-Hungary, Montenegro and Albania, and in practice to the two first In negotiating the "secret" Treaty of London of April 26, 1915, the Italian Government aimed at securing, in return for Italy's entrance into the war on the side of the Allies, the conversion of the Adriatic into an Italian lake—*il nostro mare*.

Article 4 of that treaty provided that "all Istria up to the Quarnero and comprising Volosca, just beyond Abbazia and the Istrian islands of Cherso, Lussin . . . and the adjoining islets" with Castua and Mattuglie, the station for Abbazia, should become Italian. Article 5 declared that Italy "shall equally receive the province of Dalmatia . . . comprising Lisarica and Tribanj in the north" to a line as far south as Cape Planca (Ploče). between Sebenico and Traù (Trogir), on the mainland, with "all the islands . . . from Premuda, Selve (Silba) and Pago in the north to Meleda in the south, comprising Lissa, Lesina, Curzola, Lagosta (Lastovo) and Pelagosa, with the solitary exception of Great Zirona (Veli Drvenik) and Small Zirona (Mali Drvenik), Bua (Ciovo), Solta and Brazza." The whole coast from Cape Planca to the "southern root" of the peninsula of Sabbioncello and from a point 10km. to the south of Ragusa Vecchia (Cavtat) to the river Viosa (north of Valona), except Montenegro, and all the non-Italian islands were to be neutralized. The rest of the Dalmatian coast, besides Fiume and the islands of Veglia and Arbe in the north, were to go to Croatia, Serbia and Montenegro, besides the Albanian roadstead of San Giovanni di Medua (the landing-place for Scutari); but Durazzo was to be Albanian

Article 6 further conferred upon Italy "the entire sovereignity over Valona, the island of Saseno and a territory sufficiently extended to assure the defence of those points" (from the Viosa . . . approximately to the northern frontier of the district of Chimara). Article 7 neutralized the coast south of the above as far as Cape Stylos opposite Corfu. This treaty violated every principle of nationality; it assigned to Italy provinces overwhelmingly Slav (for the Italian population of Dalmatia was only 3.5%), it dismembered Albania and would have created a new Irredentism far more powerful than that which Italy had fought to cure. The entrance of the United States into the war made the treaty a dead letter, although Baron Sonnino, then Italian Minister of Foreign Affairs, still clung to it, for President Wilson refused

to be bound by it, and even some Italians, notably Bissolati and Prof. Salvemini disapproved of it.

Thus began the wearisome "Adriatic question," which at times threatened war between Italy and the Yugoslavs, and attempts were made by British publicists, notably Messrs. Steed and Seton-Watson, to bring about an agreement, the "Pact of Rome," between the two races. The departure of Sig Orlando, then the Italian premier, and Baron Sonnino from the Paris Conference was due to this question, which was not regulated till the Treaty of Rapallo between the Italians and the Yugoslavs on Nov. 12, 1920, largely the work of Signor Giolitti and Count Sforza, who had meanwhile become Premier and Minister of Foreign Affairs. In Dalmatia, Italy obtained only Zara—the one overwhelmingly Italian town—with an enclave which included the Albanian settlement of Borgo Erizzo—and the island of Lagosta. Italy kept the whole of Istria (despite its large Slav minority) with the islands of Cherso and Lussin and that of Pelagosa. "All the other islands which belonged to the former Austro-Hungarian Monarchy" were "recognized as forming part of the Kingdom of the Serbs, Croats and Slovenes."

By article 4, both States recognized the full liberty and independence of the State of Fiume (*q v.*), consisting of the *corpus separatum* (the city) and a corridor south of Castua (which became Yugoslav) connecting it with Volosca and Abbazia. Sig. Giolitti evacuated Albania, where Italy retains only the island of Saseno. Mussolini observed the Rapallo Treaty and subsequently settled the question of Fiume, which is now Italian.

The Adriatic is described at Belgrade, no less than in Rome, as "our sea," but the keys of the mouth of the Adriatic, Brindisi and Saseno, are in Italian hands.

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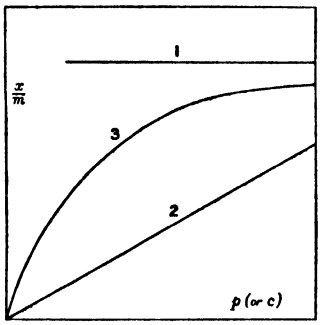
ADSCRIPT. A *villein* was called an "adscript of the soil" (*adscriptus glebae*) since he could be sold or transferred with it, as in feudal days, and as in Russia until 1861. *See* VILLEINAGE.

ADSORPTION. If a gas or solution is brought into contact with a very finely divided or porous material (*e g.*, charcoal, kaolin) the pressure of the gas or the concentration of the solution generally decreases, the gas or solute being concentrated on the surface of the solid. This phenomenon is known as adsorption, and the finely divided or porous solid is called the adsorbent. The gas or solid can be easily removed from the surface of the solid by exhaustion, heating or washing. The efficiency of an adsorbent depends largely on its specific surface (*i.e.*, area of surface per unit mass), but as we shall see later it also depends on other factors.



CURVES OF THREE POSSIBLE TYPES OF RELATION BETWEEN THE PROPORTION OF GAS ADSORBED ON THE SURFACE AND THE PRESSURE OF THE GAS

This phenomenon of *ad*sorption is to be distinguished from *ab*sorption by the fact that the adsorbed gas or solute is concentrated on the surface of the adsorbent, while in absorption the matter taken up penetrates throughout the mass of the absorbing agent. (*See* ELECTRIC LAMP)

The Adsorption of Gases.—Wood charcoal is very porous; so that it possesses a large specific surface, and is very efficient as an adsorbent. On exposure to the air it adsorbs the atmospheric gases. In order to demonstrate its adsorbing properties it should first be heated to redness in order to remove the adsorbed gases from its surface. If then it is brought into a vessel containing a gas, an immediate diminution of pressure would be indicated by an attached manometer, reaching eventually a constant value. This final equilibrium pressure depends on the temperature, the nature of the gas and adsorbent, and also on the specific surface of the latter. Adsorption can also be shown by filling a glass tube with ammonia with the open end of the tube dipping into a trough of mercury. A piece of charcoal (after being heated to redness and allowed to cool) is introduced on to the surface of the mercury in the tube. The mercury rises rapidly in the tube, indicating a rapid diminution in the volume of the gas. The ammonia can be recovered from the charcoal by heat or by exhaustion. Hydrogen burns with a pale blue flame which is non-luminous; if the hydrogen is bubbled through benzene it burns with a smoky luminous flame due to the presence of benzene vapour. If the mixture of hydrogen and benzene vapour is passed over charcoal the benzene is adsorbed, as shown by the non-luminous character of the flame of the gas which passes through.

When an adsorbent remains for some time in contact with a gas, an adsorption equilibrium is established, the amount of gas adsorbed per unit mass of the adsorbent increasing with decreasing temperature and with increasing pressure. By plotting the pressures p as abscissae, and the amount of gas adsorbed per unit mass of the adsorbent as ordinates, curves similar to those shown in figure (Curve 3) are obtained Such a curve, which represents the amount adsorbed at constant temperature, is termed an "adsorption isothermal" It is seen from the curves that the amount of gas adsorbed is not proportional to the gas pressure, but that it increases much more rapidly at low pressures than at high pressures. The adsorption isothermal can be represented by the equation:

$$x/m = ap^{1/n}$$

where x is the amount of gas adsorbed by m grams of the adsorbent at gas pressure p; a and n are arbitrary constants. The value of a depends on the units of measurement, and n is characteristic of the adsorbent and of the gas. Thus, for the adsorption of CO_2 NH_3 or SO_2 on charcoal, the values of $1/n$ are 0·394, 0·437 and 0·324, respectively, whereas for the same three gases on glass, the values are 0 66, 0·53, 0·28. These constants also vary with the temperature, $1/n$ approaching unity at high temperatures The temperature at which the unity value is reached depends on the critical temperature of the gas. For hydrogen, which has a very low critical temperature, the value of $1/n$ is unity at ordinary temperatures, but it is less than unity at the temperature of liquid air. In general the value of $1/n$ becomes 1 at temperatures considerably above the critical temperature of the gas.

The logarithmic equation of the isotherm is:

$$\log x/m = \log a + 1/n \log p,$$

which is the equation of a straight line. On plotting experimental values, however, it is found that it only holds at low pressures As the pressure increases the logarithmic curve ceases to be a straight line, and bends towards the pressure axis. The pressure at which this deflection occurs varies from gas to gas; it is lower the more readily the gas is condensed. Below the critical temperature the equation does not hold for even low pressures The adsorbability of gases runs more or less parallel with their condensability. The above equations, which are due to Freundlich, imply that an indefinite increase in pressure produces an indefinitely large adsorption. Recent work by Langmuir and others indicates that on increasing the pressure surface saturation is reached. Arrhenius introduced this (s) into his equation for adsorption, viz., $k \cdot dx/dp = (s-x)/x$.

The rate of adsorption is high, equilibrium being reached in a few minutes. The kinetic equation is $dp/dt = k(p\infty - p)$, dp/dt being the rate of diminution of pressure; $p\infty$ and p being the pressures at equilibrium and at time t respectively. Since adsorption is decreased by a rise in temperature, it follows that it is accompanied by evolution of heat. This can be readily shown by means of a thermometer immersed in the adsorbent when adsorption takes place. The heat of adsorption can be calculated from the temperature-coefficient of adsorption. If the adsorbent is in contact with several gases at the same time, the adsorption of each is diminished, and at equilibrium the amounts of the several gases adsorbed are in proportion to their respective adsorbabilities. Nothing is definitely known about the influence of the nature of

the adsorbent. Wood or animal charcoal is by far the most efficient. Silica gel is also a very powerful adsorbent. In the adsorption of *gases* on the surface of solids the adsorbed gas forms a layer one molecule thick on the adsorbent, but in the adsorption of *vapours* the layer may be several molecules thick.

Adsorption in Solution.—Small drops of a pure liquid, when free from external influences assume a spherical shape. This can be seen with drops of water on a waxy surface—if the drops are large then the effect of gravity is appreciable and the drops become flattened. A liquid suspended in another liquid of the same density and in which it is insoluble also assumes a spherical shape. The second law of thermodynamics states that free energy always tends to become a minimum, and in the case of liquids the free surface energy therefore tends towards a minimum The free surface energy of a liquid is the product of its surface tension and the area of its surface, so that if there is a diminution in the surface tension or in the superficial area there is a diminution in the free surface energy. A pure liquid cannot change its surface tension, but its surface area is reduced to a minimum if it assumes a spherical shape, for it is characteristic of a sphere that for a given volume it has the minimum surface. If we consider a liquid containing a substance in solution, and having a lower surface tension than the pure liquid, *e.g*, a solution of one of the fatty acids in water, we find that the lowering of the surface tension results in a lowering of the free surface energy of the liquid; the effect is all the greater the more concentrated the solution. The free surface energy would decrease still further if there were an unequal distribution of the solute in the solution, *i e*, if the concentration of the surface layer of the solution were greater than the concentration of the bulk of the solution. This is found to be the case in all solutions where the solute lowers the surface tension of the solvent, and we may state generally that those solutes which decrease the surface tension of the solvent are concentrated at the surface, and, conversely, those solutes which raise the surface tension of the solvent have a lower concentration in the surface layers than in the bulk of the solution This generalization is known as Gibbs's adsorption theorem The increase in concentration of the solute at the surface is a case of adsorption of the solute at this surface Solutions of low surface tension are apt to foam or froth. Conditions favourable to frothing are low surface tension, low volatility and not too high mobility of the liquid. Pure liquids do not froth. A solution of soap in water froths very readily; if this froth is collected it is found to contain a much greater concentration of soap than the bulk of the liquid, *i.e.*, the soap has been adsorbed on the air-liquid surface.

Adsorption of Solutes by Solids.—The adsorption of solvents by solids is explained in exactly the same way as that of solutes at the gas-liquid interface. It is the application of Gibbs's adsorption theorem to the distribution of the solute. Those solutes which lower the surface tension at the liquid-solid interface will be concentrated or adsorbed at that surface and vice versa. When the surface area of the solid is very large (porous or very finely divided solids), the free surface energy assumes very high values, and may be considerably reduced as a result of adsorption. In the case of the gas liquid interface, the surface tension, and consequently the free surface energy, can be readily determined, and thus the results of adsorption interpreted quantitatively. It does not follow that a decrease in the surface tension at the gas-liquid interface involves a decrease in the surface tension at the liquid-solid interface The measurement of the surface tension in the latter case is extremely difficult, and the results are not trustworthy. If charcoal is shaken with a solution of methylene blue in water, a decrease in the concentration of the solution is indicated by a decrease in the intensity of its colour. A similar result is obtained by shaking charcoal with a solution of the fatty acids, amines, phenols, etc, in water; the solutes are adsorbed by the charcoal, since they lower the surface tension and therefore the free surface energy at the solution-charcoal interface.

In the case of solutes which raise the surface tension of the solvent, the converse holds, *i.e.*, the concentration of the surface layers will be less than that of the bulk of the solution, and the concentration of the solvent is relatively greater at the solid–liquid surface. We thus have two cases of adsorption; the first, resulting in a diminution in the concentration of the solution, is generally known as positive adsorption, and the second, resulting in an increase in the concentration of the solution, is known as negative adsorption.

It has been suggested that liquids in contact with charcoal are actually compressed on the surface of the solid, and this pressure has been estimated at 10,000 to 60,000 atmospheres. Positive adsorption is utilized largely in industry. Bancroft has determined the efficiencies of the more important decolorizing agents.

Material	*Efficiency*	*Material*	*Efficiency*
Alumina	100	Bone charcoal	17
Fuller's earth	50	Ferric oxide	3
Bauxite	40	Kieselguhr	3

The amount of adsorption generally decreases with increasing temperature, but the rate of adsorption increases with increasing temperature. In adsorption efficiency, specific surface plays a very important part—the higher the specific surface the more efficient the adsorbent. Freundlich's isotherm for adsorption from solution is:

$$x/m = Kc^{1/n};$$

x/m is the amount of solute adsorbed per unit mass of adsorbent; c is the concentration of the solution at equilibrium; K and n are constants, the values of which vary considerably (*e g*, n varies between 1 and 5), and depend on the temperature, nature and specific surface of the adsorbent, and also on the solvent.

The adsorption isothermal defines the relationship between concentration in the solution and the quantity adsorbed, as with gases; at small concentrations relatively more is adsorbed than at higher concentrations. This relationship only holds for dilute solutions. at high concentrations a saturation value is reached—in fact, at very high concentrations the amount adsorbed seems to decrease, due to more of the solvent being adsorbed. The adsorption of a salt is an additive property of the cation and the anion, thus, the adsorbability of a series of potassium salts is in the same order as that of sodium salts. The order of adsorbability of cations is as follows: Organic dyes (basic), H^+, Ag^+, Hg^+, Cu^{++}, Al^{+++}, Zn^{++}, Mg^{++}, Ca^{++}, NH^+_4, K^+, Na^+, and for the anions: Organic dyes (acidic), OH^-, CN^-, S^{--}, I^-, NO_3^-, Br^-, Cl^-, SO^{--}_4. Apart from the organic dyes, hydrogen and hydroxyl ions are the most readily adsorbed. In the case of the metals, the valency and the position of the element in the electrolytic potential series seem to be of importance. This preferential adsorption of H^+ and OH^- gives the adsorbent a positive or negative charge, and explains the origin of the electric charge on colloidal particles. The coagulation of colloidal solutions by electrolytes is also explained by the preferential adsorption on the surface of the colloidal particles of one ion which neutralizes its charge (*see* COLLOIDS).

If we consider the adsorption of methylene blue by kaolin, we find that the adsorbent is very efficient, much more efficient than in the adsorption of the fatty acids, etc. The solute in the case of methylene blue is highly ionized, and it comes into contact with a solid (calcium silicate) whose anion is extremely insoluble, but whose cation readily goes into solution. The calcium ions of the solid therefore change places with the methylene blue cation in solution. This kind of adsorption is known as exchange adsorption and is polar in character.

Theories of Adsorption.—Three theories of adsorption have been advanced: (1) Chemical theory; (2) Solution theory; (3) Surface theory

Chemical Theory.—If one regards adsorption equilibria as chemical equilibria, then the adsorption isotherm must be a special case of the law of mass action (*see* CHEMICAL ACTION) If one considers the adsorbent and the compound of the adsorbent and adsorbed substance as solid phases of constant composition, one must also assume a phase of variable composition (a solid solution) in order to apply the adsorption isotherm. Then the adsorption equilibrium can be regarded as a chemical equilibrium The opponents of this theory claim that chemical equilibrium is very

specific, the equilibrium and velocity coefficients vary considerably with the number of reacting molecules (in the adsorption isotherm this is $1/n$). Adsorption equilibrium, on the other hand, is but slightly specific; the constant K (the equilibrium constant in the law of mass action) does not vary much under very different conditions; the same applies to $1/n$. The chemical theory makes it difficult to understand the relation between the adsorbability of a gas and its condensability, or the influence of a solute on the surface tension of a solvent and the readiness with which it is adsorbed. Again, the chemically inactive gases helium and argon are adsorbed.

Solution Theory.—Adsorption as a solution phenomenon has but few adherents. In adsorption, equilibrium is rapidly established, but diffusion in a solid is extremely slow. Again to bring the phenomenon of adsorption into line with Henry's law, one must assume the dissociation of the gas, which is highly improbable in most cases. Some suggest that the gas is liquefied on the surface of the solid; this explains the relationship between adsorption and condensability of gases, but does not assist in the case of adsorption from solution.

Surface Theory.—Many regard adsorption merely as a concentration on the surface of the adsorbent in accordance with the second law of thermodynamics Assuming the validity of the gas laws and van't Hoff's law for dilute solutions, the following equation can be deduced thermodynamically.

$$u = -c/RT\, d\sigma/dc$$

where u=excess of gas or solute in the surface layer; c=concentration of solution (pressure of gas); R=gas constant; and T=absolute temperature.

It is difficult to test this equation in the case of solid surfaces because of the difficulty of determining the value of the surface tension σ. In the case of gas–liquid and liquid–liquid surfaces, the experimental results agree qualitatively, but quantitative results are difficult to obtain on account of the necessity of using very large surfaces.

The laws of chemical combination, solution and adsorption are represented by the curves in figure.

Curve 1: $x=K$ (law of constant composition). Action is due to the attractive forces between the atoms or molecules

Curve 2: $x/p=K$ (Henry's law of solubility).

Curve 3: $x/p=K^{1/n}$. K is given an exponent between 0 and 1, the values found in the case of chemical combination and solubility respectively. This phenomenon is due to molecular attraction and also to the kinetic motion of the molecules

Modern research tends to bring together the extreme views (chemical and physical) of adsorption. At one time the phenomenon was regarded as purely physical and non-specific; adsorption is now shown to depend on a variety of factors, many of which are extremely specific and closely related to chemical phenomena. I. Langmuir and N. K. Adam studied the behaviour of oils spread in unimolecular layers on water, and found that the forces operating were not readily distinguishable from chemical forces or affinity.

Applications of Adsorption.—Cocoa-nut charcoal is generally employed at very low temperatures (temperature of liquid air). Adsorption facilitates the separation of the difficultly adsorbed gases hydrogen and helium from the more easily adsorbed, such as nitrogen and oxygen. The effectiveness of gas masks depends on the efficiency of the charcoal which they contain for adsorbing such poisonous gases as chlorine, phosgene, etc. A very active and porous grade of charcoal is also used in an important process for the adsorption of gasolene from natural gas.

Adsorption is of very great importance in chemical reactions, for many of them are accelerated on various solid surfaces, and this has found extensive application in industry. Mention need only be made of the contact process for the manufacture of sulphuric acid (*q.v.*), the synthesis of ammonia (*q.v.*), hydrogenation (*q.v.*) of oils, etc. Catalytic poisoning is also due to adsorption. (*See* CATALYSIS.) In dyeing, adsorption plays a very prominent part in the fixing of the dye on the material, although the formation of compounds may also play a part in some cases. In the photographic plate the silver bromide is in the colloidal form and adsorbs the sensitiser. In brewing, the gas content and taste of the beer depend largely on adsorption of the colloidal particles. The growth of crystals from solution or from a molten mass is frequently influenced by the presence of other substances in solution; this rate of growth of the crystals in different directions determines their shape.

Adsorption plays a very important part in the agglutination of bacteria, and in the neutralization of a toxin by an anti-toxin. In the field of public health we find adsorption of importance. Aluminium hydroxide and ferric hydroxide, which are present in the soil, are very pronounced adsorbents, and filtration through soil is therefore a very efficient means of freeing sewage and other waste water from colloidal organic particles. This is also of importance to agriculture as the means whereby the soil is able to retain solvents from solutions which percolate through it.

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ADULIS (mod. *Zula*) —An ancient city of Eritrea. According to Pliny, it was founded by slaves who had fled from their Egyptian masters. Excavations have led to the discovery of a considerable amount of prehistoric pottery, and of various buildings, including an altar of the Sun and two Christian churches The principal periods of its prosperity were the Ptolemaic, Graeco-Roman and Christian The city, as far as can be ascertained, had neither fortifications nor walls.

See R. Paribeni in *Monumenti dei Lincei*, xviii. (1907) 437 *sqq.*

ADULLAM, a Canaanite city (Gen. xxxviii. 2), fortified by Rehoboam (2 Chron. xi. 7), and still a place of importance at the time of the Maccabees (2 Mac. xii. 38). Its chief interest lies in its connection with David who took refuge in its stronghold ("Cave" is a scribal error) on two occasions (1 Sam xxii. 1; 2 Sam. v 17). A site on the eastern edge of the Shephelah in the neighbourhood of Socoh (Shuweikah) seems to be indicated Conjectural identifications are (1) Khareitun, south-east of Bethlehem, which has a large cave but nothing else to commend it (2) Deir ed-Dibban, some 6m. east of Shuweikah, where there are caves and (3) Aid el-Ma', south of Shuweikah and at no great distance from it. The last identification is the one most favoured. The name, which appears to represent an Arabic reconstruction of Adullam, the position and the physical characteristics of the site support it In modern political history the term "Cave of Adullam" was applied by John Bright to certain Liberals who seceded from their party to oppose the Reform Bill of 1866. But the expression had been used earlier by President Lincoln (1864). From the same usage is derived the shorter political term "Cave" for any body of men who secede from their party on some special subject

See Clermont Gannean, *Pal. Expl. Fund Quart. Statement*, 177 (1875); G. A. Smith, *Hist. Geography of the Holy Land*, 229f (1910).

ADULT EDUCATION, a phrase originally meaning education of adults who have not been properly educated as children. As the educational system improved, the need for such education diminished, but as democratic government developed, it brought with it the need, felt by everyone, for education in citizenship. Adult education in this sense has been described as "an inseparable aspect of citizenship" and the new movement, which dates from the beginning of this century, has extended to democratic countries all over the world, including such countries as Germany and the United States. Because these countries had early possessed a comprehensive system of elementary and secondary education, they have not felt the need for adult education in its original sense. (*See* Adult Education in the United States, page 185.) It is often also distinguished as non-continual adult education from the continual education now given to adults in technical and commercial colleges in many parts of the country.

The new movement has taken many forms and is carried on

by many different organizations, some of which are described in the article on Workers' Education (*q.v.*). Thus in England the Workers' Educational Association, founded by Albert Mansbridge in 1903, originally aimed at bringing together working-class organizations to provide for an education, designed not to take men out of their class or trade, but to equip them, whatever their occupation in life should be, for the work of citizenship. It was to be a highway and not a ladder. The education it desired to bring into being was to be broad, impartial and scholarly, was to aim at a higher university standard and was to enlist the aid of the universities and of public authorities.

The universities were asked to help in maintaining the standard of education, but the choice of subjects and of tutors was to be with the students It was recognized that adult students bring an experience of life and an understanding of practical problems which are as important a contribution as the more theoretical knowledge of the teachers, and that adult education, therefore, requires a technique and organization in which both students and university trained teachers have their parts to play

Tutorial Classes.—In 1907 the University of Oxford organized the first tutorial class, the characteristic educational instrument of the new movement. These classes were small, between 20 and 30 persons, meeting once a week in the winter over a period of three years Each class period consisted of an hour's lecture and an hour's discussion, the students undertaking from the start to attend for the full period of three years and to do written work. The classes were under the control of a joint committee consisting of equal numbers of representatives of the university and of working-class organizations. The quality of work done in these classes was often of a good university standard. All the other universities of England and Wales followed the example of the University of Oxford, and in 1925 there were over 500 tutorial classes with 12,000 students, while the number of affiliated bodies was 2,500 and of independent members 23,000 The Board of Education has supported this work from the beginning and through its inspectors and the reports of its advisory adult education committee done much to further the standard of the teaching given Most local education authorities now give some support to adult education by grants either to tutorial classes or to the more elementary one-year classes and terminal courses which have greatly increased in numbers

The total amount of education of this kind given in democratic countries is very considerable and is rapidly increasing. The movement is still young and its future organization is still uncertain. Its great strength in the past was that it has been run by voluntary associations and has in a real sense been a university controlled in the main by its students. It suffers, however, from the weakness of administration and the fluctuating enthusiasm characteristic of all voluntary organizations. Its success in the future will depend on how far it can be connected more closely with public educational institutions on the one hand and organized labour on the other, without losing its voluntary character. The British Institute of Adult Education attempts to survey and co-ordinate by the publication of its journal and other literature, and by the holding of conferences, the work of the various organizations in the country which are concerned with adult education. The World Association of Adult Education is working to spread knowledge of adult education in all parts of the world.

See *Final Report* of the Adult Education Committee (Cmd. 321, 1919) and *Journal of the British Institute.* (A. D. L.)

UNITED STATES

In the United States the term adult education is used to denote an educational movement for men and women, young and old, who no longer are in contact with formalized education and whose primary interest lies in a vocation but who possess a secondary interest in their own educational improvement as a sustained and continuing process. It is sometimes called "continuing education." It interprets graduation from any sort of schooling as a commencement of educational opportunity extending throughout life.

While the movement was not recognized in the United States under the name "adult education" until 1924, its roots were already deeply imbedded in American life. The New England town meeting of the 17th century formed the initial adult education venture of record in the English colonies of North America. It was a logical next step to the formation of the first lyceum in Massachusetts in 1826, a voluntary association of farmers and mechanics "for the purpose of self-culture, community instruction and mutual discussion of common public interests." The town lyceums made rapid growth and in 1839 more than 3,000 were in existence. They assumed an educational leadership with the years, Emerson, Thoreau, Lowell and Holmes among others lending them prestige. It was the example of the lyceum which led Bishop John H. Vincent and his colleagues in 1874 to expand a Sunday school association into a general adult education venture. The Chautauqua Institution (*see* CHAUTAUQUA and LYCEUM) resulted and in its train numerous imitators, later to be served by the commercial Chautauqua and lyceum circuits. The last quarter of the 19th century saw the beginnings of the university extension movement and with the 20th century impetus to popular education was given through Andrew Carnegie's large benefactions to public libraries. Meanwhile the tax-supported school system, as the compulsory school age was pushed upward, had instituted a series of vocational extensions, soon accompanied by such non-vocational enterprises for adults as the voluntary evening high school.

The increase in public estimation of these agencies gave rise to many other forms of educational activity for adults. Most of them were based on the American tradition of education at cost, less than cost or no cost to the student. In addition there were devised, to meet the recognized educational needs of large numbers of people, certain commercial organizations known as private correspondence schools (*see* CORRESPONDENCE SCHOOLS) operated for profit under modern salesmanship methods Almost wholly vocational and technical in nature, these courses attracted such numbers that in 1927 the current enrolment was estimated at more than 2,000,000 persons who were annually expending $70 000,000 for the instruction offered

An inquiry into adult education needs and possibilities in England and Scotland, made as a part of the British ministry of reconstruction report of 1919, had resulted in the phenomenal growth of adult classes in those countries. Increasing recognition of the British movement and observance of a considerable American interest in various forms of continuing education led to an inquiry into American conditions, instituted in 1924 by the Carnegie Corporation of New York Five volumes constituting reports on as many broad phases of the general subject were published, a series of regional and national conferences of teachers and leaders of adults was held and, in March, 1926, there was formed the American Association for Adult Education with headquarters in New York. It serves as a national clearing house for information, sponsors and initiates researches and studies, and supervises and conducts experiments and demonstrations in co-operation with local and national agencies.

Urban and Rural Community Organization for Adult Education.—The initial attempt in the United States to organize an entire community's educational facilities with special reference to the adult and his needs was made in Cleveland in 1924. The Cleveland Conference for Educational Co-operation resulted and later a complementary body, the Adult Education Association of Cleveland. In 1925, Buffalo, organized similarly, conducted a self-survey under the auspices of a co-operative group known as the Buffalo Educational council The survey has since been published and the recommendations of the council are rapidly becoming effective. The Cleveland and Buffalo examples have brought together like groups in Chicago, Detroit, St. Louis and Brooklyn Plans for organization have been made in eight other cities. In addition, Dallas, Texas, in its Civic Federation and Institute for social education, founded in 1920, furnishes perhaps the best example in the country of a private educational venture for adults. Representatives of the various community enterprises have formed a national community conference which has affiliated

itself with the National Community Foundation. The latter organization is conducting, on an experimental basis, community organization activities and educational programmes in 60 small cities and towns of the Middle Atlantic States. It co-operates with its related organization, the Swarthmore Chautauqua. Michigan state college is experimenting with continuing education for rural areas in two Michigan counties selected for the purpose. A preliminary survey has been made and responsibility has been assumed by local groups. The California State board of education has likewise initiated a rural county demonstration. A privately supported small town circuit in western New York has been formed, initiating programmes in 16 centres.

Tax-supported Adult Education.—Approximately 100,000 men and women are enrolled in public evening schools (*see* CONTINUATION SCHOOLS) annually. They are almost exclusively in urban centres of 25,000 population or more. The work offered is either the same as the day school, designed to meet the needs of those who have had to leave school for economic reasons, or technical courses for vocational preparation, or classes for immigrants desiring to learn English. The last group has diminished rapidly since the revision of the immigration laws, although evidence is at hand that the need for such instruction still is large. The continuation school (*see* CONTINUATION SCHOOLS) is newly established and is found in only half the States of the Union and there only in the larger urban communities. It requires from four to 18 hours of student school time each week The co-operative school, originating at the University of Cincinnati, is still in an experimental stage. It provides for equal division of time between class-room and work in a factory. The usual practice is to alternate weeks. Antioch college, O, is wholly given over to the industrial co-operative idea.

Private Technical, Commercial and Correspondence Schools.—Thousands of business schools (*see* COMMERCIAL EDUCATION), trade schools (*see* TECHNICAL EDUCATION; INDUSTRIAL SCHOOL), and technical institutes, conducted for profit and in a relatively small number of cases, philanthropically endowed, operate in cities of all sizes throughout the country. They vary widely in efficiency and in repute. The schools of this type which utilize the correspondence method of instruction have reached large proportions in the United States. Of the 1,500,000 new students enrolled each year, 95% wish to obtain vocational training and pay from $10 to $280 for each course, the average payment being about $40. Extensive advertising methods are employed, from 30% to 80% of all tuition fees received being devoted to course salesmanship. Efforts are being made by the Federal trade commission, by the Better Business bureau of the National advertising clubs and by the National Home Study council, an association of correspondence schools, to improve business ethics and to create instructional standards.

Schools Operated by Religious Organizations.—Each of the large associations originally organized for religious and social purposes maintains an educational activity as an auxiliary phase. The Young Men's Christian Association (*q.v*) enrolls about 90,000 young men, mostly in evening classes which are chiefly of a vocational nature but which recently have shown a trend toward the non-vocational. The Young Women's Christian Association (*q.v.*) has an even more widespread educational programme, though of a much more informal nature than that of the Young Men's Christian Association. Its emphasis is definitely on the side of cultural studies. The Knights of Columbus (*q.v.*) and Young Men's and Young Women's Hebrew associations repeat the patterns of the other associations on a smaller scale.

Corporation Schools.—Education for workers is of two general types in the United States: that provided by the workers themselves and that provided by the employers. In the latter group fall some interesting experiments in education for the job-vocational education designed for immediate practical use in the industry which offers it. The larger corporations such as the Standard Oil Company, The Westinghouse Company, the telephone and allied interests, and to a lesser degree the automobile manufacturers, have educational departments which take employés from apprentice courses to the highest technical branches.

Workers' Education.—Although sporadic efforts had been made during the preceding quarter century, it was not until after the World War that an organized educational movement of wage-earners assumed sizable proportions in the United States. In 1921 a group of trade unionists and teachers in New York formed the Workers' Education bureau of America as a national organization to serve as a clearing house for information and to establish study classes. The bureau has since become the agency through which the American Federation of Labor carries on its entire adult education programme for its membership It has not only increased the number of workers' classes, but has published text-books, syllabi and study outlines. Of the dozen or so labour colleges scattered through the country, the residential Brookwood Labor college at Katonah, N Y., is the best known. It has a two-year course and also conducts special summer institutes. The International Ladies' Garment Workers' union has the most highly developed educational programme among national unions, although those of the United Mine Workers in Illinois and Pennsylvania are worthy of note. In California, the State Federation of Labor and the University of California Extension Division have embarked upon a joint programme for workers.

Special Summer Schools.—At Bryn Mawr college, a summer session for women workers in industry is held annually for 100 women workers, equally divided between unionized and non-unionized workers. The Bryn Mawr plan has been successfully adopted at the University of Wisconsin, Barnard college of Columbia university, New York, and at Sweetbriar college, Virginia. The National League of Girls' clubs holds an annual summer session on Long Island for mill girls, stenographers and other industrial workers, initially trained in the league's winter classes in New England and Middle Atlantic States. These summer schools are not to be confused with those conducted in great numbers by the universities and colleges throughout the country (*see* SUMMER SCHOOLS) which, while open to adults generally, are chiefly attended by teachers and college students. The California State board of education in 1927 initiated a series of special summer schools of adult education to be held annually. The first session was held at Mills college, Oakland, with an attendance of 250. The Chautauqua Institution of New York conducts a two months' summer session annually attended by about 12,000 people. This course is comparable with a university summer session. In addition winter reading courses are attended by 10,000 persons

University Extension and Adult Education.—The total enrolment of university extension students in the United States, exclusive of agricultural extension (*see* UNIVERSITY EXTENSION and AGRICULTURAL EDUCATION) may conservatively be estimated at 250,000. The university extension movement (*see* UNIVERSITY EXTENSION), through lectures, visual education media, correspondence courses, exhibits, discussion groups, reading circles, etc., easily reaches five times that number If the 5,000,000 members of farm families reached by the State agricultural colleges in co-operation with the Federal department of agriculture be added to the general extension total, it will be seen that university and college extension is the most important factor numerically in adult education in the United States.

Libraries and Museums.—Through the activities of the board on the library and adult education of the American Library Association, the 4,000 communities in the United States which have their own public library facilities, together with a number of State and regional organizations, have been acquainted with a new conception of the library as a dynamic agency of education. Many of the larger libraries have instituted readers' advisory services providing individual attention for every serious reader, including the preparation of special reading courses. This association has published a "Reading With a Purpose Series" consisting of more than 40 pamphlets, each of which is a short introduction to a given subject together with a list of half a dozen recommended books in the field. Hundreds of thousands of copies of these pamphlets have been sold and distributed. (*See* LIBRARIES and SCHOOL LIBRARIES.) By means of lectures, gallery talks, guidance for visitors, publications for the layman, loan collections, travelling exhibits, consultation hours for students and manufacturers, and

formal classes, a great educational work has also been done by the museums.

Chautauquas and Lyceums.—The modern Chautauqua and lyceum serve towns of less than 2,500 population almost exclusively. With the exception of one circuit, they are conducted for profit. The competition deriving from the radio, motion pictures and cheap transportation has resulted in large financial loss to the Chautauqua and lyceum operators of late years and it is questionable whether this form of combination lecture and entertainment bureau will persist in America. The commercial Chautauquas are not to be confused with the Chautauqua Institution of New York.

Women's Clubs, Parent Groups and Forums.—Three million women in the United States belong to women's clubs, in towns and cities of all sizes. Study materials are prepared by national and State offices which form the bases of educational programmes throughout the year. With the public school as the basic unit, hundreds of thousands of parents, chiefly mothers, are united in parent-teacher associations, child study (*see* CHILD STUDY ASSOCIATIONS), child welfare groups, etc. They are served by several national organizations. Each group is engaged upon an educational programme. Certain of the large State universities, notably Iowa, Minnesota and California, have recently assumed responsibilities in relation to the parental education programmes within their respective areas. Varying greatly in accordance with the communities which they serve, open forums flourish in many parts of the country. They are purely individualistic and autonomous; half of them are conducted by Protestant or Jewish churches.

Individual Enterprises.—Certain individual enterprises reflect the best which the nation has to offer in adult educational thought. Among these should be cited the People's Institute of New York, founded in 1897 as a forum for public discussion. Courses of instruction of a high standard and individual lectures are offered. In its school, the institute conducts experimental classes for adults in various parts of New York city Similarly, the New School for Social Research of New York city may be considered an adult education enterprise. There are others of less note, including at least three Danish folk school experiments which have not yet demonstrated their adaptability to American life.

(M. A. C.)

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ADULTERATION, the act of debasing a commercial commodity with the object of passing it off as or under the name of a pure or genuine commodity for illegitimate profit, or the substitution of an inferior article for a superior one, to the detriment of the purchaser. Although the term is mainly used in connection with the falsification of articles of food, drink or drugs, and is so dealt with in this article, the practice of adulteration extends to almost all manufactured products and even to unmanufactured natural substances. In its crudest forms, as old as commerce itself, it has progressed with the growth of knowledge and of science, and is, in its most modern developments, almost a branch —and that not the least vigorous one—of applied science. From the mere concealment of a piece of metal or a stone in a loaf of bread or in a lump of butter, a bullet in a musk bag or in a piece of opium, it has developed into the use of aniline dyes, of antiseptic chemicals, of synthetic sweetening agents in foods, the manufacture of butter from coco-nuts, of lard from cotton-seed and of pepper from olive stones. Its growth and development has necessitated the employment of multitudes of scientific officers charged with its detection and the passing of numerous laws for its repression and punishment. While for all common forms of fraud the common law is in most cases considered strong enough, special laws against the adulteration of food have been found necessary in all civilized countries. A vigorous branch of chemical literature deals with it; there exist scientific societies specially devoted to its study; laboratories are maintained by governments with staffs of highly trained chemists for its detection; and yet it not only develops and flourishes but becomes more general, if less virulent and dangerous to health.

There are numerous references to adulteration in the classics. Both in Rome and in Athens wine was often adulterated with colours and flavouring agents, and inspectors were charged with looking after it.

In England, so far back as the reign of John (1203), a proclamation was made throughout the kingdom as regards bread; and in the following reign the statute (51 Hen. III Stat. 6) entitled "the pillory and tumbrel" was framed for the express purpose of protecting the public from the dishonest dealings of bakers, vintners, brewers, butchers and others. This statute is the first in which the adulteration of human food is specially noticed and prohibited; it seems to have been enforced with more or less rigour until 1709, when it was repealed.

Similar records have come down from the continental European countries. In 1390 an Augsburg wine-seller was sentenced to be led out of the city with his hands bound and a rope round his neck; in 1400 two others were branded and otherwise severely punished; in 1435 "were the taverner Christian Corper and his wife put in a cask in which he sold false wine, and then exposed in the pillory. The punishment was adjudged because they had roasted pears and put them into new sour wine, in order to sweeten the wine. Some pears were hung round their necks like unto a Paternoster" In Biebrich, on the Rhine, in 1482, a wine-falsifier was condemned to drink six quarts of his own wine; from this he died. In Frankfurt, casks in which false wine had been found were placed with a red flag on the knacker's cart, "the jailer marched before, the rabble after, and when they came to the river they broke the casks and tumbled the stuff into the stream." In France successive *ordonnances* from 1330 to 1672 forbade the mixing of two wines together under the penalty of a fine and the confiscation of the wine.

MODERN BRITISH LEGISLATION

In modern times the English parliament has dealt frequently with the subject of food adulteration. In 1725 and 1730 acts were passed prescribing a penalty for "sophisticating" tea; in 1718 adulteration of coffee and in 1803 of cocoa were the subjects of legislation; in 1816 the addition of extraneous colouring matters to beer and porter was prohibited. It was only in 1847 that brewers were allowed to make for their own use from sugar a liquor for darkening the colour of worts or beer and to use it in brewing.

All the laws hitherto referred to were mainly passed in the interest of the inland revenue, and their execution was left entirely in the hands of the revenue officers About the middle of the 19th century statements were from time to time published concerning the food supply of the nation and roused the public attention. (*See* PLATE.) In 1850 Dr. Arthur H Hassall, had the happy idea of looking at ground coffee through the microscope. Eminent chemists had previously found great difficulty in establishing any satisfactory chemical distinction between coffee, chicory and other adulterants of coffee; the microscope immediately showed the structural difference of the particles, however small. Hassall was in consequence commissioned by Thomas Wakley (1795–1862), the owner of the *Lancet,* to extend his examination to other articles of food, and for a period of nearly four years reports of the *Lancet Analytical Sanitary Commission* were regularly published, the names and addresses of hundreds of manufacturers and tradesmen selling adulterated articles being fearlessly given. The responsibility incurred was immense, but the assertions of the journal were so well founded upon fact that they were universally accepted as accurately representing the appalling state of the food supply. As instances may be cited, that of 34 samples of coffee only three were pure, chicory being present in 31, roasted corn in 12, beans and potato-flour each in one; of 34 samples of chicory, 14 were adulterated with corn, beans or

acorns; of 49 samples of bread, every one contained alum; of 56 samples of cocoa, only eight were pure; of 26 milks, 14 were adulterated; of 28 cayenne peppers, only four were genuine, 13 containing red-lead and one vermilion; of upwards of 100 samples of coloured sugar-confectionery, 59 contained chromate of lead, 11 gamboge, 12 red-lead, six vermilion, nine arsenite of copper, and four white-lead.

First Measures.—In consequence of the *Lancet's* disclosures a parliamentary committee was appointed in 1855, the labours of which resulted in 1860 in the Adulteration of Food and Drink Act, the first act that dealt generally with the adulteration of food. As the act, however, left it optional to the district authorities to appoint analysts or not, and did not provide for the appointment of any officer upon whom should rest the duty of obtaining samples or of prosecuting offenders, it virtually remained a dead letter till 1872, when the Adulteration of Food and Drugs Act came into force, prescribing a penalty not exceeding £50 for the sale of injurious food and, for a second offence, imprisonment for six months with hard labour. Inspectors were empowered to make purchases of samples to be submitted for analysis, but appointment of analysts was still left optional. The definition of an adulterated article given in that act was essentially that still accepted at the present time, namely, "any article of food or drink or any drug mixed with any other substances, with intent fraudulently to increase its weight or bulk, without declaration of such admixture to any purchaser thereof before delivering the same." The adoption of the act was sporadic, and, outside London and a few large towns, the number of proceedings against offenders remained exceedingly small. Nevertheless complaints soon arose that it inflicted considerable injury and imposed heavy and undeserved penalties upon some respectable tradesmen, mainly owing to the "want of a clear understanding of what does and does not constitute adulteration," and in some cases to conflicting decisions and the inexperience of analysts.

Again a parliamentary committee was appointed which took a mass of evidence, the outcome of its enquiries being the Sale of Food and Drugs Act 1875, which is in force at the present day, subject to amendments and additions made at later dates. This act avoided the term "adulteration" altogether and endeavoured to give a clearer description of punishable offences. Also it made the appointment of analysts compulsory upon the City of London, the vestries, county quarter sessions and town councils or boroughs having a separate police establishment.

Endless disputes unavoidably arose, friction with manufacturers and traders, unfortunately also with the referees at the inland revenue, who for many years were altogether out of touch with the analysts. Conflicting decisions come to by various benches of magistrates upon similar cases, allowing of the legal sale of an article in one district which in another had been declared illegal, rendered the position of merchants often unsatisfactory. It was not recognized by parliament until almost a quarter of a century had elapsed that it was not enough to compel local authorities to get samples analysed, but that it was also the duty of parliament to lay down specific and clear instructions that might enable the officers to do their work. This has only been very partially done even at the present time.

As many thousands of samples were annually submitted by inspectors under the act to the analysts who had been appointed in 237 boroughs and districts, a very large number of cases led to disputes of law or fact, about 70 high court cases being decided within 18 years of the passing of the act. While these cases related to a variety of different articles and conditions, dairy produce—namely, milk and butter—led to the greatest amount of litigation. It may seem to be a simple matter to ascertain whether a vendor of milk supplies his customer with milk of the "nature, substance and quality demanded," but milk is subject, naturally, to great variations in composition owing to a large number of circumstances.

Not many years after the passing of the Food Act of 1875 the sale of butter substitutes assumed very large proportions, and so seriously prejudiced dairy-farmers that, as regards these, an act was passed which was not exactly an amendment of the Sale of Food and Drugs Act, although it embodied a good many provisions of that act. It was called the Margarine Act 1887. It provided that every package of articles made in imitation of butter should be labelled "margarine" in letters 1½ inches square. The Margarine Act is the first statute that makes reference to and sanctions the use of preservatives, concerning which something will have to be said farther on.

Administrative Difficulties.—In the course of 20 years of administration of the Food Acts so many difficulties had arisen on various points, that in 1894 a select committee was appointed to enquire into the working of the various acts and to report whether any, and if so what, amendments were desirable. During three sessions the committee sat and took voluminous evidence. They reported that where the acts had been well administered they had been most beneficial in diminishing adulteration offences, but that wide local differences in the administration of the acts existed, and that in many parts of the country the local authorities had failed to exercise their powers. The important question of food standards was considered at great length. The absence of legal standards or definitions of articles of food had occasioned great difficulty in numerous cases, but as no authority was provided by the existing acts that might fix such standards they recommended the formation of a scientific authority or court of reference composed of representatives of the laboratory of the Inland Revenue, of the Local Government Board, the Board of Agriculture, the General Medical Council, the Institute of Chemistry, the Pharmaceutical Society, of other scientific men, and of the trading and manufacturing community, who should have the duty of fixing standards of quality and purity of food to be confirmed by a secretary of state.

The committee's deliberations and recommendations resulted in the Sale of Food and Drugs Act 1899. This unfortunately was not a comprehensive act superseding the previous acts, but was an additional and amending one, so that at the present time four food acts run parallel and are together in force, rendering the subject from a legal point of view one of extreme complexity.

The act of 1899 embodies, with one exception, the most important recommendations of the Food Products Committee, the exception being the omission to institute a board of reference that might deal with difficulties as they arose, guide analysts and public authorities in fixing limits for articles other than milk and butter, and take up the important questions of preservatives and colouring matters and such like. An occurrence which almost immediately followed the passing of the act showed in the strongest manner the necessity of such guiding board—namely, the outbreak of arsenical poisoning in the Midlands in the latter part of 1900.

In the month of June 1900 there occurred, mainly in the Midlands but also in other parts of England and Wales, an outbreak of an illness variously described as "alcoholism," "peripheral neuritis" or "multiple neuritis." This affected about 6,000 persons and resulted in about 70 deaths. It was soon ascertained that the sufferers were all beer drinkers, and several of them were employees of a local brewery, the majority of whom had suffered for some months past. Although suspicion fell early upon beer, some considerable time elapsed before Dr. E. S. Reynolds of Manchester discovered arsenic in dangerous proportions in the beer. Steps were immediately taken by brewers and sanitary authorities to ensure that this arsenical beer was withdrawn from sale, and, as a result, the epidemic came speedily to an end. In all instances where this epidemic of sickness had been traced to particular breweries, the latter had been users of brewing sugars—glucose and invert sugar—supplied by a single firm. The quantity of arsenic detected in specimens of these brewing sugars was in some cases very large, amounting to upward of four grains per pound. The implicated brewing sugars were found to have become contaminated by arsenic in course of their manufacture through the use of sulphuric acid made from highly arsenical iron pyrites. Strictly speaking, arsenical poisoning does not belong to the subject of adulteration. It is not due to wilfulness but to stupidity, but it affords a lesson which cannot be taken too much to heart, that mankind, by relying too much upon "science" in feeding, is

on a path that is fraught with considerable danger. For there is hardly a chemical substance which has, directly or indirectly, come into contact with sulphuric acid that is not at times arsenical. Recently, arsenical poisoning has been reported from consumption of apples that had received a "summer spray" against insect pests.

To safeguard consumers, as far as practicable, the royal commission made important recommendations concerning amendments of the Food Acts. Pending the establishment of official standards in respect of arsenic under the Food Acts, they were of opinion that penalties should be imposed upon any vendor of beer or any other liquid food, or of any liquor entering into the composition of food, if that liquid be shown by adequate test to contain one-hundredth of a grain or more of arsenic in the gallon; and with regard to solid food, no matter whether it be consumed habitually in large or small quantities, or whether it be taken by itself (like golden syrup), or mixed with water or other substances (like chicory or yeast extract)—if the substance contain one-hundredth of a grain of arsenic or more to the pound. The board of reference, most urgently needed for the protection of the public and for the guidance of manufacturers and officers, has yet to be created.

PRESERVATIVES IN FOOD

While from time immemorial certain articles of food have been preserved by salting, smoking, drying, the addition of sugar or of saltpetre, during the last quarter of the 19th century the use of chemicals acting as antiseptics or preservatives extended enormously. Refrigeration and cold-storage have enabled meat and other highly perishable foods to be imported, but it is necessary to prevent decomposition prior to such goods coming into cold store. This difficulty—apart from the use of preservatives—can only be overcome by improvement in transport facilities or constriction of the area from which supplies can be obtained The legality or otherwise of the use of chemical preservatives hinges upon the difficult question of their innocuousness Hence in 1899 a committee of the Local Government Board was appointed to inquire into the use of preservatives and colouring matters in food. In 1901 this committee recommended that the use of formaldehyde or formalin, or preparations thereof, in food or drinks, be absolutely prohibited, and that salicylic acid be not used in a greater proportion than one grain per pint in liquid food and one grain per pound in solid food, its presence in all cases to be declared; that the use of any preservatives or colouring matter whatever in milk offered for sale in the United Kingdom be constituted an offence under the Sale of Food and Drugs Act; that the only preservative which it shall be lawful to use in cream be boric acid, or mixtures of boric acid and borax, and in amount not exceeding 0·25% expressed as boric acid, the amount of such preservative to be notified by a label upon the vessel; that the only preservative permitted to be used in butter and margarine be boric acid, or mixtures of boric acid and borax, to be used in proportions not exceeding 0·5% expressed as boric acid; that in the case of all dietetic preparations intended for the use of invalids or infants, chemical preservatives of all kinds be prohibited

Boric Acid.—As the most commonly used chemical preservative is boric acid, free or in the form of borax, which is extensively employed in butter, cream, ham, sausages, potted meats, cured fish, and sometimes in jams and preserved fruit, the arguments for and against its employment deserve more detailed attention. It cannot be looked upon in the light of common adulteration because, in any case, the quantity used is but an inconsiderable fraction, and the cost of it is generally greater than that of the food itself. It is not used to hide any traces of decomposition that may have taken place or to efface its effects. It enables food to be kept from decomposition, but it also lessens the need for cleanliness and encourages neglect and slovenliness in factories. It has little taste and hence cannot be perceived by the consumer or avoided by him should he desire to do so. Its preservative action is very slight in comparison with most other preservatives; its potential injuriousness to man must be proportionately small. It is practically without interference upon salivary, peptic or tryptic digestion, unless given in large quantities. An exhaustive investigation was carried out by Dr. H W. Wiley, chief chemist to the United States Department of Agriculture. Dr. Wiley concludes his report: "It appears, therefore, that both boric acid and borax, when continuously administered in small doses for a long period or when given in large quantities for a short period, create disturbance of appetite, of digestion and of health." This report was adversely criticized, but on the whole the balance of evidence seems to be that while no acute injury is likely to result from boron compounds in food, they are liable to produce slighter digestive interferences. Its use as a preservative for food was prohibited in England in 1925.

Formaldehyde.—Other chemical substances used to preserve food may be treated more shortly. Formaldehyde, coming into commerce in the form of a 40% solution under the name of formalin, was for a time largely used in milk. It is now generally recognized as admirably adapted for disinfecting a sick-room, but unsuitable for food preservation.

Salicylic Acid.—Salicylic acid or orthohydroxybenzoic acid is either obtained from oil of winter-green or is made synthetically. When pure, salicylic acid employed as a food preservative has never produced decided injurious effects, although it is a powerful drug in larger doses and requires careful administration, especially as about 60% of the persons to whom it is administered show symptoms known as "salicylism," namely, deafness, headache, delirium, vomiting, sometimes haemorrhage or heart-failure. When present in proportion of 1 to 1,000 it inhibits the growth of moulds and yeasts. In jams two grains per pound and in beverages seven grains to a gallon are considered by manufacturers to be sufficient for preservative purposes. It is used mainly in articles of food or drink containing sugar. Its use in butter, potted meat, milk or cream, is now quite exceptional. To some extent benzoic acid and benzoates have taken the place of salicylic acid and salicylates, partly because salicylic acid can readily be detected analytically, while benzoic acid is not quite easily discoverable.

Sulphurous Acid.—For the preservation of meat and beer, lime juice and dried fruit, sulphur dioxide (sulphurous acid) and some of the sulphites have long been employed About 1 part in 4,000 or 5,000 of beer is the usual amount. By the Public Health (Preservatives, etc., in Food) Regulations, 1925, in England, the amount of sulphur dioxide (by weight) in beer must not exceed 70 parts per million. While in larger quantities the sulphites produce nephritis, there is no evidence that they have ever caused injurious effects in alcoholic liquors.

Other Preservatives.—Sodium fluoride, a salt possessing powerfully antiseptic properties but interfering with salivary and peptic digestion, has been found in butter, imported mainly from Brittany, in quantities quite inadmissible in food under any circumstances A few other chemical preservatives are occasionally used Hydrogen peroxide has been found effective in milk sterilization, and if the substance is pure no serious objection can be raised against it. Saccharine and other artificial sweetening agents having antiseptic properties are taking the place of sugar in beverages like ginger-beer and lemonade, but the substitution of a trace of a substance that provides sweetness without at the same time giving the substance and food value of sugar is strongly to be deprecated.

The employment of chemical preservative matters in articles intended for human consumption threatens to become a grave danger to health or well-being. Each dealer in food contributes but a little; each one claims that his particular article of food cannot be brought into commerce without a preservative, and each condemns the use of these substances by others. There is doubtless something to be said for the practice, but infinitely more against it. It cheapens food by allowing its collection in districts far away, but the chief gainer is not the public as a whole but the manufacturer and the wholesale merchant. It is clearly the duty of the state to see that the evil is checked.

COLOURING MATTER

A similar criticism applies to the continually extending use of colouring matter in food. Civilized man requires his food not

only to be healthy and tasty, but also attractive in appearance.

Vegetables.—This is difficult to ensure, for the various colouring matters which are naturally present in meat and fish, in fruit, legumes and green vegetables are of a delicate and changeable nature and easily affected or destroyed by cooking. The manufacturer who used to put up "green" peas in pots or tins for sale produced the effect by the wilful addition of a substance known to be injurious to health, namely, sulphate of copper. The copper combines with the chlorophyll, forming copper phyllocyanate, which, by reason of its insolubility in the gastric juice, is comparatively innocuous. Preserved peas and beans have been for so many years "coppered" in this manner that it is difficult to induce the public to accept these vegetables when possessed of their natural colour only. The use of copper compounds as colouring matters was prohibited in England in 1925.

Milk.—Milk is naturally almost white with a tint of cream colour. When adulterated with water this tint changes to a bluish one. To hide this tell-tale of a fraud a yellow colouring matter used to be added by London milkmen. Very gradually this practice, which had its origin in fraud, extended to all milk sold in London. The consumer, mis-educated into believing milk to be yellow, required it to be so. Large dairy companies endeavoured to wean the public of its error, without success. In England the addition of colouring matter to milk was prohibited in 1925. From milk the practice extended to butter; natural butter is sometimes yellowish, mostly a faint fawn, and sometimes almost white. In agricultural districts this is well known and taken as a matter of course. In big towns, where the connection of butter and the cow is not well known, the consumer requires butter to be of that colour which he imagines to be butter-colour. Anatto, turmeric, carrot-juice used formerly to be employed for colouring milk, butter and cheese, but of late certain aniline dyes, mostly quite as harmless physiologically as the vegetable dyes just mentioned, are largely being used. In England, the addition of picric acid, dinitrocresol, Martius or naphthol yellow, aurantia and aurine (rosolic acid) is prohibited.

Sugars and Jams.—The same aniline dyes are also employed in the manufacture of an imitation Demerara sugar from white beet-sugar crystals. Aniline dyes are very frequently used by jam-makers; the natural colour of the fruit is apt to suffer in the boiling-pan, and unripe, discoloured or unsound fruit can be made brilliant and enticing by dye. The brilliant colours of cheap sugar confectionery are almost invariably produced by artificial tar-colours. Most members of this class of colouring matters are quite harmless, especially in the small quantities that are required for colouring, but there are a few exceptions, picric acid, dinitrocresol, Martius yellow, Bismarck brown and one of the tropaeolins being distinctly poisonous.

On the whole, the employment of powerful aniline dyes is an advance as compared with the use of the vicious and often highly poisonous mineral colours which Hassall met with so frequently in the middle of the 19th century. Mineral colours, with very few exceptions, are no longer used in food. Oxide of iron or ochre is still very often found in potted meats, fish sauces and chocolates; dioxide of manganese is admixed with cheap chocolates. All lump sugar of commerce is dyed. Naturally it has a yellow tint. Ultramarine is added to it and counteracts the yellowness. In the same way our linen is naturally yellow and only made to look white by the use of the blue-bag.

Difficult Cases.—The same idea underlies both practices, and indeed the use of all colouring matters in manufactured articles, namely, to make them look better than they would otherwise. Within bounds, this is a reasonable and laudable desire, but it also covers many sins—poor materials, bad workmanship, faulty manufacturing and often fraud. Like sugar, flour and rice are sometimes blued to make them look white. All vinegar, most beers, all stout, are artificially coloured with burnt sugar or caramel. The line dividing the legitimate and laudable from the fraudulent and punishable is so thin and difficult to draw that neither the law nor its officers have ventured to draw it, and yet it is a matter which urgently requires regulation at the hands of the State. Practices which, when new, admit of regulation are almost ineradicable when they have become old and possessed of "vested rights." Recognizing this, the departmental committee, like the royal commission on arsenical poisons, recommended that "means be provided, either by the establishment of a separate court of reference, or by the imposition of more direct obligation on the Local Government Board, to exercise supervision over the use of preservatives and colouring matters in foods and to prepare schedules of such as may be considered inimical to the public health."

Metallic Impurities.—In close connection with this subject is the occasional occurrence of injurious metallic impurities in food-materials. Tin chloride is used in the West Indies to produce the yellow colour of Demerara sugar. The old processes of sugar-boiling left some of the brown syrup attached to the crystals, giving them both their colour and their delicious aroma; with the introduction of modern processes affording a much greater yield of highly refined sugar white sugar only was the result. The consumer, accustomed to yellow sugar, had the colour artificially supplied by the action of the tin compound upon the sugar. Nowadays all Demerara sugar, with the exception of that portion that is dyed with aniline dye, has had its colour artificially given it and consequently contains strong traces of tin.

Soda-water, lemonade and other artificial aerated liquors are liable to tin or lead contamination, the former proceeding from the tin pipes and vessels, the latter from citric and tartaric acids and cream of tartar used as ingredients, these being crystallized by their manufacturers in leaden pans. Almost all "canned" goods contain more or less tin as a contamination from the tin-plate. While animal foods do not attack the tin to any great extent, their acidity being small, almost all vegetable materials, especially fruits and tomatoes, powerfully corrode the tin covering of the plate, dissolving it and becoming impregnated with tin compounds. These tin compounds are by no means innocuous; yet poisoning from tinned vegetable foods is of rare occurrence. On the whole, tin-plate is a very unsuitable material for the storage and preservation of acid goods. Certain enamels, used for glazing earthenware or for coating metal cooking pots, contain lead, which they yield to the food prepared in them Food materials that have been in contact with galvanized vessels sometimes are contaminated with zinc. Zinc is also not infrequently present in wines.

PARTICULAR ARTICLES ADULTERATED

We will now proceed to consider adulteration as practised during recent years in the more important articles of food.

Milk.—Milk adulteration means in modern times either addition of water, abstraction of cream, or both, or addition of chemical preservative. Owing to the wide variation to which milk is naturally liable it is exceedingly difficult to establish beyond doubt whether any given sample is in the state in which it came from the cow or has been impoverished. These natural variations are seen from the following analyses, fairly representing the maximum, minimum and mean composition of the milk of single cows:

	Minimum	Maximum	Mean
Specific gravity	1·0264	1 0370	1 0316
Fat	1·67%	6·47%	3·59%
Casein	1·79%	6·29%	3·02%
Albumen	0 25%	1·44%	0·50%
Milk sugar (lactose)	2·11%	6·12%	4·78%
Salts	0·35%	1·21%	0·71%
Water	80·32%	90 69%	87 40%

In market milk such wide variations are not so liable to occur as the milk from one animal tends to average that from another. The average composition of genuine milk supplied by one of the largest dairy companies in London, as established by the analysis of 120,000 separate samples recorded by Dr. P. Vieth, is fat 4·1%, other milk solids ("solids not fat" or "non-fatty solids") 8·8%, total dissolved matters (total solids) 12·9%, the variations being from 3·6% to 4·6% in the fat and 8·6% to 9·1% in the solids not fat. It is clear that the 4·6% of fat could be reduced, by skimming, to 3·0%, and the 9·1% of solids not fat to 8·5% by

addition of water, without bringing the composition of the milk thus adulterated outside that of genuine milk.

Condensed milk is milk that has been evaporated under reduced pressure with or without the addition of sugar. Generally one part of condensed milk corresponds to three parts of the original milk. There is no case on record of adulteration of unsweetened condensed milk, but sweetened milk has in the past been frequently prepared either from machine-skimmed or partly skimmed milk and sold as whole-milk. As sweetened condensed milk is largely used by the poorer part of the population for the feeding of infants, and as the fat of milk is its most valuable constituent, this class of fraud was particularly mischievous. The average composition of sweetened condensed milk may be taken, with slight variations, to be: water 24·6%, fat 11·4%, casein and albumen 10%, milk-sugar 11·7%, cane-sugar 40·3%, mineral matters 2·0%.

Cream.—There are, in England, no regulations or official standards relating to this article, the value of which depends upon its contents in fat. Additions of starch paste, or any thickening substance (other than cane or beet sugar), with the object of giving an appearance of richness to a naturally poor and dilute article, are forbidden in England. Within recent times all cream sold by others than milkmen, and much of that even, contained boric acid The limit of boric preservative that might be permitted, but which was nearly always exceeded, was one-quarter of 1%. Its use is now prohibited altogether.

Butter.—Of all articles of food butter is the most extensively adulterated by the addition of water either directly or by the way of milk or salt. Another form of adulteration consists in the substitution of other fatty matters for the whole or part of the really valuable portion of the butter-fat. Margarine, coco-nut oil and other fats are of this class.

Margarine is frequently adulterated. Excessive amounts of water or of milk—margarines with over 30% of water are met with—sugar, glucose, starch, gelatinous matter, solid paraffin, in fact anything that is cheaper than fat has been used.

Cheese varies very widely in composition, so-called cream cheese containing not less than 60% of fat; Stilton upwards of 40%; Cheddar about 30%; Dutch, Parmesan and some Swiss and Danish less than 20% The amount of water varies with the kind and age of the cheese and may be as low as 20% and as high as 60% When, however, cheese is made from skimmed milk and the fat is replaced by margarine, as is the case in so-called "filled" or margarine cheeses, the sale of these amounts to an adulteration, unless the presence of the foreign substance is declared.

Lard.—Between the years 1880 and 1890 a gigantic fraudulent trade in adulterated lard was carried on from the United States A great proportion of the American lard imported into England was found to consist of a mixture of more or less real lard with cotton-seed oil and beef-stearine. Maize oil is now used as a lard adulterant, its detection being far more difficult than that of cotton-seed oil.

Oils.—The most common adulterant of the more valuable oils, like olive oil, is cotton-seed oil. The oils expressed from the sesame seed or the earth-nut (arachis oil) are also frequently admixed with olive oil. Almond oil is adulterated with the closely allied oils from the peach-kernel or the pine-seed. Deodorized paraffin hydrocarbons also enter as adulterants into edible oils.

Flour and Bread as sold in England are almost invariably genuine. The old forms of adulteration, such as the use of alum for the production of a white but indigestible loaf from bad flour, have disappeared. The only admixture which has been met with during recent years is maize-meal in American produce. This is of inferior food value to wheat-meal. In 1927 a committee of the British Ministry of Health issued a report on the treatment of flour with chemical substances. These bleaching agents and so-called "improvers" are chiefly nitrogen peroxide, benzoyl peroxide, chlorine and nitrogen trichloride, acid calcium phosphate, acid ammonium phosphate and persulphates. It was considered that chlorine, nitrogen trioxide and benzoyl peroxide were more open to objection than the others, and that the use of physical rather than chemical methods of improving flour merited extension.

Sugar in its various forms is not subject to adulteration by the addition of inferior substitutes. There have, however, been numerous prosecutions for a fraud of another class, namely, the substitution of dyed beetroot sugar for Demerara sugar.

Marmalade and Jams.—In the preparation of marmalade and jams a part of the sugar, from 10% to 15%, is often now replaced by starch glucose. Artificial colouring matters and chemical preservatives are almost constant ingredients of jams. To such fruits which, when boiled with sugar, do not readily yield a jelly (strawberries, raspberries) an addition of apple juice is frequently made in the manufacture of jam, without much objection; the pulp of the apple, however, is sometimes bodily added as an adulterant. The only preservatives now allowed in England are sulphur dioxide and benzoic acid in quantities prescribed in the Statutory Rules and Orders, 1925, No. 775.

Tea.—In consequence of the proviso contained in the Food Act of 1875 that tea was to be examined by the customs on importation, such tea as was found to be admixed with other substance or exhausted tea being refused entry into England, the adulteration of tea has been virtually suppressed. The practice, very common a generation ago, of artificially colouring tea green with a mixture of Prussian blue and turmeric has quite vanished with the decline of the consumption of green tea.

Coffee.—A few cases of artificially manufactured coffee berries, made from flour and chicory, have been observed, but it would not be fair to speak of a practice of adulteration regarding coffee berries. Not infrequently coffee is roasted with the addition of some fatty matter or paraffin or sugar, to give to the roasted coffee a glossy appearance. These additions as a rule are small in amount. Ground coffee is often sold adulterated with chicory, sugar or caramel.

Cocoa and Chocolate are liable to a number of fraudulent additions. In the cheaper qualities of cocoa-powder, sugar and starch—the latter in the form of sago flour or arrowroot—are admixed in very large proportions, and, in order to give to such mixtures something like the appearance of genuine cocoa, red oxide of iron is added. This almost invariably is more or less arsenical Cocoa-shell, a perfectly valueless material, is mixed in a very finely ground state with cocoa of the commoner kind.

Wine.—Much wine is fortified with alcohol made from other sources than the grape, and the addition of sugar, precipitated chalk, salts of zinc, to correct the product of poor vintages is common in certain instances.

Beer cannot be said to be adulterated, although materials often very different from those which the general public believe to be the proper raw materials for the manufacture of beer, namely, water, malt and hops, are largely used. That is to say, beer is legally anything that is sold as beer provided that it has 2% of proof spirit. There is not any restriction upon the materials that are employed provided that they are not positively poisonous. For inland revenue purposes, however, a prohibition has been made against the admixture of anything to beer after it has been manufactured, and excise prosecutions of publicans for watering beer are not infrequent.

Non-alcoholic Drinks.—Of these again it is hardly proper to speak as liable to adulteration. So-called soda-water is very often devoid of soda and is only carbonated water. Potash and especially lithia waters very frequently contain only mere traces of the substances from which they derive their names. The sweetness of ginger-beer and often of lemonade is no longer due to sugar but to saccharine (the toluol derivative), which is possessed of sweetness but not of nourishment; and since, as an antiseptic, it may affect the digestion, its use in these beverages is to be deprecated.

Vinegar ought to be the product obtained by the successive alcoholic and acetous fermentation of a sugary liquor. When this is obtained from malt or from malt admixed with other grain the vinegar is called a malt vinegar. Often, however, acid liquors pass under that name which have been made by the action of a mineral acid upon any starchy material such as maize or tapioca, with or without the addition of beet sugar. Dilute acetic acid, obtained from wood, is very frequently used as an adulterant of vinegar.

When properly purified such acid is unobjectionable physiologically, but it is improper to sell it as vinegar. Adulteration of vinegar by sulphuric or other acids, formerly a common practice, is now exceedingly rare.

Spirits.—For many years the only form of adulteration known was dilution with water. It was, however, well known that many so-called brandies were not the product of the grape, but that spirits of other origin were mixed with grape brandy. These were deficient in alcohol derivatives ("esters") to which the flavour of real brandy is due. For the present a brandy is not considered genuine unless it contains in 100,000 parts (calculated free from water) at least 60 parts of "esters." As a consequence a trade has sprung up in artificially produced esters, sold for the purpose of adding them to any spirit to convert it into a liquor passing as "brandy." Formerly a common form of adulteration of whisky was the addition to it of spirit made on the Continent mainly from potatoes.

Drugs.—Very few of the great number of drugs included in the pharmacopoeias are liable to serious adulteration, and cases on record during recent years where real fraudulent adulteration was involved, are rare. Certain perishable drugs, such as sweet spirits of nitre, or others liable to contain from their mode of manufacture metallic impurities, form the subjects of frequent prosecutions, but the element of intentional fraud which characterizes many forms of food adulteration is happily generally absent in the case of drugs.

Results of Legislation.—In general it may be said that so far as England and Wales are concerned the effect of the application of the food laws has been entirely beneficial. Not only has the percentage proportion of samples found adulterated largely declined, but the gross forms of adulteration which prevailed in the middle of the 19th century have almost vanished. Plenty of fraud still prevails, but poisoning by reckless admixture is of exceedingly rare occurrence. Whilst formerly milk was not infrequently adulterated with an equal bulk of water, few fraudulent milkmen now venture to exceed an addition of 10% or 15%.

So far as concerns the latest regulations in England, section 4 (1) of the Public Health (Preservatives, etc, in Food) Regulations 1925, dated August 4, 1925, made by the Minister of Health is as follows:

4.—(1) No person shall manufacture for sale or sell any article of food which contains any added preservative or any of the colouring matters specified in part ii. of the First Schedule to these Regulations: provided that—(i) any article of food specified in part i. of the said Schedule may contain preservative of the nature and in the proportion therein specified; (ii.) where an article of food specified in part i. of the said Schedule is used in the preparation of any other article of food, the latter article may contain any preservative necessarily introduced by the use of the former article, but the total proportion of any one preservative contained in any article of food specified in that part of the Schedule shall not exceed the proportion therein specified For the First Schedule *see* adjoining column.

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PART I.—*Articles of Food Which May Contain Preservative and Nature and Proportion of Preservative in Each Case:*—

The articles of food specified in the first column of the following table may contain the preservative specified in the second column in proportions not exceeding the number of parts (estimated by weight) per million specified in the third column —

Food	Preservative	Parts per million
1 Sausages and sausage meat containing raw meat, cereals and condiments	Sulphur dioxide	450
2. Fruit and fruit pulp, not dried		
(*a*) Strawberries and raspberries	,, ,,	2,000
(*b*) Other fruit . .	,, ,,	1,500
3. Dried fruit:		
(*a*) Apricots, peaches, nectarines, apples and pears	,, ,,	2,000
(*b*) Raisins and sultanas .	,, ,,	750
4. Unfermented grape juice and non-alcoholic wine made from such grape juice if labelled in accordance with the rules contained in the Second Schedule to these Regulations	Benzoic acid	2,000
5 Other non-alcoholic wines, cordials and fruit juices, sweetened or unsweetened	Either sulphur dioxide	350
	or benzoic acid	600
6 Jam (including fruit jelly prepared in the way in which jam is prepared, but not including marmalade made from citrous fruits)	Sulphur dioxide	40
7. Candied peel	,,	100
8 Sugar (including solid glucose)	,, ,,	70
9. Corn syrup (liquid glucose)	,, ,,	450
10 Gelatine	,, ,,	1,000
11 Beer	,, ,,	70
12. Cider	,, ,,	200
13 Alcoholic wines	,, ,,	450
14 Sweetened mineral waters	Either sulphur dioxide	70
	or benzoic acid	120
15. Brewed ginger beer	Benzoic acid	120
16 Coffee extract	,,	450
17 Pickles and sauces made from fruit or vegetables	,,	250

PART II —*Colouring Matters Which May Not Be Added to Articles of Food*

1 METALLIC COLOURING MATTERS

Compounds of any of the following metals

Antimony	Copper
Arsenic	Mercury
Cadmium	Lead
Chromium	Zinc

2. VEGETABLE COLOURING MATTER

Gamboge

3. COAL TAR COLOURS

Number of colour index of Society of Dyers and Colourists, 1924	Name	Synonyms
7	Picric acid	Carbazotic acid
8	Victoria yellow	Saffron substitute; dinitrocresol
9	Manchester yellow	Naphthol yellow; Martius yellow
12	Aurantia	Imperial yellow
724	Aurine	Rosolic acid; yellow coralline

FOOD LAWS IN THE UNITED STATES

In the United States the control of foods is exercised by the Federal Government of the United States under the Federal Food and Drugs act, the Meat Inspection act, the Tea Inspection act and certain acts relating to specific products such as filled cheese, filled milk, butter and mixed flour. Forty-seven of the 48 States of the Union have some form of food control legislation. A number of States have laws which follow the general principles of the Federal Food and Drugs act, but other States have laws differing very materially from that act. In some States foods are controlled under the general provisions of one act, in other States they are controlled under a number of acts relating to specific food products. Each State has complete control of the foods produced and consumed within that State. The Federal Government has control of foods shipped into interstate or foreign commerce.

The Federal Food and Drugs act, approved on June 30, 1906, and amended in 1912, 1913 and 1919, provides in general that all foods coming within its jurisdiction be prepared in a cleanly manner from pure and wholesome materials; free from any added substances which might render them injurious to health; not labelled or sold under representations which are in any manner deceptive. Food packages must bear a plain and conspicuous statement of the quantity of the contents.

The Meat Inspection act, approved on June 30, 1906, provides that every establishment in which cattle, sheep, swine or goats are slaughtered or their carcasses are wholly or in part canned, cured, smoked, salted, packed, rendered or otherwise prepared for transportation or sale as articles of interstate or foreign commerce, shall be inspected under the act. The inspection begins when live animals are received for slaughter, and includes a thorough ante-mortem and post-mortem examination, a rigid inspection of products such as smoked or cured meats, lard and by-products, and a final inspection when meats and their products leave the inspected establishments.

The Tea Inspection act of March 2, 1897, amended on May 16, 1908, provides that all shipments of tea offered for entry into the United States shall be inspected to see that they comply with the standards of quality and purity adopted each year by a board of tea experts appointed by the secretary of agriculture. Every consignment of tea offered for entry into the United States is inspected, and only such tea admitted as complies with the standards.

The department of agriculture in the enforcement of the Federal Food and Drugs act endeavours to see that out of the great volume and variety of foods coming from other countries only such as comply with the act are allowed to enter the United States. Shipments in violation of the Food and Drugs act are denied entry into the United States, and if not exported within three months are destroyed. If the violation is a form of misbranding that can be entirely corrected by relabelling, the importer is permitted to relabel the shipment, after which it may be admitted to the country, if the relabelling is correct. Foods that are harmful to health, however, are not admitted to the United States and must be exported or destroyed.

For the control of interstate commerce two forms of action are provided by the Federal Food and Drugs act—criminal prosecution against the party responsible for the violation, and seizure of any shipments of adulterated or misbranded foods or drugs found in interstate or foreign commerce. Both actions may be invoked when necessary. Under the Federal Food and Drugs act more than 14,000 cases, including both criminal prosecutions and seizures, have been terminated in the Federal courts and the results published in the form of notices of judgment. This number represents only those instances of flagrant misbranding or adulteration in which court action was necessary to check the practice. Countless minor violations have been corrected by serving notices on the firms responsible without recourse to formal legal action.

Most of the grosser forms of adulteration and misbranding which prevailed at the time of the enactment of the Federal Food and Drugs act and Meat Inspection act in 1906 have been eliminated as general trade practices. Occasional sporadic instances on the part of widely scattered dealers to adulterate and misbrand in the old way are still detected at intervals; but such practices are no longer general. New and more subtle forms of adulteration, however, are being detected. As a result of the effects of pure food legislation by the Federal and State Governments, and by the application of the principles of sanitary science in the food industries, very great improvement was made in the purity of food in the markets of the United States between 1910 and 1925. No other classes of merchandise are to-day, on the whole, so free from adulteration and misbranding as foods.

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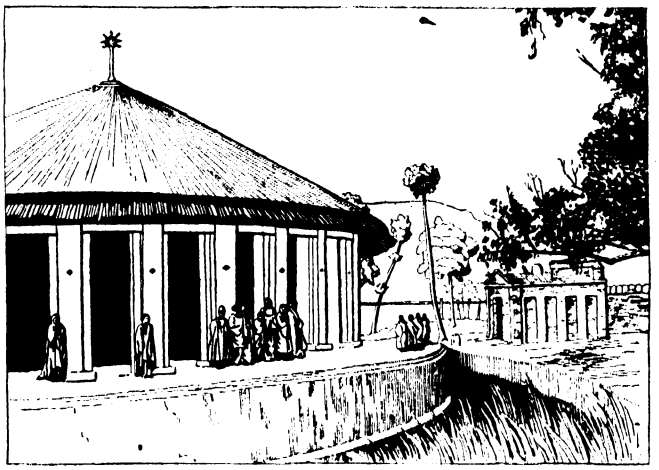
ADULTERY, the sexual intercourse of a married person with another than the offender's husband or wife (from Lat. *adulterium*). Among the Greeks, and in the earlier period of Roman law, it was not adultery unless a married woman was the offender. The foundation of the later Roman law with regard to adultery was the *lex Iulia de adulteriis coercendis* passed by Augustus about 17 B.C. (See *Dig.* 48. 5; Paull. *Rec. Sent.* ii. 26; Brisson, *Ad Leg. Iul. de Adult.*) (*See* DIVORCE.)

ADUWA (previously Adowa), in the province of Tigré, northern Abyssinia, 145m. north-east of Gondar and 17m. east by north of Aksum, the ancient capital of Abyssinia. Aduwa, a



ADUWA, CAPITAL OF TIGRÉ, IS THE CHIEF CENTRE OF TRADE BETWEEN CENTRAL ABYSSINIA AND THE COAST. HERE IS SHOWN THE CHURCH OF THE SAVIOUR OF THE WORLD

hill-slope at an elevation of 6,500ft., in a rich agricultural district, is an important market centre. On a hill about 2½m. north-west of Aduwa are the ruins of Fremona, the headquarters of the Portuguese Jesuits who lived in Abyssinia during the 16th and 17th centuries. On March 1, 1896, in the hills north of the town, was fought the battle of Aduwa, in which the Abyssinians inflicted a crushing defeat on the Italian forces (*see* ITALY: *History* and ABYSSINIA: *History*).

AD VALOREM. The term appropriately used in commerce for a duty which is levied by customs authorities on goods or commodities "according to value." An ad valorem duty is the opposite of a "specific" duty, which is chargeable on the measure or weight of goods. The early English customs tax called "poundage" was an ad valorem duty levied at the rate of one shilling in the pound, or five per cent. In Great Britain in 1927 the duties, commonly called "McKenna Duties," on motor cars, musical instruments, etc., and most of those under the Safeguarding of Industries act, are on an ad valorem basis, and duties of this description are also levied in several British overseas dominions and in the United States of America; in some cases a combined specific and ad valorem duty is leviable, particularly in the United States.

The general practice in the United States is that duty is levied on the foreign export value, *i.e.*, the actual cost at the place of purchase, or the home consumption value in the exporting country, whichever is the greater. It is usual to require at the port of entry the production of an invoice with full particulars of the place where, time when, and the person from whom the goods were purchased, and the actual cost of the goods and any charges on them. Such invoice has to be countersigned by the American consular officer for the district from which the goods are actually destined for America, *i.e.*, place of consignment, not place of shipment. On arrival at the U.S. port of entry the invoice is sworn to by the importer. The definite establishment of the dutiable value is then decided upon by the appraisers at the port of entry, appeal lying to the customs court, formerly the board of general appraisers.

In the British overseas dominions ad valorem duties are usually assessed on the value of the goods in the home trade of the exporting country. In some countries, although nominally ad valorem duties are imposed by the tariff, in practice arbitrary unit values are fixed, either periodically as in the case of Egypt or permanently as in the case of Argentina; the prescribed ad valorem duty is levied on these arbitrary valuations, thus in effect making the duties specific.

It has been argued that, theoretically, an ad valorem duty is preferable to a specific duty, inasmuch as it falls in proper proportion alike on the high-priced and low-priced grades of a commodity, and no matter how the value of any article fluctuates the rate of taxation automatically adjusts itself to the new value. This adjustment has been of particular importance in countries where the currency has been subject to violent fluctuations or where prices have been notably unstable. In practice, however, ad valorem duties may lead to great inequalities and are also difficult to assess equitably; while the relative value of two commodities may remain relatively unchanged under an ad valorem duty, yet owing to the difference in the cost of production, or through the different proportions of fixed and circulating capital employed in their manufacture, an ad valorem tax will be felt much more severely by one commodity than another, from the exporter's point of view. Again, there is always a difficulty in obtaining a true valuation of the exported goods, for values from their very nature are variable.

Ad valorem fees are imposed by some countries (mostly Latin American) on the consular certification of invoices, which are necessary for the clearance of goods through the customs on arrival at the port of destination. These range from 2% to 10%.

The term ad valorem is also used for British stamp duties. By the Stamp Act of 1891, certain classes of instruments, *e g*, bills of exchange, conveyances or transfers, leases, mortgages, etc, must be stamped in England with the proper ad valorem duty, that is, the duty chargeable according to the value of the subject-matter of the particular instrument or writing. (*See* STAMP DUTIES; CUSTOMS DUTIES; SAFEGUARDING OF INDUSTRY)

ADVANCED GUARD, the protective detachment pushed forward in advance of an army, or smaller force, moving towards the enemy. Although protective in purpose, its action is largely offensive in order to fulfil its duties. These are to gain information of the position and strength of the enemy's main forces, to deny similar information to the enemy's reconnoitring troops, to brush aside his advanced detachments and so prevent delay to the march of the main body. When the advanced guard eventually comes to grips with the real strength of the enemy, it should fix him securely in order to allow its own main force to deploy and manoeuvre. Gaining time is then as vital as saving time in the earlier phase, and for this purpose the advanced guard may have to resort to attack, defence, or an alternation of both.

The rôle of an advanced guard may be likened to that of an outstretched arm of a man moving in the dark. Flank guards and rear guards are variations of an advanced guard whose names explain their rôles. Outposts are a protective detachment to a force halted.

ADVANCEMENT, a term used in English law to describe a sum of money or other benefit conferred by a father or a person *in loco parentis* upon a child by blood or adoption for the purpose of establishing such child in life. It may be considered thus:

1. Advancements during a father's life when the father dies intestate. The law as to this is of very ancient origin but is now summed up for our purpose in ss. 47 1 (iii) and 49 (a) of the Administration of Estates Act 1925 By the former, when a person who dies intestate has during his life paid money or transferred property to a child of his by way of advancement, or has settled money or property on a child of his on such child's marriage, then, if on the parent's death intestate the child is entitled to a share of the parent's estate, the money or property advanced or settled is to be taken *prima facie* as being so paid or settled in and towards the satisfaction of such child's share of the estate as one of the next of kin, and must be taken into account in apportionating the estate among the issue of the intestate. The value of the advancement is what it is worth at the death of the intestate. By s. 49 (a), where a testator dies partially intestate, any benefits given to the issue of the testator by the will are to be brought into account as if they were advancements in distributing the undisposed of estate among such issue.

2. Double portions. The provisions of s. 49 (a) are really an adaptation of the equitable rule against double portions to cases of partial intestacy. By that rule, where a father or person *in loco parentis* by his will leaves a legacy to a child by blood or adoption and afterwards gives an advancement to such child, then if the advancement was of property of a similar description to that given by the will, the advancement is *prima facie* to be taken as an ademption, total or *pro tanto*, of the legacy. In the same way if the deceased has before he made his will covenanted to advance a certain sum to the child, then if, not having made the advancement during his life, he by his will leaves a legacy to the child, or if he dies intestate and the child is entitled to a share of his estate as next of kin, the legacy or the share of the estate is to be taken into account in total or *pro tanto* satisfaction of the debt due by the covenant.

3 Formerly advancements out of the capital of property held in trust for sale for persons absolutely or contingently entitled could only be made by direction of the court. Now they may be made by the trustees at their absolute discretion, provided that no more than one half part of the cestui que trust's actual and prospective share is so advanced, that if the person advanced becomes indefeasibly entitled to a share of the trust property the amount advanced shall be taken into account, and that no interest in the trust property taking precedence of his share shall be prejudiced by such advancement without the owner's consent in writing (*see* the Trustee Act 1925, s. 32).

ADVANTAGE, that which gives gain or helps forward in any way (Fr. *avant*, before). It is often contracted to "vantage" In some games (*e g*, lawn tennis) the term "vantage" is used technically in scoring. A position which gives a better chance of success than its surroundings is called a "vantage ground."

ADVANTAGE, MECHANICAL. Mechanical advantage is obtained by using a machine which exerts a *force* greater than the force applied, and is expressed by the ratio $\frac{\text{force obtained}}{\text{force applied}}$. "Machine" is here used in its widest sense, the simplest form being the lever. (*See* MECHANICS)

ADVENT (Lat. *Adventus*, sc. *Redemptoris*, "the coming of the Saviour"), a holy season of the Christian Church, the period of preparation for the celebration of the nativity or Christmas In the Ethiopic Church it lasts from Nov. 11, in other Churches from the Sunday nearest to Nov. 30, till Christmas. It is uncertain at what date the season began to be observed. A council at Saragossa in 380 forbade the faithful to be absent from church from Dec. 17 to Epiphany; but the first unquestionable mention of Advent is at the Council of Tours (567). It has long been recognized in the West as the beginning of the ecclesiastical year. The Roman Catholic Church forbids the solemnization of marriage during Advent.

In many countries Advent was marked by diverse popular observances, some of which still survive. In some parts of England poor women used to carry round the "Advent images," two dolls dressed to represent Christ and the Virgin Mary, visiting every household and demanding halfpence.

In Normandy the farmers still employ children under 12 to run with torches through the fields and orchards setting fire to bundles of straw to drive out vermin. In Italy the last days of Advent are marked by the entry into Rome of the Calabrian pifferari who play bagpipes before the shrines of the Holy Mother (as the shepherds of Bethlehem are believed to have done before the infant Saviour).

ADVENTISTS, SECOND, members of religious bodies whose distinctive feature is a belief in the imminent physical return of Jesus Christ. For the historical affiliations of this doctrine, *see* ESCHATOLOGY.

ADVENTITIOUS, coming from outside, in no sense part of the substance or circumstance (Lat. *adventicius*, coming from

abroad). Carlyle called a man's clothes, or condition of life "adventitious wrappages," as being superadded and not a natural part of him. In botany the word means that which is not normal to the plant, *e.g.*, buds or roots out of place, or strange spots and streaks not native to the flower.

ADVENTURE, a hazardous enterprise. Thus an "adventurer," from meaning one who takes part in some speculative course of action, came to mean one who lived by his wits and a person of no character. The word is also used in certain restricted legal connections. *Joint adventure,* for instance, may be distinguished from partnership (*q.v.*). The *bill of gross adventure* in French maritime law is an instrument making a loan on maritime security. The word was freely used of mercantile enterprises during the colonizing period: hence the title of "Merchant Adventurers." (*See* CHARTERED COMPANIES.)

ADVERB, a part of speech modifying or qualifying an adjective, verb or other adverb. According to their function they are divided into adverbs of time, place, quantity, manner, etc.

ADVERTISING, the process of disseminating information for commercial purposes. Advertisement has existed from early times. Traders made themselves known and called attention to their products by mural inscriptions before the age of printing: a papyrus, discovered at Thebes offering a reward for a runaway slave, is reputed to be 3,000 years old

The public crier, a civic institution in ancient Greece, is not yet extinct. In the middle ages the spoken word was almost the only mode of publicity in use The invention of printing ushered in the modern period of advertising The Bodleian library has a small poster or broadside by William Caxton, 7in by 5in , advertising a service-book, "The Pyes of Salisbury Use" for sale at the Red Pole in the almonry of Westminster. It was issued in 1480. Printing alone made possible the transition from simple announcement to the system of argument and suggestion which constitutes modern advertising, and the medium of this development was the newspaper. The *Mercuries* or weekly papers sometimes carried a few advertisements, including the first offerings of coffee (1652), chocolate (1657) and tea (1658).

In June 1666 the *London Gazette,* No. 62, announced the first advertisement-supplement, as follows: "An Advertisement—Being daily prest to the publication of Books, Medicines, and other things not properly the business of a Paper of Intelligence This is to notifie once for all, that we will not charge the *Gazette* with Advertisements, unless they be matter of state; but that a Paper of Advertisements will be forthwith printed apart, and recommended to the Publick by another hand."

In No. 94 of the same journal, published in Oct. 1666, there appeared a suggestion that sufferers from the Great Fire of London should avail themselves of this means of publicity: "Such as have settled in new habitations since the late Fire and desire for the convenience of their correspondence to publish the place of their present abode, or to give Notice of Goods lost or found, may repair to the corner House in Bloomsbury on the East Side of the Great Square, before the House of the Right Honourable of the Lord Treasurer, where there is care taken for the Receipt and Publication of such Advertisements."

Clearly, the restriction of the word "advertisement," which for Shakespeare and the translators of the Authorized Version had meant information of any kind, to a business announcement was in *The Tatler* of Sept. 14, 1710:

"It is my custom, in a dearth of News, to entertain myself with those Collections of Advertisements that appear at the end of all our Publick Prints. . . . Advertisements are of great use to the vulgar. First of all, as they are instruments of ambition. A man that is by no means big enough for the *Gazette* may easily creep into the advertisements. . . . A second use which this sort of writings have been turned to of late Years, has been the management of Controversy. . . . The inventors of *Strops for Razors* have written against one another in this way for several years. The third and last of these writings is to inform the World where they may be furnished with almost everything that is necessary for Life. If a Man has Pains in His head, Cholic in his Bowels, or spots in his Cloathes, he may here meet with proper Cures and Remedies. If a Man would recover a Wife or a Horse that is stolen or strayed; if he wants new Sermons, Electuaries, Asses' milk, or anything else, either for his Body or his Mind, this is the place to look for them in."

By the middle of the century, advertisements began to be complained of, and the stains which the practice of that age left upon its reputation are not yet quite obliterated. In *The Idler* Jan. 20, 1758, Dr. Johnson has:

"Advertisements are now so numerous that they are very negligently perused, and it is therefore become necessary to gain attention by magnificence of promises and by eloquence sometimes sublime and sometimes pathetick. Promise, large promise, is the soul of an advertisement. I remember a washball that had a quality truly wonderful—it gave *an exquisite edge to the razor!* . . . The trade of advertising is now so near to perfection that it is not easy to propose any improvement."

MODERN ADVERTISING IN GREAT BRITAIN

Complaints have been heard in our own time, though the loudest of them were directed against unsightly notice-boards in rural surroundings. A British society for correcting the abuses of public advertising has been active in this, but the suppression of fraudulent advertising was left to the industry itself. The national vigilance committee of the advertising association systematically calls the attention of newspaper-publishers to doubtful announcements, and the censorship committee of the British poster advertising association (a society of hoarding-owners) is powerful enough to suppress any poster calculated to offend public taste or morality.

Such movements in restraint of abuses are a mark of the modern spirit in advertising, which claims the name of an economic necessity. Through the use of trade-marks and other brands, it enables a consumer to identify wares of standard quality, while by aiding the distribution of merchandise, and sometimes facilitating the introduction of useful inventions which could not be produced at all if they were not marketable on a large scale, it performs public services of no small value.

The use of advertising as an aid to distribution of goods is traceable to the coming of railways and the factory system, early in the 19th century. When commodities of many kinds, formerly produced slowly by hand in small workshops, began to be turned out in large quantities by machinery, markets had to be enlarged, or overhead expenses and interest charges might have crippled the young factories. Simultaneously, improved and cheapened transport made it possible for manufacturers to seek custom far afield.

Economic and Psychological Aspects.—Economic justification has only been claimed for advertising in quite recent times. George Binney Dibblee (*The Psychological Theory of Value,* 1924) showed that the measure of exchange value is the purchaser's desire to possess. Distribution is perceived to be for practical purposes an element of production, since production is useless without it. Distributive costs can be greatly reduced by publicity, but through the stress of competition, the economies thus obtained cannot be retained by the producer, who is therefore stimulated to improve the quality of his wares or to reduce his prices. The consumer thus becomes the beneficiary of advertising.

The statement may seem to require explanation since the cost of advertising must necessarily be added to the price of the goods. Other and larger expenses, however, are reduced or saved. The economy of mass-production is well known. The effects of advertising may be described as mass-selling. Where a specific article is demanded by the public and bought in large quantities, the expense of prevailing upon retailers to offer it for sale is greatly reduced. A commercial traveller, instead of selling by slow persuasion to a few shopkeepers, has only to call on the wholesale trade for orders; sometimes travellers can be dispensed with altogether as salesmen, being employed only to stimulate the proper display and exploitation of the goods

Yet another economic service of advertising to the public is

the assistance which it gives to the habit of using branded or trade-marked goods. Manufacturers of these have a natural interest in maintaining a good and uniform standard of quality, whereby the reputation of the brand is upheld. When large sums have been invested in advertising, the motive of self-interest in maintaining quality is proportionately great. If advertising did no more than favour the consumption of branded, and (as a consequence) standardized, wares, it still would have the economic justification which is not inherent in it regarded as a mere aid to competition. But it does more. By giving news of desirable things it actually increases the volume of trade and in that same measure reduces unemployment. This fact is recognized and is turned to account in a highly significant use of advertising during the present century. In a certain number of industries in Great Britain manufacturers have banded themselves together to advertise their product jointly and uncompetitively. This co-operative advertising, as it is called, has been applied to such manufactured products as gas, woollen textiles, tyres, motor-cars and paint; and such agricultural products as milk, British tomatoes and fruit. The success achieved in these and in other spheres is naturally encouraging other manufacturing and trading groups to similar acts of combined selling The most conspicuous advertising campaigns of this character have, of course, been those of the empire marketing board, which enjoys a large government grant Its operations are yet another instance of State advertising—this time of a productive nature, more agreeable to contemplate than those that served the deadly purposes of war.

Apart from the effects of reasoned exposition, the psychological mechanism by which advertising operates to sell goods may briefly be summarized under two headings.

Constant repetition of a name makes a path in the mind. The consumer, in want of a given commodity, tends to take the path made ready for him by the reiteration of the brand-name.

Association of ideas has an effect somewhat similar on the subconscious mind. If an article be advertised systematically in a tasteful and elegant way, or if verbal or pictorial suggestions of an agreeable kind have been attached to it, the brand-name and an accompanying good opinion of it are entwined among the roots from which volition springs.

A very similar kind of suggestion is exercised by the form in which goods are announced. Modern scientific salesmanship has discovered that emotion plays at least an equal part with cold and deliberate reason in the selection of wares. Attractive and tasteful presentation in both goods and advertisements has an appeal which often proves irresistible.

Organization.—The financial importance of advertising cannot easily be computed unless some agreement be reached upon what, for the purpose of the calculation, shall constitute an advertisement. If the total cost of all Press advertisement, hoarding-space and posters, of all other outdoor publicity and of the printing and postage in advertising by circular, be added together, the yearly outlay must be enormous. There remains to be added very large payments for show-cards, signs, pamphlets, handbills, the window-dressing apparatus and equipment sent to shopkeepers or provided by them, price-lists, catalogues and other printed matter (often in colour) issued by the great departmentalized shops. A substantial sum for printing-blocks, lithographic stones and other materials consumed must also be taken into account. A lecturer at the London school of economics and political science estimated the annual total in Great Britain in 1919 at 100 millions sterling, and the charges for newspaper space have risen very considerably since then; but it is doubtful whether any satisfactory estimate can be formed. Several individual companies are known to spend more than £200,000 annually on publicity and a larger number spend £100,000 or over—in almost every instance for the marketing of cheap, popular commodities. Nor is it easier to compute the number of persons employed in and by advertising. Among the specialized avocations which it has called into being are those of advertising agents, contractors for poster-advertising, advertisement consultants, commercial studios (whose work is practically confined to the designing of advertisements), research men and window-dressing specialists; besides a large number of printers, lithographers and blockmakers, wholly or chiefly employed in the varied services of publicity.

In order to provide something in the nature of a qualification or certificate of proficiency, public examinations in the theory and practice of advertising were initiated in Great Britain in 1925 by the incorporated society of advertisement consultants, and being continued annually, attracted a considerable number of candidates in each year. They have since been taken over by the advertising association, which represents all branches of the business, and the certificate of either of these bodies is widely accepted as a qualification for employment.

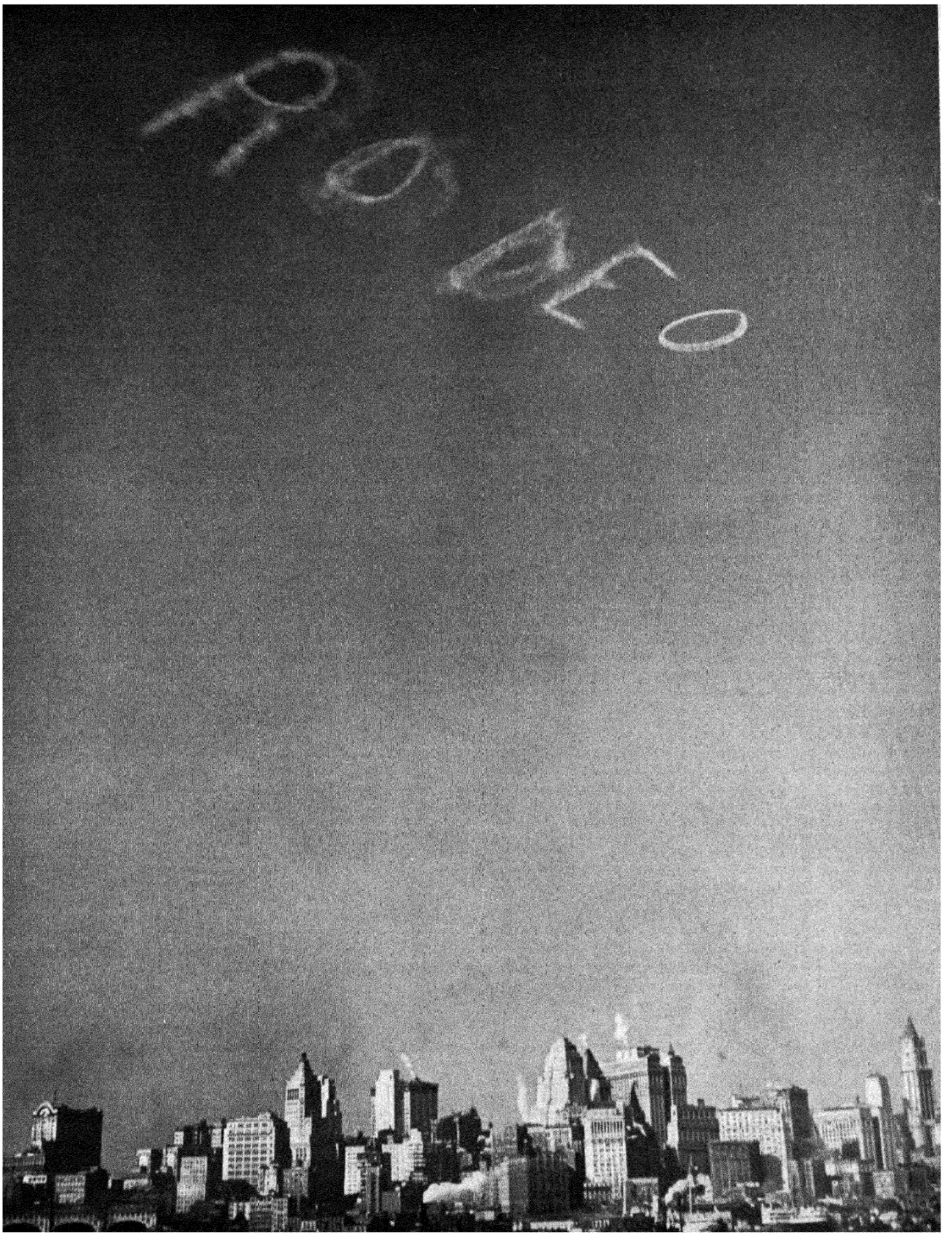
Of all the avocations directly concerned that of the advertising agent is the most important and the most varied; and it is to the work and influence of the great advertising agencies that the vast growth and development of advertising in the last 35 years are chiefly due. The service of a first-class advertising agency to its clients includes direct examination of markets and elaborate research work; the designing of packages and wrappings for new articles; the invention of selling plans; the formulation of an advertising policy and its embodiment in Press advertisements and sometimes posters; preparation of window-dressing designs and materials and of show-cards, and contracting with newspapers, periodicals and hoarding-owners for the supply of space. Yet more important than these is the work, largely carried out by the agencies and also by advertisement consultants, of bringing to the notice of manufacturers and others proposals for the benefit of their respective businesses by means of national or trade advertising, whereby those who have not yet turned to advertising for the promotion of their business interests are induced to avail themselves of it

A marked tendency now exists for advertising agents to claim something like professional status and to prescribe rules of conduct for themselves. In Great Britain an institute of incorporated practitioners in advertising has been founded, whose standards of practice are strict.

Preparation of Advertisements.—For the actual preparation of advertisements, as for the work of contracting with publishers and the owners of hoardings and other outdoor sites, an advertiser may either keep his own staff or employ advertising agents and poster advertising contractors In most instances he prefers the latter course, entrusting the general conduct of his advertising to an agent, but keeping the control of it in principle and detail firmly in his own hands It is to his advantage to employ an advertising agency, as most of the work (including the drafting of advertisements and the preparation of rough designs) is performed without expense to himself, the agency receiving a trade discount on the price of space.

The agent's functions are a matter of arrangement, but generally speaking an advertiser pays for the drawings required for Press or poster advertising unless these are of the simplest character. The larger agencies maintain a studio with a supervisor and a sufficient number of artists and draughtsmen for their normal requirements. At times of pressure, or when work has to be done for which this staff is not sufficiently well equipped, resort may be had to one of the commercial studios, and advertisers who prepare their own "copy" are regular patrons of these establishments. The larger studios sometimes retain commercial artists of reputation, in addition to a whole-time staff of artists, draughtsmen, designers and what are termed lay-out men. The function of the last named is to contrive the skilful arrangement of type, and the well-balanced combinations of pictures and lettering, with which the reader is familiar in advertisements.

Marketing Plans.—The distribution of an advertised article to the public is usually effected through retail traders and middlemen. To advertise anything to the public without first arranging that supplies shall be available when demanded is wasteful; the public will not always wait while the advertised article is obtained. Hence, the first step taken, when anything is to be marketed by the aid of advertising, is to convince the distributing trades that the advertising which is projected will in fact create

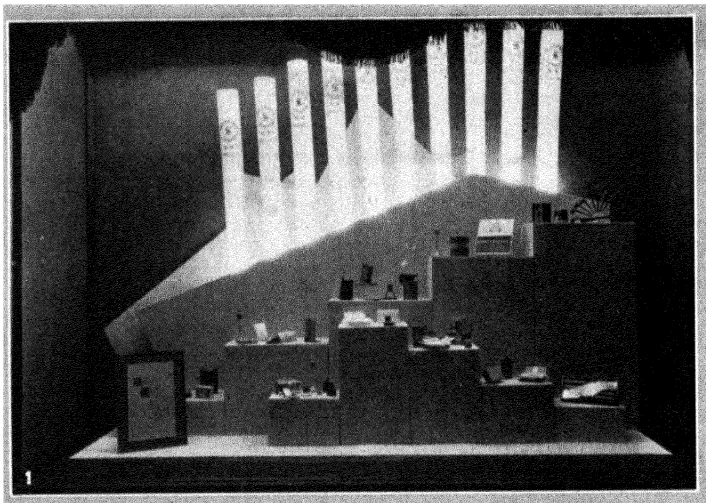


BY COURTESY OF THE NORTH AMERICAN PHOTO SERVICE

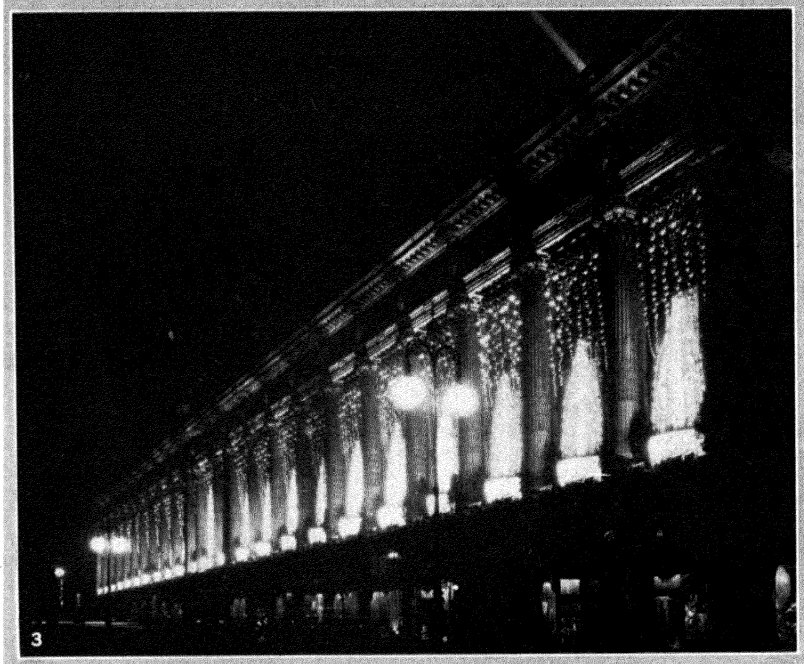
AEROPLANE SKY-WRITING OVER LOWER NEW YORK CITY

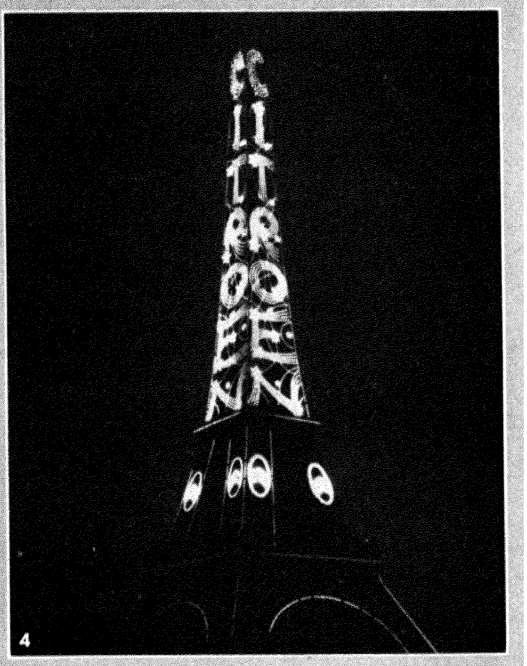
In making the letters of this advertisement the sky-writer worked at an altitude of 12,000 feet. The letter R is approximately a mile in length and is directly over the City Hall. The estimated length of the five letters of the word is five miles

ADVERTISING

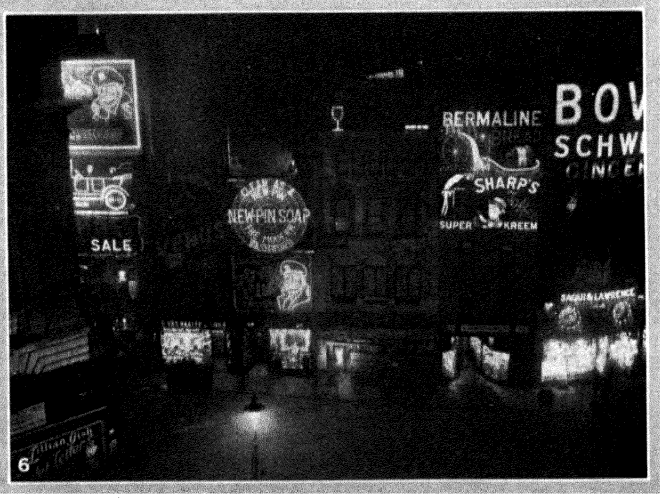












BY COURTESY OF (1, 2, 3, 4, 5) SIMS & CO., (6) SPORT & GENERAL PRESS AGENCY LTD.

ADVERTISEMENTS AND WINDOW DISPLAYS IN LONDON AND PARIS

1. A display of smokers' requisites arranged in a "modernistic" manner
2. Use of contrasting backgrounds to set off a white sale
3. Upper window illumination installed in a London department store
4. The Eiffel Tower illuminated by the Citroen Motor Car Company
5. Window display of Willow pattern design chinaware
6. A corner of Piccadilly circus at night showing the illuminated advertising signs

a demand profitable to those who handle the goods. Retailers will then place initial orders for stocks either directly or through middlemen, and the latter will place themselves in a position to fulfil their further requirements. Advertisements in trade papers prepare the way for circulars and travellers, whose work is thereby expedited in the breaking down of what is known as retailer resistance.

The expense of this preparatory work is considerable, and the discounts required by middlemen and retailers are nearly always much larger than the net profit of the producer. In some trades the largest manufacturers find it less expensive to maintain their own shops. The boot-and-shoe and margarine trades of Great Britain are examples. Another alternative is to advertise for direct orders from the public through the post, when the term mail-order trading is used. This expression, like much else in advertising, is American, but the system has also been very highly elaborated in Great Britain. Although orders for small and uncostly articles can be obtained in direct response to advertisements in newspapers and magazines, such advertisements are more often used with the object of compiling a list of names for circularization. Where the price is more than a few shillings, the advertisement seldom asks for any remittance, and, if instalments are to be accepted, often gives no clue to the price, merely offering a catalogue or descriptive pamphlet. Applicants for this receive very elaborate printed matter, showing signs of careful attention to detail and little, if any, regard for expense. Those who do not respond with an order for the goods advertised receive further circulars and letters according to an organized plan known as the follow-up system.

Such a system requires extreme patience and forethought, no detail being too small to affect results. In the marketing of goods trifles often make perfection. Variations in detail are purposely introduced and examined in the light of their effect on enquirers; even the order in which the enclosures with a follow-up letter are arranged and the intervals at which successive follow-ups are sent out, are the subject of careful experiment. The follow-up process is continued as long as there are profitable returns. As the cost of each letter and its enclosures is considerable, when sent to a large number of persons, any argument and device which will bring the order to fruition earlier means a proportionate addition to the profits

Direct circularization of addresses from directories is a variant of mail-order trading if results are sought by post. More frequently it is employed by large and by small shopkeepers, occasionally by general advertisers whose goods are distributed through trade channels, though the latter have difficulty in ascertaining whether their circulars bring profitable results or not. Unless a somewhat specialized public is sought, or a very complete and elaborately illustrated description has to be circulated, very little calculation is required to show that this method is much less economical than Press advertising; but it is a valuable alternative where capital is not available for the latter, or in places where no local paper may be available as an advertising medium; but such places are few and far between.

The Newspaper Press.—Systematic advertising dates from the rise of the newspaper Press. At first grudgingly admitted, inserted or left out at the editor's whim or convenience, advertisements came in time to exercise a reflex action on nearly all publications. The major revenue of newspapers and periodicals is derived from them, and great improvements in contents and production, accepted by readers as a matter of course, find their explanation and exchequer here.

Until quite recent times, advertisers in the great majority of British newspapers and periodicals laboured under a grievance not yet wholly redressed. Publishers resolutely withheld any information about the net sales of their publications, and perhaps even permitted exaggerations as to the actual number of copies printed and sold to stalk about unchecked and assume the dimensions of mere rumour. In consequence, the advertiser rarely knew what measure of publicity his expenditure produced for him. He was in the dark concerning the arithmetic of circulation. A few publishers, however, broke away from the general silence and mystery, and from 1920 onwards the custom of publishing an audited statement of net sales, with the certificate of a chartered accountant, has spread rapidly. The institute of practitioners in advertising maintains an audit bureau, by which this practice is encouraged. (By net sales is meant the actual number of copies sold and paid for. Circulation is a vague term, but it must be borne in mind that one purchased copy of a paper may have several readers, the whole household in fact.) A partial censorship of advertisements by newspapers has likewise extended, and while only a few publishers assume overt responsibility for everything inserted, nearly all, with the assistance of the advertising association's national vigilance committee, take pains to exclude anything to which objection can reasonably be taken.

The cost of Press advertising has risen steadily since the end of the World War. The best evidence of the fact that the burden is not too grievous to be borne is the persistency with which this form of publicity is used and the apparent prosperity of those whose expenditure is largest. The cost might well appal manufacturers of cheap commodities, were it not that the articles most largely advertised are those on which the percentage of profit is lowest. In a general sense it is true to say that the lower the factory cost of an article the larger the return from advertising Where gross profits are heavy, the cost of advertising is high. Household soaps, cocoa, beef-extracts, condiments, bread and similar general requirements are advertised on an enormous scale, and the highest payments are made for contributions to the efficiency of announcements relating to them. All these articles have to meet the competition of goods marketed without publicity. Economies due to advertising enable them to meet this competition by superior quality.

Great sums are invested by advertisers in the writing and designing of announcements; and what is called copy-writing offers an attractive career to both sexes. The fact must not be overlooked, however, that the trading policy of which advertisements are the support and expression is more important to success than the advertisements themselves. Good writing and artistic decoration are important when they set forth and adorn some new or striking mode of distribution, where they reveal some new reason for preferring the article advertised, or where they turn the thoughts of the public in a new direction.

Papers issued daily, whether morning or evening, are, on account of their practical and business-like tone (whereby the mood of readers is affected), best suited for the advertising of everyday needs and other commodities ordinarily bought by routine and not with slow deliberation. The daily paper is in some sort a daily guide consulted for information on a number of topics. He who desires to rent a house, to find a servant, to attend a concert, to order coal, to hear of bargains, to hire a car or to buy a dog, turns to the advertisements in his daily paper as a matter of course. Announcements on these subjects almost have the character of news; the paper would be incomplete without them; but they would not be sent for publication unless such advertisements were known to bring replies. The newspaper which carries habitually the largest number of such small advertisements is the one to which more and more are sent. The appearance of numerous "smalls" or classified announcements, moreover, reacts on the quantity of displayed advertising sent to a paper, it being held that one in which the former appear must be powerful in the locality of publication.

It should be noted that in comparatively recent years in Great Britain the national morning popular paper has extended its geographical range and added considerably to its sales, while the evening papers in the provincial towns and cities have increased in power and importance.

Improvements in printing-blocks, mechanically reproducing drawings or photographs, have brought to the daily papers a preponderance of illustrated advertisements; and refusal to insert these, once common, is now the reverse. The only limitation placed on them (except on grounds of propriety) is that they be not over-obtrusive. Heavy masses of black are relieved by scoring them with white lines, and this is often done in the newspaper

office itself where something too black has been tendered. The rotary presses upon which daily papers are printed make it difficult to produce satisfactory results with great masses of black, or with half-tone blocks if the screen is finer than 50 or 60 lines to the inch. For an explanation of these terms the article PROCESS should be consulted.

The same difficulties do not occur in the slower flat-bed method of printing when smooth paper is used. Hence weekly illustrated periodicals are enabled to give advertisers the benefit of better printed half-tone blocks and in general of more perfect typography. This has led to a great development of illustrated publicity with a corresponding attention to the suggestive value of pictures in advertising.

The greater deliberation with which weekly and monthly periodicals are read, their higher price, and the automatic selection of a special public by the nature of the contents, makes these, on the face of them, more suitable for the advertising of expensive wares than are the popular dailies. The latter, by reason of enormously greater circulations, are employed by every class of advertisers, but only those who sell to a public which is entirely artisan can afford to confine their announcements to them. If what may be called the austerer part of the Press be neglected, the richer and more cultured part of the public may be lost. The extension of public advertising has brought home to those who use it, and in some measure to their competitors also, that the real customer of every manufacturer is the ultimate consumer. It is just as needful for this ultimate consumer to be approached through his own especial part of the Press as through the class of shops which he habitually uses. This lends importance to the illustrated weeklies and other "society" papers and the literary Press far in excess of what could be attributed to them on the ground of circulation alone.

Besides periodicals of general interest, many others devoted to restricted subjects exist and have importance for certain advertisers. The monthly reviews—papers treating of almost every conceivable science, art and hobby, technical papers for the engineer and the manufacturer and trade papers for the shopkeeper—all have their places in the scheme of Press advertising.

Posters.—Next to the Press, the most important medium of publicity is the poster—defined as a sheet or combination of sheets of paper, printed with an advertisement and intended to be displayed out of doors. This definition excludes other things sometimes loosely referred to as posters, such as window bills and painted or other signs on roadways.

The poster, by reason of its size and the facilities which it affords for the use of colour, has a very powerful effect on the public mind. This effect is an instance of commercial suggestion. The impact, constantly repeated on the memory, of the name on a large coloured bill is almost irresistible. The aim of the advertiser is exactly that—to make his own brand synonymous with the generic name of the product which he sells. For this reason, newspaper advertisements sometimes contain nothing but the name of the product advertised, with some short phrase which, if associated with it for a period of time, is termed a slogan. As the effect sought is precisely similar to that of many posters, and as such announcements can be displayed before a much larger number of persons for a longer time by means of a poster than by the same expenditure of money in the Press, the poster is often found to be a better implement for the purpose. It is estimated that a commanding display of posters throughout Great Britain and Northern Ireland may be obtained, together with the posters themselves, for £60,000 a year. An equal preponderance in the Press would, at present rates, cost perhaps not less than £150,000. This comparison should not be accepted without remembering that the attention received by a newspaper or periodical is much closer and more intimate than that given to a poster. Nor must it be forgotten that the newspaper is bought by the reader and has on that account a value beyond the intrinsic; and further that the newspaper does in most cases enter the home. If more is desired than an instantaneous impact on the mind, the advertising value of the poster falls sharply. In its own sphere, however, it is at present unchallenged.

Improved colour-printing processes and certain details of organization have enormously influenced poster-advertising since it first began to have serious commercial importance. Small bills were pasted up out-of-doors at a very early date in the history of printing, as has already been shown. They may be presumed to have been so affixed to walls and gates without permission of the property-owner, and the practice continued in Great Britain until a date well within living memory. A furtive and disreputable trade was carried on until 1863, when Edward Sheldon, a Leeds billposter, introduced the practice of contracting with the owners for the use of wall space. This soon became general, and poster advertising of an organized character may be said to date from that time. Substantial hoardings, erected according to a standard plan and kept in good order by the contractor, with the growing practice of bordering each poster with neutral-tinted paper, have supplemented a vast improvement in design and execution. At first coarsely printed on letter-press machines from wooden type or blocks, usually in black and red, posters made a great stride forward with the rapid development of chromolithography from 1880 onwards. Very soon afterwards, a new school of designing from this use began to develop, especially in France. Details of this will be found in the article POSTER.

Other forms of outdoor advertising, especially in the country, have often brought undeserved opprobrium upon the poster. Field boards, displayed to railway passengers beside the route, caused a great outcry on their first introduction into Great Britain about 1890, and it was widely suggested that the objection to them on aesthetic grounds would make them ineffective as advertisements. This expectation seems to have been unfounded, as one of these advertisers, who reinforced the involuntary attention of passengers by adding a small tablet to each field-sign to show the distance from London, experienced an immediate rise in the sales of the article which he advertised.

The display of roadside and other advertisements where they deface natural scenery, once common, is now passing out of use, not solely as result of legislation, presently to be described, but also through the voluntary action of advertisers. The maxim that an Englishman's house is his castle makes parliament reluctant to restrain him from putting what he chooses upon the outside of it; but there are indications of a tendency in at least one trade to get round this difficulty: advertisers of motor spirit and lubricants are beginning to withhold signboards from owners of filling stations and repair shops in the country, after having removed their signboards from roadside positions and railway bridges.

Large painted signs on gable ends; sky-signs on the roofs of houses; a variety of illuminated signs, with a growing preponderance of flash-light effects; mobile devices for shop-windows; boards and enamelled iron signs on omnibuses; paper posters on the sides of carriers' vans; the rather antiquated expedient of sandwich-men; and motor delivery-vans modelled on the shape of the owner's speciality, enormously magnified, are among the other forms of outdoor publicity familiar to dwellers in towns. Some of these are the subject of legislative restriction, as will be shown.

Conveyance Advertising, which may be considered to include the display of bills at railway stations and in the London "tubes," is a rather specialized form of publicity. Advertisements on public vehicles are subject to the control of the police in London and other large cities. They are forbidden in or upon cabs, and when displayed on omnibuses they must be submitted to the approval of the police, the probable motive being to exclude anything which detracts from the conspicuousness of destination and route-boards. From the point of view of the advertiser, there is a perceptible difference between the effect of anything carried outside an omnibus, and seen by everyone but the passengers, and that of internal notices and window-transparencies, visible to them alone. What is held before a man's eyes from the moment he sits down until the end of his journey is more likely to be studied and remembered than something flashing past him in the street; but the external advertisement is seen by more people. The mobile poster on the side of a van is very effective and the growth of road transport in competition with the railways favours its use as an advertising medium.

Moving Advertisements.—The tendency of anything in motion to attract the eye is used by a growing number of advertisers in order to compel attention to shop windows. Shopkeepers are able to profit substantially by hiring out their windows for stated periods, to be "dressed" either by the servants of an advertiser, or according to a plan sent out by him and accompanied by the necessary equipment. Mechanical models, worked by electric motors, are sometimes included in these window-shows, but more often they are lent for long periods to the shopkeeper, to be used at will. But the most interesting development of moving advertisements is to be seen in picture-theatres, especially in the provinces.

A minor form of advertisement which nevertheless consumes substantial sums annually is known as the advertising novelty—a small object such as a penknife, cigarette holder, pencil, almanack, note-book or the like, carrying the advertiser's name and message. In the same category are included the ashtrays, match-holders and similar articles, bearing an advertisement, and distributed for use in hotels and restaurants.

Taxes were levied on advertisements in the Press from 1712 to 1853, and, though it is dangerous to prophesy in regard to times of economic stress, are not likely to be revived. The idea of imposing a duty on posters (common on the Continent) is mooted from time to time, generally at the instance of those who dislike them, but the proposal has not yet attracted any chancellor of the exchequer. The growing recognition of advertising as an economic influence in the betterment of trade is indicated by the abandonment of taxation and the official and increasing use of advertising by state departments. The British Empire exhibition at Wembley, to which the Imperial Government gave official support and subsidy, was an effort to advertise the Empire by almost every conceivable phase of modern publicity. And the British industries fair, held annually simultaneously in London and in Birmingham, is advertised by the Government both at home and abroad

Advertisements in British Law.—Apart from the provisions for formal notification by advertisement in the *London Gazette* and local papers of a large variety of matters of which the public should be informed, acts of parliament relating to advertisements have generally been restrictive Nevertheless, public moneys have been voted with increasing readiness for advertising. Moreover, local authorities engaged in commercial undertakings (as gas and transport) have increasingly advertised their services, and, by the Health Resorts and Watering Places Act, 1921, the local authorities of such places were authorized to expend from certain moneys coming into their hands on advertising in other districts an amount not exceeding the amount produced by a penny rate.

Whatever their subject matter, certain forms of advertisement are forbidden, usually under by-laws of local authorities. By the Advertisements Regulation Act, 1907, such by-laws were authorized for the regulation and control of hoardings over 12ft. in height and for regulating, restricting or preventing the exhibition of advertisements calculated to affect injuriously the amenities of a public park or pleasure promenade, or to disfigure the natural beauty of a landscape. In 1925 the powers were extended to include advertisements which would disfigure or injuriously affect the view of rural scenery from a highway or railway, or from any public place or water, or the amenities of any village, or of any historic or public building or monument, or any place frequented by the public chiefly on account of its beauty or historic interest. The Home Office prepared model forms of by-laws, and more than 100 local authorities in Great Britain have exercised their statutory powers.

In congested areas further restrictions are often imposed for the greater safety or convenience of those using the streets. Thus, under the London Traffic Act, 1924, the minister of transport may within the London traffic area restrict the use of sandwichmen and other persons in the street for the purpose of advertisement, if they are likely to be a source of danger or to cause obstruction to traffic; and in 1927 the minister, Col. Wilfrid Ashley, M.P., forbade the use of displayed vehicles for advertising purposes in certain streets. Within the City of London and the metropolitan police district, no person may carry on foot or horseback or any carriage in any thoroughfare or public place any advertisement to the obstruction or annoyance of the inhabitants or passengers (London Hackney Carriage Act, 1853), and by the Metropolitan Streets Acts 1867 and 1885 no advertisement except in such form and manner as may be approved by the commissioner of police having jurisdiction in the area, may, within six miles of Charing Cross, be exhibited or distributed in any street by any person on foot or riding in any vehicle or on horseback. In the County of London, by the London Building Act, 1894, and in areas in which the Public Health Acts Amendment Act, 1907, applies, sky-signs as defined by those acts are prohibited. By a by-law made in 1900 under general statutory powers for the suppression of nuisances, the London County Council, in great measure as a result of observation made at coroners' inquests, prohibited advertisement by searchlight or flash light causing danger to traffic in any street. "Flash light" is defined as a light which alters suddenly either in intensity, colour or direction. A large number of by-laws for the regulation of advertisements have been passed in different parts of Great Britain.

Other advertisements are prohibited by statute because they are themselves an evil or because they are incidental to evils which the legislature wishes to suppress. Although money-lending is a legitimate trade, it tends to create abuses unless it is severely restricted. In 1892 the sending of an advertisement to any infant inviting him to borrow money was prohibited Much more drastic restrictions are imposed by the Moneylenders Act, 1927 No person may send to any person, except in response to such person's written request, any advertisement with the name, address or telephone number of a moneylender, or inviting him to borrow, or to enter into any transaction involving the borrowing of, or to apply for information as to the borrowing of money from, a moneylender. A moneylender may, however, advertise in newspapers and at an authorized address by poster or placard, but in each case the Act severely limits the contents of the advertisement Moreover, an advertisement or document sent in response to a written request must show with due prominence the moneylender's authorized name, any other name in which he or a partner was registered under the Moneylenders Act, 1900, and must not contain expressions which might reasonably be held to imply that the moneylender carries on a banking business. If the terms of interest are indicated they must be stated at the rate per cent per annum, or, if otherwise stated, the rate per cent. per annum represented by the interest proposed must also be shown.

By the Larceny Act, 1861, advertisements of reward for the return of property stolen or lost must not indicate that no questions will be asked or enquiries made, and must not promise to repay the purchaser or pledgee of stolen property. A number of statutes prohibit advertisements relating to betting and lotteries. The most recent is the Ready Money Football Betting Act, 1920. Prize schemes used for advertising are often illegal, as being lotteries. If in a competition skill contributes to the winning of a prize, however, the competition is not a lottery. Indecent and obscene advertisements are penalized by the Indecent Advertisements Act, 1889.

The general law also affects advertisements. False representations, offers to contract, defamatory statements, incitements to crime, contempt of court, breach of copyright and infringement of trade marks may be contained in advertisements and will be governed by the ordinary rules relating to deceit, contract, libel, crime and infringement of rights. The courts have, however, firmly refused to allow puffing advertisements to become the basis of law suits between rival traders, and will only give a remedy for the disparagement of goods by advertisement when false statements are made with specific reference to the plaintiff's goods, with intent to injure the plaintiff, and then only when the plaintiff has actually been involved in financial loss.

The law recognizes the value of advertisements to advertisers. Hence for breach of a contract to insert advertisements damages will be given for the loss of business due to the failure to insert the advertisements. Similarly, where advertisement can be shown

to be one of the objects of a contract—as, for instance, where an actor is engaged for a theatre of high repute—loss of publicity may be a substantial element in the damages recoverable for breach of the contract.

A summary of laws and regulations dealing with advertisements in certain other countries is contained in an official return issued by the British Home Office in 1903, but no similar return has since been issued.

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UNITED STATES

In America, the first newspaper was entitled *Publick Occurrences both Foreign and Domestick,* published in Boston in 1690. This was succeeded in 1704 by *The Boston News Letter,* a weekly publication. The first issue of *The Boston News Letter,* published April 26, 1704, contained advertisements. It was 40 years before this publication reached a circulation of 300 copies per issue. The early history of advertising, together with numerous sample advertisements of this early period, is well presented in Sampson's *History of Advertising.*

The Modern Period may be dated from 1850 to 1911. The reason for putting the dividing point between the second and third periods at 1850 is the rapid appearance of newspapers and magazines, which made possible the development of modern advertising on a large scale. Advertising was impossible until printing developed and until people generally learned to read. One reason for the rapid increase in the number and distribution of advertising media at this time is probably to be found in the development of transportation systems—railways and waterways. Prior to that time railway lines were limited to restricted areas. There was no national transportation system. To illustrate the difficulties of transportation before that time, and even up to 1870 or 1875, we may quote the following announcement of the Kenosha (Wisconsin) *Telegraph* in Rowell's Directory in 1869:—

> The town is renowned for the manufacture of wagons, which find a market all the way to the Rocky Mountains, and even to Oregon, being shipped by way of New York.

This shows how difficult it was to distribute goods generally over the country. It is obvious, then, that without the possibility of transporting goods there was no need of advertising media of wide circulation, and furthermore media could not develop a wide circulation because they could not be distributed conveniently or rapidly. During the middle and latter part of the 19th century the development of a national transportation system made possible the ready distribution of goods and publications. About this time also advertising agencies arose whose primary purpose was to serve as brokers of advertising space. They were rather different in this respect from the present advertising agency, which, in addition to contracting for space, is, in its best form, an organization giving expert counsel and service regarding marketing and advertising plans and methods.

During this period the number of magazines and newspapers grew very rapidly, so that in 1861 there were 5,203 magazines, papers and periodicals of all kinds in the United States. Yet advertising was relatively limited as compared with the present day. *Harper's Magazine* had its first advertisement in 1864; *Scribner's* in 1872. Magazine advertising on a large scale did not begin until about 1860 to 1870. It was stated in 1926 that *Harper's Magazine* had approximately as many pages of advertising in one year as it had in its first 24 years. At first it was used chiefly as a medium for advertising the Harper publications. Advertising rates at that time began to assume real proportions. *Harper's Weekly* was receiving $35 an inch for its back page in the 'sixties.

The first advertising agency was established in Philadelphia in 1840 by Volney B. Palmer. Later, offices were established in Boston and New York. Rates and contracts were not standardized at that time. The agent contracted for a certain amount of space with a publication and then sold it for whatever he could, receiving sometimes as high as 50% of the cost of the space as his commission. Among the better known early advertising agents were V. B. Palmer, S. M. Pettingill and George P. Rowell. In 1928 the United States had about 1,200 advertising agencies. Some 140, including most of the larger ones, were members of the American Association of Advertising Agencies.

Development of Higher Standards.—Since 1911 advertising has developed most rapidly as a standardized business. It was in that year that definite organized steps were taken to forward the movement of truth in advertising. In 1911 counsel for *Printers' Ink,* a leading advertising journal in the United States, formulated what has become known as "The Printers' Ink Model Statute," which has been adopted in a large number of States. This statute makes dishonest advertising a misdemeanour.

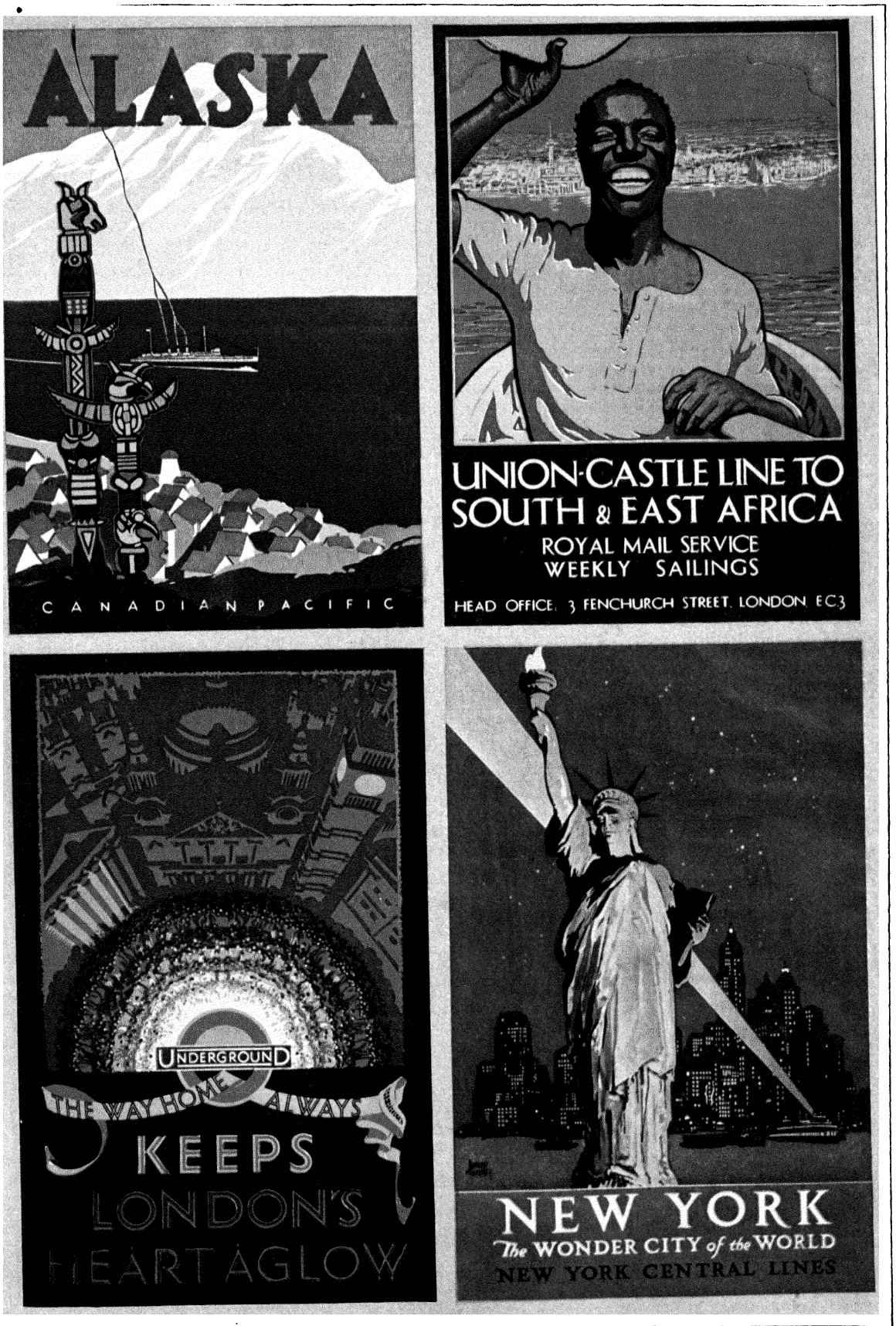
It (*a*) places the responsibility for deception upon the advertiser, (*b*) deals with questions of facts about goods rather than opinions and (*c*) designates the making of untruthful, deceptive or misleading statements a misdemeanour. Up to Feb. 1928 this statute had been adopted in 23 States in substantially the form in which it was originally prepared by counsel for *Printers' Ink,* and in 15 States in modified form.

In these 15 States the modification which was made in the statute consisted for the most part of the insertion of the words "knowingly" or "with fraudulent intent." It is obvious that this change very considerably weakens the force of the statute. Nevertheless, the adoption of this statute has been a powerful force in bringing deception, misrepresentation and dishonesty in advertising under legal control. The Associated Advertising Clubs of the World, now known as the International Advertising Association, the national and local advertising clubs and other organizations have been active in pushing the adoption of this or similar legislation, which has been a powerful influence toward the remedying of objectionable practices. In addition to State legislation a number of larger cities have ordinances intended to check certain undesirable advertising practices.

About 1912, the Associated Advertising Clubs of the World at their annual convention adopted the motto "truth in advertising," and established a National Vigilance committee in the United States, now called the National Better Business commission, with the purpose of forwarding higher standards of honesty and reliability in advertising. This committee organized, in connection with the various local clubs throughout the United States, local vigilance committees or Better Business commissions to eliminate objectionable, untruthful advertising. The purpose of these commissions has been to carry on locally in each city active efforts, similar to those of the national commission, toward the elimination of dishonest and objectionable advertising and related business methods. Up to 1928, such commissions had been established in over 40 cities, including Boston, St. Louis, Cleveland, Indianapolis, Kansas City, Des Moines, Minneapolis, St. Paul, Spokane, Portland, Ore., and New York city.

About this same time the Associated Advertising Clubs of the World undertook definite educational activity in outlining courses of study and discussions to be conducted by the various local clubs, for the purpose of studying advertising methods and of improving them. A distinct service has been rendered in this connection by the several educational activities of the different local organizations. Colleges and universities began to give serious attention to the study of advertising by establishing well-defined courses of instruction.

Facts About Circulations.—In 1914 there was organized the Audit Bureau of Circulations. This has become the leading agency for securing reliable information about the circulation and distribution of publications. The work of this bureau came about as the result of several organizations which were interested in the endeavour to develop a generally acceptable means of obtaining reliable, standardized statements of circulation. It was felt that the time was ripe for devising such means, and that the advertiser had a right to know what he was buying when he bought space in publications. It was desirable to know not only the total circulation but also something about the various aspects of this



MODERN POSTER ADVERTISEMENTS

Four examples of modern British and American poster design, illustrating the adaptation of artistic principles to the uses of publicity

circulation, facts which are as important as the statement of the total amount of the circulation.

About 1870 the only facts generally available regarding circulation were the statements in George P. Rowell's *Directory;* and after that time the Ayer *Directory* was the chief source of information. In order to bring about a somewhat more reliable statement of circulations at that time, Rowell added a gold mark to the name of the publication if the publisher made an affidavit concerning his circulation. This was accompanied by an offer of $100 to anyone who could disprove the claim made. In general, the audit bureau reports attempt to answer three main questions: (*a*) How large is the circulation? (*b*) Where does it go? and (*c*) How was it obtained? The bureau operates by requiring from its publisher members a so-called publisher's statement every six months. The bureau itself makes an audited report once a year.

The Audit Bureau of Circulations became of great value to advertising, because it made available reliable statements of circulation covering many different phases. In case of error, either intentional or unintentional, the bureau established certain rules. In case of error, a publisher or advertiser member of the bureau could ask for a re-audit of any publication, if he so desired. If the re-audit proved that the publisher had misrepresented the facts the expense was to be borne by the publisher. This fact being then bulletined to the other members of the bureau, the publisher became subject to suspension and expulsion from the bureau. Up to Oct. 1927, 186 general magazines and periodicals were members of the bureau, 75 farm publications, 251 business publications and 923 newspapers. In addition to publications, 142 national advertisers, 56 local advertisers and 178 advertising agencies were members.

About 1913 there was organized in the United States the Association of National Advertisers, another important influence in the study and development of advertising practices. Likewise, during that period publishers developed a distinct consciousness of censorship of advertising. A considerable number of publishers took a definite stand with regard to the advertising which they would or would not accept. The announced or stated policy might not be fully lived up to in practice in all instances, but the best evidence of actual progress made in this regard lies in a comparison of the present issues of leading magazines and newspapers with issues of the early years of the century. The improvement is marked. In addition to the elimination of objectionable and doubtful advertising, a considerable number of media went a step further by guaranteeing their advertising in the sense that they would either themselves make good on any misrepresentation or deception which appeared in connection with an advertisement, or would see that the advertiser in question made good. With most of the high-grade media a policy of guaranteeing is substantially implied, and is almost unnecessary in view of the commendable care which is exercised in rejecting questionable commodities or irresponsible business houses.

In 1917 the American Association of Advertising Agencies was organized. It contributed materially toward the establishment of standards of practices and uniform methods of procedure. In 1925 it inaugurated a department of research for studying fundamental problems of advertising and marketing. Finally, and perhaps most important, an increasing use of research methods developed. Here and there these methods appear to be thoroughgoing in finding the facts on which marketing and advertising plans may be based, scientific research and planning taking the place of guesswork.

SUMMARY OF DEVELOPMENTS SINCE 1850

Considering the last two periods together, the chief developments, in addition to those mentioned, may be designated as follows:—

Growth in Quantity.—There has been a tremendous growth in the number of firms employing advertising in one form or another. In 1928 there were about 10,000 firms doing some national advertising. The report entitled *Leading Advertisers,* prepared each year by the Curtis Publishing Co., mentions 2,405 firms, which spent $20,000 in either 1924, 1925 or 1926 in 32 leading national magazines. In this list there were 50 firms which spent $264,500 or more in 36 leading national publications in 1921. There has been likewise an enormous growth in the number of media. In 1830, it is estimated that there were approximately 800 magazines and newspapers in the United States, of which some 50 were daily publications. Their combined annual circulation was estimated at about 60,000,000 copies, or a circulation of approximately 950,000 copies per issue. In 1830 the total population of the United States was 23,500,000.

In 1861 there were 5,203 papers and magazines for a population of approximately 30,000,000. In 1922 there were 22,128 magazines and newspapers in the United States for a population of about 126,000,000. In other words, there has been an increase of magazines and newspapers since 1861 of approximately 4½ times, whereas the population during the same period of time has increased approximately 4 times; but since 1830 the population has increased approximately 4½ times, while the number of magazines and newspapers has increased almost 30 times. A more striking increase has taken place in the total combined circulation. The estimated combined circulation per issue of the magazines was (1928) approximately 63,000,000 copies, and the total combined circulation of the newspapers approximately 45,000,000. Thus since 1830 there has been a growth in total combined circulation of all magazines and newspapers from less than 1,000,000 to approximately 108,000,000 per issue. Besides the marked increase in the number of media and in the extent of their circulation, there has been an equally marked increase in the amount of advertising carried in a given issue of a publication. Two representative newspapers in the United States show an increase in advertising space of 5 times and 13 times respectively from 1850 to 1918.

During that period, also, there developed entirely new media of advertising, including street-car cards, posters, direct-mail, motion-picture and radio advertising. Street-car advertising did not come into general use until about 1890, when the change was made from horse-drawn cars to electric cars. The mail-order field developed rapidly. Not only did mail-order houses spring up in large numbers during the period, but also business firms of all kinds developed a very extensive use of direct-mail material in the form of circulars, catalogues, letters and so on. The large mail-order houses commonly sent out twice a year upwards of 4,000,000 large catalogues in addition to numerous smaller departmental catalogues issued. Figures obtained in 1920 estimated the total approximate amount spent in direct-mail advertising to be $300,000,000; in 1928 the amount was greater, probably much greater.

Advance in Quality and Scope.—During the periods under consideration there was a distinct improvement in the quality of advertising. Methods of printing, typography, colour printing, art work and the like, greatly advanced. Besides the mechanical improvements there were likewise distinct advances in such essential qualities as accuracy of statement and descriptions, reliability and truthfulness.

A widening of the scope of advertising developed rapidly There was a marked increase in the variety of advertising used. Perhaps the dominating types of advertising which flourished originally—that is, about the middle and latter half of the 19th century —were patent-medicine advertising and circus bills and in general much unreliable, dishonest and objectionable advertising. As developed there is hardly a business or type of commodity for which the printed word is not used as a means of selling. Banks and financial institutions of high grade turned to advertising, finding it profitable to employ in a dependable manner the methods which had been found profitable by unreliable financial houses. Advertising suffered because of the objectionable features which were so prominent in its earlier development. For this reason, undoubtedly, high-grade financial houses and to some extent other types of business were slow to take advantage of the possibilities which it offered.

Public service institutions use advertising to place themselves before the public in the proper light, to secure the co-operation of the community and to offer their securities to customers and

to others. What is termed institutional or good will advertising is widely used, not only by banking or similar institutions, but by large firms of all kinds, retail stores and manufacturers. Causes of one kind or another—local, national and international—use advertising to secure publicity and to gain adherents. Churches, charitable institutions, schools, educational endowments, public health bureaux, political parties, candidates and even governments find advertising a suitable and dignified means of publicity. In industrial disputes, employers and employees alike use advertising as a means of influencing public opinion, securing sympathy and moral support.

The development of trade marks is likewise a conspicuous characteristic of the periods mentioned, particularly of the first quarter of the 20th century. A large proportion of the trade marks known throughout the United States and all over the world developed during this time. Of the somewhat more than 150,300 valid trade marks registered in the U S. Patent Office up to 1922 practically none was used prior to 1870, and only a small handful go back to 1885 or 1890. The development of national and international business made trade marks virtually a necessity; and advertising became an important means, perhaps the chief means, of making them known to the public.

Volume of Advertising.—Advertising is playing an important rôle in the operation of business It is assuming such large proportions that it is difficult to estimate its magnitude and to calculate its exact place in commercial affairs. We may gain some notion of its immense proportions from the amount of money expended and from the amount of space used each year for printed advertising in the United States It has been estimated that in the neighbourhood of a billion dollars is spent annually for this purpose. Approximately $500,000 is spent annually for advertising any one of a score or more of well-known commodities, as high as $3,000,000 and $4,000,000 being spent in exceptional cases. Or we may gain a concrete idea of the immensity of advertising from the cost of space for single advertisements in some of the leading media. Thus, for example, a page in a well-known monthly magazine in a single issue may cost $350, and the back outside cover $800. A page in a well-known weekly publication would run to $8,000, and the back outside cover $15,000 A page in the large metropolitan newspapers costs as high as $1,500 to $2,000. From still another angle the immensity of advertising is indicated by the fact that from two-thirds to three-fourths of the cost of maintaining a newspaper or a magazine comes from its advertising space.

The outsider naturally wonders whether advertising with such high rates for space can really be a profitable aid in selling; or whether it may not be an expensive luxury indulged in by large business concerns. The extent to which advertising plays a justifiable rôle in the distribution of goods is an important and intricate problem which must be dealt with in any important consideration of the subject.

ADVERTISING IN BUSINESS

There are wastes in advertising, but there are wastes everywhere in production, in distribution, in personal selling. Economy in the distribution side of business has lagged behind, but distinct advances have been made. Probably the chief sources of waste in advertising are:—

(1) The lack of proper co-ordination between advertising and the other phases of a business—lack of co-ordination with distribution, personal sales, plans and production—advertising where there is no distribution, and the like.

(2) The use of inefficient methods—weak, unconvincing and ineffective appeals, poor presentation, ineffective technique, the use of too large space or too small space due to guessing instead of finding the facts on which to build and plan. It has been estimated that if every piece of advertising material were made 10% more effective it would mean a saving of $100,000,000 to the business interests of the United States.

(3) The use of advertising for commodities in circumstances in which returns are highly uncertain or for business ventures which are too hazardous.

(4) The excessive use of advertising in over-keen competition.

(5) The failure to make all advertising literally truthful and dependable. Even if 96% or 97% of advertising were in the main trustworthy and meritorious, the remaining 3% or 4% would weaken the effectiveness of the rest.

(6) The use of advertising for illegitimate business, highly speculative investments, financial frauds or for commodities of doubtful value or actually injurious to mankind.

Improvements are proceeding in all these directions. Fundamentally, these sources of waste are not peculiar to advertising, but due to the waste and inefficiency in business as a whole. The same sources of waste exist in oral selling—making plans on guesses instead of on facts, not being literally truthful and dependable in every instance, a lack of proper co-ordination with other phases of a business, the waste of time on the part of salesmen and excessive personal expenditure. Preliminary time studies show that the average salesman uses only about 15% to 50% of his working time in actual selling. Fundamentally these wastes in oral as well as in printed selling are not to be laid upon these two aspects of business, but are due to conditions in business as a whole, to mistaken judgment, to ignorance and moral weakness.

The Case Against Advertising.—The actual total amount of money spent on advertising is large. The probable amount spent in the United States in one year is in the neighbourhood of one billion dollars. The question is, Who pays for it, and how far different would be the price of commodities if this expenditure were entirely eliminated, and in what way would the methods of distribution and the cost of distribution be different? The critic assumes that this money is an economic waste and that prices are higher because of it.

A second argument is that advertising has considerably increased the demand for, and the purchase of, luxuries and semi-luxuries, such as cameras, beverages, automobiles, pianos, phonographs, vacuum cleaners and so on.

A third argument is that advertising has been responsible to a considerable extent for the increasing and widespread use of packages, cartons, wrappers and labels for a large variety of products. Advertising has been responsible to a very large extent for the development of standardized brands and trade-marked articles. These wrappers and containers cost money which supposedly is not a part of the price paid for commodities bought in bulk. The argument is that all of this expenditure is added to the price of the product.

Relative Cost.—It is found that the amount actually spent for advertising specific commodities differs widely from the amount which the average person thinks is spent for advertising specific products. Almost every person who makes a general statement that the prices of commodities are higher because of the advertising, or that the money expended for advertising is wasted, knows little about the actual facts of the relative amount of money expended for advertising a specific commodity. People quite generally have a greatly exaggerated notion of the amount of money spent for printed advertising. An investigation was made to determine the amount which people think is spent for advertising certain commodities. The results of the investigation showed that people generally over-estimate from four to five times the amount spent for advertising specific products. For example, the amount spent for advertising a package of breakfast food retailing at 15 cents was estimated by this representative group of persons as two cents, whereas the actual amount spent by the manufacturer of this food for advertising a single package was three-tenths of a cent, an over-estimation of about eight times. The average person believes that approximately five times as much money is expended for this purpose as is actually the case.

Averages of expenditures for advertising by a considerable number of firms in all lines of business show that actual figures are relatively small. Figures obtained by the Harvard Bureau of Business Research, and based on a considerable number of stores in each case, give the percentages of net sales expended for advertising for the years 1919 and 1920 in several lines of business. The accompanying table furnishes the percentages.

The average expenditure for advertising on the part of retailers is approximately 2% or less. Certain types of stores, in particular department stores, expend over that amount, and, on the other hand, a very considerable proportion of retailers spend under that amount. Figures supplied by reliable sources show that the

amount spent by manufacturers for advertising is from 2% to 3%, and that therefore the expenditure for advertising as a whole is probably not over 4% to 5%. It is therefore evident that while the total expenditure for advertising runs into large figures, the relative expenditure in proportion to the cost of a commodity is small. In other words, if advertising played no part whatever in stimulating the sale of commodities, and if the cost of advertising

Percentages of Net Sales Expended for Advertising, 1919 and 1920, in Retail Stores

		Common Figure %
	General stores	0 2
	Retail groceries	0 2
187	Retail drug stores (1919)	0 7
130	Retail shoe stores (1919)	1 3
397	Retail shoe stores (1920)	1 9
182	Retail jewellery stores (1920)	2 0
190	Retail jewellery stores (1921)	2 5
266	Department stores (1920)	2 0
301	Department stores (1921)	2 4

were therefore directly added to the price of a commodity to the consumer, the price of an article would be almost inappreciably higher than it now is. An article selling at $1 00 would have to be sold at $1.04 or $1 05 if advertising were purely a dead expenditure of money. Although the actual expenditure for advertising is relatively small—probably not over 4% to 5% in the aggregate—even this expenditure would be a serious waste if it produced no economic or social value. The 1% to 2% spent by retailers, or the 2% to 3% spent by manufacturers, would in many instances serve to make the difference between success and failure.

Effects of Advertising.—In 1925 a National Distribution Conference was held in Washington under the auspices of the Chamber of Commerce of the United States. The report of the committee appointed to investigate "Market Analysis—Advertising and Advertising Mediums" gives some information with regard to the point just brought up. The investigation consisted of a survey of articles which had appeared in publications, giving specific data about the effects of advertising on costs and prices to the ultimate consumer; and in addition of a questionnaire which was sent out to a group of national advertisers, requesting specific data showing the effects of their advertising on their costs and prices The results were tabulated and summarized in part as follow:

From the data available it is hardly possible to make a non-disputative demonstration. Nevertheless, we believe that it can safely be said that the use of effective advertising by national distributors as a general rule produces one or more of the following results.—

(1) Decreases the cost of selling.

(2) Lowers the cost of production on account of increased volume.

(3) Lowers prices to the consumer and thereby raises the standard of living.

(4) As a by-product, aids in the education of the general public.

Data have been obtained from a number of national advertisers to show the effects advertising has had upon the cost of production and the cost of selling, and prices to the consumer. It is realized that changes in business conditions during the past few years and changes in distribution policies within the individual companies make it very difficult to eliminate the variable factors and to prove the effects of advertising. The data which have been collected, however, seemed to indicate conclusively that the first three results named above are brought about by advertising. . . .

In addition to the four results obtained by advertising which have been mentioned above, advertising often has the following beneficial effects for the manufacturer, dealer or consumer.—

(1) Advertising aids in stabilizing production.

(2) Advertising aids in standardization and quality.

(3) Advertising aids in the simplification of products. (Elimination of unnecessary items in the line)

(4) Advertising helps to prevent fluctuation in prices.

Summary of Advantages.—A beneficial effect of advertising has been the reduction of seasonal fluctuation in the volume of business. In certain fields of business, the seasonable fluctuation, if not entirely eliminated, has been greatly reduced. The two seasons of buying men's clothing have been greatly extended, and the sale of toys, formerly largely confined to the holiday season, is more evenly distributed throughout the entire year. The same is true of fountain pens, millinery, arms and ammunition, oranges and lemons and other products. The result has been a reduction in the cost of doing business.

Advertising has aided materially in the standardization of products and quality of goods. This has been brought about through the establishment of brand names and trade marks, which have become associated with uniform quantities and qualities in the mind of the public, until the recollection of a brand name of any number of specific products calls up the picture of a certain definite quantity and a certain recognized standard of quality, which the public has been educated to receive when it calls for a product by a specific trade-name. Although the establishment of standard packages has probably added to the cost of commodities to some extent, it has had certain other advantages. It has facilitated retailing, requiring less time on the part of assistants in the preparation of products for delivery to the consumer, and it has secured a more hygienic handling of goods, particularly foods.

The noteworthy advances made in the general level of living, in public taste, in personal and domestic conveniences, in the general use of cultural agencies, must be attributed in part to the use of the printed word in the form of advertising. Such products as phonographs and radios and the development in musical taste generally, vacuum cleaners, better-fitting clothes, better-constructed and designed houses, better-painted houses, evidence the advance made in the level of living, due in a considerable measure to the insistent and continuous force of advertising. There is no doubt that we should very likely have most if not all of these improvements and conveniences without advertising, but probably not so many people would have had them so soon. Printed publicity has no doubt helped to educate people to want more and better things in food, clothing, housing, personal comfort and enjoyment.

The almost universal reading of magazines and newspapers has been made possible largely, if not solely, through advertising, since approximately three-fourths of the income of a periodical is derived from its advertising space. In this sense, the newspaper or magazine is practically a by-product of advertising. The trifling sum which is now charged for a newspaper or magazine —in comparison with the large sum which such magazine or newspaper would cost if it were not for the advertising which it carries —has made some form of reading matter available to even the poorest classes of persons. Advertising revenue has made possible the large-scale production of newspapers, magazines and periodicals of all kinds, the social and educational value of which is beyond estimate.

It seems to have been found from experience that some products may be sold most economically primarily through personal salesmanship, that some products may be sold to certain classes of people most economically primarily through printed salesmanship, but that probably the great majority of products may be distributed most economically by varied proportions of personal and printed selling. So long as competition is believed to be a desirable factor in human welfare, just so long will competitive means be used. Critics of advertising perhaps may neglect the fact that if advertising were eliminated or abolished other competitive methods would necessarily be substituted for it. If the use of advertising were eliminated, it is quite likely that its place would be taken in most instances by some form of personal selling, with its accompanying expense. The fact that numerous firms which have consistently and continuously used printed salesmanship over a long period of years have survived from early periods of business activity may be taken as some indication that advertising has been found to be a fairly effective agency of business progress. (D. St.)

PSYCHOLOGY OF ADVERTISING

The psychology of advertising embraces the application of modern psychology to the problems of advertising. Every effect has a cause: human behaviour is just as susceptible of interpretation in terms of cause and effect as are the movements of the heavenly bodies. To understand behaviour one needs to understand its causes, and to control behaviour one needs to get control of its

causes. The control of human behaviour in the purchase of goods is the ultimate aim of the advertiser.

Dynamic psychology has disclosed the driving forces of the human machine to be motives, desires, needs and wants. Thus, human beings want food and drink, rest and comfort, protection from danger, comradeship with their fellows, superiority over their rivals, etc. The universal presence of these needs or desires guarantees that only relatively slight stimuli need be applied to set the human being into action in order to satisfy them. The advertiser, knowing these facts, attempts not only to engender action by playing upon these motives through his printed advertising, but also to show that his own product will satisfy a fundamental need *more effectively* than any other competing product. We find, therefore, that such a commodity as a tooth-paste will be offered as a means of satisfying the desire for cleanliness, for beauty, for protection from disease, for prestige, for success in love, or in business. Other things being equal, that commodity which stimulates into action the most powerful motive will win the market. The use of argument and logic plays a minor rôle in successful present-day advertising in comparison with the direct appeal to desire.

After the proper appeal is chosen the advertiser is faced with the necessity of presenting it to his readers most effectively. At every step in this process psychological problems are encountered. For instance, in order to attract and hold attention the advertisement must be different from its neighbours; it must be *distinctive*. Now, distinction of a given amount may be attained in a variety of ways and at varying cost, for example, by the use of a large space or through the use of coloured advertising. But when full-page advertisements are too common, and the use of colour is too nearly universal, both these devices lose their power of grasping the attention. Many other psychological ways of making the appeal effective are known, such as the influence of a pleasant state of mind, however it may be created, upon the memory; the dependence of the comprehension of a printed message upon the intelligence level of its readers; the dependence of the effectiveness of the trade names and trade marks of commodities, of packages and other containers upon the ability of the reader to discriminate between them and those of competitors and imitators. All these matters of attention value, of aesthetic quality, of ease of comprehension, of freedom from confusion with imitations and many others have been measured by methods developed in the psychological laboratory. For instance, an adaptation of the familiar free association test has been employed to measure the influence of years of advertising upon the familiarity of certain commodities, trade names and slogans in the minds of the public. By presenting a series of commodity names to a sampling of consumers with the request that they report the first thing suggested by each, it has been possible not only to determine the relative familiarity of products in the minds of people, but to analyse some of the most important factors that determined their status. On the basis of the intelligence surveys that have been made of the population of the United States, the copy-writer can gauge his copy so as to be intelligible to any desired proportion of the population. It is obvious, for example, that any advertising message that is to reach as many as three-fourths of the people of the United States must be expressed in the simplest possible words, with short uncomplicated sentences and with the use of pictures whenever feasible.

Choice of a Medium and a Product.—The choice of the medium in which the advertisement shall appear, whether it be billboard, newspaper, magazine, theatre programme or handbill, and the position that it shall occupy in that medium is dependent upon such psychological factors as attitude and interest. Is the hurried reader of a morning newspaper in the attitude favourable to the purchase of a given article, or is the reader sitting in a comfortable chair at home in the evening in a more appropriate attitude? What is the most appropriate time and place to make a favourable impression upon the professional man, the financier, the merchant or the labourer?

More fundamental than all of these matters of the choice of an appeal and its presentation is the part that psychology may play in determining the nature of the actual product to be sold. It is, indeed, no longer necessary to guess at the popular taste. It may be measured upon a sampling of the buying public. The pleasingness of a proposed brand of coffee, a pattern of linoleum, a musical composition or a perfume, as well as the name that shall be given to it, can be, and occasionally is, determined before it is put upon the market through the simple process of taking a census of preferences. The technique of measuring such subjective data as preferences, likes and dislikes, as developed in the psychological laboratory, is simple and applicable to an almost unlimited range of practical business problems.

Experimental Studies of Advertising Psychology.—The earliest studies of advertising problems dealt with attention and how to attract it, as this was considered the primary requisite of successful advertising. Such questions as how big an advertisement should be, how frequently it should be repeated, what colours had greatest attention value, what part of the printed page attracted the most attention were examined in the psychological laboratory (H. Gale, *On the Psychology of Advertising; Psychological Studies,* University of Minnesota, 1900). Problems of the memory value of advertising were then attacked as second only in importance to attention value. For this purpose the laboratory methods for measuring recall, recognition and retention were adopted outright, or in slightly modified form (W. D. Scott, *The Theory of Advertising,* 1903, and H. L. Hollingworth, *Advertising and Selling,* 1913). The application of the "order of merit method" of Cattell for measuring the value of a whole advertisement introduced a long series of researches of this nature, which have had a profound effect upon the content of the psychology of advertising (E. K. Strong, *The Relative Merit of Advertisements,* 1911). In recent years more complex and less tangible factors affecting advertising success have been subjected to experiment. For example, the power of the reader to discriminate among various commodities, advertisements, trade names, etc., has been tested with interesting results (R. H. Paynter, *A Psychological Study of Trade-Mark Infringement,* 1920). The feelings and faint emotional states aroused by advertisements and their various components have been measured and evaluated. (*See* A. T. Poffenberger, *Psychology in Advertising,* chaps. xiv. to xix., 1925) And finally, attention is being directed to the factors which create and strengthen belief in advertising, such as the effect of exaggeration, of positive and negative suggestion and of the reputation of the advertising medium. Such measuring methods as these, added to a general knowledge of human nature, furnish the means of predicting the success of advertising within a known degree of probability. (A. T. P.)

Colour in Advertising as it is known to-day, began in 1894 The first colour advertisement was for a rug and was printed for one of the large mail order houses. Fusion of colours in printing had only recently been perfected; it was made possible by the half-tone process. (*See* PRINTING.) The use of colour in advertising did not grow rapidly at first owing to the difficulties of securing a highly surfaced paper, printing inks that would fuse without blotting out certain tones, and printing presses that would give perfect register.

Colour in advertising was first extensively used for posters and street-car cards, and it was not until about 1910 that the printing-press was so improved as to turn out high grade colour work in large quantities, and at a reasonable cost for publications. Colour printing has now become so common that it is found in most of the advertising matter. Even some newspapers have their coloured section. In 1927, 32 of the leading American magazines carried over $71,800,000 worth of advertising in colour. That amount was about twice as much as was invested in all periodical advertising in America in 1914. The rapid growth in coloured advertising in the last few years, has been partly the result and partly the cause of the very wide adaptation of colour in the home, in dress, in automobiles and even in architecture.

First coloured illustrations were desired to advertise these products in all of their colourful attractiveness. On the other hand, presenting so many different articles in colour set a new standard, speeding and spreading the vogue for iridescent tones where black, white and grey had so long held sway. Much of the early use of colour in advertising was primarily to help catch the attention of

the reader. This, however, did not prove either practical or economical. By laboratory tests it has been shown that the addition of colour to the page adds only about 13% to its attention value. As the printing cost of extra colours is more than 13%, it did not pay.

Colour advertising has been strikingly successful: (1) in portraying goods in their actual colours, (2) in giving various articles a setting of richness and a refined atmosphere, (3) in showing the appearance of the package or container, (4) in reproducing trade-marks or other distinguishing features.

Psychologists state that colour actually has a physiological as well as a psychological effect; *e.g*, red is irritating as shown by the fact that a red rag waved at a bull or tom-turkey arouses anger. Blue and green are said to be cool colours giving a restful effect. It is also cited that such expressions as "feeling blue," "a drab life," "a grey day," etc., are popular acceptances of the effect of colour upon the mental state. This particular effect of colour has not been very much studied in advertising although it is occasionally observed. Of course red, rather than blue, is used to give the feeling of warmth; and blue, rather than yellow or orange, to give the effect of coolness. This has been observed in the summer and winter resort advertising. However, these are rather exceptional uses of colour in commercial printing. So far, psychologists have not made a sufficiently detailed study of colour so that individual preferences are well established. It is commonly said that women prefer red and men blue and a number of superficial psychological investigations have tended to establish the correctness of this observation especially when applied to dress, but in the selection and sale of merchandise broad generalizations of this nature are regarded as conjectural Advertisers have not found the public well enough informed as to the traditional significance of the different colours to rely on it as a dependable factor in advertising; *e g.*, yellow traditionally may be the colour of hope, of light and cheer, of optimism. But to the average consumer it may also be a symbol of age—"the sear and yellow leaf," "yellowed with age," and an indication of independability as "being yellow" or having a "streak of yellow."

Many forms of advertising are chosen because of the possibility of utilizing colour. Certain magazines and periodicals, posters, bulletins, and street-car cards are selected because of the possibilities of employing colour. In posters, painted bulletins and street-car cards approximately 90% of the showings contain colour. (H. E. A)

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ADVERTISING AGENT or **AGENCY,** an individual or an organization engaged primarily in the preparation of advertising and also in giving counsel and assistance in the advertising and merchandising of commodities, securities and services. In the United States, where advertising as a business is most highly developed, and where the advertising agent first became a recognized factor in business, the activities of the agent differ considerably. These may be limited to one element of advertising or may embody all phases.

In Great Britain and Australia, on the Continent, and in Latin American countries, the advertising agent confines his services largely to preparing copy, both text and illustrations, and arranging for its publication in whatever medium may be used. In recent years, the services of the advertising agent in Great Britain have developed somewhat along American lines. In the United States and Canada there are about six hundred "recognized" national advertising agents or agencies, and as many more local ones, the majority of which extend their activities to everything which has to do with advertising, including any research necessary to its preparation and any merchandising that may be helpful to make the advertising profitable. An American advertising agent generally undertakes to perform the following work: (a) Conduct marketing researches; (b) Suggest the most saleable form of a product, including the design of the package and determination of price. (c) Assist in the organization and direction of the advertiser's sales force. (d) Prepare the advertising, suggesting the amount of money to be expended, the space required, the mediums to be used and writing and illustrating the copy; also such advertising literature as catalogues, mailing pieces, etc. (e) Make contracts with publishers or the purveyors of advertising space in which the advertisements are published. (f) Assist the advertiser to cultivate the good will of the trade and the public.

As an organization, serving any number of advertisers, the agency (or agent) usually divides itself into departments as follows: (1) Executive, which includes the securing of business and its development. (2) Research and plans, which conducts marketing enquiries and investigations, and plans the extent and character of an advertising campaign. (3) Production, which provides for the writing and illustration of advertising copy, and the preparation of the engraving cuts and mats necessary to mechanical reproduction, and other details. Formerly, the advertising agent was remunerated by means of a commission allowed to him by the publisher. At present, in the United States this commission is credited to the advertiser and the agent is paid by a commission, more or less equivalent, on all advertising placed, and he may also receive extra fees. Certain advertising agents specialize in giving advertising advice and help either regarding the merchandising of a product or the advertising thereof or both Certain other agents specialize in the preparation and production of advertising copy only. In Great Britain the advertising agent generally obtains his remuneration in the commission allowed by publishers, and in fees for special work. The number of British agencies is about 150.

ADVICE, counsel given after consideration, or information from a distance giving particulars of something prospective (*e g.*, "advice" of an imminent battle, or of a cargo due). In commerce it is a common word for a formal notice from one person concerned in a transaction to another.

ADVOCATE, a person called in to plead the cause of another; especially one entitled, as having the right of audience, to plead the cause of another in a court of law. In Scotland the word is used particularly to designate a member of the bar of Scotland (*see* ADVOCATES, FACULTY OF). The lord advocate is the chief law officer of the Crown in Scotland. As chief public prosecutor he appoints six members of the bar to be his deputies in the conduct of criminal prosecutions, and they are termed advocate-deputies.

The lawyers who practised in the English courts of common law were never officially known as advocates, the word being reserved for those who practised in the courts of the civil and canon law (*see* DOCTORS' COMMONS). There was formerly an important official termed his majesty's advocate-general, or more shortly, the king's advocate, who was the principal law officer of the crown in the College of Advocates or Doctors' Commons, and in the admiralty and ecclesiastical courts. He discharged for these courts the duties which correspond to those of the solicitor of the treasury (*see* SOLICITOR). His opinion was taken by the foreign office on international matters, and on high ecclesiastical matters he was also consulted; all orders in council were submitted to him for approval. The office may now be said to be obsolete, for after the resignation of Sir Travers Twiss, the last holder, in 1872, it was not filled up. There was also a second law officer of the crown in the admiralty court called the admiralty advocate. This office has long been vacant. Advocate is also the title still in use in some of the British colonies to denote the chief law officer of the crown there.

In France, the *avocats*, as a body, were reorganized under the Empire by a decree of Dec. 15, 1810. There is, however, a distinction between *avocats* and *avoués*. The latter, whose number is limited, act as procurators or agents, representing the parties before the tribunals, draft and prepare all formal acts and writings, and prepare lawsuits for the oral debates. The office of the *avocat*, on the other hand, consists in giving advice as to the law, and con-

ucting the causes of his clients by written and oral pleadings. The number of *avocats* is not limited.

In Germany the *advocat* no longer forms a distinct class of lawyer. Since 1879, when a sweeping judicature act (*Deutsche Justizgesetzgebung*) reconstituted the judicial system, the *advocat* in his character of adviser, as distinguished from the *procurator*, who formerly represented the client in the courts, has become merged in the *rechtsanwalt*, who has the dual character of counsellor and pleader.

Advocatus Ecclesiae.—In the middle ages the word *advocatus* was used on the continent as the title of the lay lord charged with the protection and representation in secular matters of an abbey. The office is traceable as early as the beginning of the 5th century in the Roman empire, the churches being allowed to choose *defensores* from the body of advocates to represent them in the courts. In the Frankish kingdom, under the Merovingians, these lay representatives of the churches appear as *agentes, defensores* and *advocati;* and under the Carolingians it was made obligatory on bishops, abbots and abbesses to appoint such officials in every county where they held property. The office was not hereditary, the *advocatus* being chosen, either by the abbot alone, or by the abbot and bishop concurrently with the count. The same causes that led to the development of the feudal system also affected the *advocatus*. In times of confusion churches and abbeys needed not so much a legal representative as an armed protector, while as feudal immunities were conceded to the ecclesiastical foundations, these required a representative to defend their rights and to fulfil their secular obligations to the state, *e g.*, to lead the ecclesiastical levies to war. A new class of *advocatus* thus arose, whose office, commonly rewarded by a grant of land, crystallized into a fief which, like other fiefs, had by the beginning of the 11th century become hereditary.

In France the *advocati* (*avoués*) were of two classes—(1) great barons, who held the advocateship of an abbey or abbeys rather as an office than a fief, though they were indemnified for the protection they afforded by a domain and revenues granted by the abbey: thus the duke of Normandy was *advocatus* of nearly all the abbeys in the duchy; (2) petty seigneurs, who held their *avoueries* as hereditary fiefs and often as their sole means of subsistence. The *voué* of an abbey, of this class, corresponded to the *vidame* (*q.v.*) of a bishop. Their function was generally to represent the abbot in his capacity as feudal lord; to act as his representative in the courts of his superior lord; to exercise secular justice in the abbot's name in the abbatial court; to lead the retainers of the abbey to battle under the banner of the patron saint.

The *advocatus* played a more important part in the feudal polity of the Empire and of the Low Countries than in France, where his functions, confined to the protection of the interests of religious houses, were superseded from the 13th century onwards by the growth of the central power and the increasing efficiency of the royal administration. They had, indeed, long ceased to be effective for their original purpose; and from the time when their office became a fief they had taken advantage of their position to pillage and suppress those whom it was their function to defend The mediaeval records, not in France only, are full of complaints by abbots of their usurpations, exactions and acts of violence.

In England *advocatus* was never used to denote the representative of an abbot; but in some of the larger abbeys there were hereditary stewards whose functions and privileges were not dissimilar to those of the continental *advocati*. The word *advocatus*, however, was in constant use in England to denote the patron of an ecclesiastical benefice, whose sole right of any importance was an hereditary one of presenting a parson to the bishop for institution. In this way the hereditary right of presentation to a benefice came to be called in English an "advowson" (*advocatio*).

In Germany the title of *advocatus* (*Vogt*) was given not only to the *advocati* of churches and abbeys, but to the officials appointed, early in the middle ages, by the emperor to administer their immediate domains, in contradistinction to the counts, who had become hereditary princes of the empire. The territory so administered was known as Vogtland (*terra advocatorum*), a name still sometimes employed to designate the strip of country which embraces the principalities of Reuss and adjacent portions of Saxony, Prussia and Bavaria. These imperial *advocati* tended in their turn to become hereditary. Sometimes the emperor himself assumed the title of *Vogt* of some particular part of his immediate domain. In the Netherlands as well as in Germany *advocati* were often appointed in the cities, by the overlord or by the emperor, sometimes to take the place of the bailiff (Ger. *Schultheiss*, Dutch *schout*, Lat. *scultetus*), sometimes alongside this official.

See Du Cange, *Glossarium* (ed. 1882–87, Niort), s. "Advocati"; A. Luchaire, *Manuel des institutions françaises* (1892); Herzog-Hauck, *Realencyklopadie* (ed. Leipzig, 1896), s. "Advocatus ecclesiae," where further references will be found.

ADVOCATES, FACULTY OF, the collective term employed to designate the members of the bar of Scotland. The faculty has grown out of the Scots act of 1532, which established the College of Justice, or Court of Session, in Scotland. The advocates had, and still have, the sole right of audience in the Court of Session and High Court of Justiciary. By immemorial custom, they have formed themselves into a self-governing faculty under annually elected office-bearers consisting of the dean of faculty and his council, the vice-dean, the treasurer and the clerk. When properly instructed by a law agent an advocate is, under pain of deprivation of office, bound and entitled to plead in any court in Scotland, civil or criminal, superior or inferior. He is also entitled to plead before the House of Lords, the judicial committee of the privy council and parliamentary committees The magnificent library collected by the faculty has now been formed into the National Library of Scotland.

ADVOCATUS DIABOLI, devil's advocate, the popular name for the promoter of the Faith (*promotor fidei*), an officer of the Sacred Congregation of Rites at Rome, whose duty is to prepare all possible arguments against the beatification or canonization of an alleged saint. This functionary first occurs in connection with the beatification of St. Lorenzo Giustiniani under Leo X (1513–21). (*See* CANONIZATION)

ADVOWSON, the right of presentation to a vacant ecclesiastical benefice, so called because the patron defends or advocates the claims of the person whom he presents, or because he is the advocate, patron or defender of the church and benefice and is as such given the right to name the priest. At what period the right of advowson arose is uncertain; it was probably the result of gradual growth. The earliest trace of the practice is found in the decree of the council of Orange, A.D. 441, which allowed a bishop, who had built a church in the diocese of another bishop, to nominate the clerk, but not to consecrate the church. The 123rd Novel of Justinian, promulgated about the end of the 5th century, decreed "that if any man should erect an oratory, and desire to present a clerk thereto by himself or his heirs, if they furnish a competency for his livelihood, and nominate to the bishop such as are worthy, they may be ordained." The 57th Novel empowered the bishop to examine them and judge of their qualifications, and, where those were sufficient, obliged him to admit the clerk. In England, for quite two centuries after its conversion, the clergy administered only *pro tempore* in the parochial churches, receiving their maintenance from the cathedral church, all the appointments within the diocese lying with the bishop. But in order to promote the building and endowment of parochial churches, those who had contributed to their erection either by a grant of land, by building or by endowment, became entitled to present a clerk of their own choice to the bishop, who was invested with the revenues derived from such contribution. After the Norman Conquest, it became quite usual for patrons to appoint to livings not only without the consent, but even against the will, of the bishops.

Advowsons are divided into two kinds, *appendant* and *in gross*. The right of presenting, originally given to the person who built or endowed the church, gradually became annexed to the manor in which it was built, and where the right of advowson remains attached to the manor, it is called an advowson *appendant*, and passes with the estate by inheritance or sale without any special conveyance. But where, as is now generally the case, the right of presentation has been sold by itself, and so separated from the

manor, it is called an advowson *in gross.* An advowson may also be partly *appendant,* and partly *in gross; e.g.,* if an owner granted to another every second presentment, the advowson would be *appendant* for the grantor's turn and *in gross* for the grantee's.

Advowsons are further distinguished into *presentative* and *collative.* In a *presentative* advowson, the patron presents a clergyman to the bishop, with the petition that he be instituted into the vacant living, and the bishop then, if the presentee be a fit clerk, admits and institutes him. In a *collative* advowson the bishop is himself the patron, either in his own right or in the right of the proper patron, which has lapsed to him through not being exercised within the statutory period of six months after the vacancy occurred. Collation takes the place of presentation, admission and institution. Before 1898 there were also *donative* advowsons, but the Benefices Act, 1898, made all donations with cure of souls *presentative.* In a *donative* advowson, the patron conferred the benefice by a simple letter of gift, without any reference to the bishop.

The Benefices Act of 1898 did not make any substantial change in the legal character of advowsons, which remain practically the same as before the act. Briefly, it prevents the dealing with the right of presentation as a thing apart from the advowson itself; increases the power of the bishops to refuse the presentation of unfit persons, and removes various abuses. An advowson may, still, be sold during a vacancy, but that will not carry the right to present on the vacancy But under the Benefices Act, advowsons may not be sold by public auction except in conjunction with landed property adjacent to the benefice; transfers of patronage must be registered in the registry of the diocese, and no such transfers can be made within 12 months after the last admission or institution to the benefice. Restrictions have also been imposed on the transfer of patronage of churches built under the Church Building acts and New Parishes acts, and on that of benefices in the gift of the lord chancellor, and sold by him in order to augment others; but agreements may be made as to the patronage of such churches in favour of persons who have contributed to their building or enlargement without being void for simony.

The Benefices Act, 1898 (Amendment) Measure, 1923, provides that after two further vacancies of the benefice subsequent to the passing of the measure, the right of patronage shall become incapable of sale, and that a patron may anticipate the two avoidances by a registered declaration, and declare the patronage shall from the date of declaration be without power of sale. The measure further provides that if a right of patronage becomes after the date of the measure vested in a clergyman or his wife, or in someone on his or her behalf, that clergyman shall not be presented to the living. There is a further provision in the measure, repealing the act called the Clergy Resignation Bonds Act, 1828, which sanctioned the giving by presentees of a bond to a patron that he would resign the benefice in favour of any one named person, or either of two named persons, if both were related to the patron within certain limited degrees.

The right of presentation may be exercised by the owners, whether they be infants, executors, trustees, coparceners (who, if they cannot agree, present in turn in order of age) or mortgagees (who must present the nominee[1] of the mortgagor), or a bankrupt (*who,* although the advowson belongs to his *creditors,* yet has the right to *present to* a vacancy). Certain owners of advowsons are temporarily or permanently disabled from exercising the right, which devolves upon other persons; and the Crown as patron paramount of all benefices can fill all churches not regularly filled by other patrons. It thus presents to all vacancies caused by simoniacal presentations, or by the incumbent having been presented to a bishopric or in benefices belonging to a bishopric when the see is vacant by the bishop's death, translation or deprivation. Where a presentation belongs to a lunatic, the lord chancellor presents for him. Where it belongs to a Roman Catholic the right is exercised in his behalf by the University of Oxford if the benefice be situate south of the River Trent, and by that of Cambridge if it be north of that river. (For the conditions which make a fit clerk *see* the article BENEFICE.) If the bishop refuses to admit and institute, the patron has his remedy by an action called after the words in the ancient writ *Quare impedit;* that is, the bishop is called upon to show "why he hinders" the patron in the exercise of his right. If the bishop's refusal be due to the fact that there is another claimant to the patronage, that person is also made defendant. If the refusal be because the clerk is alleged to be unfit, the clerk can himself appeal to the court of the metropolitan by a process known as *duplex querela.* The Benefices act also gives to both patron and presentee an alternative mode of appeal against a bishop's refusal to institute or admit, except on a ground of doctrine or ritual, to a court composed of the archbishop of the province and a judge of the high court nominated for that purpose by the lord chancellor, a course which, however, bars resort being had to the ordinary suits of *duplex querela* or action of *quare impedit.*

In case of refusal of one presentee, the patron may present another so long as he does it before lapse.

Upon institution the church is full against everybody except the Crown, and after six months' peaceable possession the clerk is secured in possession of the benefice, even though he may have been presented by a person who is not the proper patron. The true patron can, however, exercise his right to present at the next vacancy, and can recover the advowson from an usurper at any time within three successive incumbencies so created adversely to his right, or within 60 years. Collation, which otherwise corresponds to institution, does not make the church full, and the true patron can dispossess the clerk. Possession of the benefice is completed by induction, which makes the church full against any one, including the Crown. If the proper patron fails to exercise his right within six calendar months from the vacancy, the right devolves or lapses to the next superior patron; *e g,* from an ordinary patron to the bishop, and if he makes similar default to the archbishop, and from him on similar default to the Crown. If a bishopric becomes vacant after a lapse has accrued to it, the right goes to the metropolitan; but in case of a vacancy of a benefice during the vacancy of the see the Crown presents Until the right of presentation so accruing to a bishop or archbishop is exercised, the patron can still effectually present but not if lapse has gone to the Crown. (*See* also BENEFICE; GLEBE; INCUMBENT; RECTOR; VICAR)

See J. Mirehouse, *On Advowson* (1824); Phillimore, *Ecclesiastical Law;* J Bingham, *Origines Ecclesiasticae, or, the Antiquities of the English Church* (1838–40). (P.)

ADWAN, a Moabite tribe claiming an Arabian origin. They declare that ten generations ago they formed part of a settled population in a fertile district of Arabia and were driven out by invaders much stronger in numbers.

See *The Cambridge Ancient History,* vol. i., 2nd ed. (1924).

ADY, ENDRE (1877–1919), Hungarian poet, was born Nov. 21, 1877, at Ermindszent, Transylvania. He was a leader of the modern school and one of the greatest lyrical poets of Hungary. During his youth he became intimate with the publicists and politicians of the Radical and Socialist parties. When he settled down in Budapest he turned his attention towards revolutionary politics and contributed to several Radical papers. He also made prolonged visits to Paris and the Riviera but returned finally to Hungary owing to ill-health, and lived there quietly until his death on Jan. 27, 1919. During the World War he adopted a pacifist attitude, and prophesied the Karolyi revolution of 1918.

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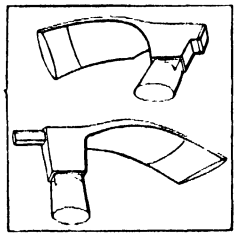
ADYE, SIR JOHN MILLER (1819–1900), British general, son of Major James P. Adye, was born at Sevenoaks, Kent, on Nov. 1, 1819, and died on Aug 26, 1900 Sir John Adye served in the Crimean War, in the Indian Mutiny, on the North-West frontier in India in 1863 and subsequently in important commands at home. In 1882 he was chief of staff and second in command of the expedition to Egypt and served throughout the

[1] A *nomination* is to be distinguished from a *presentation.* The latter is the legal act, which alone will be recognized by the bishop. But if the legal patron be not entitled in equity, the true patron nominates him.

campaign (G. C. B. and thanks of parliament). He held the government of Gibraltar from 1883 to 1886. Promoted general and colonel commandant of the Royal Artillery in 1884, he retired in 1886. He unsuccessfully contested Bath in the Liberal interest in 1892. He was author of *Recollections of a Military Life* (1895) and other works.

ADYTUM, the most sacred part of a shrine, temple or church such as the Holy of Holies of the Temple at Jerusalem, or the cave of the Oracle of Apollo at Delphi, occasionally used for the chancel (*q.v.*) of a Christian church.



CARPENTER'S ADZE. TOOL WITH RAZOR-LIKE EDGE WHICH IS USED FOR CUTTING AND PLANING

ADZE, a tool used for cutting and planing. It is somewhat like an axe reversed, the edge of the blade curving inward and placed at right angles to the handle. This shape is most suitable for planing uneven timber, as inequalities are "hooked off" by the curved blade. At the same time, each cut of the adze leaves its own facet, giving a peculiarly wrought effect to work so finished. The beams of old houses, or of new ones finished in an old-fashioned way, show most pleasantly the marks of the adze. *See* TOOLS.

ADZHAR, an autonomous socialist soviet republic, a zone under the protection of the Georgian S S R. Its boundaries are, on the west, the Black sea, on the south, Turkey, on the north and east, the Georgian S S.R. Area 1,328sq km.; pop. (1926) 128,553: urban 47,241 and rural 81,312. It consists mainly of the former military Government of Batum with Ardvin, *i.e.,* the slopes and a portion of the Armenian highlands, drained by the Chorokh river and its tributary the Adzharis-Tsakhali, forming deep, picturesque ravines. It is divided for administrative purposes into the following provinces: Adzhar-Tskalsk, pop. 5,524, entirely rural; Kedsk, pop. 10,307, entirely rural; Kobyletsk, pop. 16,996: urban, 1,791, rural, 15,205; Khylosk, pop. 27,172, entirely rural; Chorokh, pop. 59,199: urban, 45,450, rural, 13,749. The climate is "west coast Mediterranean" in type, with southerly and south-easterly rain-bearing winter winds from the low pressure systems over the Black sea. The Caucasus shelters it from north and north-east winds. Rainfall averages 60in. per annum or more—at Batum 93·3in. (maximum in November); average temperature January, 43·0° F.; August, 73·8° F. Malaria is prevalent and insect pests, *e.g.,* mosquitoes and locusts, abound. Along the coastal plains from Batum northwards are cultivated vine, peach, pomegranate, fig, olive (up to 1,500ft. above sea-level), chestnut, apricot, citrus fruits, apple, pear, plum, cherry, melon and tea, maize (the staple food), wheat (up to 5,000ft), potatoes, peas, currants, cotton, rice, colza, tobacco, sunflower seeds and barley. The eucalyptus, mulberry (with silk cultivation), bamboo and ramie are also produced. Much of the republic is forested; the mountain slopes bearing dense forests with a great variety of timber, interspersed with climbing and twining plants and along the plains and lower slopes flowering shrubs bloom, *e.g* , magnolia, azalea, camellia japonica, begonia. Petroleum exists north of Batum, but is not worked much. Batum (*q.v.*) is the chief city and port and is linked by rail with Baku (on Caspian) and with Kutais and Poti. Pipes also convey petroleum from Baku to Batum.

A. E.: *see* RUSSELL, GEORGE WILLIAM.

AEACUS, in Greek legend, was the son of Zeus and of Aegina, daughter of the river-god Asopus. His mother was carried off by Zeus to the island of Oenone, afterwards called by her name. The island having been depopulated by a pestilence, Zeus changed the ants upon it into human beings (Ovid, *Met* , vii. 520), who were called Myrmidones (*murmēkes* = ants). Aeacus ruled so impartially that after his death he was made judge of the lower world, together with Minos and Rhadamanthus. His successful prayer to Zeus for rain at a time of drought was commemorated by a temple at Aegina (Pausanias ii. 29), where a festival (*Aiakeia*) was held in his honour.

AECLANUM, an ancient town of Samnium, Italy, 15m. E.-S.E. of Beneventum, on the Via Appia (near modern Mirabella). It became the chief town of the Hirpini after Beneventum had become a Roman colony. Sulla captured it in 89 B.C. by setting on fire its wooden breastwork, and new fortifications were erected. Hadrian, who repaired the Via Appia from Beneventum to this point, made it a colony; it has ruins of city walls, aqueduct, baths and amphitheatre; nearly 400 inscriptions have been found. Two different routes to Apulia diverged at this point, one (Via Aurelia Aeclanensis) leading through the modern Ariano to Herdonie, the other (the Via Appia of the Empire) passing the Lacus Ampsanctus and going on to Aquilonia and Venusia.

See Ashby and Gardner, *Papers of the British School at Rome,* viii. 108 *sqq.*

AEDESIUS (d. A D. 355), Neoplatonist philosopher, was born of a noble Cappadocian family. He migrated to Syria, attracted by the lectures of Iamblichus, whose disciple he became. He taught at Pergamum, his chief disciples being Eusebius and Maximus.

See Ritter and Preller, 552; Ritter's *Geschichte der Philosophie;* T. Whittaker, *The Neoplatonists* (1901).

AEDICULA, a small house or temple, especially the Roman household shrine of the Lares and Penates.

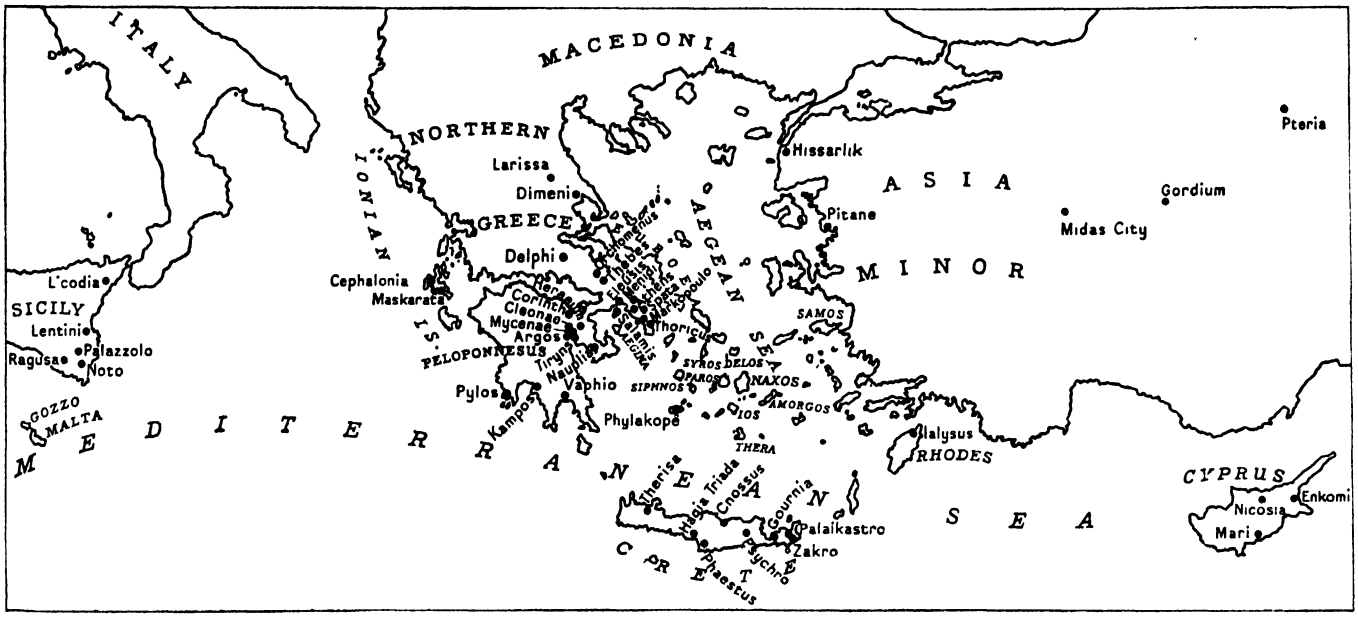
AEDILES, the magistrates at Rome who had care of the temples (*aedes*). Created in the same year as the tribunes of the people (494 B C.), they were plebeians, elected, two in number, by the *Concilium Plebis.* Intended as assistants to the tribunes, they exercised police functions and had power to inflict fines. They also managed the plebeian and Roman games. In 367 B.C. an extra day was added to the Roman games. The patricians offered to bear the expense if admitted to the aedileship. Accordingly two "curule" aediles (*see* CURULE) were appointed by the *Comitia Tributa,* at first patricians, then patricians and plebeians in turn and lastly from either class. They managed the Roman and Megalesian games, cared for the patrician temples and issued edicts for the markets. The curule aediles ranked higher than the plebeian, but in time their functions became practically identical.

These functions fell under three heads: (1) Care of the city—repair, etc., of temples, sewers and aqueducts; traffic regulation and precautions against fire; control of baths and taverns, and general supervision of public morals. (2) Care of provisions—testing of quality and of weights and measures; purchase of corn for disposal in emergencies at a low price. (3) Care of the games—organization of the public games and control of those given by private individuals (*e.g.* at funerals). These were often used by ambitious persons as a means of gaining popularity.

In 44 B.C. Caesar added two patrician aediles, called *Cereales,* for the care of the corn supply. Under Augustus the juridical functions of the office and the care of the games were transferred to the praetor, while its city responsibilities were limited by the appointment of a *praefectus urbi.* In the 3rd century A.D. it disappeared altogether.

See W. E. Heitland, *The Roman Republic* (1923), pp. 157–158; J. E. Sandys, *Companion to Latin Studies* (1921) (useful bibliography), pp. 321, 345, 385; A. H. J. Greenidge, *Roman Public Life* (1901).

AEDUI (ī-dŏŏ-ē), HAEDUI or HEDUI, a Gallic people of Gallia Lugdunensis, who inhabited the country between the Arar (Saône) and Liger (Loire). Their territory thus included the greater part of the modern departments of Saône-et-Loire, Côte d'Or and Nièvre. According to Livy (v. 34), they took part in the expedition of Bellovesus into Italy in the 6th century B C. Before Caesar's time they had attached themselves to the Romans, and were honoured with the title of brothers and kinsmen of the Roman people. When the Sequani (*q.v.*), their neighbours on the other side of the Arar, subjugated them, the Aedui sent Divitiacus, the druid, to Rome to appeal for help, but his mission was unsuccessful. On his arrival in Gaul (58 B.C), Caesar restored their independence. In spite of this, the Aedui joined the Gallic coalition against Caesar (*B.G.* vii. 42), but after the surrender of Vercingetorix at Alesia (*q.v.*) were glad to return to their allegiance. Augustus dismantled their native capital Bibracte (*q.v.*) on Mont Beuvray, and substituted a new town with a



SKETCH MAP OF THE AREA OF AEGEAN CIVILIZATION

The map shows both modern and classical names. The chief centres of Aegean civilization were in Crete and in the Peloponnese, but its influence extended over a much greater area, including the Aegean islands and parts of the coast of Asia Minor. Its middle period may, with some confidence, be placed 2,000 years before Christ, and its duration covered at least 3,000 years

half-Roman, half-Gaulish name, Augustodunum (mod. Autun). During the reign of Tiberius (A.D. 21), they revolted and seized Augustodunum, but were soon put down (Tacitus, *Ann.* iii. 43–46). The Aedui were the first of the Gauls to receive from the Emperor Claudius the distinction of the *ius honorum.* *See* MUNICIPIUM.

See A. E. Desjardins, *Géographie de la Gaule* ii. (1876–93); T. R. Holmes, *Caesar's Conquest of Gaul* (1899).

AEGADIAN ISLANDS (Ital. ISOLE EGADI; anc. AEGATES INSULAE), small mountainous islands off the west coast of Sicily, scene of the defeat of the Carthaginian fleet by C. Lutatius Catulus in 241 B.C., which ended the First Punic War. Favignana (Aegusa), the largest (pop. 5,828 in 1921), lies 10m. S.W. of Trapani; Levanzo (Phorbantia) 8m. W.; Maritimo, the ancient ἱερὰ νῆσος, 15m. W of Trapani, is now reckoned in the group.

AEGEAN CIVILIZATION, the general term for the prehistoric civilization, previously called "Mycenaean" because its existence was first brought to popular notice by Heinrich Schliemann's excavations at Mycenae in 1876, or "Minoan" when Sir Arthur Evans' explorations in Crete from 1899 onwards showed its main source. Subsequent discoveries, however, have made it clear that Crete was its chief centre in its earlier stages, and Mycenae, or the mainland at least, in its later stages; and, accordingly, it is more usual now to adopt a wider geographical title for this culture, which is that of Greece and the Aegean basin in the bronze age.

I. HISTORY OF DISCOVERY AND DISTRIBUTION OF REMAINS

Mycenae and Tiryns are the two principal sites on which evidence of a prehistoric civilization was remarked by the classical Greeks. The Cyclopean walls of the citadel of Mycenae, its gate with heraldic lions, the great "treasury of Atreus" and the galleries of Tiryns had borne silent witness for ages before Schliemann's time; but they were supposed only to speak to the Homeric, or at farthest a rude Heroic beginning of purely Hellenic, civilization. Only when Schliemann exposed the contents of the graves which lay just inside the gate (*see* MYCENAE), scholars recognized the advanced stage of art to which prehistoric dwellers in the Mycenaean citadel had attained. A good deal of other evidence was available before 1876, but had not been collated and seriously studied. Although it was recognized that certain tributaries, represented, *e.g.*, in the 18th dynasty tomb of Rekhmara at Egyptian Thebes as bearing vases of peculiar forms, were of some Mediterranean race, neither their precise habitat nor the degree of their civilization could be determined while so few actual prehistoric remains were known in the Mediterranean lands. Nor did the Aegean objects which were lying obscurely in museums in 1870, or thereabouts, provide a sufficient test of the real basis underlying the Hellenic myths of the Argolid, the Troad and Crete, to cause these to be taken seriously. Both at Sèvres and Neuchâtel Aegean vases had been exhibited since about 1840, the provenance being in the one case Phylacope in Melos, in the other Cephalonia. Ludwig Ross, by his explorations in the Greek islands from 1835 onwards, called attention to certain early intaglios, since known as "island gems"; but it was not till 1878 that C. T. Newton demonstrated these to be no strayed Phoenician products. In 1806 primitive structures were discovered in the island of Therasia by quarrymen extracting pozzolana for the Suez canal works; and when this discovery was followed up on the neighbouring Santorin (Thera), by representatives of the French school at Athens, much pottery of a class now known to belong to the transition from the middle to the late bronze age, and many stone and metal objects, were found and dated by the geologist Fouqué, somewhat arbitrarily, to 2000 B.C., by consideration of the superincumbent eruptive stratum. Meanwhile, in 1868, tombs at Ialysus in Rhodes had yielded to M. A. Biliotti many fine painted vases of styles which were called later the 3rd and 4th "Mycenaean"; but these, bought by John Ruskin, and presented to the British Museum, were supposed to be of some local Asiatic fabric of uncertain date.

Schliemann's Excavations.—Even H. Schliemann's first excavations at Hissarlik in the Troad (*q.v.*) did not excite surprise. But the "Burnt City" of his second stratum, revealed in 1873, with its fortifications and vases, and a hoard of gold, silver and bronze objects, which the discoverer connected with it, began to arouse a curiosity which was destined to spread far. As soon as Schliemann came on the royal "shaft graves" at Mycenae three years later, light poured from all sides on the prehistoric period of Greece. The character of both the fabric and the decoration of the Mycenaean objects was not that of any well-known art. A wide range in space was proved by the identification of the island gems and the Ialysus vases with the new style, and a wide range in time by collation of the earlier Theraean and Hissarlik discoveries. A relation between objects of art described by Homer and the Mycenaean treasures was generally allowed, and a correct opinion prevailed that, while certainly posterior, the civilization

of the *Iliad* was reminiscent of the Mycenaean. Schliemann got to work again at Hissarlik in 1878, and greatly increased our knowledge of the lower strata, but did not recognize the Aegean remains in his "Lydian" city of the 6th stratum, which were not to be fully revealed till Dörpfeld resumed the work at Hissarlik in 1892 after the first explorer's death. But by laying bare in 1884 the upper stratum of remains on the rock of Tiryns (*q.v.*), Schliemann made a contribution to our knowledge of prehistoric domestic life which was amplified two years later by Chr. Tsountas's discovery of a similar palace at Mycenae. Work at Tiryns was not resumed till 1905, when it was proved, as had long been suspected, that earlier strata dating back to the beginning of the bronze age lie below the palace cleared by Schliemann. From 1877 dates the finding of Mycenaean sepulchres outside the Argolid, from which, and from the continuation of Tsountas's exploration of the buildings and lesser graves at Mycenae, a large treasure, independent of Schliemann's princely gift, has been gathered into the National museum at Athens.

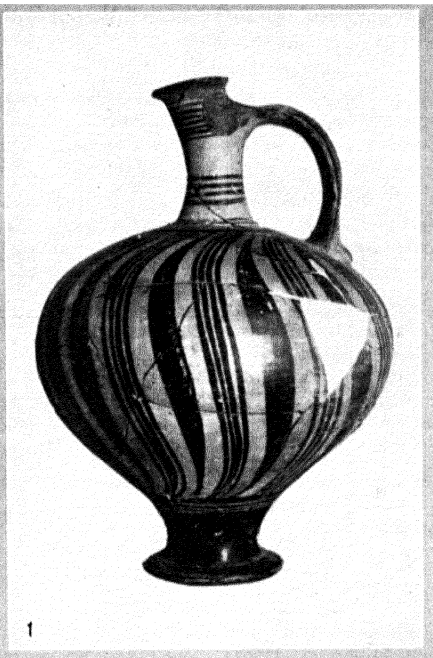
Between this date and the end of the century many isolated tombs of the beehive type and cemeteries of rectangular rock-cut chamber tombs were explored in different districts of Greece. Chamber tombs were found in Attica, at Spata, Markopoulo and Alyke, and in Argolis at Nauplia, and near the Argive Heraeum, and some late graves in Salamis. Beehive tombs, already rifled, but retaining some of their furniture, were excavated at Dimeni in Thessaly, Menidi and Thoricus in Attica, Orchomenus in Boeotia, and Kampos in Laconia. The richest tomb of all was cleared at Vaphio in Laconia in 1889, and this produced, in addition to a fine series of engraved gems and miscellaneous goldsmith's work, two splendid golden cups chased with scenes of bull hunting, and fragments of large vases painted in a bold florid style. These latter, with similar fragments from the Argive Heraeum, Thoricus, and Mycenae itself, remained an enigma till the excavation of Cnossus revealed the "Palace" style. The exploration of famous classical sites showed too that many of these, with the notable exception of Olympia, had been important centres of culture in Aegean times. Thus the sanctuary at Delphi, the Heraeum by Argos and the Acropolis of Athens all yielded their quota of what were still called Mycenaean objects and the last site boasts a fortification wall similar in style to those of Mycenae and Tiryns with column bases and foundations of a "palace." A Cyclopean acropolis and "palace" were explored on the island of Goulas in Lake Copais, the prehistoric dykes of which were now surveyed. Mycenaean remains came to light in most parts of Greece, but except for Eleusis, Aegina and Thoricus, where little was done, no inhabited sites were touched. At these last three sites pottery of new types was found which we now know to be pre-Mycenaean; but this and the discovery by Wide in 1894 in a barrow at Aphidna of burials containing similar wares remained almost unnoticed. Similarly some early rock-cut tombs with peculiar hand-made pottery found in the American excavations at Corinth in 1896 did not fall into their right context till the discoveries at Korakou, near Corinth, almost 20 years later.

Excavation Outside Greece.—Meanwhile prehistoric research had begun to extend beyond the Greek mainland. Certain central Aegean islands, Antiparos, Ios, Amorgos, Syros and Siphnos, were all found to be singularly rich in evidence of the early Aegean period. The series of Syran-built graves, containing crouching corpses, is the most representative known in the Aegean. Exceptionally rich cemeteries of the same date have been explored in Naxos, and Paros has yielded in addition to early graves some remains of the middle period. Delos too has proved an unexpected source of early Aegean culture. Melos, long marked as a source of early objects, but not systematically excavated till taken in hand by the British school at Athens in 1896, yielded at Phylacope remains of all the Aegean periods, except the Neolithic. Numerous cemeteries with late Aegean pottery have been found in Rhodes. A map of Cyprus in the later Bronze Age (such as is given by J. L. Myres and M. O. Richter in *Catalogue of the Cyprus Museum*) shows more than 25 settlements in and about the Mesaoréa district alone, of which one, that at Enkomi, near the site of Salamis, has yielded the richest Aegean treasure in precious metal found outside Argolis. E. Gjerstad (*Studies on Prehistoric Cyprus*) has since added to the number of prehistoric sites in the island, the relationship of which to the general Aegean culture is gradually becoming clearer. In Asia Minor a cemetery at Yortan in Mysia and Korte's excavations at Gordium in Phrygia have yielded pottery similar to that from the early strata of Hissarlik. Exploration of south-western Asia Minor has also brought to light remains of the prehistoric age; but though pottery of late Aegean style is found along the coast and ceramic specimens of Aegean appearance have often been brought back from many districts of Anatolia, the connections of Asia Minor and of Hissarlik (Troy) still seem, so far as the early and middle Aegean periods are concerned, to lie outside the Aegean area proper (*see* TROAD). In Egypt in 1887 W. M. F. Petrie found painted sherds of Cretan style at Kahun in the Fayum, and farther up the Nile, at Tell el-Amarna, chanced on bits of no fewer than 800 Aegean vases in 1889. Much material from subsequent excavations has accumulated to demonstrate that Egypt and the Aegean were in contact from early dynastic times There have now been recognized in the collections at Cairo, Florence, London, Paris and Bologna several Egyptian imitations of the Aegean style which can be set off against the many debts which the centres of Aegean culture owed to Egypt. Two Aegean vases were found at Sidon in 1885, and many fragments of Aegean and especially Cypriote pottery have been turned up during recent excavations of sites in Philistia and Palestine. Indeed the typical Philistine pottery is derived from the latest Aegean fabric. South-eastern Sicily, ever since P Orsi excavated the Sicel cemetery near Lentini in 1877, has proved a mine of early remains, among which appear in regular succession Aegean decorative motives from the period of the second stratum at Hissarlik. Vases of the last Aegean period have also been found. Aegean objects too have been reported from Sardinia, although the Aegean influence formerly thought to have been observed in Spain, is now discredited or at least considered much overrated.

One land, however, has eclipsed all others in the Aegean by the wealth of its remains of all the prehistoric ages; viz, Crete, so much so that, for the present, we must regard it as the fountain-head of Aegean civilization, and probably for long its political and social centre. The island first attracted the notice of archaeologists by the remarkable archaic Greek bronzes found in a cave on Mt. Ida in 1885, as well as by epigraphic monuments such as the famous law of Gortyna; but the first undoubted Aegean remains reported from it were a few objects extracted from Cnossus by Minos Kalokairinos of Candia in 1878. These were followed by important discoveries made in the southern plain (Messará) by F. Halbherr. W. J. Stillman and H. Schliemann both made unsuccessful attempts at Cnossus, and A. J. Evans, coming on the scene in 1893, travelled in succeeding years about the island picking up trifles of unconsidered evidence, which gradually convinced him that greater things would eventually be found. He obtained enough to enable him to forecast the discovery of written characters, till then not suspected in Aegean civilization. The revolution of 1897–98 opened the door to wider knowledge, and much exploration has ensued, for which *see* CRETE.

Further Mycenaean Investigations.—The success of the excavations in Crete naturally caused fresh attention to be paid to Mycenaean remains on the mainland. At Thebes the ruins of the "House of Cadmus" were found by Keramopoullos and yielded many fragments of brilliant frescoes and a store of inscribed vases of the latest period; while close to the city, chamber tombs, stored with vases and other funeral furniture, were excavated. At Orchomenos the Mycenaean stratum was explored by Furtwängler and the underlying strata, which reach down to the neolithic deposits, began to reveal for the first time the pre-Mycenaean history of the mainland. Wares of the early and middle Aegean periods were unearthed at Aegina and the later continuance of the work there has much enlarged our knowledge and shown that the town was protected by a wall. Imported Cretan ware of the middle period has also come to light. At Tiryns many fragments of frescoes from the palace were found, and in the strata beneath the palace floor, reaching down to bed rock,

AEGEAN CIVILIZATION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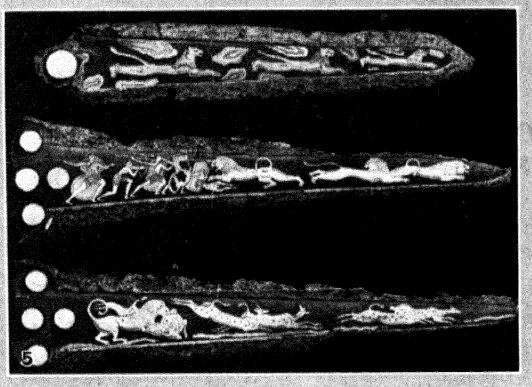
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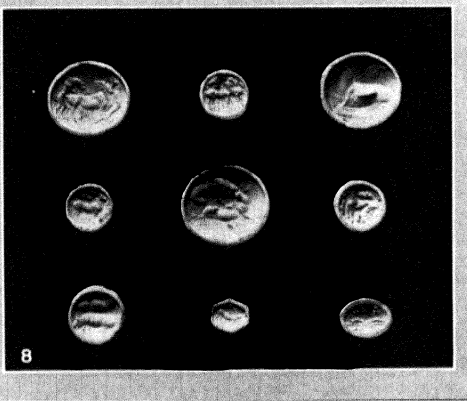
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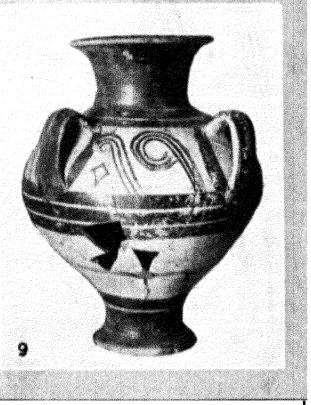
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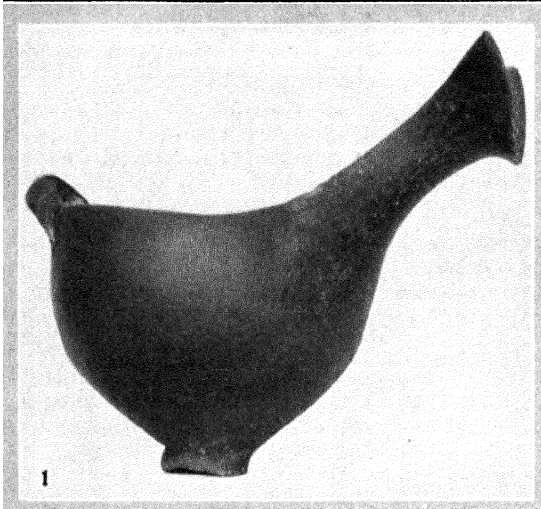
AEGEAN VASES AND BRONZE, METAL AND STONE WORK

1. Vase of 14th and 13th centuries B.C.; in the British School at Athens
2. Bronze statuette of a Minoan goddess; in the museum at Berlin
3. Vase of the 16th century B.C.; in the British School at Athens
4. Vase of 14th and 13th centuries B.C.; in the British School at Athens
5. Bronze daggers inlaid with gold from graves at Mycenae
6. Vase of 16th century B.C.; in the British School at Athens
7. Vase of 16th century B.C.; in the British School at Athens
8. Signets in metal and stone from the royal grave at Dendra, belonging to Professor Persson
9. Vase of 14th and 13th centuries B.C.; in the British School at Athens

AEGEAN CIVILIZATION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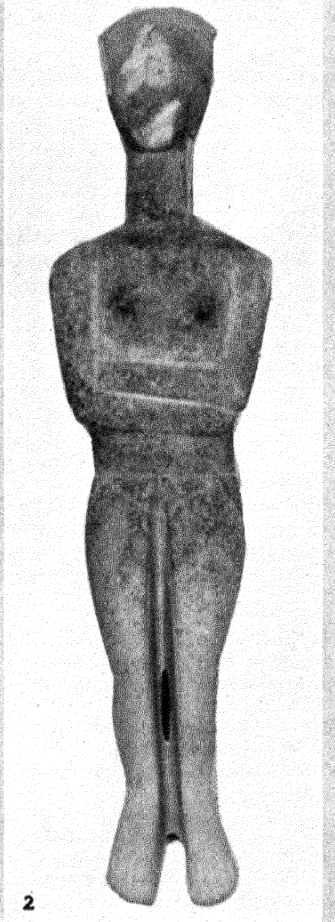
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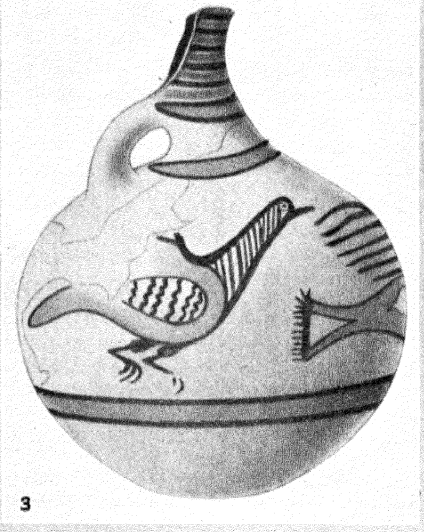
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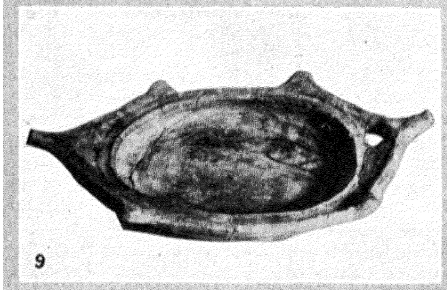
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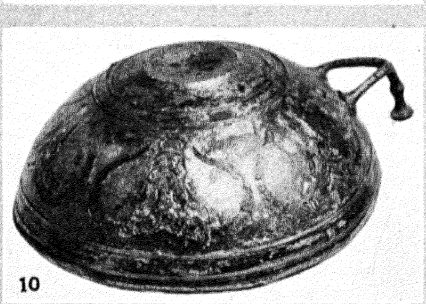
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AEGEAN POTTERY, STATUARY AND METAL WORK

1. Early Helladic sauceboat from Asine; in the Fitzwilliam Museum at Cambridge
2. Early Cycladic marble statue; in the Fitzwilliam Museum at Cambridge
3. Matt painted jug from Mycenae
4. Early Helladic bowl from Asine; in the Fitzwilliam Museum at Cambridge
5. Matt painted cup from Karakou belonging to the American Archaeological Institute
6. Early Helladic mugs from Tiryus
7. Minyan goblet from Lianokladi
8. Early Cycladic sauceboat
9. Middle Helladic dish from Mycenae
10. Queen's cup in gold, silver and niello belonging to Professor Persson

remains of the middle and early periods appeared. Further beehive tombs were excavated at Kakovatos at the Messenian Pylos and at Tiryns, but the last had unfortunately been completely plundered at least by Roman times. More evidence for the last period came in from Argos, where the middle period also appeared, Achaea, Aetolia, Locris, and Cephalonia showing that culture all over Greece in the late bronze age had been more or less uniform.

Meanwhile in Thessaly discoveries were being made which were to give a new aspect to the pre-history of Greece. Here rich deposits of painted neolithic pottery were found at Dimini and Sesklo by Tsountas, who cleared some small beehive tombs of the transitional period between the bronze and iron ages at Marmariane. Further systematic excavation of other sites in Thessaly by British archaeologists and researches by Soteriades in Boeotia and Phocis showed that the neolithic pottery of the Greek mainland was totally different from that of Crete and therefore that the underlying basis for the bronze age in these two main spheres of Aegean culture was by no means the same. This was supported by the results obtained by Dörpfeld in Leucas, where he found wares of all three periods (early, middle and late) and neolithic pottery with painted decoration closely akin to the Thessalian. Euboea produced tombs of the early bronze age, showing a striking likeness both to the wares of the Cyclades and to those of the mainland, and more tombs of the late period which indicate that the results obtained in this island coincide with those from elsewhere. Even before the war the American excavators had obtained hints that Corinth was likely to prove fertile in pre-historic remains, but not till 1915 was any great success won. Since that year the Americans under the leadership mainly of Blegen and Miss Walker have rewritten the early history of the mainland. A series of discoveries and excavations has shown that neolithic wares similar to those of Thessaly are to be found in the Peloponnese, where Corinth, Nemea, the Argive Heraeum and Arcadia have all yielded relics of this period. Further, largely as the result of the excavation of Korakou, a prehistoric port on the Gulf of Corinth near Lechaeum, supported by fruitful work at Zygouries (near Cleonae), Nemea and the Argive Heraeum, it has been possible to obtain a clear view of the three stages of the bronze age on the mainland.

The Aegean Area.—Traces of the early and middle bronze ages have also appeared in Laconia, and the German work at Amyclae has yielded many relics of the late period. At Asine, near Nauplia, a Swedish expedition under Persson has achieved brilliant results and recovered remains of all three periods. The same expedition at Dendra, near Midea, has excavated an unplundered beehive tomb which shows the burial ritual and found treasures richer than those of Vaphio. There is a splendid gold cup chased with a design of octopuses and dolphins, a gold and silver cup adorned with bulls' heads, silver cups, weapons of bronze, engraved sealstones of wondrous size, and pottery which dates the tomb to about 1350 B.C., the last period. Nearby is a chamber tomb, with a hoard of 33 bronze vessels, which, though empty of human remains, seems to have been a cenotaph and throws much light on the cult of the dead. At Mycenae the British work directed by Wace has found remains of all three periods of the bronze age, including a rich series of tombs of the last period, and established the history of the shaft graves found by Schliemann. The palace has been re-explored and, with the Lion Gate and walls, been found to date from the latter part of the last period, from 1400 B.C. The beehive tombs, also re-examined, can be dated with some degree of probability, and the finest, such as the Treasury of Atreus are seen to be contemporary with the Lion Gate. These results are confirmed by the renewed work of the Germans at Tiryns under Karo and Kurt Müller, who find that the palace and the walls, with three stages at least, are approximately contemporary with those of Mycenae. The Swedish finds at Dendra and in the beehive tombs of Bodia, in Messenia, agree with these conclusions, which all tend to show that after the fall of Cnossus, about 1400 B.C., Mycenae as the chief stronghold of the mainland succeeded to the Aegean empire and spread Aegean culture far and wide.

Further work in Boeotia at Eutresis and other sites has extended our knowledge of the houses and culture of the two first periods, and on the Acropolis of Athens itself neolithic pottery of the Thessalian type has come to light as well as pottery of the early bronze age. The latest revelation comes from Samos, where bronze age pottery of the middle and late periods, it is said, has been discovered. Thus on the one hand new discoveries have emphasized the uniform and widespread character of the Aegean culture throughout the area, and on the other hand the latest finds on the mainland indicate considerable divergence between it and Crete. The last point is of vital importance in considering the historical and ethnological problems of Greece in the Aegean or prehistoric age The "Aegean Area" now covers the Archipelago with Crete and Cyprus, the Hellenic peninsula with the Ionian isles, and western Anatolia. Evidence is also coming in from the Macedonian coast. Offshoots are found in the western Mediterranean, in Sicily, Italy, Sardinia, and in the East in Palestine and Egypt. About the Cyrenaica we are still insufficiently informed.

II. GENERAL NATURE OF THE EVIDENCE

For details of monumental evidence the articles on CRETE, MYCENAE, TIRYNS, TROAD, CYPRUS, etc , must be consulted. The most representative site explored up to now is Cnossus, which has yielded the most various and the most continuous evidence from the Neolithic age to the twilight of classical civilization. Next in importance are in Crete, Phaestus, Agia Triada, Mochlos, Vasilike, Tylissus, Gournia, Mallia and the tombs of Mesara; on the mainland, after Mycenae, Tiryns, Thebes, Asine, Korakou and the other sites already mentioned, are Agia Marina, Lianokladi and Tsangli; in the islands, Phylacope in Melos, and on the Anatolian littoral Hissarlik (Troy)

A. The *internal* evidence at present available comprises:—

(1) *Structures.*—Ruins of palaces, palatial villas, houses, built dome- or cist-graves and fortifications (Aegean isles, Greek mainland and north-west Anatolia), but not distinct temples; small shrines, however, and *temenê* (religious enclosures, remains of one of which were probably found at Petsôfa, near Palaikastro, by J. L. Myres in 1904) are represented on intaglios and frescoes From like sources and from inlay-work we have also representations of palaces and houses.

(2) *Structural Decoration.*—Architectural features, such as columns, friezes and various mouldings; mural decoration, such as fresco-paintings, coloured reliefs and mosaic inlay.

(3) *Furniture.*—(*a*) *Domestic,* such as vessels of all sorts and in many materials, from huge store-jars down to tiny unguent pots; culinary and other implements; thrones, seats, tables, etc., these all in stone or plastered terra-cotta; (*b*) *Sacred,* such as models or actual examples of ritual objects; of these we have also numerous pictorial representations; (*c*) *Funerary; e g.,* coffins in painted terra-cotta.

(4) *Artistic Fabrics, e.g.,* plastic objects, carved in stone or ivory, cast or beaten in metals (gold, silver, copper and bronze), or modelled in clay, faience, paste, etc. No trace has yet been found of large free sculpture, but many examples exist of sculptors' smaller work. Vases of all kinds, carved in marble or other stones, cast or beaten in metals or fashioned in clay, the latter in enormous number and variety, richly ornamented with coloured schemes, and sometimes bearing moulded decoration. Examples of painting on stone, opaque and transparent. Engraved objects in great number; *e.g.,* ring-bezels and gems; and an immense quantity of clay impressions, taken from these.

(5) *Weapons, tools and implements,* in stone, clay and bronze, and at the last iron, sometimes richly ornamented or inlaid Numerous representations also of the same. No actual body-armour, except such as was ceremonial and buried with the dead, like the gold breastplates in the circle-graves at Mycenae.

(6) *Articles of personal use, e.g.,* brooches (*fibulae*), pins, razors, tweezers, etc., often found as dedications to a deity; *e.g.,* in the Dictaean cavern of Crete. No textiles have survived.

(7) *Written documents; e.g.,* clay tablets and discs (so far in Crete only), but nothing of more perishable nature, such as skin, papyrus, etc.; engraved gems and gem impressions; legends writ-

ten with pigment on pottery (rare); characters incised on stone or pottery. These show two main systems of script (*see* CRETE).

(8) *Excavated tombs,* of either the pit or the grotto kind, in which the dead were laid, together with various objects of use and luxury, without cremation, and in either coffins or *loculi* or simple wrappings.

(9) *Public works,* such as paved and stepped roadways, bridges, systems of drainage, etc.

B. There is also a certain amount of *external* evidence to be gathered from:—

(1) Monuments and records of other contemporary civilizations; *e.g.,* representations of alien peoples in Egyptian frescoes; imitation of Aegean fabrics and style in non-Aegean lands; allusions to Mediterranean peoples in Egyptian, Hittite, Semitic or Babylonian records.

(2) Literary traditions of subsequent civilizations, especially the Hellenic, such as, *e g.,* those embodied in the Homeric poems, the legends concerning Crete, Mycenae, etc.; statements as to the origin of gods, cults and so forth, transmitted to us by Hellenic antiquarians such as Strabo, Pausanias, Diodorus, Siculus, etc.

(3) Traces of customs, creeds, rituals, etc., in the Aegean area at a later time, discordant with the civilization in which they were practised and indicating survival from earlier systems. There are also possible linguistic and even physical survivals to be considered.

III. GENERAL FEATURES OF AEGEAN CIVILIZATION

The leading features of Aegean civilization, as deduced from the evidence must be stated very briefly.

(1) **Political Organization.**—The great Cretan palaces and the fortified citadels of Mycenae, Tiryns and Hissarlik, each containing little more than one great residence, and dominating lower towns of meaner houses, point to monarchy at all periods. Independent local developments of art before the middle of the 2nd millennium B.C. suggest the early existence of independent units in various parts, of which the strongest was the Cnossian. After that date the evidence goes strongly to show that one political dominion was spread for a brief period, or for two brief periods, over almost all the area (*see* later). The great number of tribute tallies found at Cnossus perhaps indicates that the centre of power was there for some time.

(2) **Religion.**—The fact that shrines have so far been found within palaces and not certainly anywhere else indicates that the kings kept religious power in their own hands; perhaps they were themselves high-priests. Religion in the area seems to have been essentially the same everywhere from the earliest period; viz., the cult of divine principles, resident in dominant features of nature (sun, stars, mountains, trees, etc.) and controlling fertility. This cult passed through an aniconic stage, from which fetishes survived to the last, these being rocks or pillars, trees, weapons (*e g., bipennis,* or double war-axe, shield), etc. When the iconic stage was reached, about 2000 B.C., we find one divine spirit represented as a goddess with a subordinate young god, as in many other eastern Mediterranean lands. The god was probably son and mate of the goddess, and the divine pair represented the genius of reproductive fertility in its relations with humanity. The goddess at times appears, with doves, as uranic, at others with snakes, as chthonic. In the ritual fetishes, often of miniature form, played a great part: all sorts of plants and animals were sacred; sacrifice (not burnt, and human very doubtful), dedication of all sorts of offerings and *simulacra* invocation, etc., were practised. The dead were objects of a sort of hero-worship especially on the mainland. This early nature-cult, explains many anomalous features of Hellenic religion, especially in the cults of Artemis and Aphrodite (*see* CRETE).

(3) **Social Organization.**—There is a possibility that features of a primeval matriarchate long survived; but there is no certain evidence. Of the organization of the people under the monarch we are ignorant. There are so few representations of armed men that it seems doubtful if there can have been any professional military class. Theatral structures found at Cnossus and Phaestus, within the precincts of the palaces, were perhaps used for shows or for sittings of a royal assize, rather than for popular assemblies. The Cnossian remains contain evidence of an elaborate system of registration, account-keeping and other secretarial work, which perhaps indicates a considerable body of law. The life of the ruling class was comfortable and even luxurious from early times. Fine stone palaces, richly decorated, with separate sleeping apartments, large halls, ingenious devices for admitting light and air, sanitary conveniences and marvellously modern arrangements, for supply of water and for drainage, attest this fact. Even the smaller houses, after the Neolithic period, seem also to have been of stone, plastered within. After 1600 B.C. the palaces in Crete had more than one storey, fine stairways, bath-chambers, windows, folding and sliding doors, etc. In this later period, the distinctions of blocks of apartments in some palaces has been held to indicate the seclusion of women in *harems,* at least among the ruling caste. Cnossian frescoes show women grouped apart, and they appear alone on gems. Flesh and fish and many kinds of vegetables were evidently eaten, and wine and beer were drunk. Vessels for culinary, table and luxurious uses show an infinite variety of form and purpose. Artificers' implements of many kinds were in use, bronze succeeding obsidian and other hard stones as the material. Seats are found carefully shaped to the human person. There was evidently olive- and vine-culture on a large scale. Chariots were in use in the later period, as is proved by the pictures of them on Cretan tablets and at Mycenae, Tiryns and Vaphio, and therefore the horse was known. Main ways were paved. Sports, probably more or less religious, are often represented; *e g,* bull-fighting, dancing, boxing and armed combats.

(4) **Commerce** was practised to some extent in very early times, as is proved by the distribution of Melian obsidian over most of the Aegean area and by the Nilotic influence on early Minoan art. We find Cretan vessels exported to Melos, Egypt and the Greek mainland. Melian vases came in their turn to Crete. After 1600 B.C. there is very close intercourse with Egypt, and Aegean things find their way to all coasts of the Mediterranean (*see* below). No traces of currency have come to light, unless certain axe-heads too slight for practical use, had that character; but standard weights have been found, and representations of ingots. The Aegean written documents have not yet proved (by being found outside the area) epistolary correspondence with other lands. Representations of ships are not common, but several have been observed on Aegean gems, gem-sealings and vases. There are also leaden and clay models of boats. They are vessels of low free-board, with masts. Familiarity with the sea is proved by the free use of marine motives in decoration.

(5) **Treatment of the Dead.**—The dead in the earlier period were laid (so far as we know at present) within cists constructed of upright stones. These were sometimes inside caves and occasionally clay coffins were used. After the burial the cist was covered in with earth. A little later, in Crete, bone pits seem to have come into use, containing the remains of many burials. Possibly the flesh was boiled off the bones at once ("scarification"), or left to rot in separate cists awhile; afterwards the skeletons were collected and the cists re-used. The royal shaft graves at Mycenae are an elaboration of the simple cist grave and the circle surrounding them finds a parallel in the grave rings at Leucas. Chamber tombs built in the early period occur in Crete and rock-cut tombs of the same general type approached by a horizontal or slightly inclined way with the sides converging above are very common on the mainland and in Rhodes in the last period, and are often found in Crete where small clay coffins containing skeletons in a crouching posture are usual. Circular ossuaries which some believe to have been roofed with vaults, occur in Crete in the early period and last into the beginning of the middle period; but the great beehive tombs of Mycenae and the mainland belong to the last period (from about 1500 B.C. onwards) and the finest, such as the treasury of Atreus, to the concluding phase of the bronze age after the fall of Crete about 1400 B.C. Sometimes in Crete at the end of the middle period the dead were trussed up and thrust head foremost into

large jars for burial. On the mainland at a slightly earlier date children are found buried in jars, and sometimes in place of stone cists the dead were surrounded by walls of crude brick or covered with fragments of large store jars. At no period do the Aegean dead seem to have been burned. Weapons, food, water, unguents and various trinkets were laid with the corpse at all periods In the Mycenae circle an altar seems to have been erected over the graves, and on the mainland at least there are definite traces of the worship of the dead. A painted sarcophagus, found at Hagia Triada, also possibly shows a hero-cult of the dead.

(6) **Artistic Production.**—Ceramic art reached a specially high standard in fabric, form and decoration by the middle of the 3rd millennium B C. in Crete. The products of that period compare favourably with any potters' work in the world. The same may be said of fresco-painting, and probably of metal work. Modelling in terra-cotta, sculpture in stone and ivory, engraving on gems, were following it closely by the beginning of the 2nd millennium. After 2000 B C. all these arts revived, and sculpture, as evidenced by relief work, both on a large and on a small scale, carved stone vessels, metallurgy in gold, silver and bronze, advanced farther. This art and those of fresco- and vase-painting and of gem engraving stood higher about the 15th century B C. than at any subsequent period before the 6th century. The manufacture, modelling and painting of faience objects, and the making of inlays in many materials were also familiar to Aegean craftsmen, who show in all their best work a strong sense of natural form and an appreciation of ideal balance and decorative effect, such as are seen in the best products of later Hellenic art. Architectural ornament was also highly developed. The richness of the Aegean capitals and columns may be judged by those from the "Treasury of Atreus" now set up in the British Museum; and of the friezes we have examples in Mycenaean and Cnossian fragments, and Cnossian paintings. The magnificent gold work of the later period, preserved to us at Mycenae, Dendra and Vaphio, needs only to be mentioned. It should be compared with stone work in Crete, especially the steatite vases with reliefs found at Hagia Triada. On the whole, Aegean art, at its two great periods, in the middle of the 3rd and 2nd millennia respectively, will bear comparison with any contemporary arts.

IV. ORIGIN, NATURE AND HISTORY OF AEGEAN CIVILIZATION

The evidence, summarized above, though very various and voluminous, is not yet sufficient to answer all the questions which may be asked as to the origin, nature and history of this civilization, or to answer any but a few questions with absolute certainty.

A. **Distinctive Features.**—The fact that Aegean civilization is distinguished from all others, prior or contemporary, not only by its geographical area, but by leading organic characteristics, has never been in doubt since its remains came to be studied seriously and impartially. The truth was indeed obscured for a time by persistent prejudices in favour of certain alien Mediterranean races long known to have been in relation with the Aegean area in prehistoric times; *e.g.*, the Egyptians and especially the Phoenicians. Others put forward "Achaeans" from the north as its authors. But such claims to the authorship of the Aegean remains grew fainter with every fresh Aegean discovery and every new light thrown on their own proper products; with the Cretan revelations they ceased altogether to be considered except by a few Homeric enthusiasts. Briefly, we now know that the Aegean civilization developed these distinctive features: (1) An *indigenous script* expressed in characters of which only a very small percentage are identical, or even obviously connected, with those of any other scripts. This is equally true both of the pictographic and the linear Aegean systems. Its nearest affinities are with the "Asianic" scripts, preserved to us by Hittite, Cypriote and south-west Anatolian (Pamphylian, Lycian and Carian) inscriptions. But neither are these affinities close enough to be of any practical aid in deciphering Aegean characters, nor is it by any means certain that there is parentage. The Aegean script may be, and probably is, prior in origin to the "Asianic"; and it may equally well be owed to a remote common ancestor, or (the small number of common characters being considered) be an entirely independent evolution from representations of natural objects (*see* CRETE). (2) An *Art*, whose products cannot be confounded with those of any other known art by a trained eye. Its obligations to other contemporary arts are many and obvious, especially in its later stages; but every borrowed form and motive undergoes an essential modification at the hands of the Aegean craftsman, and the product is stamped with a new character. The secret of this character lies evidently in a constant attempt to express an ideal in forms more and more closely approaching to realities. We detect the dawn of that spirit which afterwards animated Hellenic art. The fresco-paintings, ceramic motives, reliefs, free sculpture and toreutic handiwork of Crete have supplied the clearest proof of it, confirming the impression already created by the goldsmiths' and painters' work of the Greek mainland (Mycenae, Thebes, Vaphio, Dendra, Tiryns). (3) *Architectural plans and decoration.* The arrangement of Aegean palaces is of two main types. First (and perhaps earliest in time), the chambers are grouped round a central court, being engaged one with the other in a labyrinthine complexity, and the greater oblongs are entered from a long side and divided longitudinally by pillars. Second, the main chamber is of what is known as the *megaron* type; *i.e*, it stands free, isolated from the rest of the plan by corridors, is entered from a vestibule on a short side, and has a central hearth, surrounded by pillars and perhaps hypaethral; there is no central court, and other apartments form distinct blocks. In spite of many comparisons made with Egyptian, Babylonian and "Hittite" plans, both these arrangements remain incongruous with any remains of prior or contemporary structures elsewhere. Whether either plan suits the "Homeric" palace does not affect the present question. (4) A *type of tomb*, the dome or "beehive," of which the grandest examples known are at Mycenae The Cretan "larnax" coffins, also, have no parallels outside the Aegean. There are other infinite singularities of detail; but the above are more than sufficient to establish the point.

B. **Origin and Continuity.**—With the immense expansion of the evidence, due to the Cretan excavations, a question arises how far the Aegean civilization, whose total duration covers at least 3,000 years, can be regarded as one and continuous. The exploration of Cnossus shows that Aegean civilization had its roots in a primitive Neolithic period, of uncertain but very long duration, represented by a stratum which (on that site in particular) is in places nearly 20ft. thick, and contains stone implements and sherds of hand-made and hand-polished vessels, showing a progressive development in technique from bottom to top. This Cnossian stratum seems to be throughout earlier than the lowest layer at Hissarlik It closes with the introduction of incised, white-filled decoration on pottery, whose motives are presently found reproduced in monochrome pigment. We are now in the beginning of the bronze age, and the first of Evans's "Minoan" periods. Thereafter, by exact observation of stratification, eight more periods have been distinguished at Cnossus, each marked by some important development in the universal and necessary products of the potter's art, the least destructible and therefore most generally used archaeological criterion. These periods fill the whole bronze age, with whose close, by the introduction of the superior metal, iron, the Aegean age is conventionally held to end Iron came into general Aegean use about 1000 B C., and possibly was the means by which a body of northern invaders established their power on the ruins of the earlier dominion The important point is this, that throughout the nine Cnossian periods, following the Neolithic age (named by Evans, "Minoan I. 1, 2, 3; II. 1, 2, 3; III. 1, 2, 3"; *see* CRETE), there is evidence of a perfectly orderly and continuous evolution in, at any rate, ceramic art. From one stage to another, fabrics, forms and motives of decoration develop gradually; so that, at the close of a span of more than 2,000 years, at the least, influences of the beginning can still be clearly seen and no trace of violent artistic intrusion can be detected. This fact, by itself, would go far to prove that the civilization continued fundamentally and essentially the same throughout. It is, moreover, supported by less abundant remains

of other arts. That of painting in fresco, for instance, shows the same orderly development from at any rate Period II. 2 to the end. About institutions we have less certain knowledge, there being but little evidence for the earlier periods; but in the documents relating to religion, the most significant of all, there is no trace of sharp change. We see evidence of a uniform nature worship passing through all the normal stages down to theoanthropism in the latest period. There is no appearance of intrusive deities or cult-ideas. We may take it then (and the fact is not disputed even by those who believe in one thorough racial change, at least, during the bronze age) that the Aegean civilization was indigenous, firmly rooted and strong enough to remain dominant in its own geographical area throughout the bronze age.

This conclusion does not necessarily lead to the corollary that the mass of those who possessed this civilization remained for the most part racially the same throughout the bronze age. This indeed may be true for Crete, but as already indicated there are grave reasons for believing that on the mainland matters were not so simple, and herein lies the crux of Greek ethnology. A solution which would satisfy the archaeological and anthropological problems to be indicated would go far to solving the vexed questions of Hellenic origins, especially as regards Achaeans and Dorians (*see* DORIANS, ACHAEANS and IONIANS), and the first appearance of Aryans in the peninsula. In the neolithic age the general characteristics of the culture of the mainland and of Crete are quite distinct. On the mainland at the end of the neolithic age a bronze-using culture appears which is undoubtedly akin to that of the islands and Crete. In the middle period, however, about 2000 B.C., a new element comes into the mainland typified for archaeologists by a well marked class of pottery called "Minyan Ware." This occurs as an import into Melos and was even imitated there, but though contemporary Melian wares are recognized in Crete, as in the temple repositories at Cnossus, hardly a sherd of Minyan ware has been found in Crete. Suddenly, just before the beginning of the last period, Cretan influence and culture came in full force to the mainland. Some hold that this betokens a complete conquest of the mainland by Crete, wholesale displacements of population and the institution of Cretan dynasts at Mycenae and elsewhere. Others maintain that this indicates a rapid absorption by a vigorous and progressive folk of a developed culture which they adapted to their own purposes. For the latter view we can urge:—

(1) Distinct differences are observed between the products of the mainland and those of Crete and both, for instance, appear as imports in Melos side by side; (2) the oldest royal grave at Mycenae contains mostly mainland pottery, and throughout the succeeding period, though the superficial culture is Cretan, there are clear signs that its basis is the old element which produced Minyan ware; (3) there is a variation in burial customs between Crete and the mainland pointing to a divergence in belief as regards the dead; (4) the fortified castles of the mainland like Mycenae, Tiryns and Midea are in strong contrast to the undefended palaces of Crete; (5) in the earlier periods Cretan pottery, except in a few cases, has not been found outside, but the adoption of the Cretan phase of Aegean culture by the mainland just precedes the spread of the last phase of that culture far and wide in the Levant, and it is notorious that the remains from Rhodes, Cyprus and Philistia depend on the mainland and not on Crete.

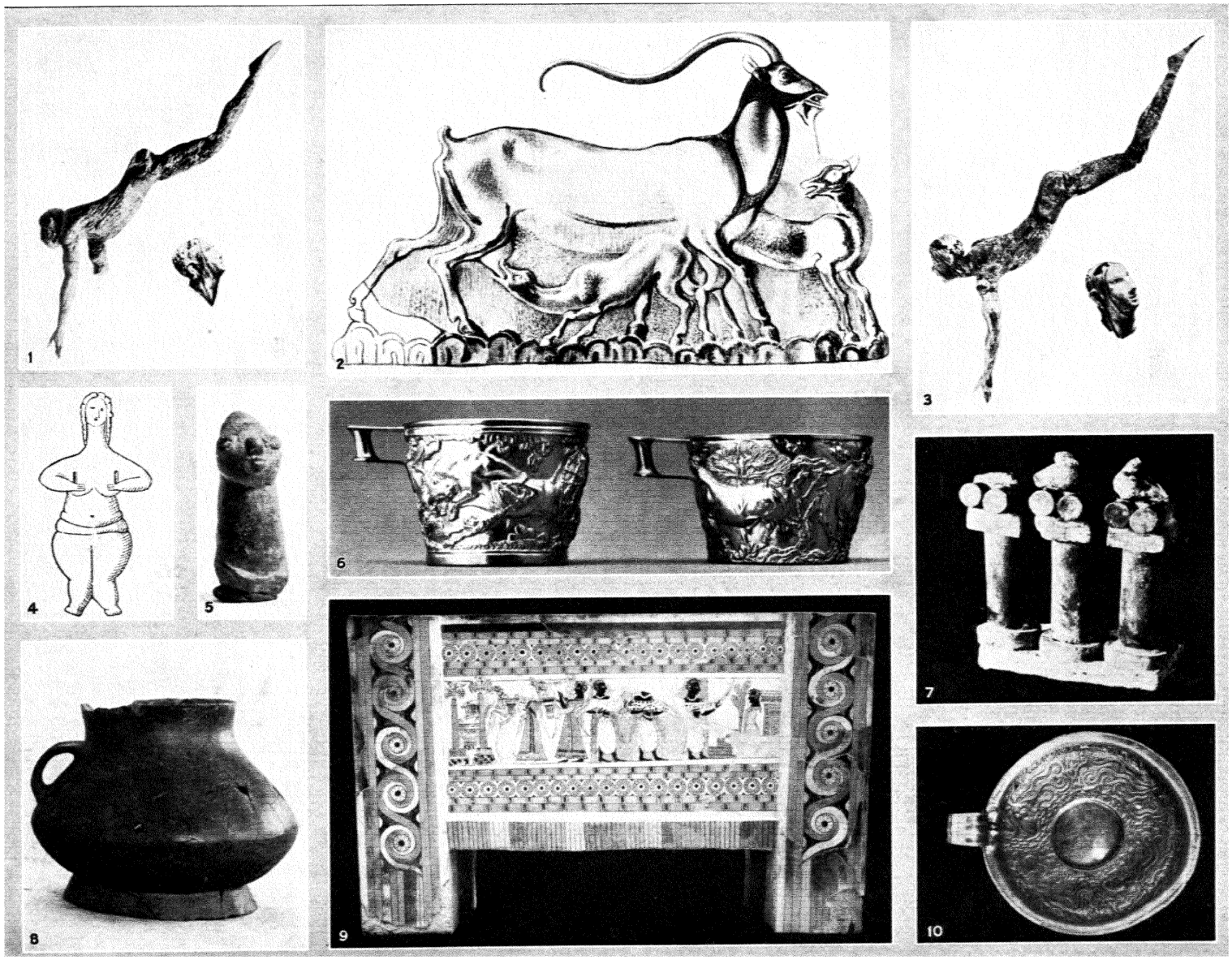
All this suggests that about 1600 B.C. when the last period began some powerful folk (that which introduced Minyan pottery) arose on the mainland and quickly absorbed the mature Aegean culture of Crete, and soon after, when Crete collapsed, about 1400 B.C., the mainlanders became the dominant force and spread their version of Aegean culture abroad. The recent discoveries that the walls and palaces of Tiryns and Mycenae belong to the last phase after 1400 B.C. support this view, as also the other conclusion which places the greatest achievements of Aegean architecture, like the treasury of Atreus, in this the culminating phase of the Aegean culture, which closed perhaps with the great armada led against Troy

A good deal of anthropometric investigation has been devoted to human remains of the Aegean epoch, especially to skulls and bones found in Crete in tombs of Period II. The result of this, however, has established the fact that the Aegean races, as a whole, belonged to the dark, long-headed *Homo Mediterraneus*—a fact only valuable in the present connection in so far as it tends to discredit an Asiatic source for Aegean civilization, though there was clearly much affinity between Crete and south-western Asia Minor. From the skull-forms studied, it would appear, that the Aegean race was by no means pure even in the earlier Minoan periods. On the mainland indeed the skulls from Asine show that both the long and the short types were present in the middle period together with one or two examples of an "Armenoid" character. This is by no means in disagreement with archaeology. There is some ground for supposing that the language spoken in Crete before the later Doric was non-Hellenic, though perhaps Indo-European. This inference rests on three inscriptions in Greek characters but non-Greek language found in eastern Crete. The language has some apparent affinities with Phrygian. The inscriptions are post-Aegean by many centuries, but they occur in the part of the island known to Homer as that inhabited by the Eteo-Cretans, or aborigines. Their language may prove to be that of the Linear tablets.

V. HISTORY OF AEGEAN CIVILIZATION

History of an inferential and summary sort only can be derived from monuments in the absence of written records The latter do, indeed, exist in the case of the Cretan civilization and in great numbers; but they are undeciphered and likely to remain so, except in the improbable event of the discovery of a long bilingual text, partly couched in some familiar script and language. Even in that event, the information which would be derived from the Cnossian tablets would probably make but a small addition to history, since in very large part they are evidently mere inventories of tribute and stores. The engraved gems probably record divine or human names (*see* CRETE).

(1) **Chronology.**—The first chronological datum is inferred from a close similarity between certain Cretan hand-made and polished vases of Minoan Period I. 1. and others discovered by Petrie at Abydos in Egypt and referred by him to the 1st dynasty. He goes so far as to pronounce the latter to be Cretan importations, their fabric and forms being unlike anything Nilotic. If that be so, the period at which stone implements were beginning to be superseded by bronze in Crete must be dated before 4000 B.C. But below all Evans's "Minoan" strata lies the immensely thick Neolithic deposit. To date the beginning of this earliest record of human production is impossible at present. The Neolithic stratum varies very much in depth, ranging from nearly 20ft. to 3ft., but is deepest on the highest part of the hillock. Its variations may be due equally to natural denudation of a stratum once of uniform depth, or to the artificial heaping up of a mound by later builders. Even were certainty as to these alternatives attained, we could only guess at the average rate of accumulation, which proceeds very differently on different sites and under different social and climatic conditions. In later periods at Cnossus accumulation seems to have proceeded at a rate of, roughly, 3ft. per 1,000 years. Reckoning by that standard we might push the earliest Neolithic remains back behind 10,000 B.C.; but the calculation would be worthy of little credence. Surer chronological links are provided by the close affinity with early dynastic Egyptian products shown by the stone bowls from tombs of the 1st period at Mochlos and in Mesara. At Cnossus actual Egyptian bowls of the earliest dynastic times have been found. These facts, and the parallelism displayed by Cretan seals in ivory and stone from the Mesara ossuaries and by Egyptian seals of the 1st six dynasties, enable us to say that the 1st period began before the middle of the 4th millennium. We reach another fairly certain date in the synchronism of remains belonging to the 12th dynasty (*c.* 2225 B.C.) with products of Minoan Period II. 2. Characteristic Cretan pottery of this period was found by Petrie in the Fayum and by Garstang at Abydos in conjunction with 12th dynasty remains, and various Cretan products of the period show striking coincidences with 12th dynasty styles, especially



BY COURTESY OF (4) NATIONAL MUSEUM, ATHENS, (5) DIRECTOR OF THE FITZWILLIAM MUSEUM, CAMBRIDGE, (6, 9) METROPOLITAN MUSEUM OF ART, NEW YORK, (8) BRITISH SCHOOL, ATHENS, (10) PROF. A. W. PERSSON

AEGEAN CERAMICS, IVORIES AND GOLD WARE

Figs. 1 and 3. Ivory figures and heads from Cnossus, Crete, probably representing athletes or acrobats. 2. A faience, or coloured and glazed earthenware, relief of a wild goat and her young, taken from the temple repository of the second palace of Cnossus. 4. Reconstructed drawing of a terra-cotta figure of the first or second Thessalian period. 5. A terra-cotta head of the first Thessalian period. 6. Reproduction of the so-called Vaphio cups of chased gold, with a design of bull-fighting scenes. Mycenaean, of the period 1800–1600 B.C. 7. Birds on a triad of pillars from Cnossus, Crete. 8. Jug of monochrome red ware of the first Thessalian period. 9. Reproduction of a sarcophagus from the palace at Hagia Triada, Crete, of the late Minoan period, about 1350 B.C. 10. A king's cup in gold from Dendra, near Medea. The cup, which was found in a tomb of 1350 B.C., is chased with a design of octopuses and dolphins

in their adoption of spiraliform ornament. The spiral, however, occurs so often in natural objects (*e.g.*, horns, climbing plants, shavings of wood or metal) that too much stress must not be laid on the mutual parentage of spiraliform ornament in different civilizations. A diorite statuette, referable by its style and inscription to Dynasty 13, was discovered in deposit of Period II. 2. in the central court, and a cartouche of the "Shepherd King," Khyan, was also found at Cnossus. He is usually dated about 1633 B.C. This brings us to the next and most certain synchronism, that of Minoan Periods III. 1, 2, with Dynasty 18 (*c.* 1600–1400 B C.). This coincidence has been observed not only at Cnossus, but previously, in connection with discoveries of scarabs and other Egyptian objects made at Mycenae, Ialysus, Enkomi, etc. In Egypt itself Kefti tributaries, bearing vases of Aegean form, and themselves similar in fashion of dress and arrangement of hair to figures on Cretan frescoes and gems of Period III., are depicted under this and the succeeding dynasties (*e.g.*, Rekhmara tomb at Thebes). Actual vases of late Aegean style have been found with remains of Dynasty 18, especially in the town of Amenophis IV.—Akhenaten—at Tell el-Amarna; while in the Aegean area itself we have abundant evidence of a great wave of Egyptian influence beginning with this same dynasty. To this wave were owed in all probability the Nilotic scenes depicted on the Mycenae daggers, on frescoes of Hagia Triada and Cnossus, on pottery of Zakro, on the shell-relief of Phaestus, etc.; and also many forms and fabrics; *e.g.*, certain Cretan coffins, and the faience industry of Cnossus. These serve to date, Periods III. 1–2 in Crete, the shaft-graves in the Mycenae circle, the Vaphio tomb, etc , to the 16th and 15th centuries B.C., and Period III. 3, the walls and palaces of Mycenae and Tiryns, the majority of the 6th stratum at Hissarlik, the Ialysus burials, the upper stratum at Phylacope, etc., to the century immediately succeeding.

The *terminus ad quem* is less certain—iron does not begin to be used for weapons in the Aegean till after Period III. 3, and then not exclusively. If we fix its introduction about 1100 B C. and make it coincident with the incursion of northern tribes, remembered by the classical Greeks as the Dorian Invasion, we must allow that this incursion did not altogether stamp out Aegean civilization, at least in the southern part of its area. But it finally destroyed the Cnossian palace and initiated the "Geometric" age, with which, for convenience at any rate, we may close the history of Aegean civilization proper.

(2) **Annals.**—From these and other data the outlines of primitive history in the Aegean may be sketched thus A people, agreeing in its prevailing skull-forms with the Mediterranean race of north Africa, was settled in the Aegean islands from a remote Neolithic antiquity, but, except in Crete, where insular security was combined with great natural fertility, remained in a savage and unproductive condition until far into the 4th millennium B.C. In Crete, however, it had long been in close contact with Egypt and had developed a certain civilization, and at a period more or less contemporary with Dynasties 11 and 12 (2200–2000 B.C.) the scattered communities of the centre of the island coalesced into a strong monarchical state, whose capital was at Cnossus. There the king, probably also high priest of the prevailing nature cult, built a great stone palace, and received the tribute of feudatories, of whom, probably, the prince of Phaestus, who commanded the Messará plain, was chief. The Cnossian monarch had maritime relations with Egypt, and presently sent his wares all over the southern Aegean (*e.g.*, to Melos in the earlier Second City period of Phylacope). A system of pictographic writing came into use early in this Palace period, but only a few documents, made of durable material, have survived. Pictorial art of a purely indigenous character, whether on ceramic material or plaster, made great strides, and from ceramic forms we may legitimately infer also a high skill in metallurgy. The absence of fortifications at Cnossus, Mallia, and Phaestus suggests that at this time Crete was internally peaceful and externally secure. Small settlements in close relation with the capital, were founded in the east of the island to command fertile districts and assist maritime commerce. Gournia and Palaikastro fulfilled both these ends; Zakro must have had mainly a commercial purpose, as the starting point for the African coast. The acme of this dominion was reached about the end of the 3rd millennium B.C., and thereafter there ensued a certain, though not very serious, decline. The period may be considered to close with a general disaster which overtook the principal Cretan sites at the end of the 17th century B.C. The cause is still to seek; some think it was due to war, others believe that it may have been the result of a terrible earthquake. This would have been caused by the explosion of the volcano of Thera which split that island in two and covered the prehistoric remains which belong to the last phase of the middle period with a deep deposit of pumice.

On the mainland the neolithic population, to judge by its brilliantly painted pottery, seems to have been distinct from that of the islands and to have been related rather to the tribes of the Danubian and Carpathian areas, which some regard as the original home of the Aryans. After the close of the first neolithic period in Thessaly a bronze-using folk, closely akin to the inhabitants of the islands, came to the mainland and advancing from the south-east gradually made themselves masters of the peninsula as far north as Othrys. When this occurred we cannot say, but as the earliest bronze age ware on the mainland is still somewhat primitive it may have taken place well before the end of the 3rd millennium B.C. Once established the bronze age people, together with the remains of the aborigines, developed on a culture parallel to that of the Cyclades, and several prosperous settlements arise as at Tiryns, Mycenae itself, Asine, Nemea, Zygouries and Korakou. If the Cretans and islanders were of non-Hellenic race, the bronze-using incomers may have introduced the non-Hellenic place-names in *-ssos* and *-nthos*. When the second period in Crete had already evolved about the beginning of the 2nd millennium B.C. a new factor entered the mainland. This was accompanied by a new kind of pottery, "Minyan Ware," but whence or how it came we do not yet know This people seems to have coalesced readily with the pre-existing population which, as we know, already contained two racial elements, and this is reflected in the skull types from Asine. At first, though in communication with islands such as Melos and Paros, they seem to have had no contact with Crete till shortly before the end of the 17th century B C Then Aegean culture, as represented by the Cretan culture of the renaissance after the disaster, came into the mainland in full force This may have been due to a conquest of the mainland by Cretans, or to the hospitable reception of refugees from the disaster in Crete, or to raids conducted by chiefs of the mainland against Crete Whatever the cause the mainland became saturated with Cretan culture, but it still retained its own individuality, which changed and charged with its own feeling whatever was borrowed from Crete For instance the evolution of certain mainland vase shapes continues unbroken, but is modified by the influence of Crete. Thus at the beginning of the 3rd period, almost coincident with the rise of the 18th dynasty in Egypt, we have a renaissance in Crete and the establishment of strong centres of culture at Mycenae, Thebes and other mainland sites. In Crete the palaces were rebuilt on a larger scale and with more sumptuous appointments, though there was a distinct tendency towards the baroque. The mainland followed suit, but there is almost the same quality of difference between them as there is between English and American 18th century culture. For two centuries this continued, the mainland becoming stronger and Crete weaker, till just about the time when the 18th dynasty decayed in the nerveless hands of Akhenaten, Crete collapsed and ceased to be the centre of Aegean culture. She still existed, but only as a provincial centre, down to the dawn of the iron age. Her inheritance passed to the mainland which, probably under the leadership of Mycenae, established a great dominion, such as that which Homer depicts under Agamemnon's suzerainty. This is the age of the greatest uniformity of the Aegean culture. Then arose the great Cyclopean fortresses of Tiryns and Mycenae with their palaces, then were built the proudest of the beehive tombs, then Aegean products of mainland style reached distant shores from Sicily to Philistia,

from Macedonia to Egypt. The energy of the mainlanders both in spreading abroad through the Mediterranean the culture which they had adopted as their own and in erecting monumental buildings which testify to amazing architectural skill, demonstrates that they were a people of strong character, capable and original. Were these the Achaeans? Who were the makers of Minyan ware? Were they from Asia Minor like the Tantalids; and were they, so to speak, the forerunners of the Etruscans, who in another land at a later date so quickly absorbed Hellenic culture? These are problems which cannot yet be answered, but it seems possible that Aryans may well have been resident in the peninsula long before the Homeric age and so were not northern invaders as modern criticism has asserted, for Greek tradition regarded the Achaeans as natives. The activities of the mainland folk after 1400 seem to find an echo in the Hittite tablets which record the doings of the Aḫḫiyava from that century onwards

Towards the beginning of the 12th century the traditional date for the Trojan War and when Egypt was vexed by the Peoples of the Sea, signs of degeneration again appear and soon after came a final catastrophe, probably about 1100 B.C. Mycenae and Tiryns went up in flames. The palace at Cnossus was once more destroyed, and never rebuilt or re-inhabited. Iron took the place of bronze, and Aegean art, as a living thing, ceased on the Greek mainland and in the Aegean isles, including Crete, together with Aegean writing. In Cyprus, and perhaps on the south-west Anatolian coasts, the cataclysm was less complete, and Aegean art continued to languish, cut off from its fountain-head. Such artistic faculty as survived elsewhere issued in the lifeless geometric style which is reminiscent of the later Aegean, but wholly unworthy of it. Cremation took the place of burial of the dead This great disaster, which cleared the ground for a further evolution of art, was probably due to an incursion of northern tribes, gradual rather than sudden, who were possessed of superior iron weapons—those tribes which later Greek tradition and Homer knew as the Dorians. They crushed a civilization that had outgrown its strength; and it took two or three centuries for the artistic spirit, instinct in the Aegean area, and probably preserved in suspended animation by the survival of Aegean racial elements, to blossom anew. On this conquest seems to have ensued a long period of unrest and popular movements, known to Greek tradition as the Ionian Migration and the Aeolic and Dorian "colonizations"; and when once more we see the Aegean area clearly, it is dominated by Hellenes, though it has by no means lost all memory of its earlier culture, which was after all the mainspring of the Greek genius. The darkness that shrouds the close of the bronze age was but the prelude to a brighter dawn

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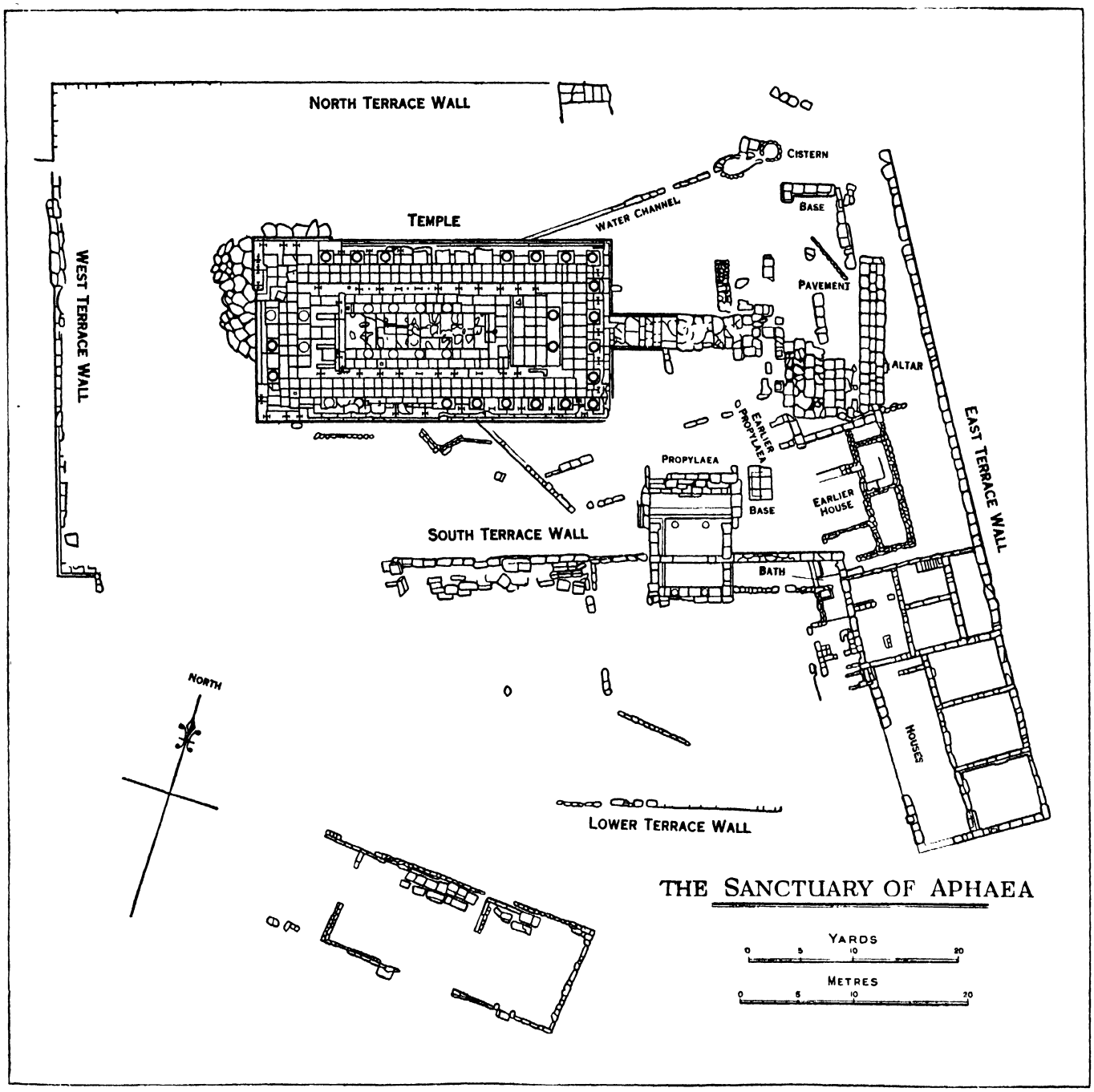
(D. G H; A. J. B W)

AEGEAN SEA, an arm of the Mediterranean sea, between Greece on the west and Asia Minor on the east, and connected by the Dardanelles with the sea of Marmora, and the Black sea. The name archipelago (*q v*) was formerly applied scientifically to this sea. Various derivations suggest origin of "Aegean" from the town of Aegeae, or from Aegea, queen of the Amazons, who perished in this sea; or from Aegeus, father of Theseus, who drowned himself here. Structurally the sea is a much-shattered old land-block almost entirely submerged, outlined by younger fold-mountains (being continuations of ranges of Asia Minor), also partly submerged Both features have accounted for this island-studded sea with its alternating deeps and shallows. Island chains may be traced through Chios, Psara and Skyros to the North Sporades, through Samos, Nikaria, Mykoni, Tinos, Andros and the south-east promontory of Euboea, and through Rhodes, Scarpanto, Crete and Cerigo to the south-east promontory of the Peloponnese. Between the latter chains are the great group of the Cyclades including Naxos, Paros and Milo. Islands in the northern section of the sea include Thasos, off the Macedonian coast, Samothrace, fronting the Gulf of Saros, and Imbros and Lemnos, in prolongation of the Gallipoli peninsula, while Mitylene lies off the coast of Asia Minor. Important sea basins are those of the Cretan sea with depths of over 1,000 fathoms, and the trough between Thessaly and the gulf of Saros over 600 fathoms Many islands are of volcanic formation; and a well-defined volcanic group includes Milo, Kimolos, Santorin (Thira) and Thirasia. The larger islands have some fertile and well-watered valleys and plains The chief productions are wheat, wine, oil, mastic, figs, raisins, honey, wax, cotton and silk The people fish for coral and sponges, as well as for bream and mullet. Greece owns most of the islands, but a number collectively known as the Dodecanese, including Rhodes, Scarpanto, Kaxo, Astypalaea, Kharki, Symi, Tilos, Nisyros, Kos, Kalymnos, Leros and Patmos and minor ones are in Italian hands. Imbros and Tenedos remain Turkish

AEGEUS, son of Pandion and grandson of Cecrops, was king of Athens and the father of Theseus (*q v*).

AEGINA (*Egina* or *Engia*), a Greek island, in the Saronic gulf, 20m from the Piraeus. Tradition derives the name from Aegina, the mother of Aeacus, who was born in and ruled the island. In shape Aegina is triangular, 8m. long from north-west to south-east, and 6m. broad, with an area of about 41 sq m The western side consists of stony but fertile plains, well cultivated with grain, vines, almonds, figs and some cotton The rest of the island is rugged. From the conical Mt. Oros at the south end, the Panhellenian ridge stretches north with narrow fertile valleys on either side. From the absence of marshes the climate is the most healthy in Greece. The island forms part of the modern *nomos* of Attica and Boeotia, of which it forms an *eparchy*. The sponge fisheries are important. The chief town is Aegina, at the north-west end of the island, the favourite summer residence of many Athenians.

Antiquities.—The well known temple stands on the ridge near the north corner of the island. In 1811 Baron Haller von Hallerstein and the English architect, C R. Cockerell, discovered much sculpture from the pediments, which was bought in 1812 by the crown prince Louis of Bavaria and set up in the Glyptothek at Munich. The restoration by B. Thorvaldsen was drastic, ancient parts being cut away to allow of additions treated in imitation of the ancient weathering. The arrangement of the figures has been disputed. Cockerell's inward-facing groups were adopted at Munich till 1901, when Furtwängler's excavation of the site, and fresh



FROM FURTWANGLER, "DAS HEILIGTUM DER APHAIA," BY COURTESY OF THE BAYERISCHE AKADEMIE DER WISSENSCHAFTEN

PLAN OF THE TEMPLE OF APHAEA, IN AEGINA

This temple with its famous sculptures was subjected to violent "restoration" at the beginning of last century, but its true character was established by Herr Furtwängler's researches in 1901. Excavations have also shown that the temple belonged not to Zeus or Athena but to a local goddess Aphaea

study of the figures and fragments in Munich, led to a rearrangement which may be regarded as approaching finality. The figures no longer all face towards the centre, but are broken up, as in other early compositions, into a series of groups of two or three figures each A figure of Athena still occupies the centre of each pediment, but is set farther forward. On each side of this, in the west pediment, is a group of two combatants over a fallen warrior; in the east pediment, a warrior whose opponent is falling into the arms of a supporting figure; other figures also—the bowmen especially—face towards the angles, and so give more variety. The west pediment, which is more conservative in type, represents the earlier expedition of Heracles and Telamon against Troy; the eastern, which is bolder and more advanced, probably refers to episodes in the Trojan war. There are also remains of a third pediment, which may have been produced in competition, but never placed on the temple (For the character of the sculptures *see* GREEK ART) Inscriptions found by the recent excavations seem to prove that the shrine belonged not to Zeus or Athena as formerly supposed, but to the local goddess, Aphaea, identified by Pausanias with Britomartis and Dictynna The present temple probably dates from the time of the Persian wars In the town of Aegina itself are the remains of another temple, dedicated to Aphrodite; one column of this still remains standing, its foundations are fairly preserved, and its votive offerings are important in the early history of Greek vase painting.

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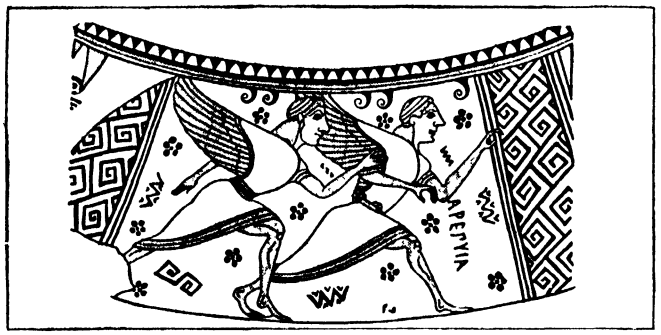
HISTORY

Aegina, according to Herodotus (v. 83), was a colony of Epidaurus, to which state it was originally subject. The discovery of gold ornaments belonging to the latest period of Mycenaean art suggests the inference that the Mycenaean culture held its own in Aegina for some generations after the Dorian conquest of Argos and Lacedaemon. It is probable that the island was not Dorized before the 9th century B.C. One of the



FROM "ARCHAEOLOG ZEITUNG"

THE "HARPY CUP." A FAMOUS EXAMPLE OF AEGINETAN ART. THE ILLUSTRATION SHOWS PART OF THE UPPER DESIGN

earliest facts known to us in its history is its membership in the League of Calauria, which included, besides Aegina, Athens, the Minyan (Boeotian) Orchomenus, Troezen, Hermione, Nauplia and Prasiae, and was probably an organization for the suppression of piracy. It follows that the maritime importance of the island dates back to pre-Dorian times. Aegina was the first state of European Greece to coin money (*see* PHEIDON). Within 40 years of the invention of coinage by the Lydians (*c.* 700 B.C.), the Aeginetans introduced the system to the western world. The fact that the Aeginetan scale of coins, weights, etc. was in general use in the Greek world is sufficient evidence of the commercial importance of the island. In the earlier half of the 7th century B.C. it appears to have belonged to the Eretrian league. In the next century Aegina is one of the three principal states, and the only state of European Greece trading at the emporium of Naucratis (*q.v.*; Herod. ii. 178). At the beginning of the 5th century it seems to have been an entrepôt of the Pontic grain trade, at a later date an Athenian monopoly (Herod vii. 147) Unlike the other commercial states of the 7th and 6th centuries B.C., Aegina founded no colonies.

The history of Aegina, as it has come down to us, is almost exclusively a history of its relations with Athens. The account which Herodotus (v. 79–80; vi. 49–51, 73, 85–94) gives of the relations between the two states is to the following effect. Thebes, after the defeat by Athens about 507 B.C., appealed to Aegina for assistance. The Aeginetans at first contented themselves with sending the images of the Aeacidae, the tutelary heroes of their island. Subsequently, however, they entered into an alliance, and ravaged the seaboard of Attica. The Athenians were preparing to make reprisals, in spite of the advice of the Delphic oracle that they should desist from attacking Aegina for 30 years, and content themselves meanwhile with dedicating a precinct to Aeacus, when their projects were interrupted by the Spartan intrigues for the restoration of Hippias. In 491 B.C. Aegina was one of the states which gave the symbols of submission ("earth and water") to Persia. Athens at once appealed to Sparta to punish this act of Medism, and Cleomenes I. (*q.v.*), one of the Spartan kings, crossed over to the island, to arrest those who were responsible for it. His attempt was at first unsuccessful; but, after the deposition of Demaratus, he visited the island a second time, accompanied by his new colleague Leotychides, seized ten of the leading citizens and deposited them at Athens as hostages. After the death of Cleomenes and the refusal of the Athenians to restore the hostages to Leotychides, the Aeginetans retaliated by seizing a number of Athenians at a festival at Sunium. Thereupon the Athenians concerted a plot with Nicodromus, the leader of the democratic party in the island, for the betrayal of Aegina. He was to seize the old city, and they were to come to his aid with 70 vessels. The plot failed owing to the late arrival of the Athenian force. An engagement followed in which the Aeginetans were defeated. Subsequently, however, they succeeded in winning a victory over the Athenian fleet. The dates of these incidents are uncertain. It is unlikely that Athens was at war in 498 B.C. as she sent 20 ships to help the Ionians in revolt against Persia, and Herodotus nowhere suggests a peace earlier than 481 B.C. If we may regard the "30 years" of the Delphic oracle as fixed after the event, *i.e.*, after the Athenian victory in 458 B.C. we may assign the dedication of the shrine to Aeacus and the beginning of the war to 488 B.C. This is supported by the building of the great Athenian fleet—"for the war against Aegina"—in 483 B.C. Overtures were unquestionably made by Thebes for an alliance with Aegina, *c.* 507 B.C., but they came to nothing. The refusal of Aegina was veiled under the diplomatic form of "sending the Aeacidae." The real occasion of the outbreak of the war was the refusal of Athens to restore the hostages some 20 years later. There was but one war, and it lasted from 488 to 481 B.C., when it was suspended owing to the invasion of Xerxes. That Athens had the worst of it in this war is certain. Herodotus had no Athenian victories to record after the initial success, and the fact that Themistocles was able to carry his proposal to devote the surplus funds of the state to the building of so large a fleet seems to imply that the Athenians were themselves convinced that a supreme effort was necessary. It may be noted, in confirmation of this view, that the naval supremacy of Aegina is assigned by the ancient writers on chronology to precisely this period, *i.e.*, the years 490–480 B.C. In the repulse of Xerxes it is possible that the Aeginetans played a larger part than is conceded to them by Herodotus. The Athenian tradition, which he follows in the main, would naturally seek to obscure their services. The destruction of the Persian fleet appears to have been as much the work of the Aeginetan contingent as of the Athenian It is difficult to credit the number of the vessels that is assigned to them by Herodotus (30 as against 180 Athenian vessels: *see* GREEK HISTORY, *Authorities*).

During the next 20 years the philo-laconian policy of Cimon (*q.v.*) secured Aegina, as a member of the Spartan league, from attack. The change in Athenian foreign policy, which was consequent upon the ostracism of Cimon in 461 B.C. led to war, in which the brunt of the fighting fell upon Corinth and Aegina. The latter state was forced to surrender to Athens after a siege, and to accept the position of a subject-ally (*c.* 456 B.C.). The tribute was fixed at 30 talents. By the terms of the Thirty Years' Truce (445 B.C.) Athens covenanted to restore to Aegina her autonomy, but the clause remained a dead letter. In the first winter of the Peloponnesian War (431 B.C.) Athens expelled the Aeginetans, and established a cleruchy in their island. The exiles were settled by Sparta in Thyreatis, on the frontiers of Laconia and Argolis. Even in their new home they were not safe from Athenian rancour. A force landed under Nicias in 424, and put most of them to the sword. At the end of the Peloponnesian War Lysander restored the scattered remnants of the old inhabitants to the island. Its greatness, however, was at an end.

It would be a mistake to attribute the fall of Aegina solely to the development of the Athenian navy. It is probable that the power of Aegina had steadily declined during the 20 years after Salamis, and that it had declined absolutely, as well as relatively to that of Athens. Commerce was the source of Aegina's greatness, and her trade, which appears to have been principally with the Levant, must have suffered seriously from the war with Persia. Her medism in 491 is to be explained by her commercial relations with the Persian Empire. She was forced into patriotism in spite of herself, and the glory won at Salamis was paid for by the loss of her trade and the decay of her marine. The completeness of the ruin of so powerful a state finds an explanation in the economic conditions of the island, the prosperity of which rested upon a basis of slave-labour. It is clear, however, that the number of slaves must have been out of all proportion to that of the free inhabitants. In this respect the history of Aegina does but anticipate the history of Greece as a whole.

The constitutional history of Aegina is unusually simple. So long as the island retained its independence the government was an oligarchy. There is no trace of the heroic monarchy and no tradition of a *tyrannis*. The story of Nicodromus, while it proves the existence of a democratic party, suggests, at the same time, that it could count upon little support.

Modern.—Aegina passed with the rest of Greece under the successive dominations of Macedon, the Aetolians, Attalus of Pergamum and Rome. In 1537 the island, then a prosperous Venetian colony, was overrun and ruined by the pirate Barbarossa (Khair-ed-Din). One of the last Venetian strongholds in the Levant, it was ceded by the treaty of Passarowitz (1718) to the Turks. In 1826–28 the town became for a time the capital of Greece and the centre of a large commercial population which has since diminished considerably.

BIBLIOGRAPHY.—The ancient authorities are Herodotus ii., v., vi., vii. and viii; also Thucydides i. 105, 108, ii. 27, iv. 56–7. For a criticism of Herodotus' account of the relations of Athens and Aegina, *see* Wilamowitz, *Aristoteles und Athen*, ii 280–8; Macan, *Herodotus* iv.–vi.; ii. 102–20. *See* also G. B. Grundy, *The Great Persian War*, pp. 154 *et seq*, 202 *et seq*, 373 *et seq*.

AEGINETA, PAULUS, a celebrated surgeon of the island of Aegina, whence he derived his name. According to Le Clerc's calculation, he lived in the 4th century of the Christian era; but Abulfaragius (Bar-Hebraeus) places him with more probability in the 7th. The title of his most important work is *Ἐπιτομῆς Ἰατρικῆς Βιβλία Ἑπτά* (*Synopsis of Medicine in Seven Books*); the 6th book, treating of operative surgery, is of interest for surgical history.

The whole work in the original Greek was published at Venice in 1528, and another edition appeared at Basle in 1538. Several Latin translations have been published, and an excellent English version, with commentary, by Dr. F. Adams (1844–48) Edition by Heiberg (Leipzig, 1912) and German trans. with appendix by I. Berendes (Leyden, 1914).

AEGIRITE or **AEGIRINE:** *see* ACMITE.

AEGIS, in Homer, the shield or buckler of Zeus. It was furnished with tassels and bearing the Gorgon's head in the centre. Originally symbolical of the storm-cloud, it probably signifies rapid, violent motion (Gr. *aissō*). In the later story Zeus is said to have used the skin of the goat Amaltheia (Gr. *aigis* = goat-skin) as a buckler when he went forth to do battle against the giants; in another legend, it is the skin of a monster slain by Athena, who afterwards wore it as a cuirass. Such skin shields were the original form of body protection, afterwards replaced by the solid shield covered with metal. It appears to have been really the goat's skin used as a belt to support the shield. When so used it would generally be fastened on the right shoulder, and would partially envelop the chest as it passed obliquely round in front and behind to be attached to the shield under the left arm. Hence, by transference, it would be employed to denote at times the shield which it supported, and at other times a cuirass. Hence the aegis appears in works of art sometimes as an animal's skin thrown over the shoulders and arms, sometimes as a cuirass, with a border of snakes corresponding to the tassels of Homer, usually with the Gorgon's head in the centre.



RESTORATION OF A STATUE OF ATHENA, WEARING THE AEGIS, A CUIRASS OF ANIMAL SKIN BORDERED WITH SNAKES AND BEARING THE HEAD OF A GORGON

See L. Preller, *Griechische Mythologie*, i. (1887); Pauly-Wissowa's *Realencyklopadie;* Roscher's *Lexikon der Mythologie;* Daremberg and Saglio's *Dictionnaire des Antiquités;* and Smith's *Dictionary of Greek and Roman Antiquities* (3rd ed., 1890).

AEGISTHUS, in Greek legend the son of Thyestes by his own daughter Pelopia (Hyginus, *fab.* 88). Having been exposed by his mother, he was found by shepherds and suckled by a goat (*αἴξ*), whence his name. His uncle Atreus, who had married Pelopia, took him to Mycenae, and brought him up as his own son For the rest of his story *see* AGAMEMNON, ATREUS.

AEGOSPOTAMI, a small creek issuing into the Hellespont, north-east of Sestos, the scene of the decisive battle in 405 B.C. in which Lysander destroyed the last Athenian squadron in the Peloponnesian War (*q.v.*). The existence of a township is attested by coins of the 5th and 4th centuries.

AEHRENTHAL, ALOYS LEXA VON, COUNT (1854–1912), Austro-Hungarian statesman, was born at Gross-Skal, in Bohemia He was the son of Baron (Freiherr) Johann Lexa von Aehrenthal and his wife Marie, *née* Countess Thun-Hohenstein, and began his diplomatic career in 1877 as attaché to the Paris embassy under Count Beust. He went in 1878 in the same capacity to St. Petersburg, and from 1883 to 1888 he worked at the Foreign Office in Vienna under Kalnoky, with whom he formed close relations In 1888 he was sent as councillor of embassy to St. Petersburg, where he exercised considerable influence with the ambassador, Count Wolkenstein Recalled in 1894 to service in the Foreign Office, he undertook important duties, and in the following year went to Bucharest as ambassador. Here he succeeded in strengthening the relations between the courts of Vienna and Bucharest, the secret alliance which King Charles had concluded in 1883 with the Central European Powers being renewed on Sept. 30. In 1899 he became ambassador in St. Petersburg, where he remained until his appointment as Foreign Minister in Oct. 1906. Aehrenthal at this time thought that Austria-Hungary must, even at the cost of some sacrifice, come to an agreement with Russia. In this sense he endeavoured to continue the negotiations successfully begun by his predecessor, Prince Franz Liechtenstein (b. 1853), for the bridging over of the difference on Balkan questions between Vienna and St. Petersburg, in order to create a basis for a permanent friendly relation between Austria-Hungary and Russia. He played a principal part in concluding the Murzsteg Agreement of 1903. During the Russo-Japanese War he took a strong line in favour of a benevolent attitude on the part of the Vienna Cabinet towards Russia. When, in Oct. 1906, he succeeded Count Goluchowski as Foreign Minister he at first maintained the views which he had professed as ambassador. He was determined to preserve the interests of Austria-Hungary in the Balkans, but also showed himself prepared to meet the Russian wishes in the Dardanelles question Accordingly he entered into negotiations, after the outbreak of the Young Turk revolution in the summer of 1908, with Isvolski, arranging with him Sept 15 at the château of Buchlau, in Moravia, an agreement which aimed at securing for Austria-Hungary the annexation of Bosnia and Hercegovina and for Russia the opening of the Dardanelles to Russian warships.

It was only when Isvolski's proposals were wrecked on the opposition of England, and the Russian minister protested against the annexation of Bosnia and Hercegovina, which had meanwhile been accomplished, and supported the Serbs in their opposition to Austria-Hungary, that Aehrenthal abandoned the idea of a friendly accommodation with the Russian Government. In the sharp struggle during the annexation crisis, not only with Russia and Serbia, but with the Western Powers, he held with tenacious energy to his purpose, and, powerfully supported by Germany, succeeded in carrying out his intentions after excited negotiations which threatened to lead to war The annexation of Bosnia and Hercegovina was acknowledged by the Powers; an agreement was reached with Turkey; Serbia, after long hesitation, was obliged to submit. For this achievement Aehrenthal was rewarded by his master by elevation to the rank of Count (Aug. 18, 1909), while at the courts of his opponents he was hated but respected.

This was the zenith of his political career. Aehrenthal took the greatest pains to prove in all quarters after the conclusion of the annexation crisis, that Austria-Hungary cherished no far-reaching plans of conquest. In this spirit he offered the most decided opposition to those circles at the court of Vienna which advocated a bloody reckoning with Serbia He held fast by the Triple Alliance, for he saw in this the surest bulwark of peace.

He sought to form the most intimate relations with the German Empire, but insisted on the independence of the Habsburg Monarchy, and energetically repulsed all efforts on the part of the German chancellery to set limits to that independence. A succession of agreements which he concluded with the Italian Foreign Minister Tittoni, enabled him to maintain correct relations with the Italian Government. Yet, by the maintenance of his peace policy, which had the full approval of the Emperor Francis Joseph, he came into serious conflict with Conrad von Hötzendorf. The battle, carried on with tenacious endurance, ended in 1911 with the victory of Aehrenthal and the resignation of Hötzendorf.

Aehrenthal married in 1902 Pauline, Countess Széchényi He died Feb. 17, 1912. During his life the estimate of his policy fluctuated violently. On the one hand it was blamed as provocative, on the other as weak. After the disastrous result of the World War, bringing with it the downfall of the Habsburg Monarchy, it is still more difficult to answer the question whether the path pursued by Aehrenthal in foreign affairs was the right one. It is certain that the Entente Powers were drawn more closely together by the active part played, during his period of office, by Austria-Hungary in Balkan affairs. It is true that the chances of success for the Central Powers in an international struggle were better in the years 1909 and 1911 than in 1914 But the question remains undecided whether, if his activity had been longer continued, Aehrenthal would have been able to maintain the position of Austria-Hungary as a great power without an appeal to the decision of arms. There is no doubt that Aehrenthal was a statesman of considerable mark, a man of wide knowledge and well-ordered intelligence; he was ambitious, but not vain, and an untiring worker. Moreover, in moments of great excitement he was able to maintain outward calmness. He was convinced of his own value, but had no desire to parade it. The Emperor Francis Joseph esteemed him, stood by him in the good and evil hours of his administration of foreign affairs, and repeatedly refused to accept his tendered resignation.

See B. Molden, *Alois, Graf Aehrenthal: Sechs Jahre auswärtiger Politik Oesterreich-Ungarns* (1917); and the article "Aehrenthal" in the *Deutsche Nekrologen* (vol. xviii., 1917, pp. 230 *seq.*). (A. F. P.)

AELFRIC, called the "Grammarian" (*c.* 955–1020), English abbot and author, was educated in the Benedictine monastery at Winchester under Aethelwold, who was bishop there from 963 to 984. Aelfric gained some reputation as a scholar at Winchester, for when, in 987, the abbey of Cernel (Cerne Abbas, Dorsetshire) was finished, he was sent by Bishop Aelfheah (Alphege), Aethelwold's successor, at the request of the chief benefactor of the abbey, the ealdorman Aethelmaer, to teach the Benedictine monks there. He was then in priest's orders. Aethelmaer and his father, Aethelweard, were both enlightened patrons of learning, and became Aelfric's faithful friends.

It was at Cernel, and partly at the desire, it appears, of Aethelweard, that he planned the two series of his English homilies (ed Benjamin Thorpe, 1844–46, for the Aelfric Society), compiled from the Christian fathers, and dedicated to Sigeric, archbishop of Canterbury (990–94). The Latin preface to the first series enumerates some of Aelfric's authorities, the chief of whom was Gregory the Great. In the preface he regrets that, except for Alfred's translations, Englishmen had no means of learning the true doctrine as expounded by the Latin fathers. The first series of 40 homilies is devoted to plain and direct exposition of the chief events of the Christian year; the second deals more fully with church doctrine and history. Aelfric denied the immaculate birth of the Virgin (*Homilies,* ed. Thorpe, ii. 466), and his teaching on the Eucharist in the *Canons* and in the *Sermo de sacrificio in die pascae* (*ibid.* ii. 262, *et seq.*) was appealed to by the Reformation writers as a proof that the early English church did not hold the doctrine of transubstantiation.

See *A Testimonie of Antiquitie, shewing the auncient fayth in the Church of England touching the sacrament of the body and bloude of the Lord here publikely preached,* printed by John Day (1567). It was quoted in John Foxe's *Actes and Monuments* (ed. 1610).

His Latin *Grammar* and *Glossary* (ed. J. Zupitza in *Sammlung englischer Denkmäler,* vol. i., 1880), were written for his pupils after the two books of homilies. A third series of homilies, the *Lives of the Saints,* dates from 996 to 997. Some of the sermons in the second series had been written in a kind of rhythmical, alliterative prose, and in the *Lives of the Saints* (ed. W. W. Skeat, 1881–1900, for the Early English Text Society) the practice is so regular that most of them are arranged as verse by Prof. Skeat. By the wish of Aethelweard he also began a paraphrase (ed. by Edward Thwaites as *Heptateuchus,* Oxford, 1698) of parts of the Old Testament, but under protest, for the stories related in it were not, he thought, suitable for simple minds. It has been suggested that this part of his life was chiefly spent at Winchester; but his writings for the patrons of Cernel, and the fact that he wrote in 998 his *Canons* as a pastoral letter for Wulfsige, the Bishop of Sherborne, the diocese in which the abbey was situated, afford presumption of continued residence there. He became, in 1005, the first abbot of Eynsham or Ensham, near Oxford, another foundation of Aethelmaer's. After his elevation he wrote an abridgment for his monks of Aethelwold's *De consuetudine monachorum,* adapted to their rudimentary ideas of monastic life; a letter to Wulfgeat of Ylmandun (*i e*, Ilmington on the borders of Warwickshire and Gloucestershire); an introduction to the study of the Old and New Testaments (about 1008, ed. William L'Isle in 1623); a Latin life of his master Aethelwold; a pastoral letter for Wulfstan, archbishop of York and bishop of Worcester, in Latin and English; and an English version of Bede's *De Temporibus. The Colloquium,* a Latin dialogue designed to serve his scholars as a manual of Latin conversation, may date from his life at Cernel. It is safe to assume that the original draft of this, afterwards enlarged by his pupil, Aelfric Bata, was by Aelfric, and represents what his own scholar days were like. The last mention of Aelfric Abbot, probably the grammarian, is in a will dating from about 1020.

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AELIA CAPITOLINA. The destruction of Jerusalem and the Temple in A D. 70 was followed by a second revolt of the Jews. After their defeat Hadrian made the ruined Jerusalem into a Roman colony, Aelia Capitolina, subordinate to Caesarea, the then capital of Palestine (about A D. 130). Aelia commemorated the emperor's family name; Capitolina is derived from Jupiter Capitolinus to whom a temple was built on the site of the Jewish Temple.

AELIAN (AELIANUS TACTICUS), Greek military writer of the 2nd century A D., resident at Rome. He is sometimes confused with his namesake Claudius Aelianus (*q.v.*). Aelian's military treatise, Τακτικὴ Θεωρία, is dedicated to Hadrian, though this is probably a mistake for Trajan, and the date A D. 106 has been assigned to it. It is a handbook of Greek, *i.e.* Macedonian, drill and tactics as practised by the Hellenistic successors of Alexander the Great. The author claims to have consulted all the best authorities, the chief of which was a lost treatise on the subject by Polybius. Perhaps the chief value of Aelian's work lies in his critical account of preceding works on the art of war and in the fullness of his technical details in matters of drill. Critics of the 18th century thought Aelian greatly inferior to Arrian, but on

the Byzantines, and on the Arabs, who translated the text for their own use, Aelian exercised a great influence. The emperor Leo VI. incorporated much of Aelian's text in his own work on the military art. The Arabic version of Aelian was made about 1350. The copious details to be found in the treatise made it valuable to the army organizers of the 16th century. The Macedonian phalanx of Aelian had many points of resemblance to the solid masses of pikemen and the "squadrons" of cavalry of the Spanish and Dutch systems, and the translations made in the 16th century formed the groundwork of numerous books on drill and tactics. It has been suggested that Aelian was the real author of most of Arrian's *Tactica,* and that the Τακτικὴ Θεωρία is a later revision of this original, but the theory is not generally accepted.

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AELIAN (CLAUDIUS AELIANUS), Roman author and teacher of rhetoric, born at Praeneste, flourished under Septimius Severus and probably outlived Elagabalus (d. 222). He spoke Greek so perfectly that he was called "honey-tongued" (μελίγλωσσος) and wrote in Greek himself. His chief works are: *De natura animalium,* curious stories of animal life, frequently used to convey moral lessons (ed. Schneider, 1784; Jacobs, 1832); *Variae historiae* in 14 books, some of which are fragmentary, consisting mainly of anecdotes of men and customs (ed. Lünemann, 1811). Both works are valuable for the numerous excerpts from older writers. Twenty *Peasants' Letters,* after the manner of Alciphron but inferior, are also attributed to him.

Editio princeps of complete works by Gesner (1556); Hercher (1864–66). English translation of the *Various History* only by Fleming (1576), and Stanley (1665) of the *Letters* by Quillard (French) (1895).

AELRED (AILRED, ETHELRED) (1109?–1166), English theologian, historical writer, and abbot of Rievaulx, was born at Hexham about the year 1109. In his youth he was at the court of Scotland as an attendant of Henry, son of David I. He renounced the prospect of a bishopric to enter the Cistercian house of Rievaulx in Yorkshire, founded in 1131 by Walter Espec. He was for a brief period abbot of Revesby, Lincolnshire, but in 1146 returned to Rievaulx as abbot. He led a life of the severest asceticism, and was credited with the power of working miracles. In 1164 he went as a missionary to the Picts of Galloway, where he accomplished a great work of pacification. Two years later he died at Rievaulx in the 57th year of his age. In 1191 he was canonized. His writings are voluminous and have never been completely published. Amongst them is the tract called *Relatio de Standardo,* an account of the Battle of the Standard (1138), better known than the similar account by Richard of Hexham but less trustworthy.

BIBLIOGRAPHY.—*See* the *Vita Alredi* in John Tynemouth's *Nova Legenda Anglie* (ed. C. Horstmann, 1901, vol. i. p. 41), whence it was taken by Capgrave. From Capgrave the work passed into the Bollandist *Acta Sanctorum* (Jan. ii. p. 30). This life is anonymous but of an early date. The most complete printed collection of Aelred's works is in Migne's *Patrologia Latina,* vol. cxcv.; but this does not include the *Miracula Hagulstaldensis Ecclesiae* which are printed in J. Raine's *Priory of Hexham,* vol. i. (Surtees Society, 1864). A complete list of works attributed to Aelred is given in T. Tanner's *Bibliotheca Britannico-Hibernica* (1748), pp. 247–248. The *Relatio de Standardo* has been critically edited by R. Howlett in *Chronicles, etc., of Stephen, Henry II. and Richard I.,* vol. iii. (Rolls Series, 1886).

AEMILIA VIA or AEMILIAN WAY. (1) A high road of Italy, constructed in 187 B.C. by the consul M. Aemilius Lepidus, whence its name; it ran from Ariminum to Placentia, a distance of 176m. almost straight N.W., with the plain of the Po (Padus) on the right, and the Apennines on the left. The 79th milestone from Ariminum found in the bed of the Rhenus at Bononia records the restoration of the road by Augustus from Ariminum to the river Trebia in 2 B.C. The bridge by which it crossed the Sillaro was restored by Trajan in A.D. 100. The modern high road follows the ancient line, and has some original and some fine modern bridges. After Augustus, the road gave its name to the eighth region of Italy.

(2) A road constructed in 109 B.C. by the censor, M. Aemilius Scaurus, from Vada Volaterrana and Luna to Vada Sabatia and thence over the Apennines to Dertona (Tortona), where it joined the Via Postumia from Genua (Genoa) to Cremona. We must, however, suppose that a coast road from Vada Volaterrana to Genua at least existed before the Via Postumia was built in 148 B.C. According to Polybius the Romans had in his time built the coast road from the Rhone to Carthago Nova; and it is incredible that the coast road in Italy itself should not have been constructed previously.

AEMILIUS, PAULUS (PAOLO EMILIO) (d. 1529), Italian historian, was born at Verona. He obtained such repute in his own country that he was invited to France in the reign of Charles VIII. in order to write in Latin the history of the kings of France, and was presented to a canonry in Notre Dame. He enjoyed the patronage and support of Louis XII. He died at Paris on May 5, 1529. His *De Rebus gestis Francorum* was translated into French in 1581, and has also been translated into Italian and German.

AENEAS, son of Anchises and Aphrodite. In Homer, he is represented as a favourite of the gods, who frequently interpose to save him from danger (*Iliad,* v. 311; xx. 308) as he was destined to rule the surviving Trojans after the war. The story of his emigration is post-Homeric, and is set forth in its fullest development by Virgil in the *Aeneid.* Carrying his aged father and household



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

A MEDIAEVAL ENAMEL ON COPPER OF ABOUT A.D. 1525–30 SHOWING AENEAS LEADING THE TROJANS IN THEIR STRUGGLE AGAINST THE GREEKS WHO HAVE ENTERED THE CITY IN THE BELLY OF THE WOODEN HORSE. THE ORIGINAL IS IN RICH SUBDUED COLOURS AND GOLD

gods on his back and leading his little son Ascanius by the hand, he made his way to the coast, his wife Creusa being lost during the confusion of the flight. After a perilous voyage to Thrace, Delos, Crete and Sicily (where his father died), he was cast up by a storm, sent by Juno, on the African coast.

Refusing to remain with Dido, queen of Carthage, who in despair put an end to her life, he set sail from Africa, and after seven years' wandering, landed at the mouth of the Tiber. He was hospitably received by Latinus, king of Latium, was betrothed to his daughter Lavinia, and founded a city called Lavinium after her. Turnus, king of the Rutuli, a rejected suitor, took up arms against

him and Latinus, but was defeated and slain by Aeneas on the river Numicius. The story of the *Aeneid* ends with the death of Turnus. According to Livy (i. i. 2), Aeneas, after reigning a few years over Latium, was slain by the Rutuli; after the battle, his body could not be found, and he was supposed to have been carried up to heaven. He received divine honours, and was worshipped under the name of *Iuppiter Indiges* (Dionysius Halic. i. 64).

See Schwegler, *Romische Geschichte* (1867); Roscher's *Lexikon*, s.v.

Romances.—The story of Aeneas, as a sequel to the legend of Troy, formed the subject of several epic romances in the middle ages. The *Roman d'Énéas* (*c.* 1160, or later), of uncertain authorship, the first French poem directly imitated from the *Aeneid*, is a fairly close adaptation of the original, but with the characteristic tone of a mediaeval romance. On this work were founded the *Eneide* or *Eneit* (between 1180 and 1190) of Heinrich von Veldeke, written in Flemish and now only extant in a version in the Thuringian dialect, and the *Eneydos*, written by William Caxton in 1490.

See *Énéas*, ed. J. Salverda de Grave (Halle, 1891); also A. Peij, *Essai sur li romans d'Énéas* (1856); A. Duval in *Hist. littéraire de la France*, xix.; Veldeke's *Eneide*, ed. Ettmueller (Leipzig, 1852) and O. Behaghel (Heilbronn, 1882); *Eneydos*, ed F J. Furnivall (1890). For Italian versions *see* E. G Parodi in *Studi di filologia romanza* (v. 1887).

AENEAS SILVIUS: *see* PIUS II.

AENEAS TACTICUS (4th century B.C), Greek writer. According to Aelianus Tacticus and Polybius, he wrote a number of treatises (ὑπομνήματα) on the art of war; the only one extant deals with the defence of fortified cities, and is chiefly valuable as containing a large number of historical illustrations Aeneas was considered by Casaubon to have been a contemporary of Xenophon and identical with the Arcadian general Aeneas of Stymphalus, whom Xenophon (*Hellenica*, vii. 3) mentions as fighting at the battle of Mantinea (362 B.C.).

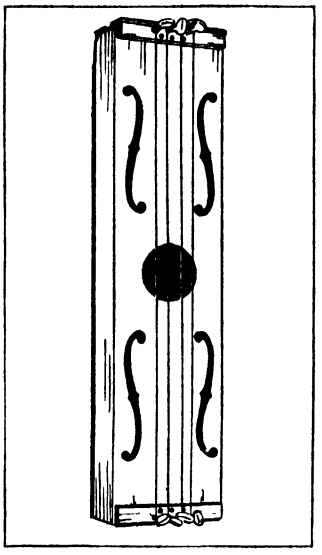
Editions in I. Casaubon's (1619), Gronovius' (1670) and Ernesti's (1763) eds. of Polybius; also separately, with the notes by J. C. Orelli (Leipzig, 1818). Other texts are those of W Rüstow and H. Kochly, *Griechische Kriegsschriftsteller*, vol. i. (Leipzig, 1853), and A. Hug, *Prolegomena Critica ad Aeneae . . . editionem* (Zürich univ. 1874), R. Schoene (Leipzig, 1911). *See* L. W. Hunter, *Aeneas on Siegecraft* (revised by S. A. Handford, 1927), an edition with translation and introduction, and the bibliography there given.

AENESIDEMUS, Greek philosopher, was born at Cnossus, in Crete and taught at Alexandria, probably during the 1st century B.C. He was the leader of what is sometimes known as the third sceptical school and revived to a great extent the doctrine of Pyrrho and Timon His chief work was the *Pyrrhonian Principles* addressed to Lucius Tubero. His philosophy consisted of four main parts: the reasons for scepticism and doubt, the attack on causality and truth, a physical theory and a theory of morality. The reasons for doubt are given in the form of the ten "tropes": (1) different animals manifest different modes of perception; (2) similar differences are seen among individual men; (3) even for the same man, sense-given data are self-contradictory; (4) vary from time to time with physical changes, and (5) according to local relations; (6) and (7) objects are known only indirectly through the medium of air, moisture, etc., and are in a condition of perpetual change in colour, temperature, size and motion; (8) all perceptions are relative and interact one upon another; (9) our impressions become less deep by repetition and custom; and (10) all men are brought up with different beliefs, under different laws and social conditions. Truth varies infinitely under circumstances whose relative weight cannot be accurately gauged. There is, therefore, no absolute knowledge, for every man has different perceptions, and groups his data in methods peculiar to himself. In attacking causality he adduces almost entirely those considerations which are the basis of modern scepticism. Cause has no existence apart from the mind which perceives; its validity is ideal. The relation between cause and effect is unthinkable. If the two things are different, they are either simultaneous or in succession. If simultaneous, cause is effect and effect cause. If not, cause must precede effect, and there must be an instant when cause is not effective, that is, is not itself. Thus he arrives at the fundamental principle of scepticism, the universal opposition of causes: παντὶ λόγῳ λόγος ἀντίκειται (*see* SCEPTICISM).

For the immediate successors of Aenesidemus *see* AGRIPPA, SEXTUS EMPIRICUS. *See* also CARNEADES and ARCESILAUS. Of the πυρρώνειοι λόγοι nothing remains; we have, however, an analysis in the *Myriobiblion* of Photius.

BIBLIOGRAPHY.—*See* Zeller's *History of Greek Philosophy*; E. Saisset, *Aenesideme, Pascal, Kant*; Ritter and Preller, sections 364–370; V. Brochard, *Les Sceptiques Grecs*, with bibliography (1923).

AEOLIAN HARP, a stringed musical instrument, played automatically by the wind. It consists of a long narrow sound box made of deal or pine over which ten or a dozen catgut strings of varying thickness are stretched The sounds are produced by the play of the wind across the strings causing them to vibrate in aliquot parts, *i.e.* (the fundamental note not being heard) the half or octave, the third or interval of the twelfth, the second octave, and the third above it, in fact the upper partials of the strings in regular succession.



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART NEW YORK

A SPECIMEN OF THE AEOLIAN HARP, WHICH WAS PLAYED AUTOMATICALLY BY THE WIND

The principle of the natural vibration of strings by the pressure of the wind was recognized in ancient times. King David, we learn from the Rabbinic records, used to hang his *kinnor* (*kithara*) over his bed at night, when it sounded in the midnight breeze. The same is related of St. Dunstan of Canterbury who was in consequence charged with sorcery The Chinese at the present day fly kites of various sizes, having strings stretched across apertures in the paper, which produce the effect of an aerial chorus.

AEOLINA, the original and more elegant name of the humble instrument familiarly known as the mouth-organ, another name for it being the mouth-harmonica. It was invented in 1829 by Sir Charles Wheatstone, who also invented the concertina, embodying the same principle, and consists simply of free reeds arranged within a small metal box, so that, each reed having a separate air aperture, it is possible by moving the instrument to right and left against the lips, to produce different notes. The mouth-organ may be regarded as a humble relation not only of the concertina (*q v.*) and the accordion (*q.v.*) but also of the harmonium (*q v*).

AEOLIS (AEOLIA), an ancient district of Asia Minor, colonized at a very early date by Aeolian Greeks. The name was applied to the coast from the river Hermus to the promontory of Lectum, *i.e.*, between Ionia to south and Troas to north. The Aeolians founded twelve cities on the mainland, including Cyme, and numerous towns in Mytilene; they were said also to have settled in the Troad and even within the Hellespont.

AEOLODION (also known as AEOLINE and AEOLODICON), one of several instruments of the harmonium type, invented and developed during the early part of the 19th century, having steel springs instead of the usual reeds. A closely similar instrument, employing wooden reeds instead of steel, was the aeolsklavier, and yet another was the aeolomelodicon or choraleon, in which the reeds were supplemented by brass tubes. The aeolopantalon in turn was in the nature of a combined harmonium and pianoforte designed so that either the one or the other could be used at will. None of these instruments succeeded in establishing itself.

AEOLUS (ī-ŏl-ŏos), in Greek mythology, according to Homer the son of Hippotes, controller of the winds, and ruler of the floating island of Aeolia. In the *Odyssey* (x. 1) he entertains Odysseus, gives him a favourable wind, and a bag in which the unfavourable winds are confined. To see what it contains Odysseus' companions open the bag; the winds escape and drive them back to the island, whence Aeolus dismisses them with

bitter reproaches. He has been identified with Zeus, and his six sons and six daughters with the 12 months. According to Virgil, Aeolus dwells on one of the Aeolian islands to the north of Sicily, Lipara or Strongyle (Stromboli), where he keeps the winds imprisoned in a vast cavern (Virgil, *Aen.* i. 52).

AEON, a Greek term used to denote an indefinite or infinite duration of time; and hence an existence that continues for ever. In the latter sense it was used by the Gnostic sects to denote those eternal beings or manifestations which emanated from the one incomprehensible and ineffable God. (*See* GNOSTICISM.)

AEPINUS, FRANZ ULRICH THEODOR (1724–1802), German natural philosopher, was born at Rostock, Saxony, on Dec. 13 1724. In 1757 he settled in St. Petersburg as member of the imperial academy of sciences and professor of physics, and remained there till his retirement in 1798. The rest of his life was spent at Dorpat, where he died on Aug. 10, 1802.

Aepinus is best known by his researches, theoretical and experimental, in electricity and magnetism, and his principal work *Tentamen Theoriae Electricitatis et Magnetismi,* published at St. Petersburg in 1759, was the first systematic attempt to apply mathematical reasoning to these subjects. His discussion of the effects of parallax in the transit of a planet over the sun's disc excited great interest, having appeared (in 1764) between the dates of the two transits of Venus that took place in the 18th century.

AEPYORNIS, a genus of large extinct flightless birds, comprising the family Aepyornithidae and the order Aepyornithiformes of the Palaeognathidae; they resembled the moas (*q.v.*) in many particulars, and inhabited Madagascar up to, possibly, 200 years ago. They are said to have been the origin of the legend of the roc. *Ae. titan* reached a height of 10ft., and the egg was larger than that of any other bird (*See* ORNITHOLOGY.)

AEQUI, an ancient people of Italy, whose name occurs constantly in Livy's first decade as hostile to Rome in the first three centuries of the city's existence. They occupied the upper reaches of the valleys of the Anio, Tolenus and Himella; the last two being mountain streams running northward to join the Nar. They were not finally subdued until the end of the second Samnite War, when they seemed to have received a limited form of franchise. After the Social War the folk of Cliternia and Nersae appear united in a *res publica Aequiculorum* which was a *municipium* (*q.v.*) of the ordinary type. The Latin colonies of Alba Fucens (304 B.C.) and Carsioli (298 B.C.) must have spread the use of Latin (or what passed as such) all over the district; through it lay the chief (and for some time the only) route (via Valeria) to Luceria and the south. At the end of the republican period the Aequi appear, under the name Aequiculi or Aequicoli, organized as a *municipium,* the territory of which seems to have comprised the upper part of the valley of the Salto, still known as Cicolano.

Of the language spoken by the Aequi before the Roman conquest we have no record; but since the Marsi (*q.v.*) who lived farther east, spoke in the 3rd century B.C. a dialect closely akin to Latin, and since the Hernici (*q.v.*) their neighbours to the south-west, did the same, we have no ground for separating any of these tribes from the Latian group (*see* LATINI).

See the articles MARSI, VOLSCI, LATINI, and the references there given; the place-names and other scanty records of the dialect are collected by R. S. Conway, *The Italic Dialects,* pp. 300 *et seq.* (1897).

AERARII, a class of Roman citizens subject to a poll-tax arbitrarily fixed by the censor (from Lat. *aes,* in its subsidiary sense of "poll-tax"). They were (1) the inhabitants of conquered towns who possessed the *ius conubii* and *ius commercii,* but no political rights; Caere is said to have been the first example of this (353 B.C.); (2) full citizens subjected to civil degradation (*infamia*) owing to their employment or to conviction for crime; (3) persons branded by the censor. Those who were thus excluded from the tribes and centuries had no vote, were incapable of filling Roman magistracies and could not serve in the army. According to Mommsen, the *aerarii* were originally the non-*assidui* (non-holders of land). The expressions "tribu movere" and "aerarium facere" are explained by A. H. J. Greenidge—the first as relegation from a higher to a lower tribe or total exclusion from the tribes, the second as exclusion from the centuries. Other views of the original *aerarii* are that they were: artisans and freedmen (Niebuhr); inhabitants of towns united with Rome by a *hospitium publicum,* who had become domiciled on Roman territory (Lange); only a class of degraded citizens, including neither the *cives sine suffragio* nor the artisans (Madvig); identical with the *capite censi* of the Serbian constitution (Belot, Greenidge).

BIBLIOGRAPHY.—*See* A. H. J. Greenidge, *Infamia in Roman Law* (1894), where Mommsen's theory is criticized; A. S. Wilkins in Smith's *Dict. of Greek and Roman Antiquities* (3rd ed., 1891); J. E. Sandys, *Companion to Latin Studies,* with useful bibliography (1921); W. E. Heitland, *The Roman Republic* (1923).

AERARIUM, in ancient Rome the public treasury. The treasury contained the moneys and accounts of the State, the standards of the legions, the public laws, the decrees of the senate, etc. These were deposited in the temple of Saturn and, during the republic, were in charge of the urban quaestors (*see* QUAESTOR), under the control of the senate. In 28 B.C. Augustus transferred the *aerarium* to two *praefecti aerarii;* in 23 B.C these were replaced by two praetors (*praetores aerarii* or *ad aerarium*), selected by lot during their term of office In addition to the common treasury, there was a special reserve fund, also in the temple of Saturn, the *aerarium sanctum* (or *sanctius*), originally consisting of the spoils of war, afterwards maintained chiefly by a 5% tax on the value of all manumitted slaves.

This fund was not to be touched except in cases of extreme necessity. Under the emperors the senate continued to have the nominal management of the *aerarium,* while the emperor had a separate exchequer, called *fiscus,* filled largely with the profits from the imperial domains in Egypt and elsewhere. But after a time, as the power of the emperors increased, this distinction virtually ceased. Besides creating the *fiscus,* Augustus also established in A.D. 6 a military treasury (*aerarium militare*), endowed by the emperor himself (see *Monumentum Ancyranum,* iii. 35) and supported by the proceeds of the tax on public sales and the succession duty. Its administration was in the hands of three *praefecti aerarii militaris,* senators of praetorian rank

The *tribuni aerarii* have been the subject of much discussion. by the *lex Aurelia* (70 B.C.) the list of *iudices* (jurymen) was composed, in addition to senators and equites, of *tribuni aerarii.* Whether these were the successors of the *tribuni aerarii* who in earlier times were paymasters of the troops, etc., or a new order closely connected with the equites, is uncertain. According to Mommsen, they were persons who possessed the equestrian census, but no public horse. They were removed from the list of *iudices* by Caesar, but replaced by Augustus. According to Madvig, the original *tribuni aerarii* were not officials but private individuals of considerable means, who undertook certain financial work connected with their own tribes. The term was subsequently extended to include all those who possessed the property qualification that would have entitled them to serve as *tribuni aerarii.*

BIBLIOGRAPHY.—*See* Tacitus, *Annals,* xiii. 29, with Furneaux's notes; J. E. Sandys, *Companion to Latin Studies* (1921), useful bibliography. On the *tribuni aerarii, see* A. H J. Greenidge, *Legal Procedure* (1901); W. E. Heitland, *The Roman Republic,* §957 (1923).

AERATED BREAD. Ordinary bread is leavened by yeast, the vesicular texture being imparted by the consequent fermentation, which produces carbonic acid gas. Dr. Dauglish invented a process by which bread is directly charged with carbonic acid gas, and to bread so lightened the name "aerated" is given. Machinery for the purpose was first devised about 1860. In the aerating process, the carbonic acid gas is supplied to the flour in conjunction with the water, and the lightening is thus performed without any decomposition whatever. For this reason it is claimed that aerated bread will agree with persons who find they cannot digest ordinary bread through the fermenting process continuing after the bread is eaten.

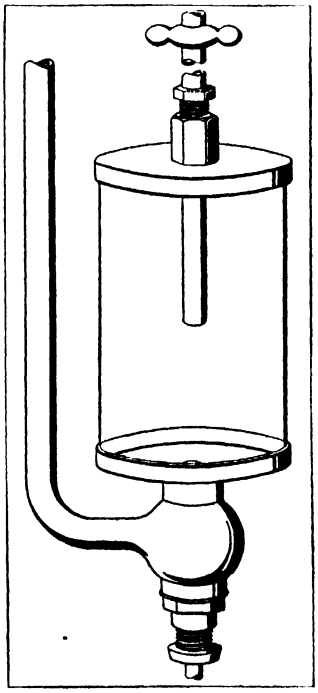
The mixing of aerated bread is performed in a hollow air-tight receptacle by the revolution of iron arms fixed upon a central spindle. Aerated water is pumped into the mixing receptacle at a very high pressure, and when the kneading is finished a valve is opened

at the bottom of the mixer and the dough is forced out by the elasticity of its contained carbonic acid gas. As the dough issues from the machine it is cut off in portions of the required weight and goes forward in tins to the oven. The aerated process is much quicker than the ordinary method of bread-making with yeast, as with the former an hour and a half serves for the entire conversion of a sack of flour into baked loaves, whereas with the latter process four or five hours are occupied in the formation of the dough and a further period of approximately an hour and a half in the moulding and baking.

The aerating process is said to prevent deterioration of the flour, which takes place with certain grades in the fermented process because the prolonged action of warmth and moisture changes the starchy matter of the flour into dextrine. With the aerating process there is no time for the glucogenic change to take place. Another advantage claimed for the aerating process is uniformity of result. Owing to differences in the character and rapidity of fermentation dependent on variations of temperature, quality of yeast, etc , the manufacture of fermented bread presents vagaries and irregularities which are not present in the aerated method.

AERATED WATERS or **CARBONATED BEVERAGES.** These may be divided into two classes, namely, aerated table-waters and effervescent beverages. The latter are flavoured and are known in the United States as carbonated beverages, also as "soda-water," "soda" and "pop" and include ginger-ales. Natural and synthetic flavours are used. Natural flavours are from fruits, nuts, roots, herbs, bark and leaves of plants.

Synthetic flavours are also made in the laboratory. Aerated waters are essentially non-alcoholic beverages artificially saturated at the normal temperature with carbon dioxide, the pressure varying according to the type of beverage. Artificially aerated waters had their inception in Priestley's success in 1772 in producing aerated water in imitation of naturally aerated mineral spring water. Large-scale manufacture of aerated water was commenced by Paul at Geneva in 1790 and shortly afterwards by Schweppe in London. In the United States Priestley's experiments interested a Philadelphia physician, Dr. Philip Syng Physick, and he induced a chemist, Townsend Speakman, of the same city, to prepare carbonated water for his patients. Speakman added fruit juice as a flavour and the soft-drink industry in the United States started at that time, 1807. From the original conception of the imitation of natural carbonated water from springs the industry has broadened to include the production of aerated sweetened drinks and substitutes for beverages, such as cider, which are aerated by fermentation. The technique of large-scale aerated-water manufacture and the apparatus employed have undergone very considerable improvement within the last 20 years. Small-scale production of aerated water has also been rendered much simpler than formerly, when the cumbersome seltzogene apparatus was the only means for small-scale aeration of water.



A DEVICE FOR MEASURING SYRUP INTO AERATED WATER BOTTLES
The syrup enters from the bottom and ceases to flow when it reaches the air tube. The bottle, pressed against bottom nozzle, cuts off the supply tube and opens the discharge valve. The bottle when removed, closes the discharge valve and opens the supply tube and the syrup again enters

Raw Materials.—Used in the manufacture of aerated waters are water, carbon dioxide, sugar and certain artificial sweeteners, acidifying materials, fruit juices, artificial fruit essences, essential oils, vegetable extracts, mineral salts and foam-producing materials. The water employed must be unexceptionable as regards purity, both from chemical and bacteriological standpoints. To this end it is customary to filter the water through an effective filtering medium, for example, kieselguhr, unglazed porcelain, filter-paper or cloth. The water must also be free from objectionable colour, odour and taste. It is sometimes necessary to rectify waters which are either too hard or too soft for the purpose in view, also in some cases manufacturers use distilled water for special purposes. Carbon dioxide is produced as a by-product in the combustion of coke in burning limestone to quick-lime, or from sulphuric acid and carbonates, or recovered as a by-product from fermentation processes. It is either made in a special gas-generator in the aerated-water factory or is purchased in a highly compressed or liquefied state in steel cylinders. In either case it must be free from objectionable taste. Carbonation furnishes in the finished beverage a gaseous pressure of from 40 to 80 lb per square inch depending upon the type of product. High-pressure carbonation is used on ginger-ales, and is carried on at about 55° and impregnates the beverages with as high as four and one-half volumes of gas. Low pressure is used on fruit drinks, at about 40° to 42° and as low as one volume of gas may be employed.

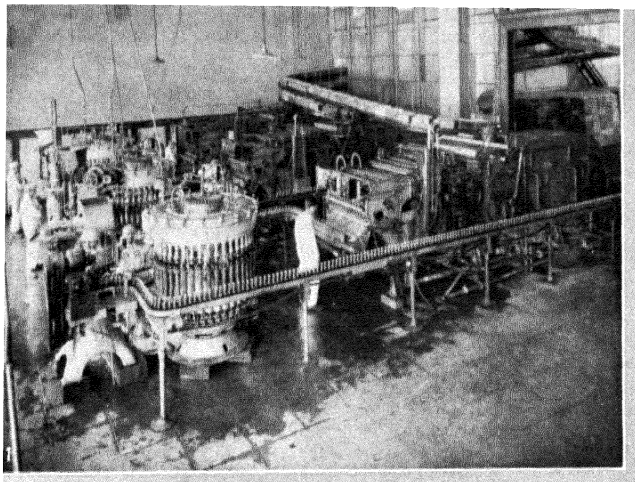
THE SUGAR CONTENT

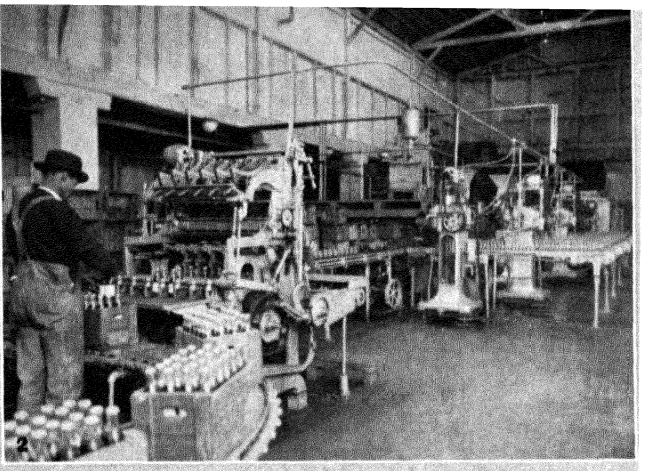
Sugar is specially manufactured for use in aerated-water production. It is highly refined by animal charcoal, no blue material having been employed to produce whiteness. Especial care is taken in the refining process to render the sugar free from sediment or scum when made into syrup. Artificial sweeteners, of which saccharin is the chief, are permitted in some countries, and such sweeteners are employed for special purposes, as in cases where sugar is undesirable because of its tendency towards fermentation, or in periods when sugar is expensive or difficult to obtain. Saccharin may be obtained in very high degrees of sweetening power, for example 550 times the sweetening power of sugar. In the United States the use of saccharin is prohibited by the U.S department of agriculture and by most of the States. The acidifying materials commonly used in aerated waters are citric acid, tartaric acid, malic acid and phosphoric acid. These acids should be free from metallic and arsenical contamination.

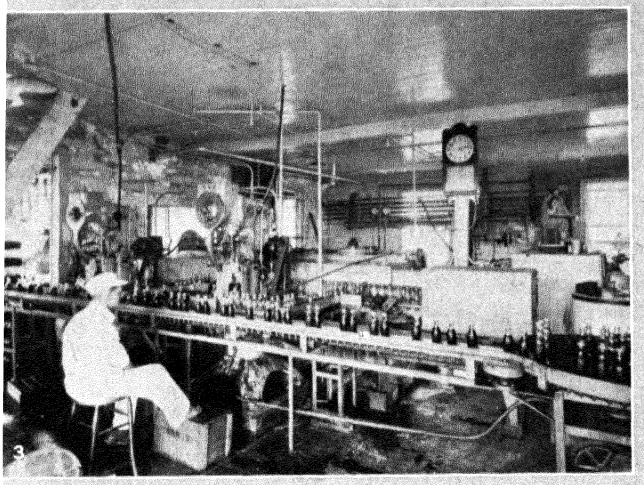
Fruit Juices and Fruit Concentrates used for aerated or carbonated beverages are usually treated to eliminate the albuminous and pectinous matter and finally filtered, so that the finished beverages may be as clear as possible. However, there are also many natural fruit or combination of natural fruit and synthetic flavoured beverages with a cloudy appearance. Concentrated fruit flavours may consist of a blend of fruit juice and fruit oil, *i.e.*, from the peel of citrus fruits, and synthetic fruit esters, or a combination of two or more of these. Essential oils, *e.g.*, lemon, orange, limes, etc., are also employed for flavouring purposes, usually after they have been deprived of their insoluble terpenes and sesquiterpenes by fractional distillation. Vegetable extracts of either aqueous or alcoholic nature are prepared from herbs, roots and seeds for use in the production of ginger and herbal beverages. Mineral salts, *e.g.*, sodium bicarbonate, sodium sulphate, calcium chloride, sodium chloride, etc., are used in the preparation of table-waters. In some countries the use of small quantities of saponin bodies is permitted for the production of foam, such bodies being known as "froth-heading." Other substances which are used for this purpose are liquorice extract, for dark-coloured beverages, and various gums. Colouring matter is frequently added to aerated beverages. This usually takes the form of burnt sugar or caramel for brown-coloured drinks, and specially pure coal-tar colours for other beverages.

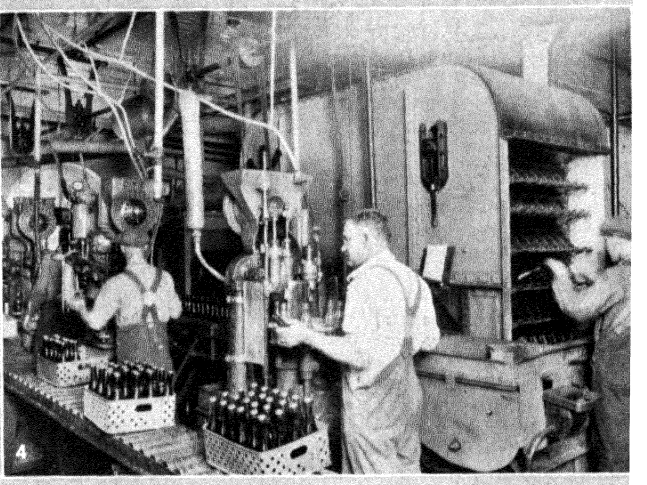
BOTTLING METHODS

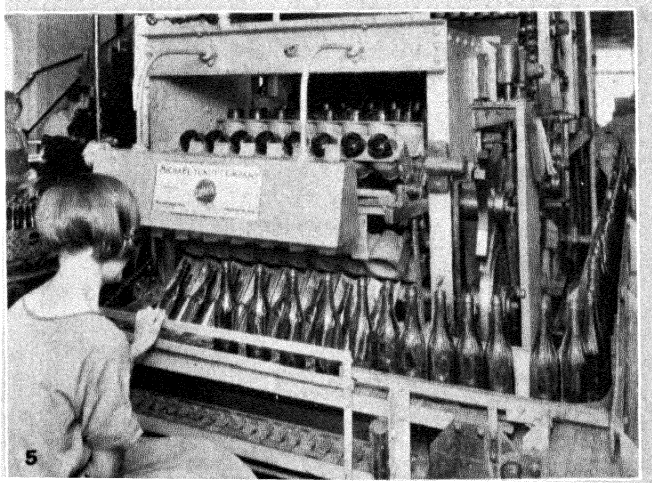
The apparatus used in aerated water bottling is of a highly specialized nature, many improvements having recently been adopted. The bottles are washed by machines of various types, some of the larger being capable of cleansing 1,000 dozen bottles

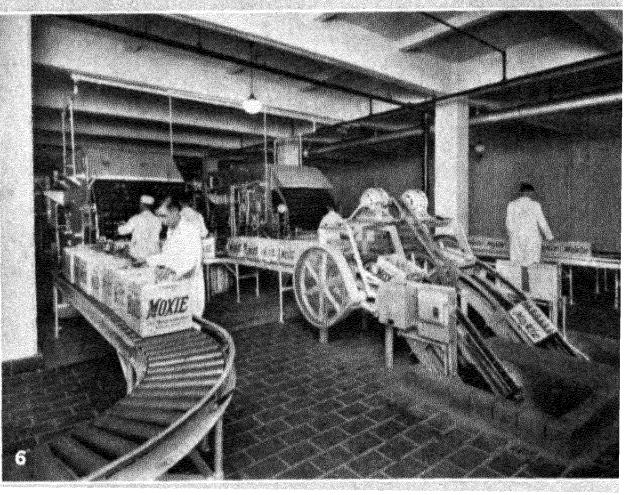












BY COURTESY OF (1) EDWARD ERMOLD CO., (2) GEO. J. MEYER MFG. CO., (3) CROWN CORK & SEAL CO., (4, 5) MICHAEL YUNDT CO., (6) GEO. J. MEYER MFG. CO.

TYPICAL MODERN MACHINERY FOR THE MANUFACTURE OF AERATED OR CARBONATED WATERS

1. Cleansed and sterilized bottles being carried by automatic conveyors from a battery of three Meyer-Dumore Bottle Cleaners to the filling and crowning machines
2. A completely automatic multiple labelling machine, with a capacity of 120 bottles a minute, in use in Philadelphia
3. Automatic conveyor to the filling and crowning machines in general use throughout the United States
4. Special Standard Junior Combination Soaker Air Washer, with a cleansing and sterilizing capacity of 48 to 60 bottles per minute
5. Special Standard Junior Air Washer, eight bottles in width, automatically unloading cleansed and sterilized bottles
6. Meyer-Dumore cleansing and sterilizing machinery automatically loading empty bottles from boxes

per hour. The bottling units are capable of measuring into each bottle the correct amount of syrup, filling with carbonated water, sealing and labelling. The bottles used for aerated-water bottling are of four main varieties: (1) Codd's bottles, in which the bottle is sealed by means of a glass marble held against an india-rubber ring by the gas pressure; (2) crown cork bottles, which are securely sealed by a cork-lined metal cap clamped on to a shallow boss on the top of the bottle mouth; (3) screw-stoppered bottles, in which a lignum-vitae stopper screws down on to an india-rubber ring; and (4) swing lever stoppered bottles, in which a porcelain stopper is held down on an india-rubber seating by a strong wire lever acting upon the bottle neck. In the United States the use of crown cork bottles is almost universal. Aerated beverages are also largely sold in siphons, the gas pressure serving to discharge the container. Aerated waters are very simply produced on a domestic scale, in protected siphons, the aeration being accomplished by means of carbon dioxide contained in small steel cylinders.

Typical Compositions of various types of both table-waters and sweetened aerated waters vary widely, each manufacturer adjusting his product according to his judgment of popular taste and the type of water he is using. The following examples of dosage for the production of table-waters are given, taking soft or distilled water as a basis.

Soda-water.—Three and one-half oz. of a mixture of sodium carbonate 15 parts, magnesium chloride 6½ parts, calcium chloride 6½ parts, are dissolved in 10gal. of water. This is strictly a table-water and should not be confused with the term "soda-water" used in the United States for flavoured beverages.

German Table-water.—Five and one-half oz. of mixture of sodium carbonate 10 parts, sodium chloride 10 parts, sodium sulphate 1 part, magnesium chloride 8 parts, calcium chloride 5 parts, are dissolved in 10gal. of water.

The dosage employed in the preparation of aerated imitations of natural mineral waters (*see* MINERAL WATERS) is much heavier than in the preparation of table-waters, and many salts are included which have well-marked medicinal properties.

The basis of sweetened aerated waters is the syrup, which contains the acidifying material, flavour and colouring matter in addition to the sugar. Usually the syrup contains about 60% of sugar and is employed in the proportion of 1 to 2 oz. for bottles of from 6–12 oz. of finished beverage. The sugar content of carbonated beverages in the United States is from 6–17%, an average of 11%. This is a food value of approximately 80–100 calories for 8 oz. of beverage. The acidity of the syrup is equivalent to about 1% of citric acid, the acidity being adjusted to this strength when acid fruit juices are used. The colouring matter is varied according to the type of fruit which the drink represents. Most essences employed for flavouring aerated beverages are standardized so that they may be used to the extent of 1½–2 oz. per gallon of syrup. Thus in the preparation of a lime-juice syrup the following essence may be used in the proportion of 2 oz. per gallon of syrup: terpeneless West Indian distilled oil of limes 1 part, alcohol 60° O.P. 28 parts, distilled water 16 parts. In the preparation of beverages of a herbal or root-beer type, a smaller proportion of syrup is employed so that the beverages may not be too sweet. Also, a small proportion of foam-producing material may be employed.

Consumption.—In the United Kingdom, the Dominions and other countries where the sale of alcoholic beverages is permitted, consumption of aerated non-alcoholic drinks depends largely on weather conditions and on prices. Taking as example the United Kingdom, the sale of aerated beverages in many years has been restricted by the succession of wet, cold summers and by the high prices of such drinks consequent upon burdens being placed upon the industry by the Government. The census of production which was taken in 1924 yielded some interesting figures of the extent of aerated beverage production. Thus, in 1924, 36,004,000gal. of table-waters, valued at £4,848,000, were produced, compared with 94,054,000 dozen bottles, valued at £4,046,000 in 1907; in the section non-alcoholic brewed drinks, as for example ginger-beer, herb-beer, etc., the value of the 1924 production was £392,000, compared with £221,000 in 1907. As regards table-waters, the comparison of outputs is, to some extent, vitiated by the difference in units of measurement. When the difference in prices between 1924 and 1907 is taken into account it is clear that the output has declined. The same remarks apply to non-alcoholic brewed drinks. The exports of table-waters from Great Britain during 1924 amounted to 434,000gal., valued at £165,000, and the imports to 878,000gal., valued at £173,000. Thus only a small proportion of the total production was exported. As regards the imports of table-waters, these were almost wholly of an unsweetened nature, and they amounted to about 8% of the quantity of similar waters produced in the United Kingdom as shown by the reports of the commissioners of customs and excise.

There has been a tremendous increase in the consumption of "soft drinks" in the United States during recent years as a result of increased capacity for production enabled by inventions and improvements of manufacturing equipment, co-operation of the manufacturers through their trade associations with State and Federal authorities to prevent the use of inferior ingredients and to promote highest standards of sanitation in manufacturing and marketing, and to extensive advertising. The output of such beverages during each of three years 1924–26 displayed very marked increase. This is evidenced by the returns issued by the Crown Manufacturers' Association of America of the crown corks sold for beverage purposes. The total of such crowns sold for all beverage purposes in 1924, 1925 and 1926 was 45,693,057, 69,602,072 and 76,610,083 gross respectively. Statistics issued by the American Bottlers of Carbonated Beverages, the national trade association of the manufacturers of "soft drinks," show the total consumption in the United States of bottled carbonated beverages, exclusive of artificial mineral waters and non-alcoholic brewed drinks, in 1924, 1925 and 1926 was 8,000,000,000, 9,014,000,000 and 10,002,502,500 half-pint bottles respectively. The retail values were $400,000,000 in 1924, $450,700,000 in 1925 and $500,125,125 in 1926.

AERIAL, an elevated wire or group of wires forming the principal part of a radio antenna of the open or "condenser" type. (*See* ANTENNA.) An aerial for the reception of programmes from broadcasting stations may consist of a single horizontal wire about 75 or 100ft. long and elevated about 30 to 50ft. from the ground. From the aerial, the lead-in wire connects to the receiving set.

AERIAL LAW, the law governing air travel. Aerial navigation is everywhere defined and limited by law. Some British and American jurists still find aviation law lacking in substance, since few precedents and no body of judicial decisions and opinions exist on the subject. With the presence, however, of national and international air statutes the law of aviation will continue to grow along with the development of commercial aeronautics. Speculation on the legal status of aeronautics arose even prior to the advent of mechanical flight. In 1900, about the time Santos-Dumont was making flights in his first power-driven air-ship, and long before heavier-than-air flight had been demonstrated by the Wright brothers, Paul Fauchille had anticipated legal problems growing out of aerial navigation, in his elaborate air code ("Le domaine aérien et le régime juridique des aérostats," *Revue générale de droit international public,* 1901). The International Juridical committee on aviation was organized in 1909 for the purpose of drafting an international air code. The rules of this code, although in a sense international, were suitable also for national or municipal codes. The committee continued its work at Paris in 1910, at Geneva in 1912, at Frankfort on the Main in 1913. This organization has continued its work since the World War and in 1928 had a membership of 28 states in the League of Nations. Another international body, the Institute of International Law, in 1911 adopted a comprehensive code of air rules, applicable also to municipal regulation, covering nationality, registration and marks of identification. ("Noveau rapport à l'Institut de droit international," Madrid, 1911, *Annuaire,* 1911.)

Legal concern before the war was chiefly centred upon the sovereignty of the air, reminiscent of the old controversy over the freedom of the seas. Speculation was based upon three main theories: (1) that, following the theory of *mare liberum,* the air

was free for all traffic regardless of nationality, with the qualification that the subjacent States could provide regulations for their own safety (Nys., *Annuaire,* vol. xxi.; Blüntschli, *Das moderne Völkerrecht,* pp. 22–26; F. Meili, *Das Luftschiff im internen Recht und Völkerrecht;* F. Despagnet, *Cours de droit international public* [1905]); (2) that the State had unlimited jurisdiction over its air space, a theory maintained chiefly by English and American jurists (Sir H. E. Richards, *Sovereignty Over The Air,* p. 27; H. D. Hazeltine, *The Law of the Air,* p. 39; Lycklama à Nijeholt, *Air Sovereignty,* pp. 13–14); (3) that State sovereignty was limited by servitude granting innocent passage for aircraft of all nationalities (J. M. Spaight, *Aircraft in Peace and the Law;* E. Catellani, *Le droit aérien*). The question was settled arbitrarily at the outbreak of the World War when all States asserted jurisdiction over their air space. Holland, Switzerland and the Scandinavian States repeatedly asserted their right of sovereignty, the Dutch enforcing this right by shooting down a German dirigible crossing their territory. (For compilation of notes exchanged by neutrals and belligerents on violations of neutrality by aircraft see *Seekriegsrecht im Weltkriege,* Reichs-Marine-Amts, 1919; also Spaight, *Air Power and War Rights*)

National sovereignty over air space is now universally enforced. The International Flying Convention of 1919 provides for sovereignty, as do all international agreements and national laws. (British Aerial Navigation Acts of 1911, 1913 and 1920; Franco-German Agreement of 1913; International Aerial Agreement between Great Britain and Switzerland; U S. Air Commerce Act of 1926.) The right of innocent passage has been accepted, in part, by all nations, but only by treaty. The International Flying Convention provides for contracting states in this respect.

National municipal law also antedates the World War. National acts regulated aerial navigation in France, Germany, Great Britain and Italy. In America the States of Connecticut and Massachusetts had enacted State laws. Air rules, however, are based primarily upon the regulations laid down in the International Flying Convention of 1919. (*See* P. Cogliolo, *Codice aeronautico,* 1927; M. Sudre and M. Peyrillier, *Répertoire de l'aéronautique et des transports aériens,* 1923; *Treaties, Conventions, International Acts, Protocols and Agreements between the United States and other Powers,* vol. iii., p. 3,768.) (M. W. R.)

The parties to this convention which begin by affirming the sovereignty of each State over the air above its territory are the British Empire, Belgium, Bulgaria, Chile, Czechoslovakia, France, Greece, Italy, Japan, Persia, Poland, Portugal, Rumania, the Saar Territory, the Serb-Croat-Slovene State, Siam and Uruguay. This principle affirmed, the convention goes on to provide for freedom of innocent air passage over the territory of the contracting States for each party to the convention, provided the conditions laid down in it are observed. Such freedom of passage does not apply to "prohibited areas" which States may desire for military reasons to close to all private aircraft, including those in their own territory.

The "nationality" of an aircraft is made to depend upon the country in which it is registered; to be registered in a particular State the aircraft must belong to a national of that State or to a company of which the chairman and two-thirds of the directors possess that nationality. Double registration is prohibited. Every aircraft engaged in international navigation must possess a certificate of airworthiness issued or rendered valid by its State of nationality, and the pilot and other members of the crew must be provided with certificates of competency and licences similarly issued or validated. The documents (certificates, licences, log-books, passenger lists, manifests) which aircraft must be provided with are laid down.

Foreign aircraft may be required to land at aerodromes fixed by the State whose territory they enter; and each State has the right to reserve in favour of its national aircraft the carriage of persons and goods for hire between any two points in its territory. Provision is made for the rendering of assistance to aircraft in landing or in distress, for the application, to aircraft wrecked at sea, of the principles of the maritime law of salvage, for the use of aerodromes at a common tariff of charges, and for certain other matters. The convention is not applicable to military aircraft nor to State non-military aircraft employed on customs and police service; other State aircraft; *e.g.,* postal, are subject to its provisions. A military aircraft is defined as one commanded by a person in military service detailed for the purpose, and such an aircraft may fly over another contracting State's territory only in virtue of a special authorization.

Rules in regard to the marking of aircraft (to show nationality and identity), certificates of airworthiness, log-books, lights and signals, "rules of the road," licensing of personnel, aeronautical maps and ground markings, the collection and dissemination of meteorological information, and customs procedure, are contained in annexes to the convention, which have been modified from time to time by the International Commission for Air Navigation.

International Commission.—A permanent International Commission for Air Navigation, composed of representatives of the contracting States, is established and charged with certain powers, including the amendment of the annexes, the receipt or initiation of proposals to amend the convention itself and the inter-communication of information affecting air navigation, etc. The office of the secretary-general of the commission is at 20, Avenue Kléber, Paris. The convention may be denounced by one year's notice. States which did not take part in the World War may adhere to it at any time; those which took part in the War may adhere under certain specified conditions. The Commission issues half-yearly a *Bulletin* containing the Convention of 1919 and its annexes revised up to date, and bilateral conventions.

Other Arrangements.—A number of important Powers, it will be seen, are not as yet parties to the Convention, and international air traffic is regulated, so far as they are concerned, by a series of special agreements between themselves and with other States; *e.g.,* the Convention between France and Germany, May 22, 1926. The terms of these agreements are in general conformity with those of the convention. The obstacle to a more general acceptance of the convention has been, first, the provision therein forbidding contracting States to permit, except by special and temporary authorization, the flight above their territory of the aircraft of non-contracting States; secondly, the "weighted" vote which was allowed to the British empire, France, Italy and Japan. Protocols of amendment of both these provisions have been signed but, not having been ratified by all the parties, are not yet in force.

The convention of 1919 does not bind the contracting parties as belligerents or neutrals (though it would continue to apply in war as between two neutrals), and an attempt to frame a corresponding code for war was made at The Hague in 1923. A commission of jurists, representing the United States, Great Britain, France, Italy, Japan and The Netherlands, under the chairmanship of John Bassett Moore, drew up rules which, though they have not been embodied in a convention, are a valuable indication of international opinion, as it stood in 1926, upon the law of air warfare.

Municipal Legislation which has been passed to regulate internal flying and to give effect to the international obligations of each country under the convention of 1919, or the separate bipartite agreements, is contained in laws, decrees, ordinances and regulations of many different kinds. It is of great volume and an indication of its general scope is all that can be attempted. One usually finds in such legislation (*lato-sensu*) provisions for ensuring the safety of air navigation as affecting both air travellers and the general public; provisions, that is to say, for registration and certification of aircraft, licensing of personnel, inspections and tests precedent to such certification and licensing, maintenance and overhaul and renewal of certificates and licences, inspection, licensing and use of aerodromes, carriage of explosives and arms, dropping of articles in flight, jettison of cargo, minimum height of flight over populated areas, investigation of accidents and so on. For defence reasons "prohibited areas" are usually defined, and in many cases corridors of entry for foreign aircraft are prescribed as well as the general conditions on which such entry is allowed; and the carriage of radio apparatus and cameras is usually restricted. Conditions for the grant of concessions for the operation of com-

mercial air lines and the establishment of international airways are occasionally included. Penalties (fine, imprisonment, suspension of licence) for the infringement of the rules are invariably laid down.

Liability for Damage.—Liability for damage occasioned by aircraft to persons or property on the ground appears in many of the codes. In the absence of special provision the liability of the owner or pilot would be dependent ordinarily on proof of actual negligence or intention. Proof would often be very difficult to obtain and hence it has generally been considered equitable to impose upon the owner or pilot an absolute liability to pay compensation for all such damage, save in so far as he can show that the person damnified was himself to blame. It is also sometimes provided that the owner of an aircraft, or the organizers of an air navigation company must cover themselves by insurance against possible claims for compensation or else must deposit security sufficient to cover their liability.

Occasionally it is provided that legal relations between parties on board a foreign aircraft in the air are governed by the law of the aircraft's nationality; *i e*, the country in which it is registered. The French law qualifies such a provision by adding that a crime or misdemeanour committed on board a foreign aircraft is within the competence of the French courts, if the guilty party is a French national, or if the aircraft lands in France after the occurrence of the offence. (J. M. S.)

Conference of 1925.—In Oct. 1925, at a conference in Paris of the European and certain other Governments, a draft convention was framed to determine the responsibility of carriers by air. This corresponds to the Berne Convention of 1890 on transport by rail. An international committee of experts is to continue the work of this first conference, and to study a series of questions, connected with unification of private law, of the very greatest practical importance for the development of air traffic, such as damage caused by aircraft to property and persons on the ground, compulsory insurance, establishment of air registers, rights of property and ownership, and mortgages in respect of traffic by air. (H. H. L B)

United States.—In contrast with European activity no national law existed in the United States until the passage of the Air Commerce Act of 1926 Until then such ordinary regulations as those governing licensing and inspection of shipping and railroads were lacking for air traffic. Pilots without licences flew aeroplanes which had never been inspected, resulting in hundreds of accidents. With the exception of the government-operated air-mail no air-lines operating on regular schedules were in existence Aviation was regarded more as a hazardous sport than as a means of communication and transportation Accidents were caused by defective machines, errors in piloting, lack of terminals, routes and weather data A Government report attributed 91% of all the accidents to "inexperience and the use of cheap and unsafe equipment"

Uniform air regulation in the United States was complicated by the independent action of many of the individual States. In 1926 there were 26 State air laws. (For State laws in the United States and for the Federal Air Commerce Act *see* C. Zollman, *Law of the Air*, 1927; R. W. Fixel, *The Law of Aviation*, 1927) In a flight of 500 m. a machine might come under the jurisdiction of six States each with a separate and perhaps conflicting set of air rules. Exclusive national control was improbable, since this would have necessitated either a constitutional amendment or the voluntary submission on the part of the 48 States to a national air law. Concurrent control alone was possible and uniformity of regulations remained dependent upon the action of the different States. A movement for uniformity had already appeared previous to the enactment of the national air law. The California air statute thus provided that the enactment of Federal air legislation would automatically void its local air law. The Uniform State Law of Aeronautics, adopted already by ten States and Territories, provides that "this act shall be so interpreted and construed as to effectuate its general purpose to make uniform the law of those states which enact it, and to harmonize, as far as possible, with Federal laws and regulations on the subject of aeronautics." The Federal enactment in 1926 of the Air Commerce Act, supplemented by the Uniform State Law, will tend to bring about uniformity if not exclusive Federal control. The Air Commerce Act follows mainly the rules of the International Flying Convention. The act provides for a Bureau of Civil Aeronautics in the Department of Commerce. This bureau, under an assistant secretary of commerce for air, has charge of Federal inspection of aircraft, crews and aerodromes and the establishment and enforcement of air navigation rules. It also furnishes aids to air navigation by approving and charting air routes, establishing air light-houses and signal stations, furnishing suitable weather reports and providing at the Government fields, in cases of emergency, supplies and repairs at their fair market value Special provision is made for trials giving the individual complete freedom to test and fly new inventions, no matter how freakish, so long as they do not endanger the public safety. No machine, however, is permitted to carry passengers unless it has been inspected and licensed as a public carrier. European air laws carefully protect the public against the unproved freak machine but they in no manner prohibit the building and testing of any type of craft, from helicopters to tail-less and wingless machines.

Safe air travel will be the preliminary aim of the air board. Public confidence in air travel must be created. To accomplish this air accidents must be decreased, if not eliminated, to a percentage lower even than railroad casualties In Germany a rigid system of inspections and licensing has helped to cut accidents to a negligible ratio. The following experts' list of "six requisites for safe flying," will serve as a basis for the new air regulations: (1) A machine sound aerodynamically and structurally; (2) a reliable engine of sufficient power; (3) a competent conservative pilot and navigator; (4) airports and emergency landing fields, sufficiently close together to insure gliding to safety; (5) nation-wide weather forecast, specialized and adapted to the needs of flying, (6) adequate charts of air routes.

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AERIAL NAVIGATION, the science of ascertaining the position of an aircraft and setting its course in a designed direction.

The possibility of applying the methods and instruments used for the older science of maritime navigation to navigation in the air, has naturally been thoroughly explored, but certain fundamental differences need to be allowed for. The speeds of aircraft are several times greater than those of ocean liners; the wind velocities are usually much greater and far less consistent than ocean currents; further, the weight of navigating instruments which can be carried in an aircraft, and the space available for their use are limited

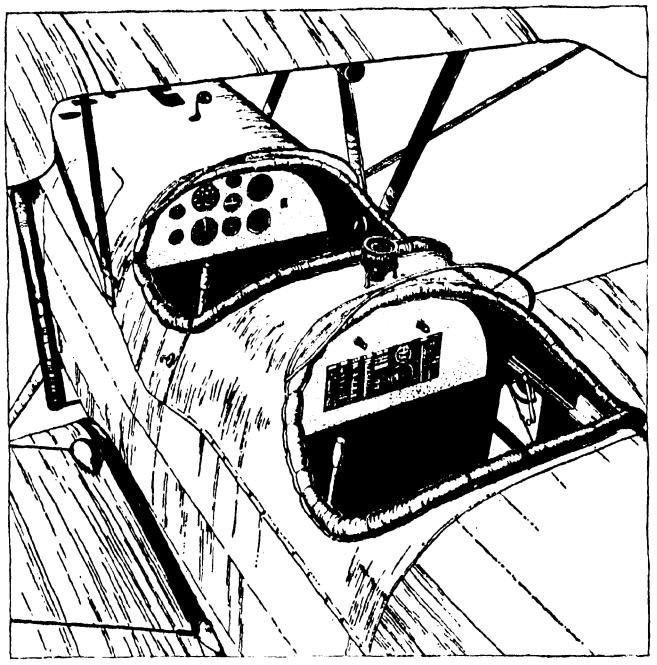
The most elementary method of navigation is the recognition, either from maps or from previous experience, of the country over which the aircraft is flying; for this purpose, maps have been made which give prominence to railways, rivers and other objects conspicuous from aircraft.

DEAD RECKONING NAVIGATION

The basic method of navigating an aircraft is known as dead reckoning (D.R); all other methods, such as wireless direction finding or the determination of the altitude of heavenly bodies, serve only to check the D.R. position. Dead reckoning necessitates that a record shall be kept of the speed of the aircraft over the ground and the "track," the latter being the actual direction along which the aircraft is passing over the ground. These values

may be obtained from a knowledge of (*a*) the speed and direction of the wind, derived either by observation from the aircraft or from meteorological reports; (*b*) the true speed through the air, obtained by correcting the air-speed indicator for height; and (*c*) the compass course.

If a vector triangle be drawn such that one side represents (*a*) above, and another side represents (*b*) and (*c*), then the length



BY COURTESY OF THE PIONEER INSTRUMENT COMPANY

FIG. 1.—POSITION OF INSTRUMENT BOARD IN AEROPLANE COCKPIT

Ordinarily there is only one instrument board in an aeroplane. The dual installation here shown is in an instrument testing plane. In the forward cockpit the instrument board consists of round indicators. In the after cockpit vertical indicators are shown

of the third side represents the ground speed and its direction the track of the aircraft over the ground. The ground speed is determined by noting the time taken for a ground object, viewed through a "sight" set at the appropriate position on a vertical bar calibrated in terms of height, to appear to traverse the distance between two timing beads fixed on a horizontal wire which is set along the track of the aircraft. The distance between the two timing beads is made to represent a certain distance on the ground (usually $\frac{1}{2}$ m.) over which the aircraft passes in the observed time.

The angle between the fore and aft line of the aircraft and the track is called the drift angle; it may be determined by observing the direction in which an object on the ground appears to move with reference to the fore and aft axis of the aircraft. If the aircraft were flying directly up or down wind, the drift angle would be zero. The true air speed being known, the wind speed and direction may be found, without timing a ground object, by observing the drift angle on two different compass courses, preferably separated by a fairly large angle.

Graphical construction cannot conveniently be employed in the limited accommodation afforded by an aeroplane cockpit and it is much preferable to solve the vector triangle by instrumental means. Moreover, it is but natural that, where possible, the means for observing ground speed and drift, and the mechanism for solving the vector triangle should be incorporated in one instrument.

Instruments and Methods.—The following are the most important of the instruments used for D.R. navigation. Each enables the ground speed to be determined in the manner described above, and incorporates means whereby the vector triangle may be solved on the instrument itself. They differ somewhat, however, in the method by which the drift is determined. (*See* fig. 2.)

The Aero Bearing Plate.—In this instrument the drift angle is determined by sighting on a ground object ahead of the aircraft and turning a horizontal drift bar so that the ground object appears to move along the bar.

The Wind Gauge Bearing Plate.—This instrument enables the drift angle to be determined by taking tail bearings of objects over which the aeroplane passed some minutes previously. These observations cannot conveniently be taken by the pilot and a navigator must be carried.

The Course-Setting Sight (*Wimperis*).—In this instrument the drift angle is determined by sighting ahead. The incorporation of a compass and a link mechanism renders the operation of the instrument to some extent automatic.

The methods of determining the height and speed of aircraft are dealt with elsewhere (*see* ALTIMETER AND SPEED INDICATOR).

The desiderata of any type of aircraft compass are: (a) that there should be a datum line indicating a known direction; (b) that a restoring force shall be set up if the direction of this line be altered by some agency external to the system; and (c) that the oscillations natural to the system after a disturbance shall be damped. The magnetic compass is particularly suitable for aircraft, since these requirements can be provided without prejudicing lightness and simplicity (*see* COMPASS and EARTH INDUCTOR COMPASS).

Altimeters.—The most convenient method of determining the height of an aircraft above the ground is by the use of an altimeter, a form of aneroid barometer (*q.v.*). All altimeters are, therefore, set at zero when the aircraft leaves the ground, and they are calibrated in accordance with a standard atmosphere, which has been adopted internationally. The standard atmosphere assumes that, at sea-level, the temperature is 15° C and that the barometric height, reduced to 0° C, is 760 mm. of mercury. The decrease of temperature with increase of height is assumed to be 6·5° C per km. Altimeters so calibrated are usually accurate to within from 2% to 3%. For some purposes, however, a greater accuracy is necessary; this can be achieved by applying a correction obtained from a knowledge of the temperature on the ground and at the operating height. Carefully designed altimeters so corrected are capable of an accuracy of the order of 1%, *so long as the conditions of atmospheric temperature and pressure do not vary*. An altimeter, however, is quite unable to distinguish a change

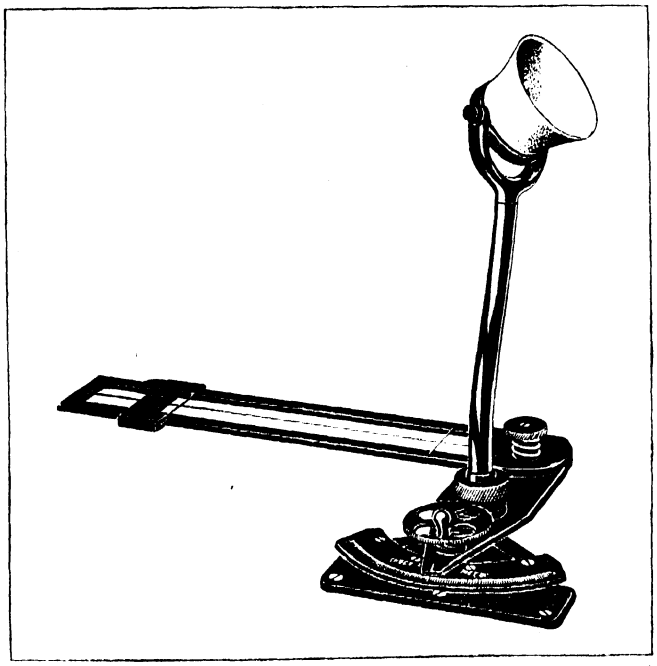


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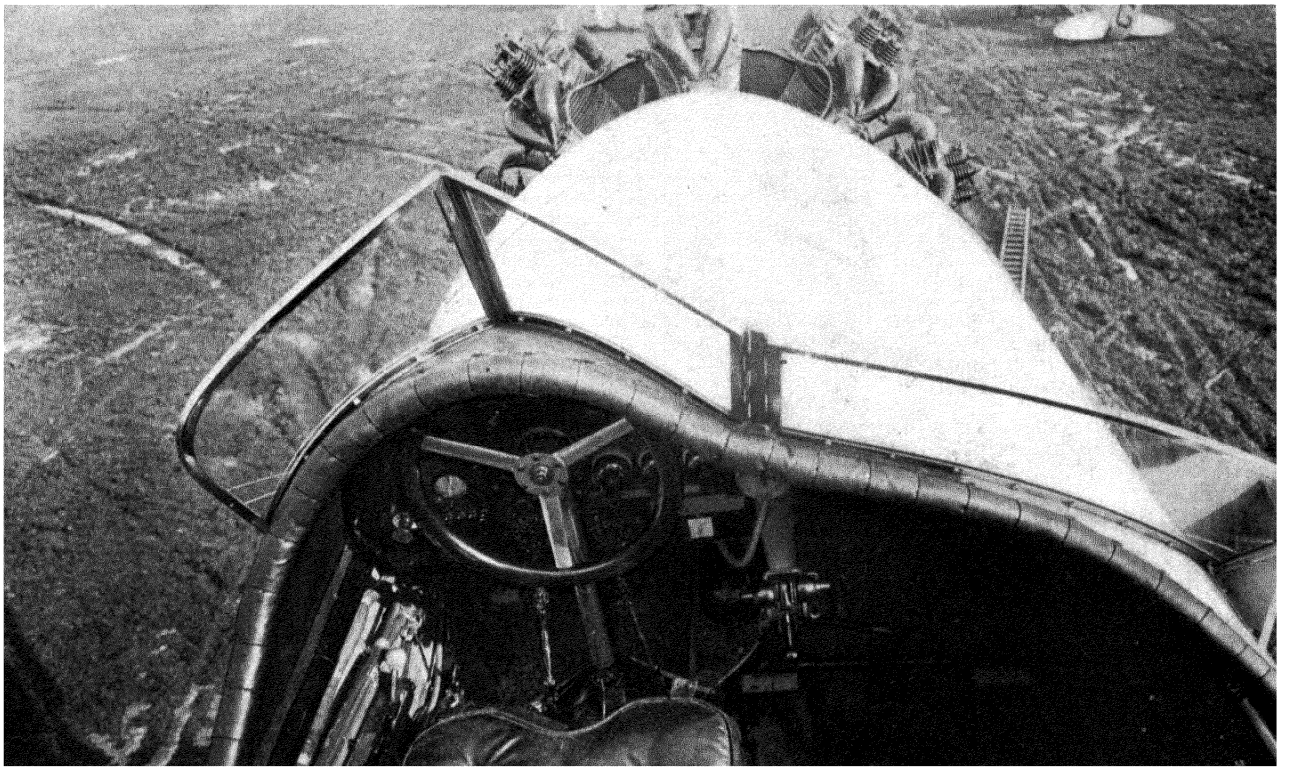
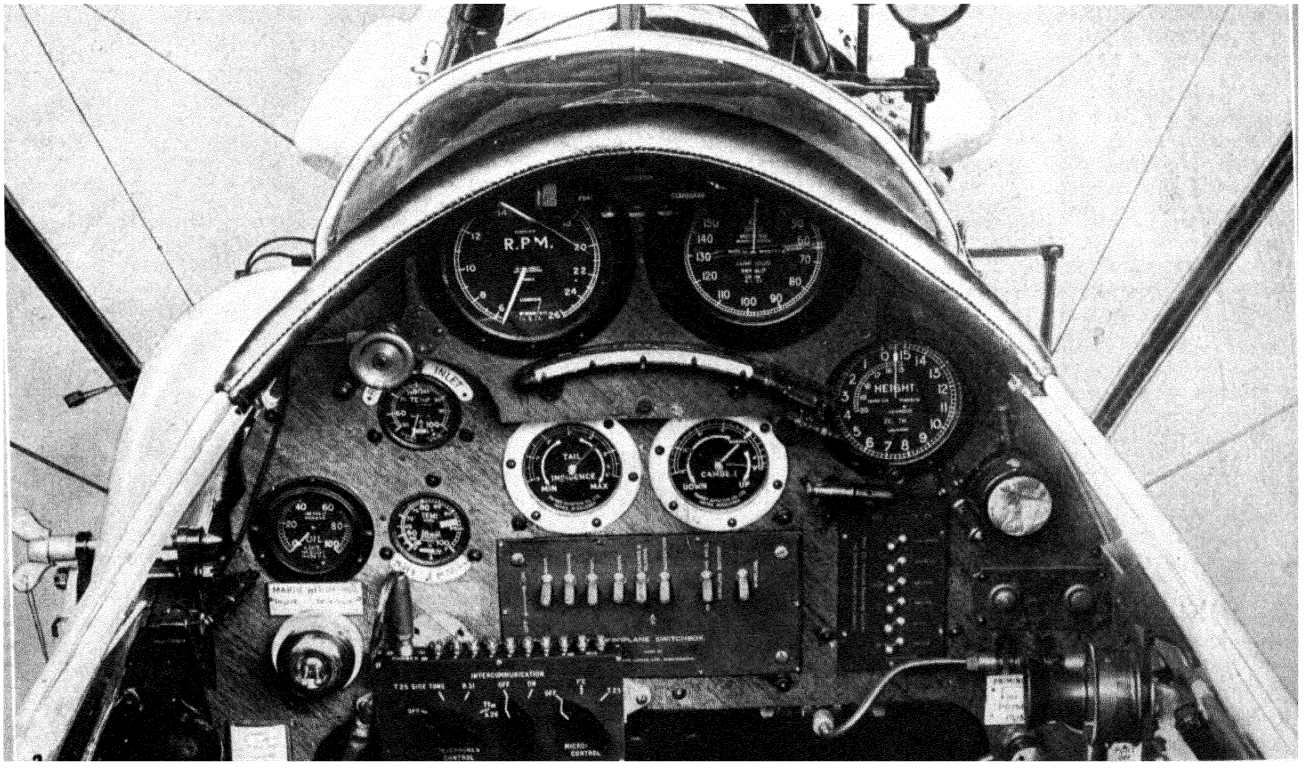
FIG. 2.—INDICATOR FOR DETERMINING THE ANGLE BETWEEN THE DIRECTION OF HEADING AND DIRECTION OF COURSE, OR THE DRIFT ANGLE. THIS INSTRUMENT IS ALSO USED TO DETERMINE GROUND SPEED

of height from a general fall of atmospheric pressure caused by an approaching "depression."

Compasses for Use in Polar Regions.—The magnetic types of compass and the earth inductor compass depend upon the existence of a horizontal component of the earth's magnetic field; this latter is zero at the earth's magnetic poles and near





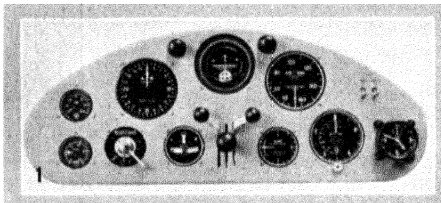
BY COURTESY OF (1) AEROFILMS LTD., (2) THE SECRETARY OF STATE FOR AIR

INSTALLATIONS OF VARIOUS KINDS OF AERIAL NAVIGATION INSTRUMENTS

1. General view of instruments mounted in the cockpit of a De Haviland "Hercules" multi-seater aeroplane

2. Close view of some of the instruments operated by the pilot in the cockpit of a standard aeroplane

AERIAL NAVIGATION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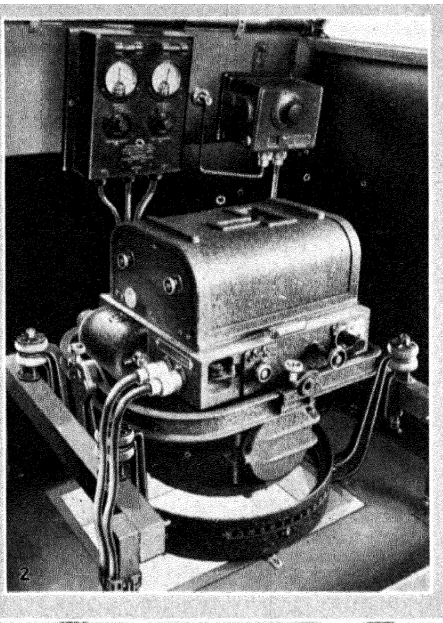
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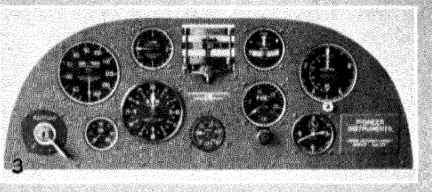
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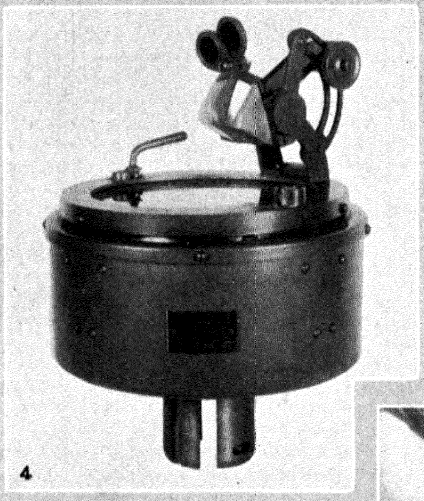
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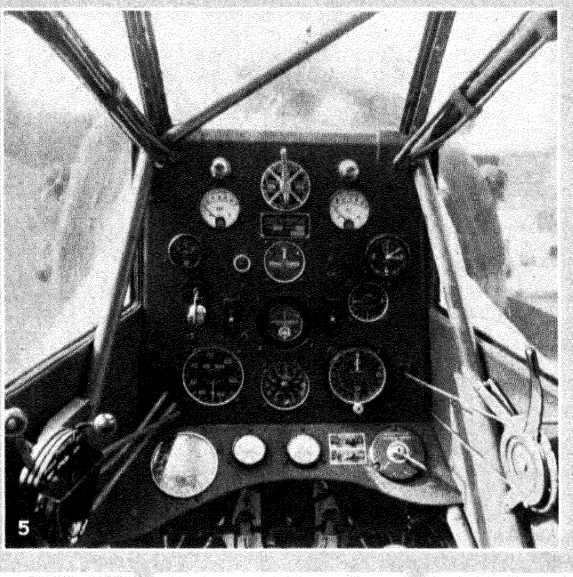
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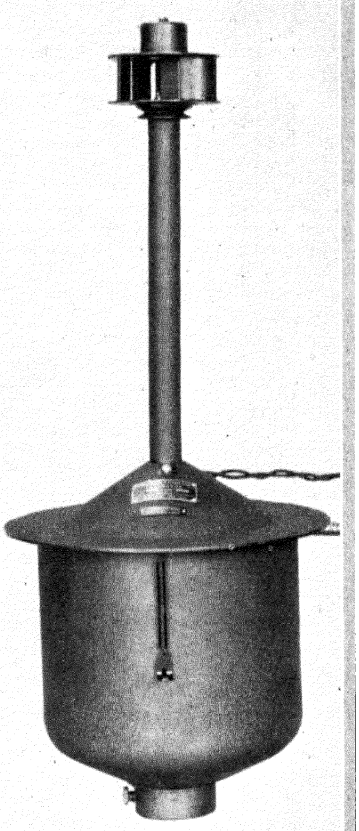
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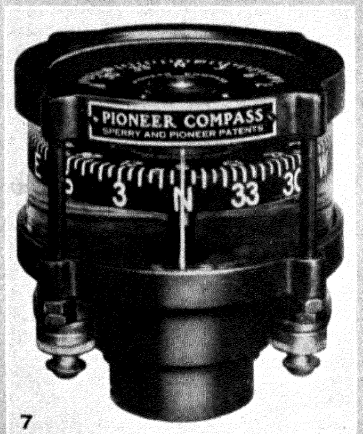

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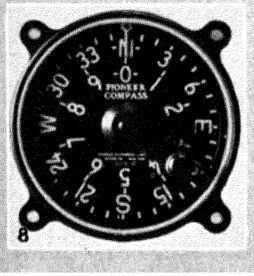

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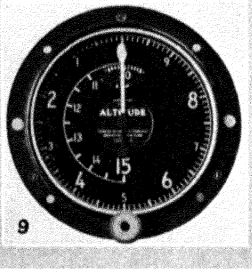

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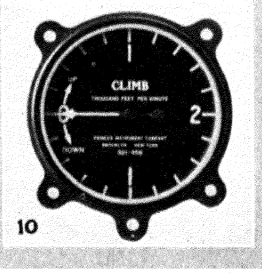

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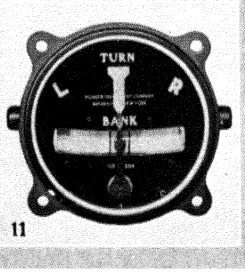

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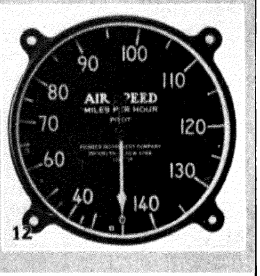

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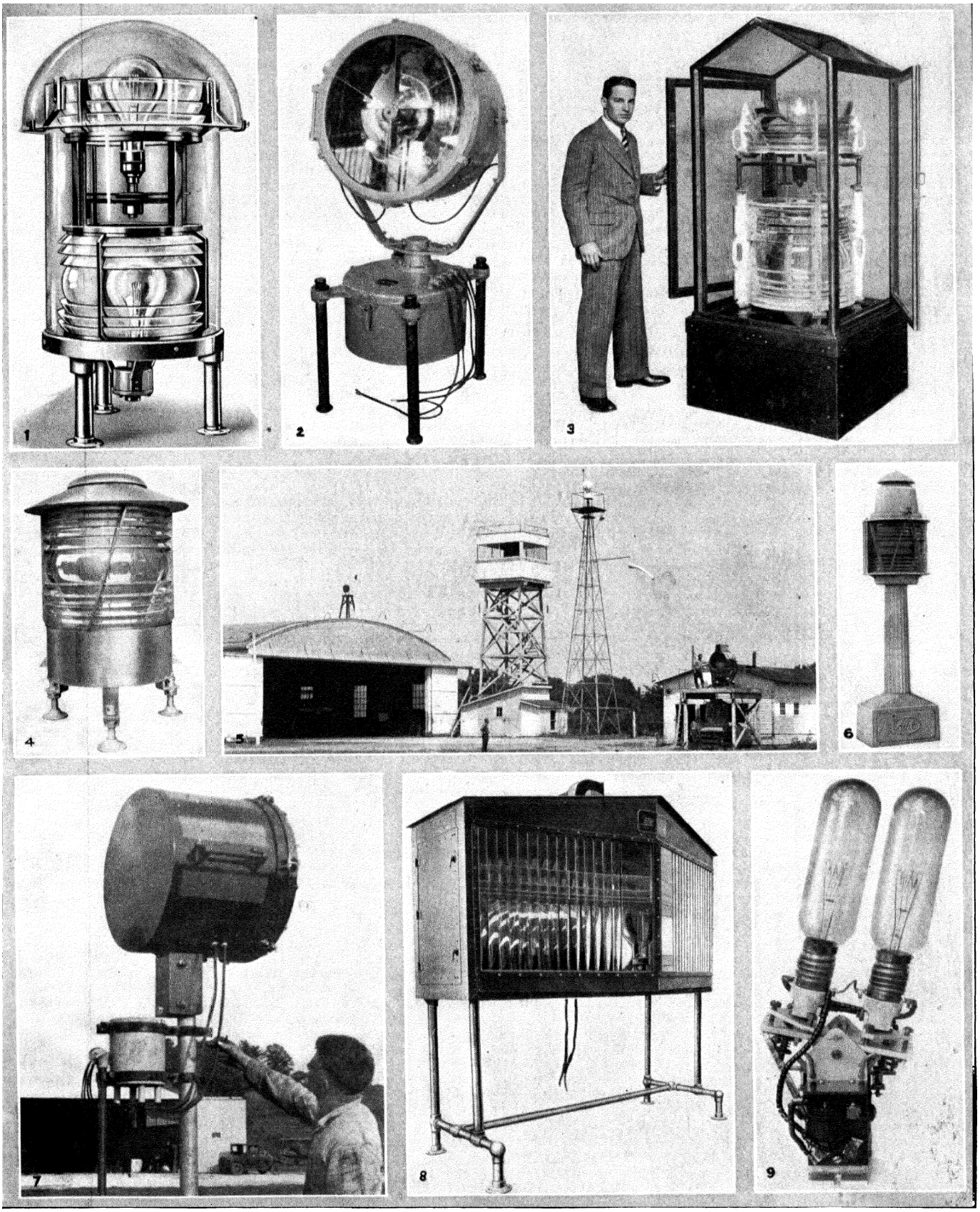
INSTRUMENTS AND DEVICES INSTALLED IN STANDARD AERIAL NAVIGATION MACHINES

1. View of a standard instrument board
2. K-8 Fairchild military type aerial camera
3. Instrument board used in Curtiss machines
4. Aeroplane compass, showing adjustable prism
5. Instrument board of Fairchild monoplane
6. Earth conductor compass generator
7. Earth indicator compass
8. Earth induction compass controller
9. Altitude meter
10. Climb indicator
11. Turn indicator
12. Air speed indicator

*



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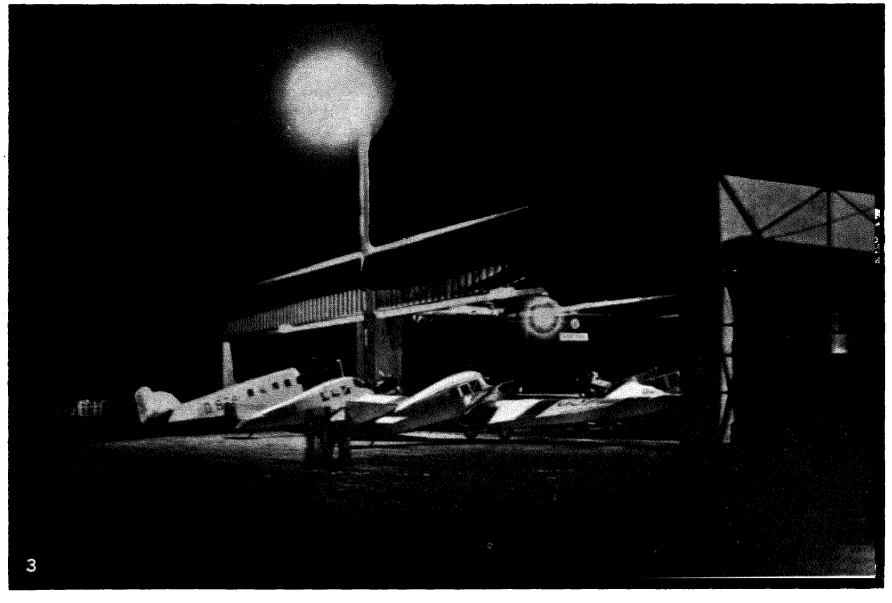
SEVERAL KINDS OF LANDING AIDS DEVELOPED IN RECENT YEARS

1. B.B.T. flashing beacon, type Q-5
2. 24 in. CR-6 Form D airway beacon
3. Flashing beacon, type H-5
5. Air mail station and equipment, Iowa City, Iowa
6. Typical landing floodlight
8. Twin floodlight with 2 5-kw. or 2 10-kw. lamps
9. Commonly used automatic lamp changer









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NIGHT LANDING EQUIPMENT IN ENGLISH, GERMAN AND AMERICAN AIRPORTS

1. The Neon Beacon at Croydon Aerodrome, London
2. Ground illumination assisting a large Farman airliner coming into port
3. Hangar in Tempelhof, Berlin, one of the largest airports in Europe
4. High intensity flood lights completely illuminating Wright Field

these poles its values are too small to afford the directive force which a compass must have. The directive properties of a gyroscopic compass also decrease as the polar regions are approached, being zero at the earth's geographical poles. An interesting attempt to solve the problem of observation of the sun, has resulted in the Goertz sun compass. In this instrument an image of the sun is projected on a ground glass screen when the aircraft is flying on a given course; a rotation of the optical system about a vertical axis once in 24 hours provides that the image is maintained on the screen unless a change of course is made. In practice, the pilot would set the sun compass to the desired course and turn the aircraft until the sun appeared on the ground glass screen; he would then steer by this sun image.

POSITION FINDING

The utility of dead reckoning navigation is limited by the need of at least occasional observation of the ground, and, unless it is possible definitely to recognize some landmark from time to time, the method is subject to accumulative error. In fog, or when an airman is flying above cloud, the ground is not visible and an alternative means of navigation must be provided. One such means, direction finding by wireless (*see* WIRELESS) is still the subject of experiment; while another, navigation by astronomical observation, has been used at sea since the 16th century.

Wireless Direction Finding.—All methods of direction finding by wireless have one underlying principle. If a rectangular coil, capable of symmetrical rotation about a vertical axis, be so placed that the plane of the coil is at right angles to the direction from which the wireless waves are transmitted, no current is set up in the coil; in any other position an oscillating current flows having a maximum value when the coil is set "edge on," *i.e.*, when the two vertical sides and the sending station are in the same vertical plane. If, therefore, the coil be rotated until the current is observed to be a maximum or a minimum, the bearing of the sending station can be determined. In practice, telephonic detection is employed and the position of the minimum or zero signal is preferred to that of maximum strength owing to the much greater sensitivity obtainable. For ground reception the Bellini-Tosi system is usually employed; this consists of two small fixed coils, mutually at right angles, each being connected to an aerial loop, and a rotatable search coil symmetrically arranged with respect to the two fixed coils.

Ground Station D. F.—This is the only method at present regularly employed on commercial air routes. The aeroplane carries transmitting and receiving sets, and calls for its position. Two or more ground stations observe the bearing of the aircraft, and one of them plots the position on a chart and communicates the information to the aeroplane. This method is fairly satisfactory for day use, but reception by a ground station at night is subject to inaccuracies known as "night-effects." Moreover, it is for many reasons desirable that the position should be determined by the aircraft itself and not by a ground station. For this purpose it is sufficient if the ground station transmits signals and the aircraft carries a receiving set, together with means for detecting the direction of the wireless waves. The following are various modifications of this system; each has been the subject of experiment but none is yet in regular use.

Wing Coil D. F.—This method has undergone successful air tests and can be operated by the pilot. Two sets of coils mutually at right angles are fitted in the aeroplane wings and connected to a receiver. One set, the main coils, is directed fore and aft, and the other, the auxiliary coils, is athwartships. When the aircraft is headed toward the sending station the auxiliary coil receives no current but the main coil receives maximum energy. Under these conditions reversal of the auxiliary coil has no effect upon the signals received by virtue of the current set up in the main coil. If now the aircraft be turned so that its fore and aft axis is no longer toward the station, a current is set up in the auxiliary coil, and alternate reversals of the auxiliary coil will, under these conditions, result in unequal strengths of signals; the aircraft must then be turned until equality of signal strength is obtained. The disadvantage of the method is that it is convenient only when the sending station is the objective or lies on the desired track of the aircraft; moreover, the time taken to fly to the sending station when navigating by wing coils will not, in general, be the shortest possible time, though this is not a very serious objection. The method cannot conveniently be employed to determine position; "homing" by wing coils merely ensures that the aircraft will eventually reach the sending station.

Fuselage Coil D. F.—An alternative method is to use two coils mounted on frames suitable for fitting in the fuselage of the aircraft; these coils are mutually at right angles and may be rotated about a vertical axis. With this arrangement the bearing of a sending station may be obtained, without change of course, by the method described for wing coils. Two or more such bearings on different sending stations, of known positions, would enable the position of the aircraft to be determined. This method necessitates special apparatus and requires the attention of a skilled observer.

Directional Transmission.—In this method the ground station apparatus consists of a fairly large loop which rotates at a speed of about one revolution per minute. No energy is radiated in a direction at right angles to the plane of the coil, and by "tuning in" to the station and observing the time between two consecutive points of silence, the exact speed of rotation can be estimated. Further, if the station emits a distinctive signal when the loop is directed, say, due north, the bearing of the sending station can be calculated by observing the time interval between the distinctive signal and the next zero signal. In practice it would be necessary to use two distinctive signals, preferably 90 degrees apart.

Navigation by Astronomical Observation.—The determination of the position of an aeroplane by astronomical observation is attended by many difficulties and is hardly likely to be employed on a developed air route along which it is convenient to erect wireless beacons. For long distance pioneer flights over undeveloped country and for trans-Atlantic flights, astronomical observation remains the only method of checking the D R position. The principles employed are essentially those used for maritime navigation (*see* NAVIGATION), but both the accuracy needed and the accuracy attainable are considerably less on aeroplanes. Determination of the altitude of a heavenly body necessitates either that the horizon shall be visible, or that the true horizontal or vertical be otherwise known. The horizon is often indefinite from an aircraft, and this fact has led to the development at the Royal Aircraft Establishment, Farnborough, of an instrument known as the Bubble Sextant.

The R.A.E. Bubble Sextant.—The image of a bubble, contained in a chamber having a spherical glass cover, is observed by reflection from a pentagonal prism and subsequent transmission through a collimating lens and an index glass. The optical distance of the bubble from the lens and the radius of curvature of the glass cover are both chosen to be equal to the focal length of the lens. This arrangement provides that if an image of the sun, obtained by reflection from the index mirror, is brought into coincidence with the bubble image and the instrument is rocked in the hand, the bubble remains in focus, and bubble and sun appear to move together. When measuring the altitude of a star it is more convenient to observe the bubble image by reflection from the under-side of the index mirror and the star by direct transmission through the mirror. The bubble is, of course, subject to displacement if the aircraft experiences an acceleration which is not truly vertical, and, in practice, an average of ten readings is taken.

NAVIGATION IN FOGS AND AT NIGHT

The safety of an aeroplane flying near the ground depends largely upon the pilot's ability to maintain, within limits, an even keel, normally not difficult; but in fog, when visual connection with terrestrial and celestial objects is not possible, means should be provided to enable a pilot instantly to recognize any involuntary change of course. It is not at first obvious why the natural gravitational force is not a sufficient indication of the vertical.

When an aircraft is turning, however, it is flying on a curved path and the centrifugal acceleration, which acts at right angles to the direction of flight, needs to be considered. It is naturally not possible for a bubble level to distinguish acceleration due to one cause from that due to any other, and the liquid in the level is acted upon, not by the earth's gravitational force alone, but by the resultant of the centrifugal force and the earth's gravitational force. This resultant acts at right angles to the "floor" of the aircraft and the bubble consequently seeks, not the true vertical, defined by gravity, but the apparent vertical, defined by the direction of the resultant of the accelerations. If, therefore, the aircraft executes a banked turn in flight, the bubble remains in the centre of the level and does not indicate a change of course. In fog or cloud a pilot may be unaware that his craft is turning and the magnetic compass affords him little aid, since, as already explained, it is unreliable, under these conditions. The need for an instrument which will indicate that the aircraft is changing course has led to the development of the gyro turn indicator.

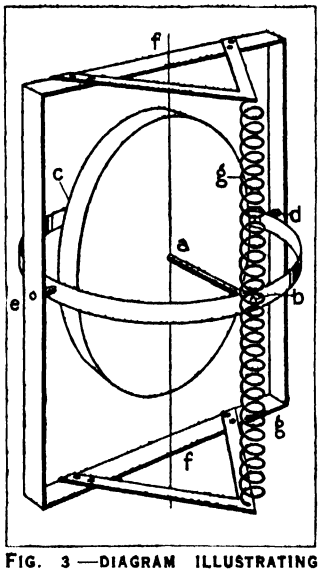

FIG. 3.—DIAGRAM ILLUSTRATING PRINCIPLES OF A TURN INDICATOR
The Turn Indicator enables a pilot to know when he is turning and is of particular use in clouds and fog and at night

The Gyro Turn Indicator.—The gyro turn indicator provides a pilot with a continuous indication either of the maintenance of straight flight or, if the aircraft is turning, of the direction and approximate rate of the change of course. The action of the instrument may be understood by referring to fig 3. A gyro wheel, *a*, rotates about an axis, *b c*, which is horizontal in level flight, and is usually arranged to be athwartships on the aircraft. The frame carrying the wheel and its axle is free to rotate about another horizontal axle, *d e*, at right angles to *b c* (*i.e.*, in the fore and aft line of the aircraft). The axle, *d e*, supports the wheel and the inner frame in an outer frame which is fixed to the aircraft. If the aircraft changes course, the whole system is rotated about a vertical axis, *f f*, and, in accordance with the laws governing the behaviour of a gyroscopic system (*q.v.*) the wheel and the axle, *b e*, commence to rotate about *d e*.

This rotation, which is known as precession, is controlled by springs, *g g*, so that the deflection of *b c* is a measure of the rate of change of course and so that the axle, *b c*, may return to a horizontal position when the aircraft is again flying on a straight course. The deflection of *b c* may be indicated to the pilot by any suitable means. The instrument has proved of the greatest use for flying in fog or cloud; it has been developed in a number of countries, but all types depend upon the principle outlined above and differ chiefly in the methods of indicating the turn and the Reid turn indicator (fig. 4) is one type of the instrument. It employs two rows of electric lamps, each row consisting of four red and four green lamps on each side of a central white lamp. The upper row is controlled by the position of mercury in a U-tube and indicates whether the aircraft is correctly banked. The lower row is controlled by the gyro and indicates the rate of turn. To maintain straight flight the pilot must fly so that no coloured lights are visible.

The Gyro Rudder Control.—Another device, making use of the gyrostatic principle, is the gyro rudder control developed at the Royal Aircraft Establishment, Farnborough. The primary object of this instrument is to relieve a pilot from the strain consequent upon the maintenance of a straight course for a long period of time. The principle is shown in fig. 5. The gyroscopic system consists of a rotor, *a*, mounted in an inner gymbal ring, *b*, which is pivoted about a horizontal axis to the outer gymbal ring, *c*. The latter carries a pin, *d*, and rotates about a vertical axis, thus operating a valve by means of the lever, *e*. The system is mounted on a vertical pivot, *f*, and two ratio arms, one attached to the false rudder bar and one to the gyro box, engage at *g*. If the aircraft turns, for example, to starboard, air is admitted to the port cylinder, shown in fig. 5, and the starboard cylinder is put into communication with the atmosphere. The pistons consequently move and operate the false rudder bar pivoted at *h*, which in turn operates the pilot's rudder. Movement of the false rudder bar, however, causes a rotation of the gyro box on its pivot, *f*; the valve then closes and the rudder bar returns to its neutral position.

Landing in Fog.—The solution of the problem of effecting a safe landing through several hundred feet of fog is of vital importance to the future of aviation. The problem is one of providing that the pilot of a rapidly moving aircraft shall be able to descend into a fog and, the ground being invisible, shall have an accurate knowledge of his height and the location of suitable landing ground. The nearest approach to success has been achieved in England, where the prevalence of fog brings the problem into particular prominence; efforts have been made in two different directions, the leader cable system and neon lighting; these should be most effective when used in conjunction. A third method is that of the Behm height-finding apparatus (fig. 6).

The Leader Cable System.—In the leader cable system, a cable laid just beneath the ground and excited by alternating current, produces a magnetic field above the cable, consisting of circular magnetic lines of intensity varying approximately inversely as the height above the cable. Vertically over the cable the lines are horizontal, and if instruments are carried enabling this condition to be detected, the pilot will be able continuously to fly vertically over the cable and by gradually decreasing his height, to effect a landing. The position of the track most suitable for landing can be indicated to the pilot by, for example, an auxiliary cable laid along a part of one of the parallel sides of the track. A leader cable has been laid down at the Royal Aircraft

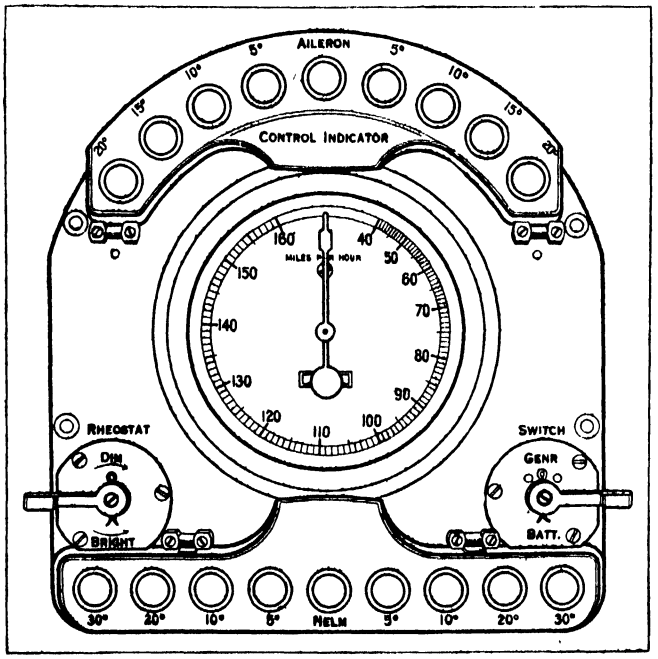

FIG. 4.—THE REID TURN AND BANK INDICATOR
Consisting of an upper and lower row of four red (port) and four green (starboard) electric lamps on either side of a middle white lamp. The upper row indicates the amount of bank, the lower, the rate of turn. If the course is straight no coloured lights will be visible to the pilot

Establishment, Farnborough, consisting of two straight sections, each about 1 mile in length, connected at the ends by semicircular bends of about ½ mile radius.

The instruments carried on the aircraft consist of two search coils oriented in such a manner that when the aircraft is vertically

over the cable the resultant electromotive force induced in them is zero, but if the aircraft departs from the desired course, the E.M.F. induced in one coil is greater than that induced in the other and the instrument indicates this condition. The height is determined by a suitable calibration of an instrument which measures the intensity of the magnetic force.

Full scale trials have proved that the operation of the scheme should be practicable, and it has been demonstrated that an aircraft can fly round the track and obtain indication of height purely by use of the instruments carried on the dashboard.

Neon Lighting is particularly suitable for landing in fog owing to its distinctive colour, and to the fact that long "lanes"

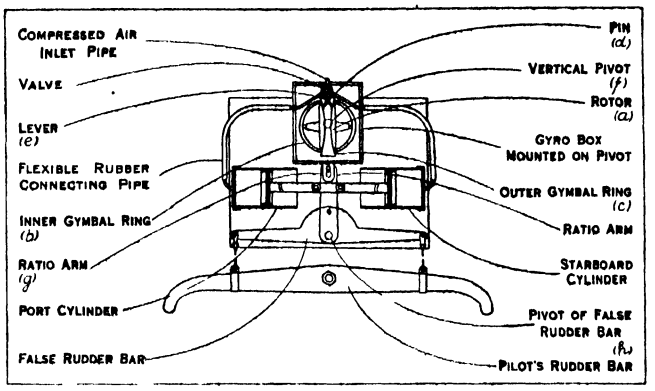

FIG. 5.—R A E GYRO RUDDER CONTROL, SHOWING PARTS

This apparatus automatically controls the rudder, relieving the pilot from the strain consequent upon maintaining a straight course and enabling aircraft to fly safely through clouds

of illumination can be provided Neon tubes have been laid on Croydon Aerodrome and it has been shown that the resulting red glow on the top of a moderately thick fog can be seen at a considerable distance when the aircraft is flying above the fog When actually in a dense fog, however, the pilot would only see the neon tubes when about 50 ft. above them. However, neon lighting would be of great assistance during the last few seconds of landing.

Flying and Landing at Night.—Navigation at night presents far less difficulty than do flying and landing in fog. There will usually be no difficulty in navigating by D.R. methods, and the problem of night landing is mainly one of supplying sufficient and suitably placed illumination at aerodromes. It is probable that a night-operated air route will have a number of light beacons at suitable distances apart and, unless visibility is very poor, the pilot's task will be merely to fly from beacon to beacon.

The United States have a lighted airway of 1,900 miles from New York to Rock Springs, consisting of a number of terminal aerodromes about 250 miles apart, each having two electric arc beacons, of 500,000,000 candle-power each, one circling the horizon every 20 seconds and the other providing flood lighting for landing purposes. In addition there are emergency fields about 15–30 miles apart, each provided with a light beacon; acetylene gas beacons have been installed every three miles over a considerable proportion of the route. A thousand million candle-power beacon near Dijon, France, having a normal range of about 300 miles has been built mainly to assist aircraft flying at night between Paris and Algiers.

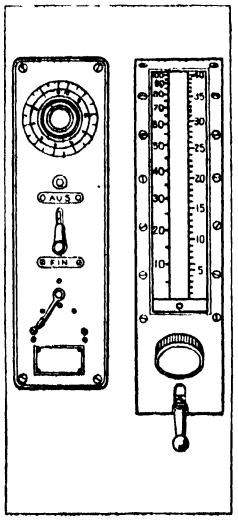

FIG 6.—THE BEHM HEIGHT-FINDING APPARATUS

Low altitudes are measured by timing a sound wave emitted from the airship and reflected back from the ground. The height is observed by watching the movement of a spot of light on the scale

An interesting method of facilitating night landing, known as the Hoenig circles, originated in Germany. The installation consists of two vertical lighted circles of different sizes, placed one behind the other, mounted on a trolley and so arranged that the common axis of the circles indicates the direction of landing. The pilot manoeuvres his craft until he observes two concentric circles; by preserving this orientation of the circles a correct landing can be effected.

Navigation of Airships.—Whilst the principles underlying the navigation of aeroplanes apply also to the navigation of airships, the foregoing description of navigational methods and of the peculiar advantages and disadvantages associated therewith applies chiefly to heavier-than-air craft.

An airship is much steadier than an aeroplane, and instruments, particularly the magnetic compass, are more reliable. Under suitable conditions, astronomical observation can be taken and reduced without difficulty and the accommodation for wireless equipment is greater than in an aeroplane. It will be seen that the conditions obtainable for airship navigation are substantially those employed in maritime navigation It is important to note, however, that the navigation of airships over long distances will render the availability of accurate meteorological information of primary importance, since an airship, unlike an aeroplane, can land or "anchor" only on prepared aerodromes or masts.

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AERODROME, AIR PORT or **AIR STATION.** An aircraft can land and take-off safely in any large open space, but an organized and equipped aerodrome is required for regular flying. Just as railways must have depots and stations of varying kinds and ocean-going liners must have harbours and docks, so is it necessary for aircraft to possess aerodromes.

Provision of Aerodromes.—On a recognized air route for the operation of land machines, such, for example, as that from London to the Continent, a series of aerodromes is provided at an average distance apart of 25m. and these are classified, according to the purpose which they serve, as terminal aerodromes, aerodromes, landing grounds, and emergency landing grounds. These are situated at Croydon (terminal aerodrome), Penshurst (landing ground), Marden (emergency landing ground), Lympne (aerodrome) and Littlestone (emergency landing ground). Lympne and Littlestone are approximately 5m. apart, and the reason for the existence of the latter, which is situated about sea-level near the coast, is that the former, being on high ground formed by the cliffs overlooking Hythe, is liable to be obscured by low clouds which drift in from the sea. Of the above, both Croydon and Lympne are provided with customs facilities and in consequence are further classified as "customs aerodromes."

The Terminal Aerodrome.—The ideal terminal aerodrome should be close to the heart of the city which it serves; but in the event of this being impossible it should be provided with good communications by road, rail, train or bus. Consideration must be given to adverse meteorological conditions, especially fog.

The ideal layout for an aerodrome is to place the main block of buildings, surrounded by the hangars, in the centre of the aerodrome so that unnecessary taxying is avoided. Such an

arrangement also keeps the landing area clear of interference from aircraft manoeuvring on the ground. One drawback is that it is necessary either to have an access road across a part of the ground used for flying, which would be both dangerous and inconvenient since it would tend to cause delays; or else to construct a tunnel road under the aerodrome, a very costly item. From an operational standpoint, the advantages of such a system far outweigh the disadvantages; but the main obstacle to its adoption is the large area of ground that would be required, since it must be of sufficient dimensions to give a clear take-off run in any direction. Consequently it is the normal practice to group all the buildings



TRANSFERRING PASSENGERS FROM AEROPLANE TO BUS FOR TRANSPORTATION TO CITY SERVED BY THE AERODROME

together on one side of the aerodrome where adequate approach facilities by road exist.

The site should afford at least 1,000yd. run into any wind. The soil should be light, the land level and for choice a plateau. The land immediately surrounding the site should be free from obstructions.

Aerodromes for the use of flying boats or seaplanes have an open-water site from which to depart and on which to alight, and slipways leading from this water site to the hangar accommodation and to the departure and arrival platforms.

Equipment.—A terminal aerodrome normally is equipped with hangars for the housing of aircraft, workshops, bonded and technical stores, administrative and booking offices for the companies operating services from the stations, as well as for travel and transport agencies, petrol and oil companies, etc. In addition, facilities frequently exist for the customs and for the immigration authorities. Aerodromes are further provided with wireless and meteorological facilities, together with government personnel to operate them. Illuminating beacons for the assistance of aircraft flying by night, and some device for indicating the direction of the wind both by day and by night, are installed. Accommodation is provided for an official belonging to the Government aeronautical inspection department, whose duty it is to ensure that aircraft are being properly maintained; for traffic workers to carry out porterage duties and assist in handling machines on the ground; and for the officials appointed by the government for controlling air traffic, the aerodrome, and the government personnel employed there.

Landing Grounds.—Landing grounds may, or may not, be equipped with hangar accommodation, but are normally provided with beacons and wind indicators. Telephones are generally installed, but no personnel other than a caretaker will be found there. Emergency landing grounds are rarely equipped with any form of hangar accommodation and may, or may not, have beacons and wind indicators. Each of the stations on the route to the Continent, with the exception of Marden, shows its name in large capital letters and the good landing area is indicated by automatic red flashing lamps.

Airship Station.—Aerodromes for the use of airships will in general be provided with all the facilities outlined above as requisite for the operation of land aircraft, but in addition will be equipped with a mast at which an airship can be moored, and a plant for the production of the gas required for inflating the ship.

Under normal conditions an airship will only be berthed in a hangar for purposes of overhaul or repair; at other times it will be moored at a mast, which is a steel structure approximately 200ft. high. The head of the mast is fitted with a receiving arm with which a cone on the bow of the airship engages, providing free movement in any direction. The mast is supplied with lifts or elevators for the crew, passengers, goods, etc., and with pipes for the supply of gas, fuel and water A passenger mounting this lift will find himself in a compartment from which a covered way leads into the nose of the airship and thence to the passenger accommodation.

The New London Terminal Aerodrome.—It became necessary in 1928 to enlarge and rebuild the London Terminal Aerodrome at Croydon. The accompanying plan shows the enlargement and alterations that were decided on. The new aerodrome possesses a maximum run north and south of 1,350yd. and east and west of 1,450 yards The old buildings were being demolished in 1928 and new ones erected on the east side. The road on which the old buildings stood has been diverted so as to form one of the boundaries. The two hangars have a floor area of 90,000 sq.ft. Offices, stores, workshops, etc., with an area of 36,000 sq ft., are included in the annexes to these hangars.

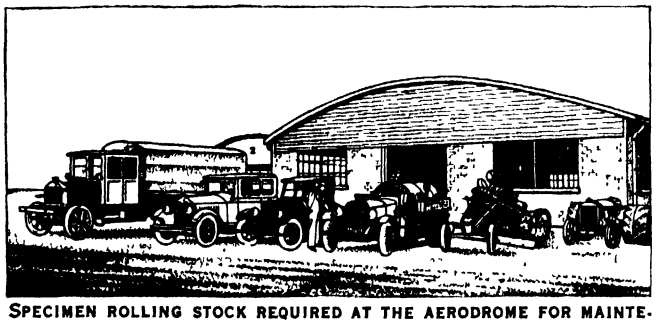
The main terminal block provides accommodation for the control staff, the operating companies, and for customs and immigration authorities Passengers arriving and departing will pass through a central hall in which the booking hall and various waiting rooms are located.

A control tower has been built on the top of the main terminal block. Here an officer assisted by a wireless operator is constantly on duty and is directly in touch with pilots in the air. As machines report their position the control officer marks them on a map and issues any directions and warnings which may be necessary He also controls the movements of aircraft about to take-off or coming in to land.

Night Lighting.—Adverse weather may compel the pilot to land just after dark, and a landing in fog may sometimes be unavoidable. Adequate lighting facilities must therefore be provided to take care also of regular night flying, which will undoubtedly be organized on the cross-channel routes in the near future.

Beacons of special design are required to meet the needs of the aerial navigator. Croydon possesses a Neon Beacon which is said to have remarkable fog-piercing properties and is visible on clear nights as far as 45 miles. All buildings and other obstructions are marked with fixed red lights and the boundaries of the aerodrome are outlined by red flashing lamps, so that a pilot has indicated beneath him the position of the buildings and the area within which it is safe to land and manoeuvre his machine.

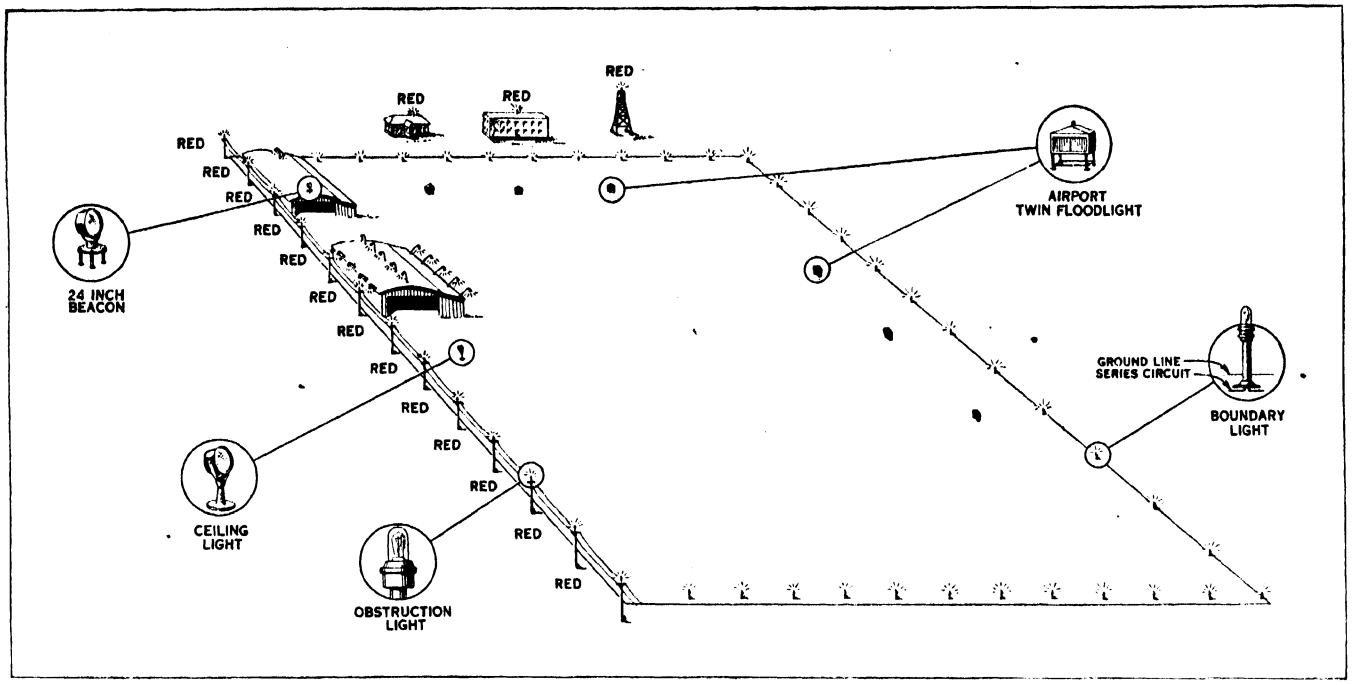
There are various methods of indicating the direction of landing. At Croydon electric lights sunk into the ground under glass covers have been used to show a double "*L*" in any one of eight directions according to the wind; the same system is applied at



SPECIMEN ROLLING STOCK REQUIRED AT THE AERODROME FOR MAINTENANCE OF THE GROUNDS AND CARE OF THE AEROPLANES

Continental aerodromes to show an isosceles triangle or the letter *T*. An automatic illuminated *T*, swinging with the wind, is in use at Littlestone and Penshurst. The illuminated "wind sleeve" has the merit of simplicity.

When landing it is important that the pilot should be able to see the surface of the ground distinctly. A floodlight of 4 million candle power has been developed which throws a flat fan-shaped beam horizontally over a large portion of the surface of the aerodrome, producing an effect equivalent to 75% daylight, with no confusing shadows.



METHOD OF LIGHTING AN AERODROME

Lighting for aviation had its inception during the World War. Reconnaissance and bombing expeditions by aircraft over enemy territory were frequently conducted after nightfall and the problem of lighting the aerodrome for take-off or landing was a new one. Portable arc searchlights and parachute flares came into use for night-flying activities. The year following the close of the war witnessed the inauguration of commercial aviation and the work of developing lighting equipment for night flying began. In the conjectural representation above, all buildings and obstructions are marked with fixed red lights and the boundaries are outlined with flashing red lights. The floodlights throw a flat fan-shaped beam on the surface of the aerodrome enabling the pilot to see the ground distinctly. The beacons guide the aerial navigator toward the aerodrome

International Obligations.—Under the International Convention for the Regulation of Air Navigation (*see* AVIATION, CIVIL) the contracting States, of which Great Britain is one, must nominate customs aerodromes, and the chief countries of the world have accepted it as a principle that the Government or local authorities should be responsible for providing and maintaining the air ports required in international air navigation. Every aircraft engaged in international flying must, before proceeding from one country to another, be cleared by the customs and must make its final departure from an appointed customs aerodrome; similarly an aircraft arriving from another country must make its first landing at a customs aerodrome for examination before proceeding elsewhere.

The Convention secures uniformity in such matters as markings, lighting, signals, rules, etc., at all public aerodromes belonging to the contracting States, whether owned by the Government or otherwise; also it provides that every public aerodrome must be available to the aircraft of all contracting States on exactly the same terms as to national aircraft.

The majority of contracting states have issued their own regulations. In the British regulations, which are laid down in the Air Navigation (Consolidation) Order, 1923, and Amending Orders, 1925 and 1927, an aerodrome is defined as follows:—

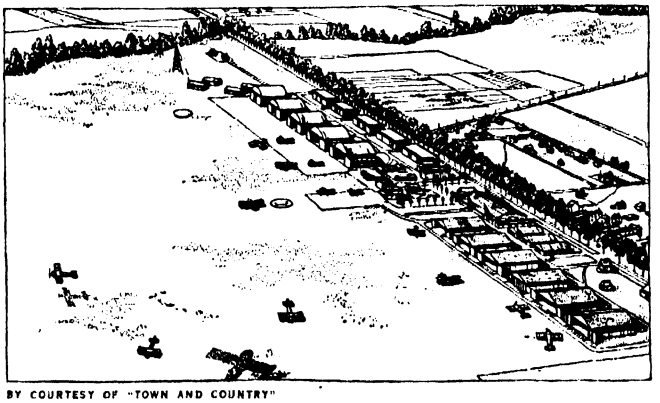
"Aerodrome" means any definite and limited ground or water area intended to be used either wholly or in part for the landing or departure of aircraft. Aircraft in this connection includes all balloons, whether fixed or free, kites, airships and flying machines.

All aerodromes in Great Britain and Northern Ireland, which are used as regular places of landing or departure by aircraft carrying passengers for hire or reward, must be licensed for the purpose by the Secretary of State for Air.

Service (Royal Air Force) Aerodromes.—Apart from the special facilities required at a civil aerodrome for commercial traffic, all the remaining features except as regards lighting are to be found equally at a service aerodrome—with the addition of quarters for the officers and airmen and the installations necessary for service operations and training.

The situation of a service aerodrome in peace time is governed largely by the nature of the units to be stationed there. It is generally unnecessary and undesirable that a service aerodrome should be located near a large town. The only exceptions to this rule are aerodromes belonging to squadrons of the Auxiliary Air Force which must be reasonably near the homes of their volunteer personnel.

Aerodromes used for training in flying are situated as a rule in the midst of open country to neutralize risk of forced landings. Aerodromes for fighting and bombing squadrons are disposed according to strategic requirements. As bombing squadrons are equipped with heavy aircraft it is particularly necessary in their case that the aerodrome should have a hard surface and not become soft in rainy weather. For co-operation with the Army and Navy it is necessary that aerodrome and seaplane stations should be provided in the vicinity of the areas employed for combined



BY COURTESY OF "TOWN AND COUNTRY"

VIEW OF THE TERMINAL AERODROME FOR PARIS AT LE BOURGET. AIR SERVICE BETWEEN CROYDON AND LE BOURGET WAS ESTABLISHED IN 1919, 10 YEARS AFTER M. BLERIOT FIRST CROSSED THE CHANNEL. LE BOURGET AND CROYDON ARE CONNECTED WITH PARIS AND LONDON RESPECTIVELY BY AUTOMOBILE SERVICE

training. A number of aerodromes are also required for experiment and tests in connection with new types of aircraft and equipment.

All British service aerodromes are available for use by civil

aircraft in emergency and may be used for setting down or taking up passengers where no other landing place exists.

(I. A. E. E.)

UNITED STATES

Airports are defined by the U S. National Advisory committee for Aeronautics (Report 240, Nomenclature for Aeronautics), as "a locality, either of water or land, which is adapted for landing and taking off of aircraft; or a place used regularly for receiving or discharging passengers or cargo by air." On Feb. 25, 1928 there were 4,000 landing fields in the United States, of which 66 were airports equipped with rotating beacons and partially or fully equipped with flood, boundary and danger lights, etc.

Basic Requirements of the U.S. Department of Commerce for all certificated airports and fields are. (1) Field or landing area; firm and approximately level with suitable approaches, well drained and without obstructions or depressions hazardous to taking off or landing; or at least two landing strips 100ft or more wide crossing or converging at not less than 45° angles. These must permit safe landing in ordinary weather If the sod or turf is not tough and hard enough for these purposes, the landing strips must be of cinders, slag, gravel, asphalt or other suitable material; then they are called runways. (2) There must be a margin of at least 100ft. clearance between the landing strip edges and field boundaries Surrounding obstructions are calculated to diminish the margins by seven times the height of such obstructions. Thus, an "L"-shaped field having landing strips 100ft. wide and margins of 100ft. on both sides is sufficiently large if there are no surrounding obstructions. Should there be obstructions 50ft. high the margins between the obstructions and the edge of the landing strip must not be less than 350 feet. (3) The airport must be very near a good highway to the nearest city or town. (4) The airport must have an improved type of wind direction indicator and be marked by day with a landing circle 100ft. in diameter having a band 4ft wide, the circle to be placed flush in the centre of the landing area or in the centre of the landing strip intersection. The name of the city or field must be in or near the centre of the marking circle. (5) The airport must be able to supply aircraft with fuel, oil and water, and the airmen with dependable communication and transportation facilities to the nearest city or town.

Geographical Location.—The aerodrome should be as accessible as possible to the population which is to be served. If it has to be at a distance from the community, it may be well to have smaller landing fields near the business centres Congested residential areas where noise is objectionable should be avoided.

Size.—The weight of commercial aeroplanes necessitates generously long runways and wide safety zones through which to glide when approaching and to gain altitude when departing The elevation above sea-level is important in determining the size of an airport as the length of runways required for taking off and landing increases with altitude. Thus an aeroplane requiring 1,500ft. for a normal take-off at sea-level would require about 2,300ft. at Denver, Colo., which is 5,280ft above sea-level. An airport may be practically any shape which provides an unobstructed take-off and landing area of 2,500ft. which is considered adequate for the largest aeroplanes. It should be planned so that it may be changed in the future

The U.S. Department of Commerce Ratings on Size of Fields.—In order to receive a rating on size from the U S. Department of Commerce an airport must meet with certain basic conditions

"A" Rating.—The field receiving an "A" rating must have 2,500ft. of landing area in all directions with clear approaches, the field to be in good condition for landing at all times; or it must have approved-type landing strips permitting landing in at least eight directions, the landing strips not to cross or converge at less than 45° angles, with appropriate margins and clear approaches The margin between any obstacle and the landing strip must be a distance at least seven times that of the obstacle's height.

The airport may be of irregular shape, but must contain enough area to permit laying out landing strips to fulfil these requirements. A square field offers the most natural solution.

"B" Rating.—A square landing area 2,500ft. on a side, laid out in landing strips permitting at least four-way landing and having clear approaches. The landing strips must be at least 100ft. wide and clear at the sides and ends. Margins between obstructions and landing strips must extend a distance of at least seven times the height of the obstacle. Landing strips shall not converge or cross at less than 45° angles, preferably intersecting at 90° angles in the case of four-way landing.

"C" Rating.—The field must have 1,500ft of landing area in all directions with clear approaches and in good condition for landing at all times, or a square landing area 2,000ft. on a side, laid out in landing strips permitting at least four-way landing and having clear approaches. Landing strip, margin, obstacle and angle regulations are as above.

"D" Rating.—The field must have 1,200ft. of landing area in all directions with clear approaches and in good condition for landing at all times; or, a square landing area of 1,500ft. on a side laid out in landing strips permitting at least four-way landing and having clear approaches. The other regulations are as above.

"E" Rating—The field must have a square landing area of 1,200ft. laid out in landing strips permitting at least four-way landing and having clear approaches. The other regulations are as above.

"F" Rating.—Fields not having the minimum dimensions of an "E" rating for size, but from which flying operations are nevertheless taking place, receive the rating of "F" if request for rating is made.

"X" Rating.—All fields not considered safe for the operation of aircraft, but which are used, or have been used for such operations, and on which rating is requested are rated "X."

U.S. Department of Commerce.—Under the Air Commerce Act of 1926, the President entrusts an assistant secretary of commerce for Aeronautics with the aeronautics branch of the department of commerce. In addition to its other duties the aeronautics branch co-operates with State and local authorities in establishing airports in all large cities. This act provides that airports shall not be owned or operated by the Federal Government, and that no exclusive rights shall be granted for the use of civil airways, airports or other navigation aids owned by the United States. The Department of Commerce may rate airports as navigation aids.

The program of the Department of Commerce provides for lighting over 6,000m. of airways. The lights are placed about 30m. apart between airports on intermediate landing fields. The fields are leased by the Government and are not to be used for any purpose inconsistent with the landing and taking off of aeroplanes. A standard beacon is placed at every such intermediate field

Cost and Revenue.—Data secured from 68 landing fields of various sizes located along contract air mail routes show an investment by cities of over $17,000,000.

The following analysis of the cost of the Buffalo airport is typical of the expenditures in airport construction: Land (518ac.) $411,000.00; building (3 hangars, 1 garage, 1 administration building), $95,778.08; runways (2 cinder runways 3,000ft. long and 100ft. wide), $48,528.56; grading and processing, $47,875.32; new roads, $9,148.18; drainage, $33,549 00; paving, $27,453 17; underground piping and electrical equipment, $17,567.20; rolling stock and parts (1 service truck, 1 five ton carryall, 1 light delivery truck, 1 coupé, 1 grader, 1 tractor), $14,123.81; office equipment and supplies, $2,563.05; insurance, $6,039 05; store-room supplies, $709 21; telephone and light during construction, $671.23; machinery and tools, $9,580.58; miscellaneous labour and supplies, $2,568.72. Income may be derived from rent from hangars, rent from postal, express and passenger accommodations, rent from restaurants, various concessions, landing charges, night lighting charges, sale of gasolene and oil, etc.

Buildings and Equipment.—The department of commerce recommends that all buildings be situated at a point not nearer the landing area than seven times the height of the tallest building. To receive the rating "A" an airport must have one or more hangars at least 80ft. by 100ft. with a clearance of 18 feet. Where the ground is soft or muddy these should be connected with the runways by specially prepared roadways of cinders, concrete or other suitable material.

Drainage and Soil.—Artificial drainage may be supplied by blind ditches filled with coarse gravel topped with cinders, and tamped down flush with the surface of the field. If the precipitation is heavy it is often necessary to lay tile pipe, with open joints, in the bottom of the ditches.

Landing fields surfaced with sand or cinders are seldom satisfactory in dry weather as stones, sand or dust may be caught up by the air driven astern by the airplane propeller and prove annoying to passengers, damage wing surfaces and cause motor trouble. If the existing surface of the airport is not durable enough for continuous use it may be made so by sowing tough, deep-rooted grass which will not readily develop ruts, mud holes and tail skid scars.

Lighting.—The lighting facilities believed essential for the safe night operation of an airport are:

(1) A rotating beacon of several million candlepower, tilted slightly upward and mounted on a tower in order to clear obstructions so that it may be visible in all directions.

(2) White boundary lights showing the shape and size of the airport.

(3) Green approach lights to show the most favourable avenues of approach.

(4) Lights illuminating the wind cone, which indicates the prevailing direction of the wind, against which the aviator has to land.

(5) Red obstruction lights to mark all buildings, pole lines, radio towers, and other dangerous obstructions within gliding or take-off distance of the landing field.

(6) Flood lights to give pilots the proper perspective and to indicate to them that portion of the field which should be used for landing.

(7) Ceiling lights which are used to enable the airport officials to determine the height of the clouds above the ground. This information is obtained by projecting a beam of light toward the clouds at an angle of 45°, and then measuring the distance from the light source to the point directly beneath the spot it makes upon the clouds, which gives the height of the clouds above the ground; that is, the height of the ceiling. Information of this sort is transmitted to other airports so that aviators may be advised of the visibility at various points.

Identification Markings.—The centre of the landing field at each airport should be marked with a circular band 4ft. wide and 100ft. in diameter. It is prescribed that the name of the airport be near the circle, composed of letters whose minimum height is 15 feet. This marker may be constructed by removing the earth, where the letters are to be placed, to a depth of 6in , and filling in with smooth stones to the field level; whitewashing the stones makes the marker visible from a height of several thousand feet. The roofs of factories and other buildings near the airport should be so marked as to aid pilots in finding the landing field with as little search as possible. Where the entire field is not available for landing, the runways should be indicated by arms projecting from the circle described above.

Roofs of hangars or other structures at the airport should be marked with the name of the field. Arrows indicating the name and direction of other airports and cities, and also an arrow with a letter "N" superimposed pointing to true north should be displayed on the airport buildings. (J. C McG.)

General information on the construction and equipment of airports has been prepared by the department as "Information Bulletin No. 2, Construction" and "Information Bulletin No. 36, Rating of Airports."

AERODYNAMICS. The word aerodynamics is applied both to the study of the disturbances generated in air by the passage of solid bodies, such as aircraft, and to the study of the motion of free aircraft under the influence of air reactions. The former is a specialized development of *fluid dynamics* and the latter of *rigid dynamics, i.e.*, the dynamics of rigid bodies under the action of external forces. (*See* DYNAMICS and HYDRODYNAMICS.)

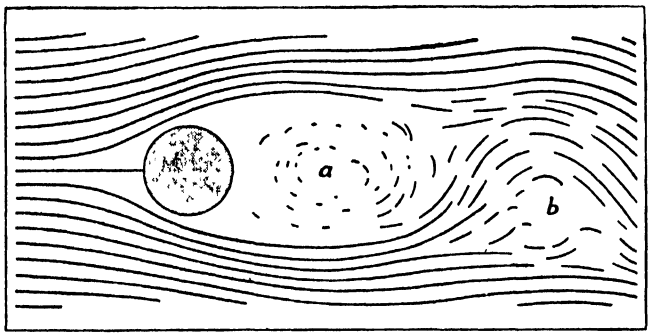
The equations of motion of a slightly viscous fluid such as air can be formulated, but have not in general been solved, and in no instance has the complete motion of the air passing a body, such as a wing, been calculated directly from the laws of motion. Aeronautics is thus dependent for its data mainly upon direct experiment, and since quantitative experiments upon the full scale are difficult and costly, the bulk of the data available has been obtained upon small models of the parts concerned suspended in artificially induced currents of air. The technique of the measurement of air reactions upon models suspended in "wind tunnels," (*see* WIND TUNNELS) as the tunnels containing these air currents are called, has reached a high development and many tunnels of great size and power have been built in all countries seriously concerned with aeronautics. The largest wind tunnel in England is in the National Physical laboratory at Teddington near London; it has a cross section of 7ft. by 14ft. and is operated by two fans, 11½ft. diameter, driven by two electric motors of 200h.p. each. This tunnel can take a model one-fifth as large as a modern two-seater aeroplane, and this model is sufficiently large to carry an air-screw driven by an electric motor within it.

It is clearly of importance to determine how nearly similar is the manner in which the air flows around such models to the manner in which it flows around the corresponding full scale aeroplane. In many aeronautical problems air can be treated as though it were an incompressible and inviscid fluid In these cases it can be shown that *similar bodies moving in a similar manner will generate similar air flows,* no matter what the size of the body, the density of the fluid, or the speed of the motion. Even the nature of the fluid, whether liquid or gas, is of no consequence, and experiments intended to relate to air may equally well be carried out in water, or in any other fluid which, for the purpose in hand, can be treated as incompressible and inviscid. The simple laws of aeronautics, such as that the pressure varies in proportion to the density of the air and to the square of the speed, are based upon this assumption.

Effects of Compressibility and Viscosity.—In aeronautics air can generally be treated as though it were incompressible, unless velocities exceeding some 300 or 400 miles per hour are involved. When velocities higher than this occur, compressions and expansions of the air as it passes the solid body may seriously influence the flow; the rule for similarity of flow becomes less simple. It is then necessary that corresponding velocities in the motions to be compared should all bear the same ratio to the velocity of sound in the fluid in which the motion takes place. For example, if high speed experiments in air and water are to be strictly comparable, the experiments in water must be carried out at speeds four times as great as the corresponding speeds in air, because sound travels some four times as fast in water as in air; but when both the model and the full scale body move through air the actual speed of the model must be the same as that of the full scale body. Such high speeds as 300 to 400 miles per hour are not yet commonly met in aeronautics, except at the tips of the blades of high speed airscrews, and hence it is unnecessary to obey this law of similarity, except in connection with the tests of such screws.

For fluid flows which are appreciably influenced by viscosity yet another condition must be fulfilled to ensure similarity between two motions. Let μ be the viscosity of the fluid, ρ its density, V the velocity of the body through the fluid, and let l be some length which defines the size of the body—for instance the diameter, if the body be a sphere, or the length, if it be an airship. Then the quantity $\frac{\rho V l}{\mu}$ must have the same value in each of the motions to be compared, otherwise viscosity will play a different part in each motion, and strict similarity will be impossible. This quantity $\frac{\rho V l}{\mu}$ has zero dimensions and is therefore a pure number or ratio,

independent of the units in which its separate factors are expressed, provided that those units form a dynamically consistent system, *i.e.*, a system of units which allows Newton's laws of motion to be expressed in the form:—Force = mass × acceleration, the pound-poundal-foot-second and the gram-dyne-centimetre-second systems being examples. It is universally known as the *Reynolds number*, after the celebrated scientist Osborne Reynolds. When the Reynolds number of a flow is small, viscosity



FROM NAYLER AND FRAZER, "REPORTS AND MEMORANDA OF THE ADVISORY COMMITTEE FOR AERONAUTICS"

FIG. 1.—THE TURBULENT FLOW OF FLUID PAST A CYLINDER
This illustrates the flow round all bodies which offer a high resistance to rapid motion through fluids. The motion of the fluid, which is from left to right, is characterized by a dead region A, followed by a turbulent wake B. Such a flow exerts a powerful drag upon the body

will play a predominating part in the motion, which will be of the kind usually associated with the flow of oils or treacle. When the number is large, the flow will be of the kind usually associated with water, and will approximate to that of an inviscid fluid. Thus the same fluid may act in a highly viscous manner when flowing slowly past small objects, and yet behave almost as though inviscid when flowing rapidly past large bodies. The Reynolds numbers which are of interest in aeronautics are of the order of a million; in these circumstances the air behaves almost as though it were inviscid, and the simple laws of comparison between model and full scale, to which reference has been made, can generally be applied without serious error. Certain flows, which are of great interest in aeronautics (*e.g*, the flow about a wing at the stalling angle which is defined later) are, however, highly critical, in the sense that small disturbances may cause an entire change in the type of flow. These critical flows may be sensitive to changes in the Reynolds number, even though the value of the number is very large, and hence the greatest caution must be used in applying the results of small model experiments on these critical phenomena. The highly practical importance of some of these critical flows has led to great efforts being made to devise laboratory experiments in which the Reynolds number will be the same as that of the full scale flow to be represented One way in which this has been successfully accomplished, though at great cost, is to enclose the whole wind tunnel in an air-tight chamber pumped up to a pressure of some 20 atmospheres; this increases ρ some 20 times, which compensates for the reduction in V and l necessary to bring the experiment within the scope of laboratory methods.

FLUID MOTION

The forms taken by the flow of air past a solid body can in general be classified as belonging to one of two characteristic types. Fig. 1 is typical of the flow around the majority of bodies not specially shaped to move easily through fluids. The motion, which in this figure is from left to right, is characterized by a dead region *a*, of small velocity and low pressure, followed by a turbulent wake *b*. Such a flow exerts a powerful drag upon the body, and much energy will be required to force the body rapidly through the fluid. Fig. 2 is typical of the flow around bodies which move easily through fluids, the dead region *a* is absent, whilst the wake has become very small. Flows of this type are generally called *streamline* flows, and bodies which generate them are called streamline bodies. The turbulent flow, as in fig. 1, is not yet susceptible to mathematical analysis, but streamline flows, as in fig. 2, approximate, when the Reynolds number is large, to the flow of a hypothetical inviscid fluid, the analysis of which has been thoroughly studied.

Bernoulli's Theorem.—This famous theorem relates to the steady flow of the hypothetical inviscid fluid, and states that the pressure p and the velocity v at all points on a single streamline are connected by the relation:

$$p + \tfrac{1}{2}\rho v^2 = \text{constant}.$$

In most aeronautical problems the air at all points far from the body is assumed to be undisturbed, so that its velocity relative to the body and its pressure are uniform; if these are called V and P respectively, then Bernoulli's equation leads easily to:.

$$p - P = \tfrac{1}{2}\rho V^2\left[1 - \left(\frac{v}{V}\right)^2\right]$$

from which the pressure at any point can be deduced from the velocity at that point, or vice versa. The maximum pressure will thus occur where v is zero, and will have the value of $P + \frac{1}{2}\rho V^2$; this maximum pressure occurs on the surface of the solid body at the point where the streamlines divide. (*See* figs. 1 and 2) This fact is used to measure the velocity of air in aeronautical experiments. If a tube, closed at one end and open at the other, is placed with the open end facing the air stream, the pressure within it will have the maximum value $P + \frac{1}{2}\rho V^2$. If the difference between this pressure and the pressure P of the undisturbed stream can be measured and if the density is known, the velocity V can be determined. The undisturbed, or static pressure P can be obtained within a closed tube placed with its axis parallel to the wind and having small holes punctured in its sides at some distance from the closed end. These two tubes are known respectively as the *pitot* and *static pressure* tubes; and together with some form of manometer, for measuring the difference between the pressures within them, they provide the standard speed measuring unit both in the laboratory and on aeroplanes in flight.

The Flow About a Streamline Body.—The theoretical study of a hypothetical inviscid fluid leads to the conclusion that when a solid body starts from rest to move through such a fluid, which is otherwise undisturbed, the form of the flow around the body is uniquely determined by its shape and mode of motion. This flow has the remarkable property that, although it may cause variations of pressure which tend to rotate the body, it exerts no resultant force upon the body, no matter what the shape of the body may be. The actual air flow about a streamline body, such as an airship (fig. 2) is a very close approximation to this theoretical flow, and hence the resultant of the pressures upon the surface of the body is almost zero—the small remaining drag, or resistance to motion, being nearly all due to *skin friction, i.e.*, the tangential forces on the surface due to the friction of the air. When the Reynolds number is large, as in aeronautics, the fluid

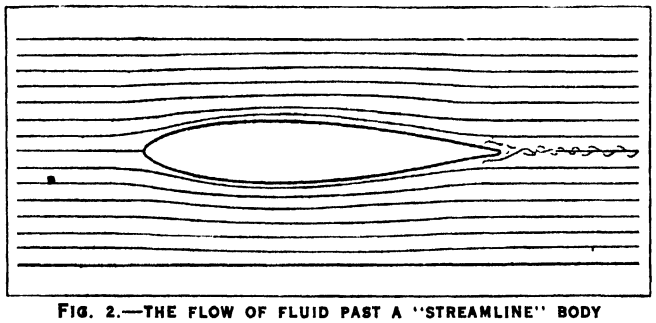
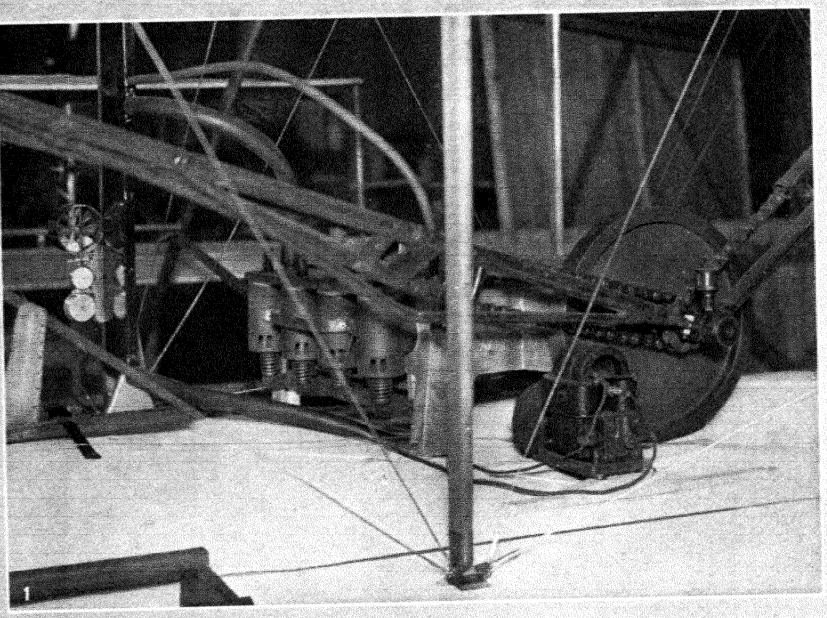
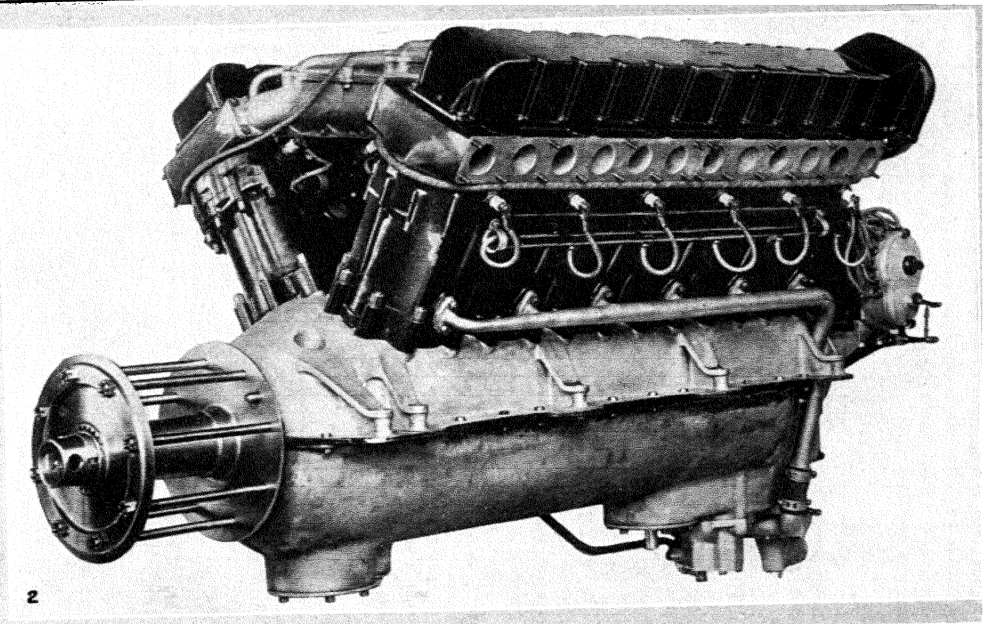


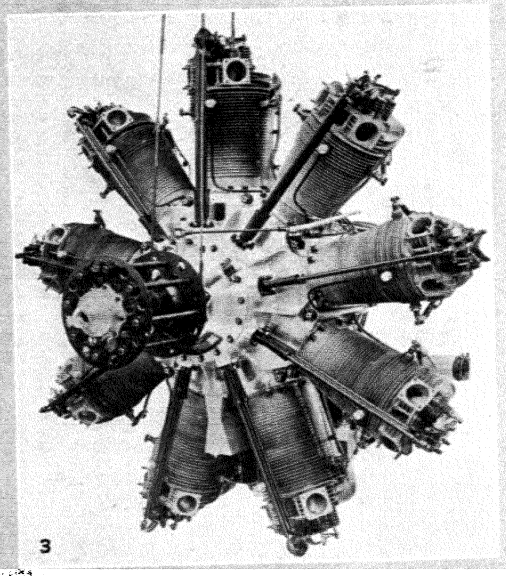
FIG. 2.—THE FLOW OF FLUID PAST A "STREAMLINE" BODY
In contrast to the turbulent flow round a body not especially shaped to move easily through fluids as in Fig. 1, this illustrates the flow round a body which offers small resistance to rapid motion through fluids

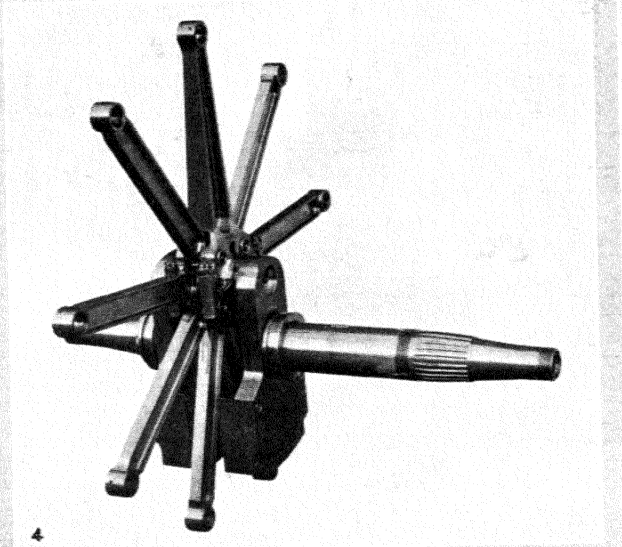
mechanism which exerts these skin friction forces is confined to a very thin sheath, or layer, enveloping the body. This is called the *boundary layer;* the motions within it are very complex and are known to provide the determining factor which decides whether the flow will be streamline or turbulent. Outside this very thin boundary layer the flow, if streamline, behaves very closely as though the fluid were absolutely inviscid.

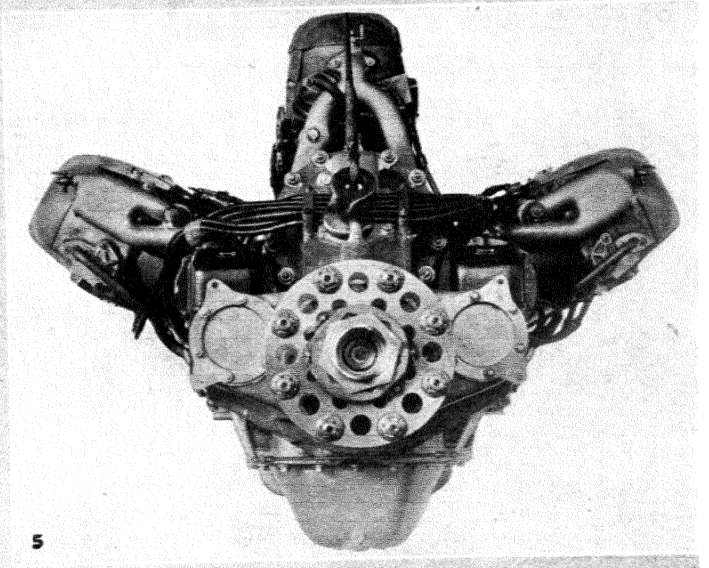
A wing may be loosely described as a flattened streamline body. Its cross section in one plane containing the direction of motion











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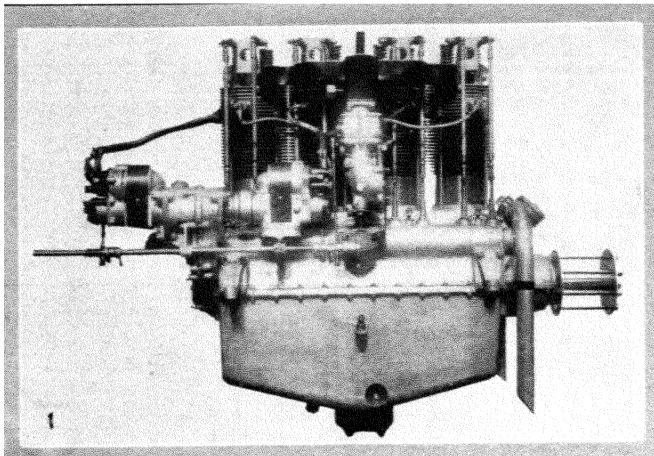
ORIGINAL WRIGHT ENGINE, 1903, AND TYPES RECENTLY DEVELOPED IN THE UNITED STATES AND GREAT BRITAIN

1. Wright engine of 1903, forerunner of huge power units of to-day
2. 400-h.p. water-cooled V-type 12-cylinder Curtiss D-12 Engine
3. 450-h.p. 9-cylinder "Jupiter" radial engine
4. Radial engine crankshaft and connecting rods
5. 875-h.p. broad arrow "Napier Lion" engine

AERO ENGINES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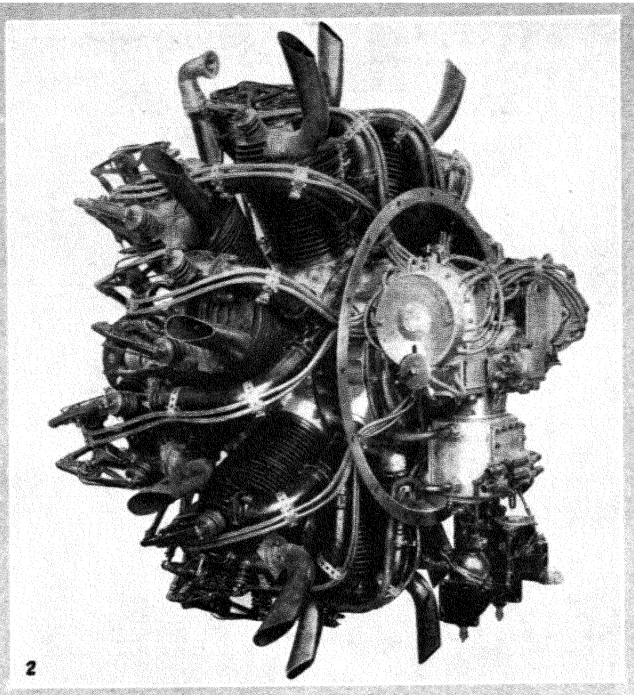
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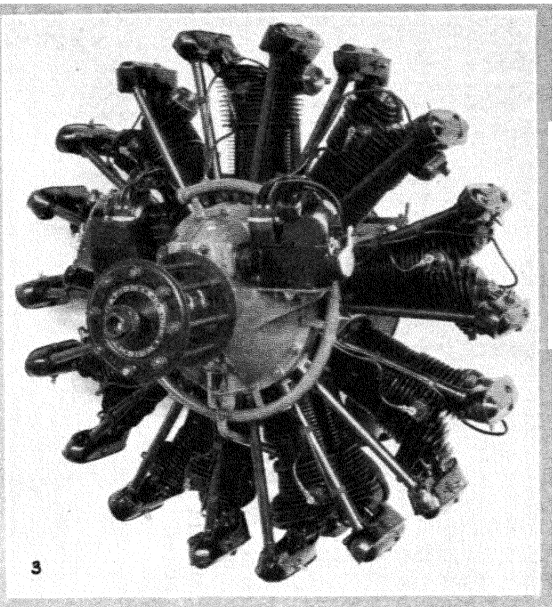
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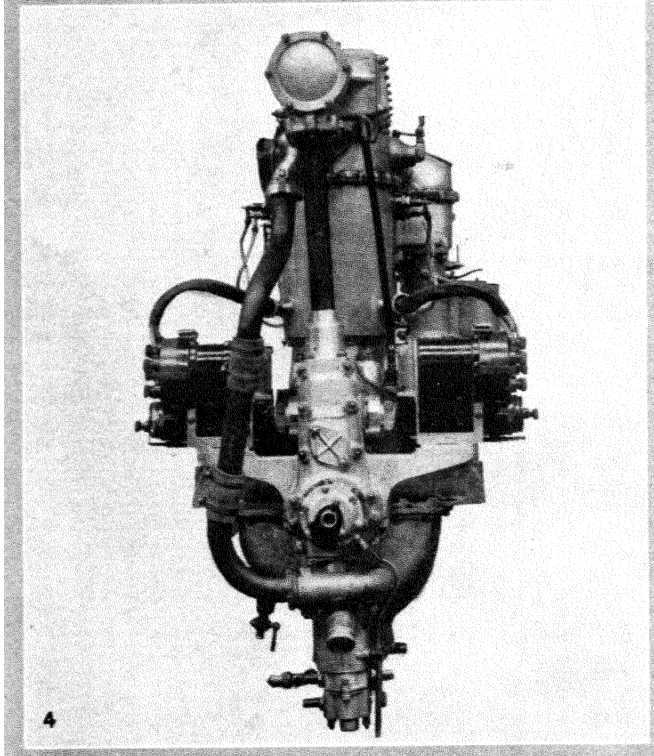
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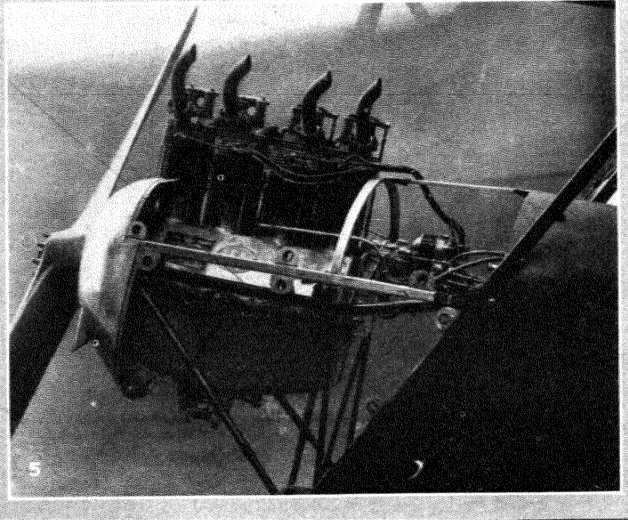
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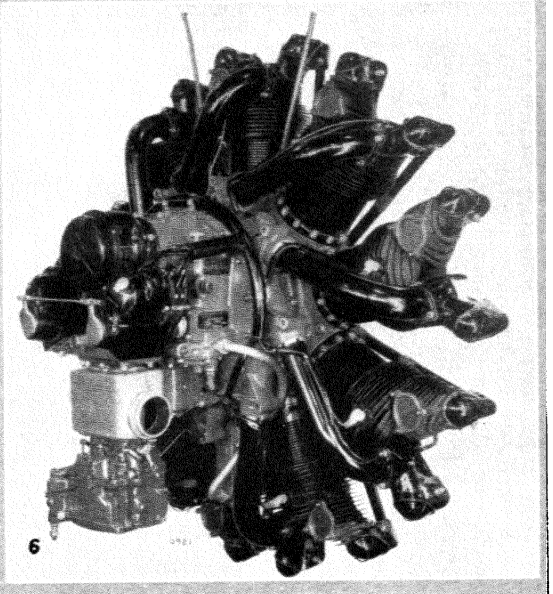
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AIR- AND WATER-COOLED AEROPLANE MOTORS, SHOWING ACCESSORIES AND METHOD OF MOUNTING

1. Four-cylinder-in-line "Cirrus" light engine
2. 385 h.p. 14-cylinder "Jaguar" radial motor
3. Wright Whirlwind 200 h.p. air-cooled type
4. Rear view of the "Nimbus Straight Six"
5. Stripped "Cirrus" light engine being mounted
6. Pratt & Whitney "Wasp" accessories

has a typical streamline form, as in fig. 3 (*see* AEROPLANE) which shows a modern wing section. So long as the incidence, or inclination of this section to the direction of motion is not too great, the flow about the wing will be streamline, the drag will be small and the wing will exert a lift perpendicular to the direction of motion which increases progressively with the incidence. If the incidence becomes too large the flow changes, more or less suddenly, to a form similar to that in fig. 1. The wing is then said to *stall* and its resistance to motion is greatly increased, whilst its lift no longer increases with incidence, but may even fall slightly.

Below the *stalling angle* the flow, though streamline, differs from that unique flow which could be generated from rest in an inviscid fluid, and approximates more nearly to one of a series of flows, which are possible to the inviscid fluid, but which could not be generated in it without the action of some additional agency. The way in which these flows are generated is still somewhat obscure, but it is known that their development is made possible by the slight trace of viscosity in the air, which allows eddies to be

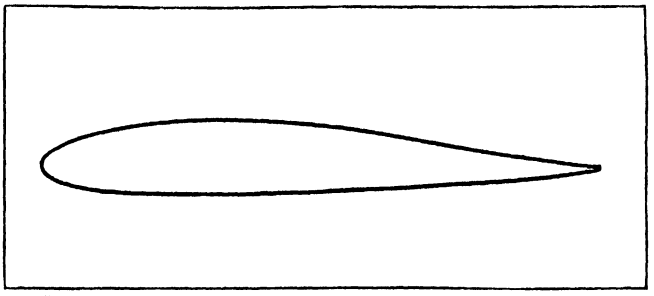

FIG. 3.—AN EXAMPLE OF A RECENT AEROPLANE WING SECTION
The most modern type of wing is more or less a flattened streamline body. The actual air flow about a body of this shape is such a close approximation to the theoretical flow that the pressure upon its surfaces is almost zero

shed from the trailing edge of the wing, and that as these eddies are shed the flow about the wing changes until the appropriate flow has developed. When these changes have ceased and the flow has become steady the viscosity plays no further appreciable part in the motion, except in the boundary layer. Theoretically there are, for each wing at each incidence, a series of such flows which could exist steadily in the inviscid fluid but could not be generated in it, and a question arises as to which one of them will occur in any given instance. Unlike the flows which could arise from rest in an inviscid fluid, these flows give theoretically, a lift upon the wing, and if the actual lift of the wing can be measured, the particular flow of this series which is occurring can be identified as that one which theoretically gives the measured lift. It is thus possible, by merely measuring the total lift of a wing, to calculate, with considerable accuracy, the direction and velocity of the flow at all points in its neighbourhood and from Bernoulli's equation the distribution of pressure over its surface. If the lift cannot be measured, the flow can be approximately identified as that one of the series in which the streams flow smoothly off the trailing edge of the wing without sharp changes of direction. This method of identification is not so accurate as the former.

Induced Drag.—Calculations such as the foregoing can most conveniently be made in relation to wings of infinite span, or length perpendicular to the direction of motion. For such wings the theoretical drag in the inviscid fluid is zero; the real drag is almost entirely due to skin friction and is so small that it may, in favourable circumstances, be less than one fiftieth of the lift. When the span of the wing is finite, circulations are set up around the tips, the air flowing round them from the high pressure region beneath to the low pressure region above the wing. Vortices are thus generated, which trail from the wing tips and remain in the air long after the wing has passed. These vortices require power for their generation and consequently the power required per running foot to propel a finite wing, and the drag on the wing, are greater than for a wing of infinite span: for this reason the drag of a wing of practicable shape is seldom less than one-twentieth of the lift. L. Prandtl has developed approximate mathematical methods of calculating this drag, which he calls the *induced* drag. The difference between the actual and the induced drag is called the *profile* drag, because it depends upon the profile, or cross section, of the wing and is not dependent on the span.

For a given wing arrangement, the induced drag is proportional to the ratio, weight supported/span; this ratio is now called the *span loading*. The induced drag varies in *inverse* proportion to the air density and the square of the speed. The profile drag, for a given incidence and profile, depends upon the total wing area and varies in *direct* proportion to the density and the square of the speed. When calculating the drag of an aeroplane wing, it is now normal practice to divide the drag into these two parts and to study them separately. Induced drag can be calculated, not only for single wings, but for multiple wings, as in a biplane, or for wings in the presence of plane boundaries, such as the walls of a wind tunnel or the surface of the earth. Such calculations are used extensively in all modern laboratories and design offices.

FREE FLIGHT

Stability.—An aeroplane which, on being disturbed from a condition of steady flight in equilibrium, ultimately returns to the condition from which it was disturbed, is said to be *stable*. Complete stability in this sense can be achieved by correct proportioning of the parts of the aeroplane, but is by no means necessary for successful flight; for if the pilot has effective control over his aeroplane he can easily check any tendency to depart from equilibrium flight, which may result from a moderate instability. It is, however, important for the designer to know, not only whether his aeroplane will be stable or unstable, but the degree of stability or instability to be expected, for its behaviour in the hands of the pilot will depend upon this factor. The subject has therefore been extensively studied mathematically, but is so complicated that it is impossible here to do more than refer the reader to standard books on the subject.

Stalling.—As the speed of an aeroplane falls the lift falls, and sufficient lift to balance the weight can be obtained only by an increase of incidence. But it has been shown in a previous paragraph that when the incidence of a wing passes a certain critical angle the character of the air flow changes, and the lift ceases to increase. There is thus a minimum speed, associated with the above critical angle, at which any aeroplane can fly steadily. This minimum speed of steady flight is called the *stalling speed*, the incidence at which it occurs is called the *stalling incidence*, and an aeroplane flying at an incidence greater than the stalling incidence is said to be flying *stalled*. With this change of flow at the stalling incidence is associated a complete change in the characteristics which determine the stability of aeroplanes and the action of their controls. For the effect of this change upon practical aviation *see* AEROPLANE.

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See also:—*Reports and Memoranda of the Aeronautical Research Committee; Reports of the National Advisory Committee for Aeronautics; Technische Berichte der Flugzeugmeisterei.* (B. M J.)

AERO ENGINES. Aero engines in use in the first quarter of the 20th century worked upon the four-stroke constant-volume-ignition cycle and the thermodynamic theory of them was similar in all essentials to that of any other petrol engine. (*See* INTERNAL COMBUSTION ENGINE.)

I. ELEMENTS OF THE PROBLEM

The great problem with which the designer of aero engines is faced is reduction of the ratio weight to horse-power, or as it is customarily expressed the "pounds per horse-power," to the smallest possible value consistent with reliability. But pounds per horse-power in the air cannot be taken simply as a figure obtained on the test-bed; an aeroplane must carry its own fuel, so that economy of fuel consumption is also of primary importance. If we take, in order to fix our ideas, the example of a 450-h.p engine which itself weighs, say 900lb., then the weight of fuel

used per hour would be of the order of 225lb., depending, of course, at what height the flight was made.

If we consider, not the weight of the engine alone, which is 2lb. per h.p., but the weight per h.p. of the "power unit (engine and fuel) for a four hours' flight," then the value of this when the aircraft leaves the ground will be not 2 but 4, and it becomes at once clear that the effective weight to power ratio of an engine in flight will be materially affected by its fuel economy. In 1915 there was no water-cooled engine which weighed, complete with water and radiator, less than about 4lb. per h.p., and no air-cooled engine of less than 3lb. per horse-power. Since that time these figures have been reduced to less than 2 and 1·5 respectively. The greater net weight of the water-cooled type is discounted, especially for long flights, by better fuel economy.

Tendency of Design.—For an engine of given size (bore and stroke) both the power and economy are increased by an increase of the compression ratio. The tendency of design has therefore been toward the use of higher and higher ratios of compression: from the figure 4·5 of the average motor-car the compression in aero engines has been pushed up to 6 to 1, and even much higher in special cases. The limit to which it can be raised depends largely on the physico-chemical properties of the fuel available. With some fuels, such as benzol, an engine of 7 to 1 compression ratio will run quite smoothly. With others which differ only in chemical analysis and not at all in appearance, volatility or specific gravity, it would be impossible to run the engine at all. Owing to the high degree of compression, the combustible gas when ignited would explode with such violence as to cause "detonation" or "knocking" in the cylinders. In order that the compression ratio may be pressed to the highest possible point, therefore, the supply of suitable fuels for aero engines is a matter of great importance.

The Factor of Head Resistance.—The aero engine designer must bear constantly in mind the factor of "head resistance." When an aeroplane is flying level, the whole available power of the engine is used up in overcoming the "drag" on body and wings as the machine tears forward through the air. In practically all modern machines the engines are at the front of the body or fixed between the wings, and if the head resistance is to be kept down, the area presented by the engine and accessories, when viewed from the front, must be as small as possible. A most important accessory, in this connection, is the radiator necessary with water-cooled engines.

II. EVOLUTION IN DESIGN

Bearing in mind the four considerations of power, weight, fuel economy and head resistance, their effect upon aero-engine design will now be traced. The designer must be a master of compromise. Compactness, rigidity, revolutions, inertia forces, piston speed and area, bearing loads, valve area, effective cooling and the rest . . . each member of this complex company must be harmonized with all the others and at the same time consideration of each must be pressed to the farthest limit in the service of the two great aims of power and lightness.

Two Main Types.—It is appropriate in the first place to point out the main subdivision into water-cooled and air-cooled types. With our primary concern for weight to power ratio the advantages of the air-cooled type are not far to seek; there is the clear gain in weight of all the circulating water, besides the elimination of the weight and drag of the radiator. But the air-cooled engine designer cannot have it all his own way. For minimum head resistance of the engine itself a design of the "cylinders-in-line" type with the crank-shaft fore-and-aft will clearly have the advantage; but if for cooling we rely wholly upon a high velocity air-stream it is imperative that no cylinder should be seriously more screened from this air-stream than any other.

Hence, although a few air-cooled engines of the cylinders-in-line type have been built, the two types which have been widely successful have been those in which the cylinders are arranged radially in one plane (*see* Pl. II.–1), or sometimes in two parallel planes (*see* Pl. II.–2), perpendicular to the axis of the machine; so that all cylinders share equally in the cooling air. Such engines, whether of the "rotary" or "static radial" types, present a large frontal area and offer very serious head resistance, in fact, far in excess of the radiator. The difficulty of air cooling is that the specific heat as compared with water is only 1/45, lb. for lb., or 1/36,000, volume for volume.

Water-cooled Engines.—The power developed by an engine depends upon the mean piston speed, the total piston area and the mean-effective pressure in the cylinders. As to the first two the question at once arises: "Shall the requisite piston speed and area be achieved with a few large or many small cylinders, and what in each case are the limiting factors in regard to speed?"

Cylinder Design.—The answer given by designers has been "many and small"; largely on account of the resulting compactness and of the rigidity obtainable with light construction. A long stroke means a heavy crank-shaft and a cylinder reaching out a long way from the shaft centre-line and upsetting the slip stream from the propeller. For getting adequate piston speed, therefore, the tendency is toward a short stroke and high revolutions. Large-bore cylinders in line, again, would lead to a long crank-shaft, involving both weight in itself and in the resulting crank-case, besides the danger of non-rigidity in a big engine of light crank-case construction. A further advantage of small cylinders is the reduced danger of distortion due to uneven heating while in service.

With many small cylinders in line we get less piston area to the same length of crank-shaft, but it is possible to make two or more cylinders operate on one crank and so the balance is redressed. Considerations of this kind have led to the development of the "Vee" and "Broad-arrow" types of engine with two and three banks of cylinders. Fig. 2 on Plate I. shows one of the most successful modern water-cooled engines of the Vee type, the Curtiss D.12 which develops 400 b.h p. at a total weight of 724lb. This engine has a crank-throw of only 3in. and the compactness of the resulting design is evident.

In Pl. I.–4 is the well known Napier Lion with three banks of four cylinders each. This engine has a crank-throw of only $2\frac{9}{16}$in., but works at enormous speeds, in the neighbourhood of 3,000 r.p.m.; for a short stroke means high revolutions to get adequate piston speed, and this in turn involves big inertia forces (since they increase as the square of the revolutions) which become most serious in their effect on the bearing loads at the crank-pins. The limit to the closeness of spacing of the cylinder centre lines, with these high-speed engines, is largely a matter of the provision of adequate lengths for the main bearings and for those between connecting-rods and crank-pins.

Valve Problems.—The combination of high piston speed with good volumetric efficiency involves ample valve area and the freest possible form of induction system. This, combined with the need for a compact and symmetrical combustion chamber to diminish detonation, has resulted in the almost universal adoption of four valves in the cylinder head, two inlet and two exhaust, the inlet being rather larger than the exhaust. By this arrangement an effective inlet valve area is obtained equal to about 20% of the piston area. With this provision mean piston speeds up to well above 2,000ft. per minute can be employed with good volumetric efficiency.

Next to the big-end bearing loads, valve operation is most critically affected by high revolutions. To get sufficiently rapid opening and closing of a poppet valve for an engine speed of 2,500 r.p.m. the accelerations involve very heavy springs and terribly severe stresses in the cams and in the valve spindles. This difficulty of high-speed poppet valve operation makes the sleeve valve so attractive a possibility.

Fuel Distribution.—With a number of cylinders in line the equal distribution of the fuel between them is a difficulty. Two or more carburetters must be used and the cylinders drawing from each carburetter must be arranged, so far as possible, to do so at equal time intervals. No one arrangement has been standardized as the best: on most 12-cyl. Vee engines one carburetter serves one whole bank of cylinders, but another arrangement divides the engine into two groups of the front six and rear six cylinders, and each group is served by one carburetter.

In at least one design some weight is sacrificed for the sake of good distribution in the provision of a carburetter to every two cylinders.

Air-cooled Engines.—Air cooling, while using an extremely inferior cooling medium, is found possible by the discovery that engines will operate at very high cylinder and valve stem temperatures. The two main classes of air-cooled engines are the Rotary and the Static Radial types. In each the cylinders are arranged radially in one or two planes round the circumference of a circular crank-case. Thus all cylinders are satisfactorily exposed to the cooling air-stream, but at the cost of presenting a large frontal area. The rotary engine, in which the cylinders and crank-case rotate with the air-screw, besides the fore and aft air-stream, gets the extra cooling due to the rotational speed of the cylinders, but at the expense of considerable waste of power in air friction.

The speed, and therefore the power, of the rotary engine is limited to about 1,200 r.p.m. by the enormous centrifugal forces on the rotating cylinders, and in consequence this type has now become obsolete.

One of the chief attractions of the static radial type is the possibility of a very compact and rigid crankcase construction (*see* Pl I.–4). This takes the form, very roughly, of a drum, with cylinders fixed radially round its circumference. Only one crank is employed for all the cylinders which lie in one plane; one piston having a connecting rod with a "big-end" as ordinarily understood, while all the other pistons have "articulated" connecting rods, which are attached by pin joints around the circumference of the big-end of the one master-rod, as shown in Pl. III.–3, where the master-rod points vertically upwards. The loading on the one crank-pin is very severe, and special designs of big-end bearing are necessary to stand up to it.

Valve Design.—Valve opening is accomplished by push-rods and rocker-arms which are carried on the cylinder heads; the rods being operated from a cam-ring which is driven at the speed appropriate to the number of cylinders by an epicyclic gear on the main shaft. Since the cylinders of a large, air-cooled, radial engine may undergo an expansion while running of as much as 70/1000ths of an inch, which is not shared by the push-rods, very careful design and proportioning of the rocker-arms are necessary if valve operation is not to be upset.

Fig 3 on Plate I. is an illustration of the Jupiter engine, one of the most successful of the air-cooled radials. Its nine cylinders, $5\frac{1}{4}\times7\frac{1}{2}$in. bore and stroke, are arranged in one plane and the engine develops 450 h p. at its normal speed of 1,700 r.p m. and at a weight complete of 730lb. Pl. II.–2 shows the Jaguar engine in which 14 cylinders are arranged in two planes.

Other forms of air-cooled engines which have met with the greatest favour outside of England are the Gnome, made by the Société des Moteurs Gnome & Rhone, which is the pioneer of all air-cooled engines; and in America the Wright "Whirlwind," Pl. III.–2, and Pratt & Whitney "Wasp," Pl. II.–6, engines are noted examples.

III. MATERIALS

With the cutting down of weight, and the ever more severe conditions as regards temperature and compression ratio, the problem of design is bound up with that of materials

Aluminium Alloys.—The introduction of the light alloys of aluminium was the first great advance in regard to materials. It is now possible to make extremely complex castings and drop forgings for a complete crank-case in this material (*see* Pl. I.–4), and, even before this had been successfully achieved, the introduction of the aluminium piston had largely reduced the mass of reciprocating parts and so brought relief in crank-pin bearing loads due to inertia. The high conductivity, too, of aluminium as compared with cast-iron has made for cooler pistons and less tendency to carbonization of the lubricating oil. The same property has led to extensive use of aluminium for making the cylinder heads of air-cooled engines, and, in combination with a steel liner, for complete cylinder construction of water-cooled types. It has even been tried to run a steel or iron piston direct in an aluminium cylinder. The two critical points in regard to high temperatures in a high-duty engine are the centre of the piston, and the exhaust valve, if this is of the poppet type.

Alloys of magnesium with copper and zinc or aluminium are lighter than the aluminium alloys. They cast well and machine easily and have been used to some extent for crank-cases with a saving of weight of about 35%. Their disadvantages are their high cost, excessive liability to corrosion and poor elastic properties.

Exhaust Valve Materials.—Exhaust valves are called upon to run continuously at a bright red heat and to resist scaling or burning under these severe conditions. The only steels which can successfully do this are certain of the nickel and chromium alloys, and these in their turn introduce new problems: they are much more troublesome to machine than carbon steels and also they develop what is known as "temper-brittleness," a condition brought about by the high temperatures at which they are used, and their subsequent slow cooling after use.

IV. THE SPECIAL PROBLEM: ALTITUDE

Effect on Engine and Air-screw (Air-screw termed propeller in the U S.)—Under comparable conditions the pressure developed in the cylinder of an internal combustion engine will be proportional to the weight, and therefore to the density, of the combustible mixture drawn in. At heights above ground level the atmospheric pressure falls off at a rate of roughly 1in. of mercury per 1,000 feet. At the same time the average temperature of the air becomes lower at a rate and in a manner which varies from day to day The density of the air will therefore fall off somewhat less rapidly with height than the pressure, and the relation between density and height may be very variable.

It is now possible to measure the indicated power of an engine in flight, and experiments on these lines have shown that the indicated power is very nearly proportional to atmospheric density, provided a proper air-fuel ratio is maintained. This, however, is a matter of some difficulty. The suction produced in the choke tube of a carburetter—and hence the quantity of fuel normally supplied through the jets—will, for the same engine speed, be proportional to the square root of the air density. The weight of fuel supplied by a carburetter will therefore fall off less rapidly, as an aircraft rises, than the weight of air drawn in, and the mixture will become too rich. To compensate for this an "altitude control" must be fitted which reduces the normal flow of petrol at high altitudes.

Engine and Air-screw.—The useful performance of an aircraft engine cannot be considered apart from its air-screw. These two must be regarded together as the power unit, for the power and efficiency of an engine may be largely thrown away if combined with an inefficient air-screw. Since both indicated engine power and air-screw resistance are proportional to air density, at constant speed, it follows that they both fall off at the same rate as the aircraft climbs. The b.h p. of the engine, friction losses being approximately constant, will fall slightly more rapidly; but the difference is not large, except at great heights, and since air-screw resistance is also proportional to the square of the revolutions the difference between available engine torque and air-screw resistance will produce only a slight drop in the speed of rotation. A fixed bladed air-screw, therefore, combined with a normal engine will, as the machine climbs, continue to work at nearly constant revolutions and efficiency.

Variation of b.h.p. with Altitude.—Although the indicated power falls off, the mechanical losses in the engine as a whole will not vary much as a machine rises, so that b h p. may be expected to fall off more rapidly than indicated horse-power and air density. To determine by direct observation just how fast the b h p falls off with increasing altitude in any given case would be a research of the highest interest. Its accurate determination would involve measurement of the torque actually delivered to the air-screw Several attempts have been made to design a torque meter for use in the air, but the mechanical difficulties are so great that so far these attempts at direct measurement have been only partially successful.

The alternative is to deduce how the b.h.p. varies from observations of the performance of the aircraft. This again is a difficult calculation to make with certainty from figures for speed and rate of climb, since the necessary reduction from actual observations must rest upon an answer to the question we are asking: how the altitude has affected engine b.h p. and air-screw efficiency. It is probably impossible, by tests in the air, to arrive at any satisfactory general law for diminution of engine b.h.p. with height, applicable to all engines, for the simple reason that the mechanical efficiency, which must always vary from engine to engine, and may even vary from day to day with the same engine, has so large an effect on an aircraft's performance as to produce very discordant results. Take, for example, an engine giving 500 i.h p. on the ground, and assume that the i h.p. will fall off in proportion to air density and the friction losses remain nearly constant. If we calculate the b.h.p. at 20,000ft. where the i.h p. is halved, this will be 200 or 175, a difference of 12½%, according to whether the mechanical efficiency is 90% or 85% on the ground. Even 1% variation of mechanical efficiency would have an appreciable effect on performance.

Examination of the results of a large number of aircraft performance tests has led to the conclusion that the best approximation to a law of variation of b.h p. with height is to take this as being a function of (pressure)$^{\frac{7}{8}}\times$(density)$^{\frac{1}{3}}$. For a full consideration of this problem reference should be made to the Reports and Memoranda series of the Aeronautic Research Committee. Low pressure refrigerating engine test chambers at the Bureau of Standards in Washington have gone far to determine these unknown factors.

Maintenance of Ground Power at Altitude.—Since the power delivered by an engine will be roughly halved at a height of 20,000ft., any plan for counteracting this effect of reduced air pressure holds out great opportunities for improved performance. But here the air-screw problem comes in. If the ground power of the engine should be delivered with the air-screw in low density air, then the engine will race away and burst, for unless the inclination of the air-screw blades can be altered the resistance to rotation must fall off with the air density. The usefulness of maintaining ground power at altitude is therefore dependent upon adapting the pitch of the air-screw blades so as to prevent excessive engine speed and at the same time retain a good air-screw efficiency. This problem of providing a variable pitch air-screw is one which is at present occupying our designers, and cannot be said yet to have been satisfactorily solved but it has been overcome by a compromise with what may be known as "over-loaded screw" at low altitude.

Supercharging for Maintaining Ground Power.—To maintain ground power, combustible mixture must be compressed so as to be delivered to the cylinders always at normal atmospheric density whatever the height This would mean, at 25,000ft., compressing in the ratio of 2·7 to 1 and then cooling through about 60° C. The necessary cooler involves additional head resistance and, if a piston compressor is used, the displacement will have to be about three times that of the main engine. All this means considerable additional weight, and every added pound is a dead loss at low altitudes and a serious handicap in getting off the ground. For this reason very high-speed rotary blowers offer the best chance of success. Such a blower might either be gear-driven from the engine shaft, or some of the energy of the exhaust gases might be used through the medium of an exhaust-gas turbine. The difficulty attending a blower, if gear-driven from the main shaft, is that, with the exceedingly high gear ratio necessary, about 10 to 1, the inertia of the blower rotor is enormous, and unless some slipping clutch device is provided the gears will probably be stripped on the very sudden starting-up of the engine.

The exhaust turbine drive is very attractive, for, whereas with a gear-driven blower the entire horse-power needed for compressing the air has to be supplied by the main engine, this type makes use of what would otherwise be largely wasted energy. The difficulties are chiefly those of providing turbine rotor blades which will stand the constant exposure to the hot exhaust gases and at these temperatures will retain a strength adequate for a speed of rotation of 25,000–30,000 revolutions per minute.

V. OTHER PROBLEMS

Fuel Economy.—As mentioned earlier, the economical use of all fuel carried in the air is of vital importance. This means the uniform distribution to all cylinders of the minimum fuel required under all conditions of operation. This uniform distribution is a problem of induction manifold design very difficult to solve. A workable method of metering out to each cylinder its proper quantity without adding excessive weight to the engine would constitute one of the most important advances which at present remain to be achieved.

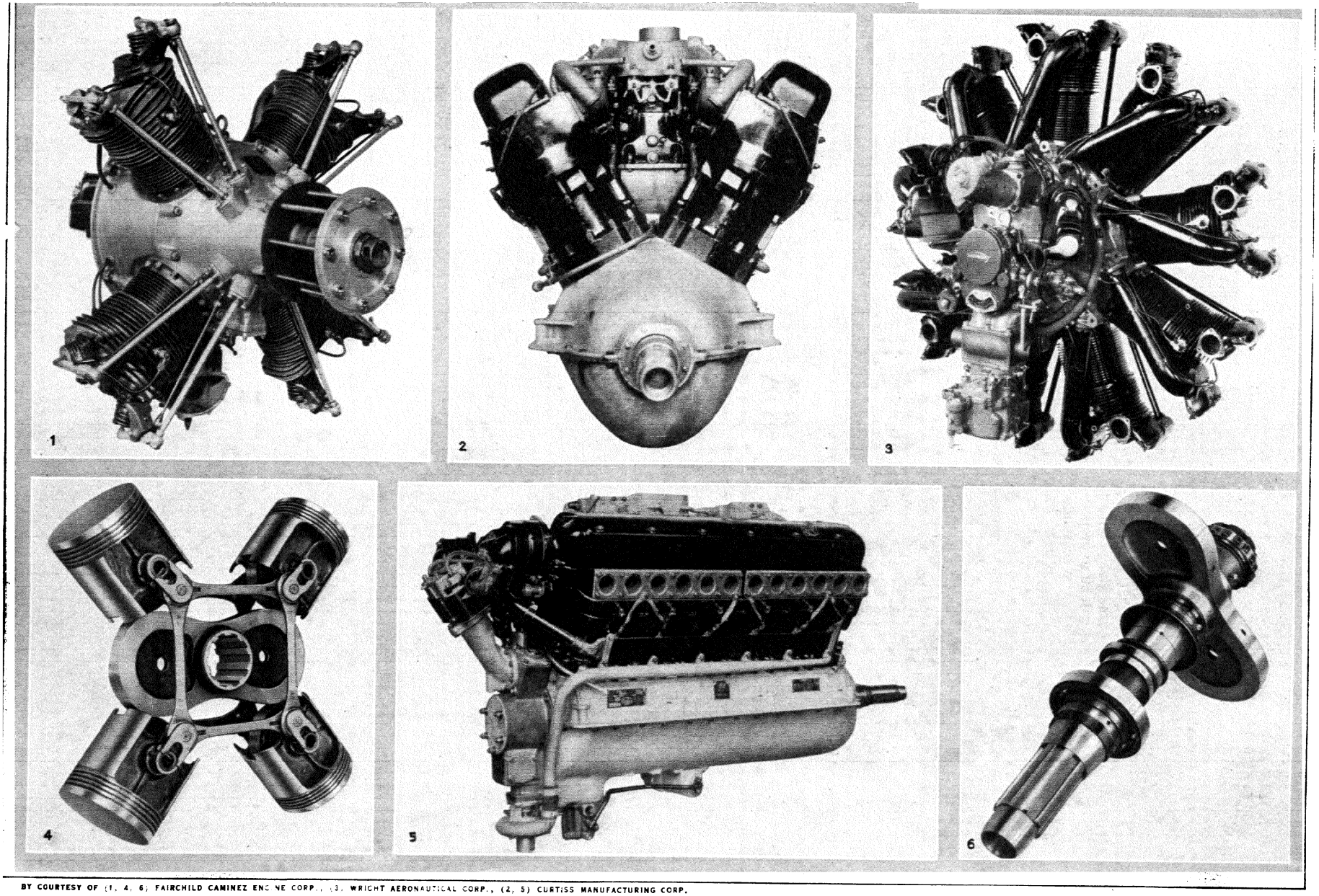
Wireless Interference.—While the engine designer has been improving the power and efficiency of his magneto and ignition system to suit high-compression engines, great strides have been made by the wireless branch in short wave-length instruments The magneto and high-tension leads produce waves which upset the sensitive wireless sets, and methods must be devised of so screening off the effects of the ignition system as to allow advantage to be taken of the improvements in signalling apparatus. The high-tension leads are therefore enclosed throughout their whole length in a woven metal sheath which is "grounded" to the engine body, and at the same time the plug-heads and contact-breaker are enclosed in small metal cowls which are likewise grounded. But the hard-won improvement in ignition efficiency is cut down by the added electrical capacity introduced by the new screening arrangements, the effect of which, and the additional weight involved, are a dead loss to the engine designer.

Oil Temperature Control.—The functioning of a system of forced lubrication, in which oil is delivered by a pump to all parts of the engine, is very greatly affected by the viscosity of the lubricant. Since viscosity varies widely with temperature some control of oil temperature is necessary. During the cold period at starting, excessive pressures will be developed by the pump; and although these can be dealt with by relief valves, the flow to the bearings will be very small, and a long period of warming up is necessary until the flow is sufficient to allow full loading to be imposed on the bearings. When flying at low altitudes and in warm climates, and more especially with airship engines which are usually not open to any cooling air-stream, it is necessary to provide for cooling of the oil after it has left the engine.

The problem is a peculiar one, for although the amount of heat to be abstracted is comparatively small, the rapid rise of viscosity as the oil is cooled has the effect of producing a thick coating of viscous oil on any surface where cooling is effective. The conductivity of this viscous layer being very bad, the remainder of the hot oil passes on out of the cooler with a very inadequate reduction of its temperature. The problem is to prevent the oil, as soon as it is cooled, from remaining in contact with the cooling surfaces and so preventing the cooling of that which comes after. The problem will not be solved until a cooler has been designed which is light, which cools effectively and can deal with the high pressures developed while the oil is cold.

Water Recovery.—A problem peculiar to airships is that of compensating for the weight of fuel used during a long flight. In flying to Egypt a large ship would burn some 25 tons of fuel oil, and unless this weight can be made up in some way an equivalent quantity of hydrogen will have to be allowed to escape. An alternative is, while drawing liquid fuel from the tanks, to use less of this and to make up the balance of fuel required by drawing from the gas bags the corresponding weight of hydrogen necessary to maintain balance in regard to buoyancy. Research upon the use as fuel in an engine of a mixture of oil and hydrogen has yielded most promising results and this may prove the most workable solution of the problem.

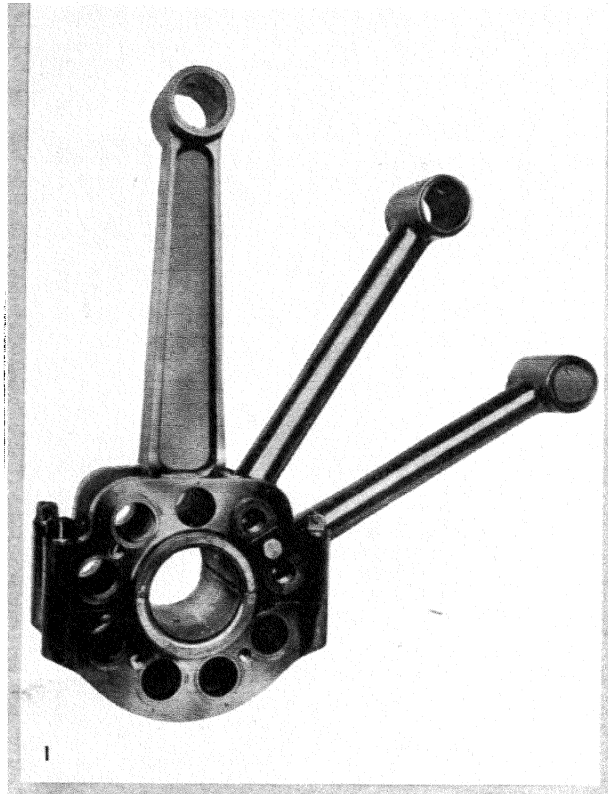
The alternative of maintaining the dead load on the airship by condensing and storing the water in the exhaust gas from the engines is a matter of considerable difficulty, but it should not prove insuperable. With a water-recovery apparatus capable of cooling the exhaust gas to within 10° C of whatever may be the surrounding atmospheric temperature, and of collecting all the

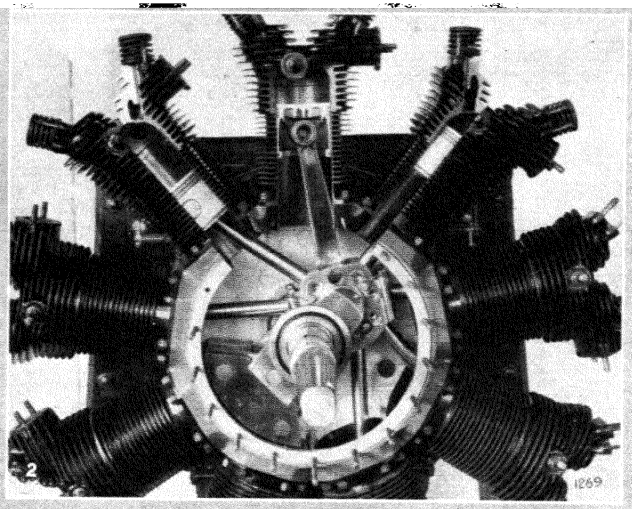


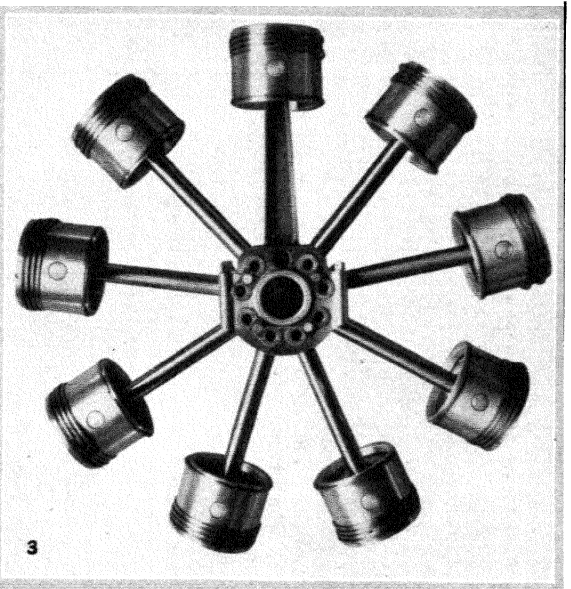
BY COURTESY OF (1, 4, 6) FAIRCHILD CAMINEZ ENGINE CORP., (3) WRIGHT AERONAUTICAL CORP., (2, 5) CURTISS MANUFACTURING CORP.

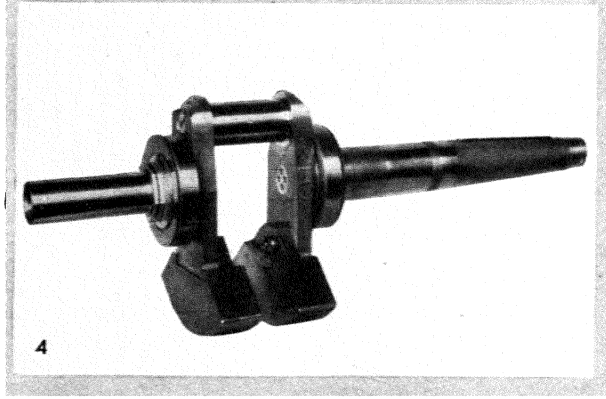
RECENT TYPES OF ENGINES AND MOTOR ASSEMBLIES USED IN HIGH-POWERED AEROPLANES

1. Caminez Aeroplane Engine Model 447-c
2. Curtiss water-cooled engine
3. Wright "Cyclone" 525 h.p. engine
4. Caminez piston roller and link assemblies
5. Curtiss water-cooled aviation motor V-1550
6. Drive shaft assembly of Fairchild Caminez engine

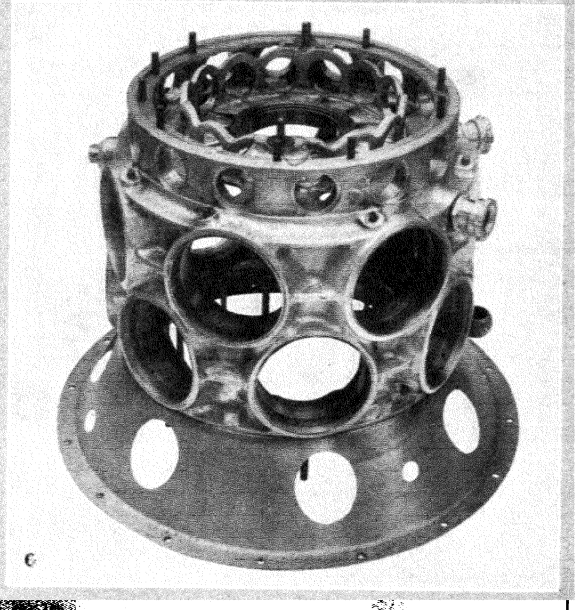












BY COURTESY OF (1, 2, 3, 4) WRIGHT AERONAUTICAL CORP., (6) THE SECRETARY OF STATE FOR AIR

RADIAL ENGINE PARTS AND ASSEMBLY

1. Master connecting rod, Wright "Whirlwind" engine
2. Wright "Whirlwind" 200 h.p. engine
3. Master rod and pistons of Wright "Whirlwind"
4. Crankshaft of Wright "Whirlwind" engine
5. Mounting radial engine on Fokker monoplane
6. Crankcase of "Jaguar" radial engine

water formed, the possible recovery should be from 0·9 to 1·1 times the weight of fuel burnt. This apparatus has for some time been working very successfully on big U.S. Naval airships. This is more important when helium is used, owing to the increased expense.

VI. FUTURE DEVELOPMENTS

Increase of Size v. Increase of Gas Pressures.—Apart from piston area and piston speed the only way of increasing the power of an engine is to increase the mean effective pressure. This can be done either by raising the pressure or lowering the temperature of the combustible mixture drawn in. The latter alternative has obviously only limited possibilities, but within these limits the use of fuels with high latent heat of evaporation, which therefore give more cooling of the charge, has been successfully applied in racing motor-car practice and may be also in aircraft engines. To raise the pressure of the mixture drawn in means the provision of a blower, not only to maintain ground pressure at altitude but to raise this pressure throughout above atmospheric. Under such conditions an engine of the same bore and stroke would have to have a heavier crank-shaft, connecting rods, pistons, etc., to stand up to the larger gas forces developed, the necessary blower and driving gear will be larger and heavier, the air coolers will be heavier and give more drag, so that it might be suggested that the extra power could be got at once by means of a bigger engine, *i.e.*, by more piston area, while leaving the gas pressures the same Only the detailed calculation of weights and estimates of drag in the two cases can settle the question of which plan will produce the most effective engine, but the small engine with high gas pressure starts with an initial advantage so far as its own head resistance is concerned.

The Two-stroke Cycle.—To design for a working stroke every revolution is not the easy way toward reducing weight per h.p. which at first sight it appears. Getting the charge into the cylinder with only the limited area available for inlet valves is, at high speeds, one of the limiting conditions even when the time of half a revolution is available. If it has to be accomplished in one-third of the time, or less, the problem is proportionately greater. Any lowering of engine speed, if combined with all the extra weight of the necessary compressors for scavenging and delivering the fresh charge, may very soon bring down the extra horse-power per lb. from a two-stroke cycle to a very narrow margin. It is unlikely, moreover, that the same thermal efficiencies will be achieved as with the four-stroke cycle. Nevertheless the two-stroke cycle is a possible line of advance, more especially with the greater perfection of compressors for supercharging and in combination with the Diesel type of fuel injection.

Sleeve Valves.—One of the most difficult aero engine problems is the satisfactory operation of poppet valves at high speeds and high temperatures. The drawback to the use of sleeve valves has been, in the past, a tendency toward gas leakage, excessive oil consumption and large mechanical loss due to friction; but with the single-sleeve valve it is possible, by skilled design, to minimize these troubles, and this type of valve holds out extremely attractive possibilities. The absence of all springs in the first place and of the excessive accelerations which are so detrimental to cams, would at once eliminate a constant source of trouble. Moreover, the sleeve would necessarily be cool, so that tendency to detonation would be reduced.

The Compound Engine.—Forty per cent or more of the heat energy of the fuel is at present thrown away in the exhaust of a high-duty engine; where weight is no consideration some of this can be used for raising steam, but such methods of improving efficiency are probably out of the question for aircraft. The question remains, "Can some of this waste heat be saved by expanding the hot gases much further in a low-pressure cylinder?" The difficulty lies in the transfer of the hot gases at 1,000° C or more from the high- to the low-pressure cylinder. So long as this has to be controlled by poppet valves the difficulties are probably insuperable; no valves could be expected to stand up to such treatment, when it is remembered that they would need to be operated from outside, and that therefore there would be continuous leakage of hot gas down the valve stems where they slide in the guides. The only hope for the compound engine seems to be through the development of the sleeve valve.

Jet Propulsion.—More than one proposal has been made that the force for propelling an aircraft forward should be obtained by shooting out a jet of air behind, on the principle of the rocket. To obtain efficiency, however, when using this principle, it would be necessary that the forward speed of the aircraft should be of the same order as that of the jet backwards, while at the same time the drag due to air resistance has to be overcome by the reaction between the aircraft and the jet. The two conditions are incompatible. An alternative of greater possibilities is to have an air-screw which is rotated by jets at the blade tips and eliminates other driving mechanism, but this could never hope to achieve more than a very poor fuel economy when compared with a present-day heat engine. This has been proposed many times, both in water and air craft, but all tests have been so extremely inefficient as to border on the absurd. (D. R. P.)

The Diesel Engine.—Many attempts have been made to solve the problem of the aircraft Diesel engine by refinements in design, but the low mean effectives as compared with the petrol engine offer too great a handicap. These engines of the four-cycle type, through extreme refinement of design, have been brought down close to 8lbs. to the h.p. dry weight, for water-cooled engines. This, however, is too heavy to be considered. These engines will operate with clear exhaust, but this has not been the experience with various attempts with two-cycle. As soon as high speed is attempted with two-cycle, the scavenging pressures and requirements in volume become insuperable and it is found impossible to get sufficient oxygen in the cylinders within the time allowed to make the engines at all practicable.

The very greatly increased net mean effectives that can be obtained through supercharging are necessary to bring the weight down, but this immediately presents the difficulty of higher exhaust pressures, which brings into consideration compounding for the sake of economy. From work that has been pushed along this line for several years it would seem that the combination of the two last mentioned modifications is likely to bring the weight of the aero Diesel down to, if not under, 2lb. per b.h.p. This, however, can only be achieved by carrying supercharging very much higher than ever before, and it is found that this is attended by no insurmountable difficulties. Difficulties were at first met, but these seem to yield to analysis and continued research. The great contribution of high supercharging is not only in greater mean effectives, but also in securing a shape and form of the combustion space that is many times more favourable than that of the comparatively minute crevice—on the order of $\frac{1}{20}$ the stroke only—constituting the normal Diesel clearance.

The lower cylinder temperatures of the Diesel as compared with the petrol engine allow of the single-sleeve valve being successfully employed, which, combined with the high supercharging pressure, introduces another very important factor—turbulence. This turbulence can be regulated and brought to an extremely high velocity, which is probably the most significant of all the gains. Not only is this velocity high at the moment of fuel injection at the end of the compression stroke, but it is found to persist throughout the remaining three strokes of the compound cycle. This has a three-fold significance. First, it allows the fuel to commingle with and finally reach a greater percentage of oxygen than has ever before been possible; secondly, it allows this process to go forward at very much higher speeds; thirdly, it ensures completeness of combustion, especially that fraction known as after-burning, which here takes place under conditions of extreme turbulence.

It is found that such an engine as this turns out to be $\frac{1}{7}$ two-cycle with very much higher net mean effectives to the crank for all power pistons than in two-cycle practice. The $\frac{6}{7}$ of the engine which remains four-cycle is performing an extremely useful function in producing the high velocity turbulence above referred to. In such an engine it is found that the negative work is only 1 : 42, accounting for the very high mechanical efficiency observed in this cycle.

The great advantages of the Diesel cycle in addition to those already referred to are: first, there is no difficulty in the distribution of fueling between the cylinders; secondly, the low fuel demand is extremely important in increasing the radius of flight or the pay load in commercial aircraft; thirdly, the complete elimination of all fire risk inasmuch as the fuel oil is not volatile. It is practically impossible to ignite it by any ordinary method and it will actually extinguish a small bonfire when dashed upon it. Besides this, it costs between ¼ and ⅓ less and develops as much as 35% more B.Th.U.'s than "aviation gas," volume for volume. Fourthly, it does away with all of the electrical ignition complications and troubles, including spark plugs, together with the serious interference with wireless and radio reception.

BIBLIOGRAPHY.—A. W. Judge, *Automobile and Aircraft Engines in Theory and Experiment* (1921); L. S Marks, *The Airplane Engine* (1922); A. G. Clark, *Aeronautical Engines. See* the *Transactions, Bulletins* etc., of the aeronautical societies, institutes, etc.

(E. A. Sp.)

AEROFOIL, a wing of an aeroplane. (*See* AEROPLANE)

AERONAUTICAL ARTICLES. The subject of aeronautics is treated in this work in the following series of articles. Under FLIGHT, NATURAL, will be found a study of natural flight, dealing with the mechanism of the bird's wing and the principles which underlie its use. From this the reader can pass to a general survey of artificial flying under AERONAUTICS and AVIATION, CIVIL.

The navigation and development of the balloon, and its transformation into an airship, can be studied in the articles BALLOON, AIRSHIP and AIRSHIP SHEDS.

Heavier than air flying machines are treated in the articles AEROPLANE, BIPLANE, MONOPLANE, HELICOPTER, ORNITHOPTER, GYROPLANE and AILERON.

Flying machines capable of alighting upon water are dealt with in the article SEAPLANE; in this connection the article AIRCRAFT-

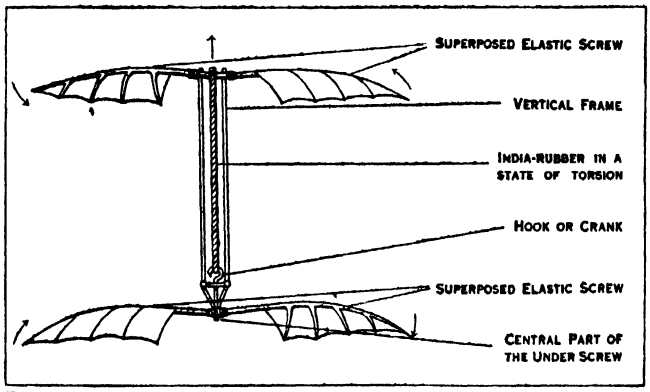


FIG. 1.—PENAUD'S HELICOPTER OR SCREW-MODEL BUILT IN 1872. MOST OF THE PIONEERS IN AERONAUTICS DIRECTED THEIR ATTENTION TO THE CONSTRUCTION OF MODELS CAPABLE OF VERTICAL FLIGHT

CARRIER studies an important factor in the application of flying machines to naval warfare.

The question of aircraft terminals and accommodation is treated in the articles AERODROME and AIRSHIP SHEDS

For engine details *see* the articles AERO-ENGINE, INTERNAL COMBUSTION ENGINES and AIRSCREW.

The practical navigation of aircraft and their employment for various purposes can be studied in the articles entitled AERIAL NAVIGATION, AIR-ROUTES and AVIATION, CIVIL. There are special articles on the PARACHUTE, AERODYNAMICS and AERIAL LAW.

AERONAUTICS. The record of man's attempts to fly goes back into the remote past. The story of Icarus is a myth founded

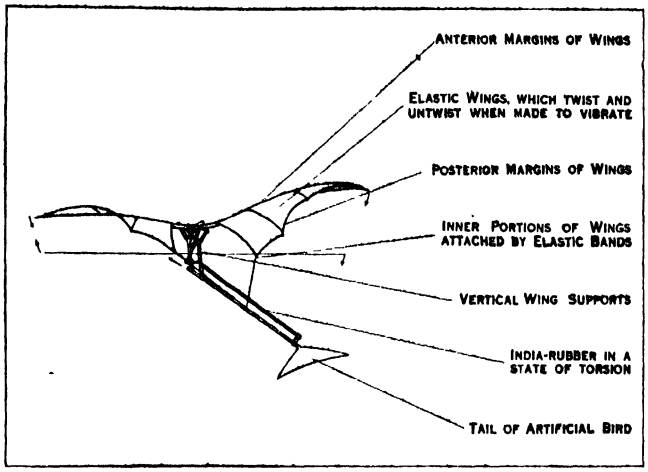


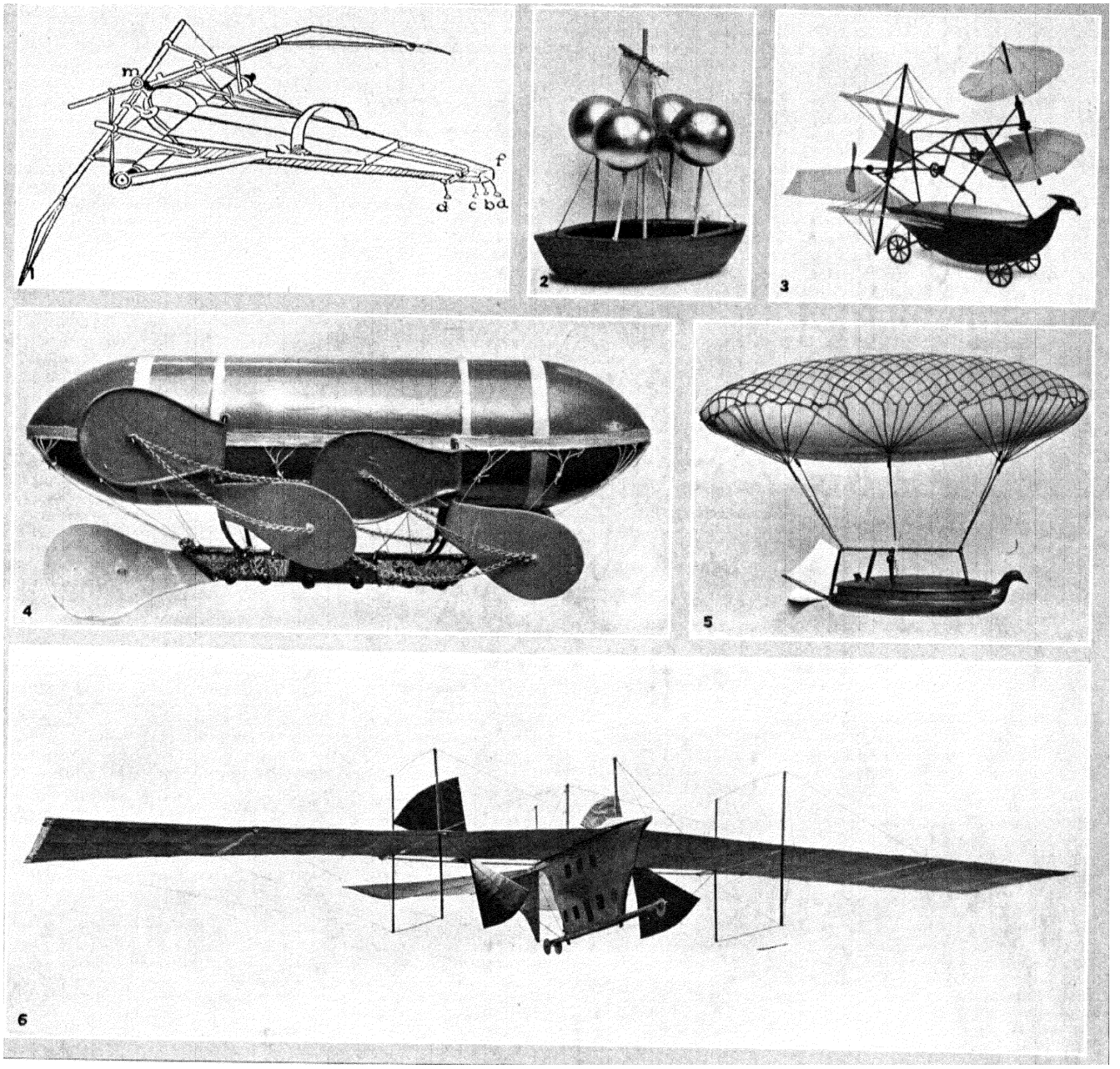
FIG. 2.—PENAUD'S SECOND MODEL WHICH WAS PROPELLED BY A SCREW AND SUSTAINED BY A HORIZONTAL FLEXIBLE WING PENAUD'S SUCCESS OVER OTHER SIMILAR MODELS WAS LARGELY DUE TO THE INVENTION OF WHAT HE CALLED AN AUTOMATIC RUDDER, WHICH WAS A SMALL WING PLACED AFT OF THE MAIN WINGS

perhaps on some early failure to imitate the birds. Leonardo da Vinci thought and wrote about it, and there are some references to the subject in the works of Francis Bacon. In 1617, Fleyder of Tübingen lectured on flying; while in Italy, again, in his book *De Motu Animalium* (1680), G. A. Borelli discussed the question in connection with the strength of man's muscles and came to the conclusion that such flight was impossible

Early History of Artificial Flight.—We are here concerned mainly with the flight of bodies heavier than air; for the early history of airships, *see* BALLOON and AIRSHIP. The first attempts, limited in all cases to the flight of models, were generally based on the endeavour to imitate the action of a bird's wings. Sir George Cayley, however, in 1706, constructed a tiny helicopter in which two windmills made of gull feathers were caused to revolve about a vertical axis. Figs. 1 and 2 illustrate two models due to Penaud, constructed in the early '70s of last century; in the first of these the motive power is obtained from a screw driven by the torsion of an india rubber cord; in the second an attempt is made to imitate the action of a bird's wings. Stringfellow in 1842 had already constructed a model in which the supporting force was obtained from the wings while the motive power came from a screw, and from that time on some of the fundamental principles underlying flight began to be more generally recognized.

TABLE I.

Year.	Experimenter.	Tip to tip.	Surface.	Weight.	Pounds per sq.ft.	Speed per hour.	Maximum flight.	Motor.	Horse-power.	Pounds sustained per h.p.
		Ft.	Sq.ft.	Lb.		Mls.	Ft.			
1879	Tatin	6·2	7 5	3·85	0·51	18	100?	Compressed air	0·03	110?
1885/1889	Hargrave (No. 16)	5·5	26·0	5·00	0·19	10	343	" "	0·06	79
1893	Phillips	22 0	136·0	402·00	3·00	28	500?	Steam	5·6	72?
1894	Maxim	50·0	4,000·0	8,000·00	2 5	36	300?	"	363·00	28
1896	Langley	12 0	70·0	30·00	0·43	24	4,000	"	1·00	30
1897	Tatin and Ritchet	21·0	86·0	72 00	0·83	40	460	"	1·33	55
1897	Ader	49·0	270·0	1,100·00	4·00	50?	100?	"	40·00	27
1895	Lilienthal	23·0	151·0	220·00	1 46	23	1,200	Gravity	2·00	110
1896	Pilcher	23·0	170·0	200·00	1·17	25	900	"	2·00	100
1896	Chanute	16·0	135·0	178·00	1·31	22	360	"	2 00	89
1906	S. Dumont	39·0	560·0	550·00	0 98	22·26	2,900	Petrol	50·00	23
1906	W. Wright	41·0	650·0	1,100·00	1·7	37	295,000	"	24·00	46



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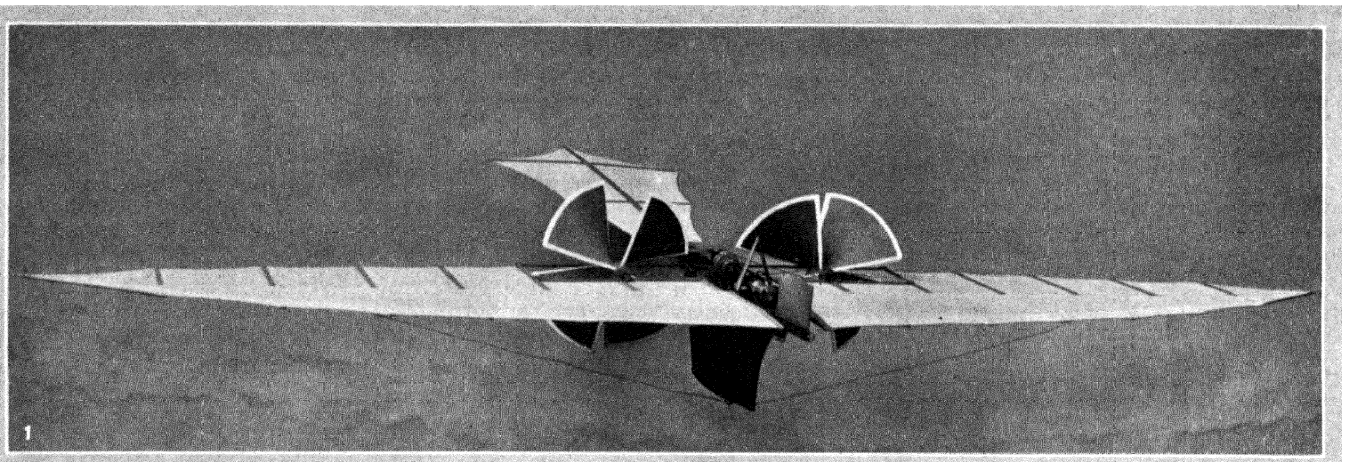
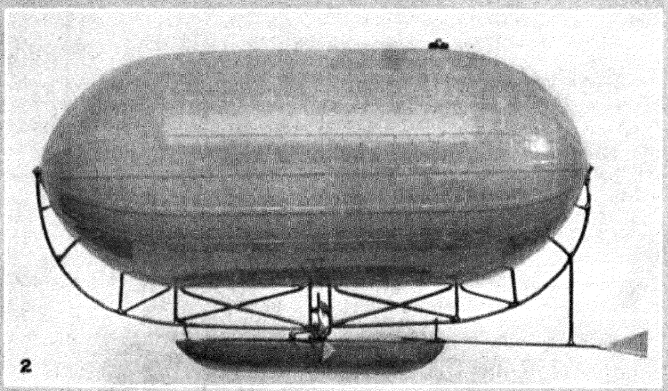
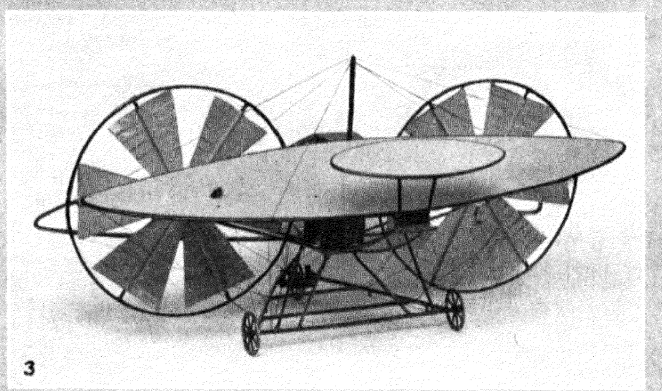
EARLY DEVICES OR PLANS FOR FLYING MACHINES, 1500 to 1843

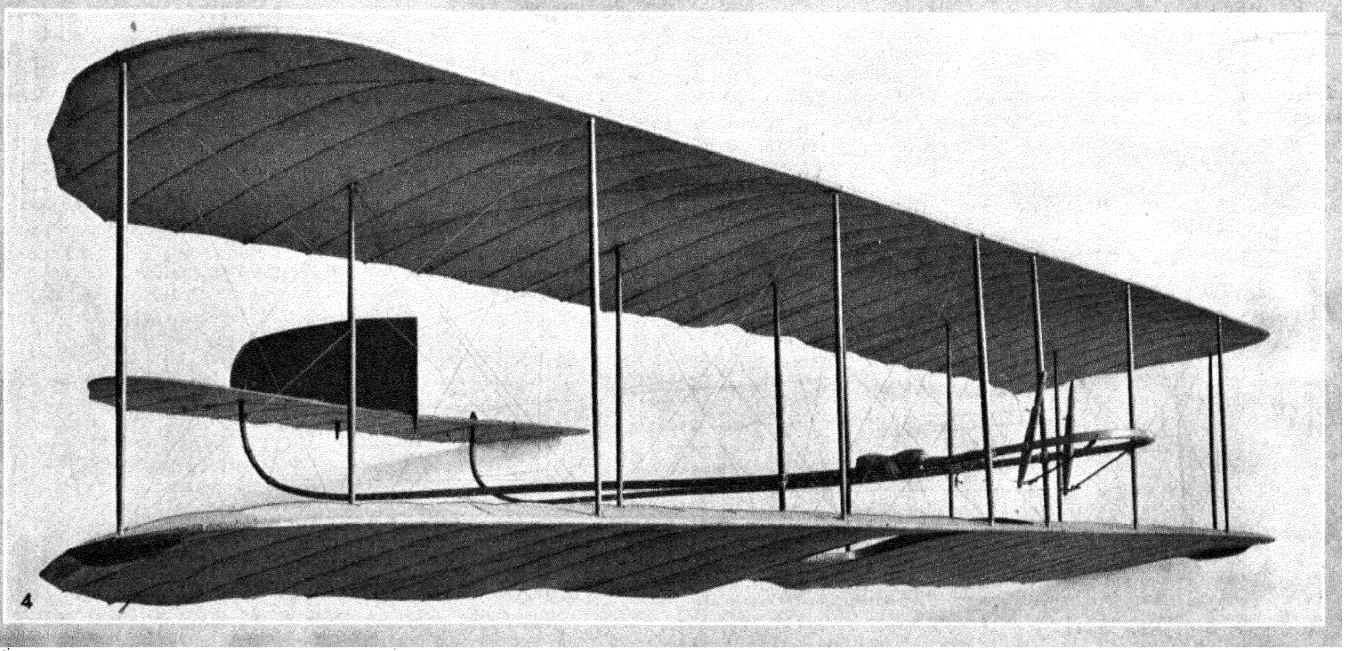
1. Leonardo da Vinci's conception of a flying machine 1500. The wings or "oars" were to be operated by a system of stirrups or pulleys
2. Francesco de Lana's flying boat, conceived about 1650. The plan was to attach a boat with sails to four large copper balls from which the air had been exhausted
3. Combination of helicopter and aeroplane planned in 1809 by Sir George Cayley, spoken of as the father of British aeronautics
4. The "Eagle," designed by Comte de Lennox in 1834 in collaboration with Le Berrier; dimensions 130 feet by 35 feet with a lifting power of 6,500 pounds
5. Hand-driven propeller type navigable balloon experimented with in 1816 by Sir George Cayley
6. Hensen's "Aerial" steam carriage, designed in 1843. The extensive supporting structures occupied a nearly horizontal position, and it was equipped with a 25-h.p. steam engine, but it never left the ground

AERONAUTICS









BY COURTESY OF (1) THE DIRECTOR OF THE SCIENCE MUSEUM, LONDON, (2, 3) SIMS & CO., (4) THE ROYAL AERO CLUB

NINETEENTH CENTURY EXPERIMENTAL NAVIGABLE BALLOON AND AEROPLANES

1. Stringfellow's aeroplane, built in 1848, the first model aeroplane to fly
2. Bell's patent locomotive navigable balloon, 1850; an early attempt at a semi-rigid dirigible with two hand-driven propellers
3. Thomas Moy's Aerial Steamer, 1874, which was fitted with a 3 h.p. steam engine but succeeded in rising only a few inches from the ground
4. Chanute's Glider, 1903. In experimenting with this and other forms of engineless aeroplanes, Octave Chanute made over a thousand glides without accident

TABLE II. RECORD OF PERFORMANCES OF BRITISH SERVICE AIRCRAFT

Type.	Tractor or pusher.	Crew.	Engine.	Normal B.H.P. & R.P.M. at G.L.	Lifting surface	Air screw D.R.G. No.	Speed in M.P.H. & R.P.M. @ 10,000′ At 6,500′	At 10,000′	At 15,000′	Air endurance. hr	Time in min. & sec. & rate of climb in ft. per min. (& R.P.M. @ 10,000′). 6,500′ Time	6,500′ Rate	10,000′ Time	10,000′ Rate R.P.M.	15,000′ Time	15,000′ Rate	Service ceiling. ft.	Loading Lb. per sq. ft	Loading Lb. per H.P.	Fuel cap. Gal	Bombs Lb.	Weight (lb.) Gross = Empty + oil & reserve water + Fuel, + Mil'y load + Crew	Dimensions. Span.	Length	Height.
S. S. fighter . .	T	1	Radial	394 at 1700	293·1		154	153	149		4′–6″	1635	6′–21″	1375	10′–36″	1000	27100	10·05	7·48	..	.	2946	2015	400	351	180 33′–1″	23′–5″	9′–8″
Army co-operation .	T		Radial	394 at 1700	381 6		135·5	133	126		6′–12″	844	10′–59″	640	21′–6″	370	20025	9·75	9·2	..		3716	2242	655	459	360 39′–3″	27′–6″	10′–2″
S. Eng. day bomber .	T	2	Water cooled	670 at 1900	695 6	..	122 5	120	113		6′–30″	790	11′–45″	565	24′–42″	260	18000	11·18	11·58	..	..	7773	4799	1580	1034	360 56′–8″	38′–5″	13′–7″
Twin Eng. day bomber	T	3	Radial	964 at 1700	964 8	..	130	129	121·5	.	6′–30″	970	10′–30″	745	19′–0″	460	21500	9·17	9·67	..		8852	5275	1980	1057	540 71′–8″	41′–4″	14′–10″
Night bomber . .	T	4	Water cooled	940 at 2000	2164		93·5	.	..		26′–36″	135				..	7600	8·53	19·4	.	.	18460	10247	4389	3104	720 87′–10″	57′–5″	17′–6″
General purpose .	T	2	Radial	482 at 1700	488		132	129	123		6′–27″	955	10′–36″	750	18′–50″	480	22700	8·7	8·8	..		4240	2644	696	540	360 46′–5″	31′–8″	11′–0″
Ship fighter . .	T	1	Radial	394 at 1700	284 5	..	133 8	131 5	125·5	.	5′–0″	1086	8′–38″	840	16′–23″	490	20600	10·64	7·74	.		3029	2141	445	263	180 29′–0″	23′–2″	9′–4″
Reconn. seaplane .	T	3	Water cooled	470 at 2000	443·4	..	130	126	117		6′–39″	800	11′–38″	603	22′–42″	320	18900	11·95	11·02	..	.	5300	3742	444	574	540 45′–10″	36′–4″	12′–7″
Fleet recom. ship plane	T	3	Water cooled	470 at 2000	650	.	86	..		..	28′–45″	118	..	.	.		6942	10·25	14·33	.		6662	5176	599	347	540 45′–7″	38′–8″	15′–6″
Torpedo carrier . .	T	2	Water cooled	470 at 2000	681 2	.	104	92			18′–15″	230	43′–15″	75			9500	10·37	15·25	.		7071	3802	779	2130	360 45′–6″	36′–9″	12′–10″
Boat seaplane . .	T	5	Water cooled	940 at 2000	1447 7	.	101·6	95			13′–46″	323	29′–19″	146			10920	9·89	15·2	.		14300	9021	2500	2059	720 5′–0″	49′–3″	18′–7″

NOTE:
Loading (Lbs. per H.P.)—Gross weight ÷ Actual H.P. developed at normal revs. (A suffix R shows that *Rated H.P.* has been used in absence of *Actual H.P.*)
Lifting surface—Surface of wings and flaps only.
Military load—Weight of guns, bombs, ammunition and reconnaissance load (not crew).
Air endurance—At 10,000 alt.; at full throttle including climb, unless otherwise stated.
Service ceiling—Height at which rate of climb is 100 ft./min.
Weight empty—Includes cooling water in radiators.

Principles of Flight.—A bird's wings have two functions to perform; they support the bird in the air and they propel it forward. For an account of how this is done reference may be made to the article on FLIGHT, NATURAL. It would appear that support is given by the portions of the wing nearer the body, while the propulsive power comes from the more rapidly moving tips.

Imagine a flat surface in the form of a long rectangle, with its long edge horizontal and its surface inclined downwards from front to back, to be moved forward in a horizontal direction at right angles to its length. The pressure of the air on the under surface exceeds that on the upper; the plane thus experiences a force directed upwards and backwards. This can be resolved into one force, the "lift," acting vertically upwards, in a direction, that is, opposite to the weight of the plane, and into one directed backwards, the "drag," tending to stop the motion.

Measurement would show that approximately these forces are proportionate to the area of the plane and the square of the speed with which it is moved.

Now support on the plane an engine driving a screw propeller. If the motion thus produced be sufficiently rapid, the lift will exceed the weight of plane and engine, and, omitting for the moment considerations of balance, the plane will fly.

Early Mechanical Machines.—It was on principles such as these that machines were constructed by Henson in 1842 and Stringfellow in 1848. Stringfellow, in 1868, exhibited at the Crystal Palace a model for which he received a prize of £100. Langley, of the Smithsonian institute of Washington, worked on similar lines. It had been realized by this time that greater lifting power could be obtained by shaping the supporting surfaces correctly, *i.e.*, by giving them a convex shape on the upper side and a concave on the lower. A steam-driven model flew, in 1896, for a distance of about ½m. along the Potomac river near Washington. At a later date, Langley built a large machine which was intended for passengers. It was fitted with a remarkably light steam engine designed by Manley and driven by two propellers; this was launched into the air from a vessel in the river. On each of the two occasions in 1903 on which it was tried, something went wrong with the launching arrangements and the machine was wrecked. Another early machine was that of Sir Hiram Maxim; this too was damaged in a trial in 1894.

Gliders.—Meanwhile, it had been realized that before success was reached more knowledge as to the conditions of balance in the air was necessary and, further, that much could be learned by the aid of gliders depending for their support on natural air currents.

The experimenters, suspended from their wings, jumped from natural or artificial heights and allowed the wind to carry them through the air. Lilienthal in Germany, who first showed the advantage of curved over flat surfaces, was killed after making over 2,000 safe flights; he endeavoured in these to maintain his balance by shifting his position relative to the wings. Chanute, in America, made the surfaces of the aeroplane movable; he constructed a number of machines. *See* GLIDING IN U.S.

The Modern Era.—Wilbur and Orville Wright, of Dayton in Ohio, began their epoch-making work in 1900 with gliders. They introduced two great improvements: the elevator, or horizontal rudder for steering the machine in the vertical plane, which they placed in front of the main planes (in nearly all modern machines it is attached to the tail); and the flexing of the rear edge of the main planes so as to vary the lift on either or both at will and thus maintain the balance in the air. A petrol motor driving a screw was added in 1903. In 1905 they made 45 flights, in the longest of which they remained in the air for half an hour and travelled 24½ miles. A little later, 1906, Santos Dûmont constructed a machine in which he flew a distance of about 250yd. in 21 seconds.

In 1908, Henry Farman, at Issy-les-Molineaux, made a circular flight of 1km. and on Sept. 29 he covered 24½m. in 42min. Meanwhile the Wrights had continued their work at Dayton. On Sept. 12, 1908, Orville made a flight of 45m. in 1hr. 14½min.; but a few days later he had an accident in which he was seriously injured and his passenger was killed. Wilbur Wright, on Sept. 21, 1908, at Le Mans, beat all previous records by a flight of 56m.

in 1hr. 31min. 25⅘sec. On Dec. 31 he remained in the air for 2hr. 20min. 23sec.

These great advances had been rendered possible by the improvement of the petrol engine.

In 1909, a number of notable flights were made, several of them in monoplanes. On July 25 Bleriot crossed the Channel from Calais to Dover, and later Latham nearly achieved the same feat.

In November, Farman covered a distance of about 134¼m. in 4hr. 17min. 53sec.

Next year Paulhan, at Los Angeles, in a biplane, reached a height of 1,383yd. and on April 27–28, 1910, the same pilot won the *Daily Mail* prize of £10,000 by flying within 24 hours from London to Manchester with one stop.

Table I., printed herewith, gives some details, approximately correct, of the principal experiments made with flying machines from 1879 to Wilbur Wright's flight in France.

Since that day the advance has been enormous. In place of the toy models of Henson and Stringfellow we have machines weighing as much as ten tons with a wing span of 70–80ft. and speeds rising to over 100m p h., and in a machine such as that which won the Schneider cup in 1927 far in excess of this, driven in some cases by twin or triple engines aggregating from 900 to 1,000h p.

For details of British Service aircraft *see* Table II. on page 243.

THE SCIENCE OF AERONAUTICS

The year 1909 opened a new era in the history of aeronautics. Towards the end of 1908, the Wrights had made their flights. The value of the aeroplane as a weapon became obvious; how valuable, it was left for the World War to show. Little was known of the forces affecting aircraft in motion; of the laws regulating the flow of air in their neighbourhood; the conditions required for balance and safety; the relation between the form and dimensions of the supporting planes and the weight carried; or the mechanism necessary for the control of the machine in flight.

The internal combustion engine had made flight possible, but the way to combine efficiency and lightness was but vaguely understood. The propeller brought problems of its own; naval architects had made a study of the action of the screw in a ship; to what extent did the conclusions they had reached apply to an airscrew? It was clear that there was much to learn and many directions in which research and experiment, conducted under proper supervision, could help.

Experiments in aerodynamics had been made by Langley in 1891. Zahm at a later date (1902–03) had measured the air velocity, pressure and friction on surfaces of various forms. Stanton, at the national physical laboratory, had experimented on the resistance of surfaces in a current of air and the pressure of the wind on plates. Lanchester, in his *Aerodynamics,* had described similar measurements. Lord Rayleigh, in various papers of great importance dating from 1876, had discussed questions of the resistance of fluids and, in 1899, contributed to the Manchester Memoirs a paper on the mechanical principles of flight; but no organized attack on the questions raised by the flight of a body heavier than air had been made.

Abroad, the airship had attracted more interest. In 1906 the society for the study of airships was formed in Germany, divided into branches dealing respectively with meteorology, dynamics, construction and engineering. Their first report, March 1907, describes in full detail programmes of the work proposed in these various branches; specially interesting is the account it gives of the method of testing resistance to the motion of an airship by means of a model in a wind tunnel and other proposals by Prof. Prandtl for testing model airships by means of towing by automobile.

Advisory Committees for Aeronautics.—Early in 1909, R. B. (later Lord) Haldane suggested that a section devoted to research in aeronautics might be established at the national physical laboratory. In May of that year the prime minister, H. H. Asquith, announced that this had been done and that, for the superintendence of the investigations and to advise on scientific problems arising in connection with the work, he had appointed a special committee—the advisory committee for aeronautics.

Meanwhile, work of a similar character was in progress elsewhere: at Göttingen, under Prandtl; at Koutchino in Russia, where Riabouchinsky was director; at a somewhat later date in America under the national advisory committee for aeronautics; and in Italy by Crocco; while papers on stability had been published by B. F. Lanchester and Soreau.

Aerodynamics.—In studying the forces to which aircraft are subject in flight, mathematics alone are of but little help; the dynamics of the air are too complex for a complete theory, and recourse must be had to experiment.

In the case of a body heavier than air an upward force, or lift, must be provided which, when the motion is horizontal, will just balance the weight. As the aircraft moves forward various actions produce a resistance to its motion, and unless a force is provided to balance that resistance, the drag on the machine, it will come to rest; the mechanism must provide a propelling force which for uniform speed must just balance the drag.

Now we have seen already that when a flat surface inclined at a small angle to the direction of motion is moved forward through the air it experiences a resistance—drag—opposing the motion and a force—the lift—at right angles to that motion.

To carry a given weight how large must this surface be, at what speed must it move and at what angle to the direction of motion should it be placed? What will be the resistance to its motion and what horse power must be supplied? What is the best form of surface for the purpose both in section and in plan? How must matters be arranged so as to secure controllability and reasonable safety to the flyer? Such were some of the questions to be answered.

Since 1909, many, perhaps all, of these and similar questions have been answered in part by observation and experiment on full scale machines, in part by the use of suitable models in a wind tunnel.

The Wind Tunnel.—W. Froude had shown that by towing the model of a ship in a tank and measuring the force required to tow it, the resistance to the motion of the ship at sea and the horse power required to propel it could be calculated

In tank experiments the model is towed through water, but the problem is one of relative motion. If it were possible to obtain a steady stream of water free from eddies and turbulence, the model might be stationary and the water stream past it. This was the method adopted by those investigating the pressure of moving air on surfaces exposed to its action. Arrangements were devised to produce a steady flow of air through a closed channel and measure its speed. The model was placed in this stream and attached to a balance specially designed to measure the forces acting on it.

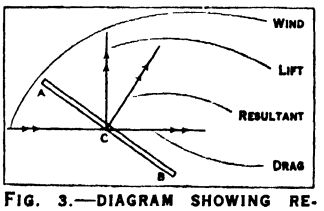


FIG. 3.—DIAGRAM SHOWING RESULTANT OF LIFT AND DRAG ON A FLAT RECTANGULAR SURFACE

Imagine the air stream in the tunnel to be horizontal, and take as an example a narrow rectangular plate placed with its longer edge horizontal and at right angles to the direction of the wind and its plane inclined at a definite angle to the same. This angle is known as the angle of attack. The balance is such that the horizontal force or drag, the vertical force or lift at right angles to the wind direction, and couple tending to turn the model about an axis parallel to its length can all be measured. The last observation enables the position of the centre of pressure, or point in which the resultant of the wind forces intersects the model, to be determined.

For fig. 3, *ACB* represents a section of the model by a vertical plane through the wind direction. *C* is the centre of pressure through which acts the resultant force; the balance measures its components, the lift, the drag, and also the couple tending to rotate the model about an axis perpendicular to the paper through some point depending on the attachment to the balance.

Details of the various forms of wind tunnel in use and of the balances and their method of attachment to the model will be found in the article on AERODYNAMICS, to which reference should be made.

It is found that, so long as the angle of attack remains the same, the lift, the drag and the couple are approximately proportional to the product of the density of the air, the square of its speed and the area of the surface on which it acts; so we may write

$$L = K_L \rho S V^2$$
$$D = K_D \rho S V^2$$
$$M = K_M \rho S V^2$$

when M represents the couple; the coefficients K_L, K_D, K_M are constant so long as α the angle of attack is not varied; ρ is the air density, S the area of the plane and V the air speed

The three coefficients depend on the angle of attack; by making observations at various inclinations of the surface to the wind we can draw a curve for each of the quantities L, D, M and thus read off their values at any angle of attack

Scale Effect.—But this is for the model How can we step from it to the actual machine? Froude had shown that for a ship there was a definite relation depending on the size and speed of model and ship Lord Rayleigh investigated the condition, which must hold in order that the motion of the air round the model should be similar to that near the machine. He found that, assuming the medium in which the motion takes place to be identically the same in both cases, the condition was expressed by the statement that vl should be the same for model and machine, v being the speed and l some length determining the scale in each case. Now, clearly this condition cannot be satisfied; for both the speed and size of the model are necessarily less than those of the machine itself Experiment, however, has shown that in many cases it is not necessary to fufil the strict condition; we may apply the equations already given to the machine using the value of the coefficients, K_L, etc., found from

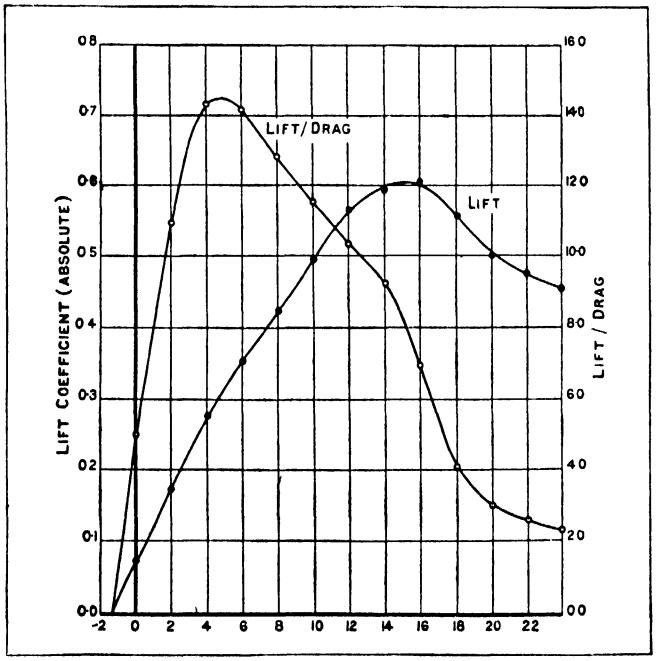


FIG. 4.—CHART OF LIFT COEFFICIENT SHOWING IN ADDITION TO THE LIFT AND DRAG CURVE, THE RATIO OF THE LIFT TO THE DRAG

the model experiments. Still, there are numerous problems in which this scale effect is of importance, and for discussion of these reference must be made to the article AERODYNAMICS.

Lift and Drag.—The curves for lift and drag depend on the form of the aerofoil under test. For a given incidence the value of K_L, the lift coefficient, will be much less for a plane surface than for a wing of good form. Fig. 4 gives the curves for a wing, while in fig. 5 are shown some wing sections. In addition to the lift and drag curves, the ratio of lift to the drag is also plotted and it will be noted that this has a minimum value for a low angle of incidence and increases somewhat rapidly with the incidence. The lift, it is true, increases up to a certain value as the angle of attack is increased; but the drag increases more rapidly. Thus, while a much greater lift is obtained by increasing the angle of the planes to the horizontal the thrust given by the airscrew necessary to do this increases in a much more rapid ratio.

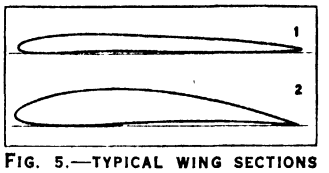


FIG. 5.—TYPICAL WING SECTIONS (1) R A F 15 (2) R A F. 32

Stalling.—The curves for different shaped wings are different and, while we may note that increasing the camber of the upper surface within limits increases the lift, reference for the detailed effect of the shape of the section on the properties of the wing must be made to the article AERODYNAMICS. All curves of the lift have one property in common. As the angle of attack increases still further the lift suddenly falls; the aeroplane can no longer fly; its power to carry its load has gone and it must fall; it is said to be stalled. If the engine power be sufficient to maintain the speed, then by increasing the angle of attack at which the machine is flown the weight carried can be increased, or alternatively, if the load remain the same while the angle is varied, the speed can be reduced, until at last a limit is reached, the stalling angle is exceeded and the machine becomes uncontrollable and falls.

A very large proportion of the accidents which occur arise from this; it may be an engine failure or a lapse on the part of the pilot causing him to attempt a turn when going at too slow a speed; the machine is stalled at too low an altitude and falls; before control can be regained it strikes the ground and is wrecked

Wind Tunnel Results.—For a full discussion of the equations giving the lift and drag and the consequences to be deduced from them reference must be made to AERODYNAMICS. A few of the more obvious consequences may be mentioned here.

Besides its wings, an aeroplane has a tail and elevator, a body fitted with a fin and rudder, an engine and airscrew, with tanks for petrol and oil; all of these contribute to the drag and some to a small extent to the lift, but neglecting these, let us see what conclusions we can draw directly from the equations.

When an aeroplane is flying horizontally at uniform speed the total lift will just balance the weight W. The lift is mostly carried by the wings; so neglecting for the present the effect of the tail and body we have the result that the weight carried is found by multiplying together the lift coefficient, the density of the air, the area of the wing and the square of the speed.

The loading, the average weight carried by each unit of area of the wings, will be given by dividing the quantity by the area of the wings.

Again, the conditions which must be satisfied if the machine is to climb well can be worked out, and we see how experiments in the wind tunnel can be utilized to predict the performance of the machine.

Conditions for Stalling.—Before passing on to consider other problems, it will be useful to look a little further into the question of stalling. Observations in the wind tunnel made by the aid of smoke or in a water channel show that for a wing of good shape, flying at a small or moderate angle of incidence, the motion of the air is approximately stream line; it flows smoothly past the wing, there is very little eddying or turbulence. As the incidence is increased the eddies formed behind the wing increase also and for a time the lift and drag increase until a condition of affairs is reached in which there is little or no semblance of stream line motion; the wake behind the wing is a mass of turbulent eddies; the drag is very large while the lift falls and is quite uncertain as to its value.

The changes outlined are illustrated by the figures 6 and 7. The figures show too why the drag increases as the incidence

becomes larger. It is known that in a frictionless fluid, and air is nearly frictionless, there would be no resistance to the motion of a body of stream-line form, a body that is, round which the air would flow in stream lines without eddies; that in any actual case there is some small resistance is due to the slight friction between the body and the air; but when the motion becomes turbulent, energy is necessary to support the turbulence and some of the power required to propel the body is used in supplying this energy; the drag on the body is increased and more power is needed to maintain the speed.

Stability.—Before turning to this section of our subject it is necessary to consider what is meant by stability.

A pendulum, such as a ball hung by a string, or a rod balanced vertically on a finger, when at rest, are both in equilibrium. So long as they are undisturbed the rod and the string both remain vertical, but the effect of a slight disturbance differs in the two cases; if the pendulum be disturbed it oscillates about its equilibrium position for a short time, finally coming to rest as before; the rod when disturbed falls to the ground unless by skilful movements of the finger it is possible to restore the balance. The pendulum exemplifies a case of stable equilibrium, the rod of unstable; similar considerations apply to a body in a state of steady motion, an aeroplane (say) moving horizontally with constant speed. Imagine that by some means—a sudden downward gust for example—the motion is slightly disturbed and the nose takes a downward direction. Suppose too that the pilot does nothing to counteract this, then two things may happen, the nose may rise again—of its own accord as it were—and after a few oscillations up and down the machine may recover its horizontal path. Like the pendulum it is stable, it can be flown without touching the controls, unless of course the initial disturbance is too violent. When the engine has once been adjusted to give the power necessary to maintain horizontal flight at the specified speed the machine will continue to fly thus of itself. On the other hand, the initial disturbance may increase, the nose may continue to drop, the machine like the rod on the finger is unstable and action is required on the pilot's part in order to recover the steady horizontal flight. It is not possible here to discuss the conditions necessary for stability; it must suffice to state that they require the knowledge of a number of quantities known as stability derivatives which can be determined by suitable experiments in an air tunnel.



FROM "THE TECHNICAL REPORT OF ADVISORY COMMITTEE FOR AERONAUTICS," 1912-13, BY PERMISSION OF H M STATIONERY OFFICE

FIG. 6.—EDDIES FORMED IN THE WAKE OF A FLYING WING

This shows the minimum air disturbance when the plane is inclined at a small angle to the wind and the motion is effectively "stream-line"



IBID

FIG. 7.—EDDIES FORMED IN THE WAKE OF A FLYING WING

The increased angle of incidence of the wing to the air current creates appreciable air eddies

As to the relative advantages of stability and instability much might be written; stability brings with it consequences which for some purposes are disadvantageous. The machine has, as it were, a will of its own, once set to a certain course it tries to keep to it; it is less easy to manoeuvre, to be deflected by the pilot from its course and forced into the sudden changes of motion and aspect needed, say, for military purposes.

For a fighting machine too great stability is a disadvantage; on the other hand, for a civil machine designed to go from one aerodrome to another at a given speed, stability is a marked advantage; it adds to the safety of the aircraft and it diminishes greatly the strain on the pilot.

Modern Theories.—So far, we have been discussing the elements of aerodynamics and the manner in which wind tunnel experiments may be used to determine the characteristics of a machine.

Reference must be made to the article on AERODYNAMICS for a description of the various forms of wind tunnel now in use, and an account of how, following up some very early work by Lanchester the lift and drag of an aeroplane wing have been derived in the first instance by Prandtl and his school at Göttingen, from the fundamental equations giving the circulation set up in the air around the wing and the vortices shed from its tips and trailing edge. Much work on the same lines has been done under research committees working in England and America. Fig. 8 (p. 247) shows the usual form of wind tunnel adopted in Great Britain.

THE AEROPLANE

Fig. 9 on p. 247 gives a diagram of an aeroplane indicating its principal parts and their names.

The main purpose of the various parts is clear from the figure which represents a biplane; the wings support the machine; to secure steady motion in a vertical plane a *tail plane* is necessary, and in order that the motion in that plane may be controllable part of the tail is hinged and can be raised and lowered thus forming the *elevator.*

Steady motion in the horizontal direction calls for a *vertical fin* at some distance behind the main planes and, to control the direction of that motion, a *rudder* is added to guide the machine.

The tail plane and fin are connected to the wings by the *fuselage,* in the fore part of which is the *cockpit* containing the pilot's seat and the controls. A portion of the rear extremity of each wing is hinged about an axis parallel to the length of the wing, thus forming an *aileron.* Lowering an aileron increases the angle of incidence and therefore the lift of that portion of the wing; raising it has the opposite effect. The pilot is thus able to control any rocking of the aeroplane about a longitudinal axis

Control wires pass from these movable parts to the pilot's seat, those from the rudder going to the *rudder bar* worked by his feet, while those from the elevator are connected to the *control column* or *joy stick,* a rod fixed in front of the pilot by a universal joint at its lower end. The connections are such that the longitudinal motion of the column raises or lowers the elevator while a transverse motion affects the aileron.

In a *tractor machine,* as shown in the drawing, engine and airscrew are in front of the pilot; in a *pusher machine* they would be placed at his back. The planes are connected by *struts,* while rigidity is secured to the structure by a series of wires arranged to keep the two planes in fixed relative position. The *longerons* are the lower main members of the body structure which are prolonged forward so as to support the engine; the machine is carried on the *landing chassis,* an under carriage on wheels fitted with springs so as to absorb shock on landing. At the rear is the *tail skid,* which rests on the ground when taxying.

The distance between the wings is the *gap* In many machines the upper wing is not set exactly above the lower but either rather in front when the machine is set to be positively *staggered* or behind when the stagger is negative.

In a *monoplane* there is only one pair of wings.

Details of Structure.—We turn now to the actual design and structure of aircraft, remembering that a fuller account appears in the article AEROPLANE.

For most purposes the design must be such that the aeroplane will fly safely with a minimum expenditure of power. Since the total weight carried is fixed, the structure must be light in order that the useful load, that part of the load not made up of the weight of the machine including the engine, petrol, oil and necessary equipment, may be as large as possible; the machine must be controllable; the stability and manoeuvrability desirable will depend on the purposes for which it is required.

Landing is made more easy if the speed is slow, hence the stalling speed, the minimum speed of flight, should be kept as low as other requirements permit; precaution against fire should be taken, and, for a civil machine, the comfort of the passengers is of great importance; the noise inseparable from a high powered engine is most trying; and steps should be taken to reduce it whenever possible.

In the earlier machines the main structure was of wood and the wings were covered with linen cloth painted or doped with a kind of varnish to secure stiffness and protect the material.

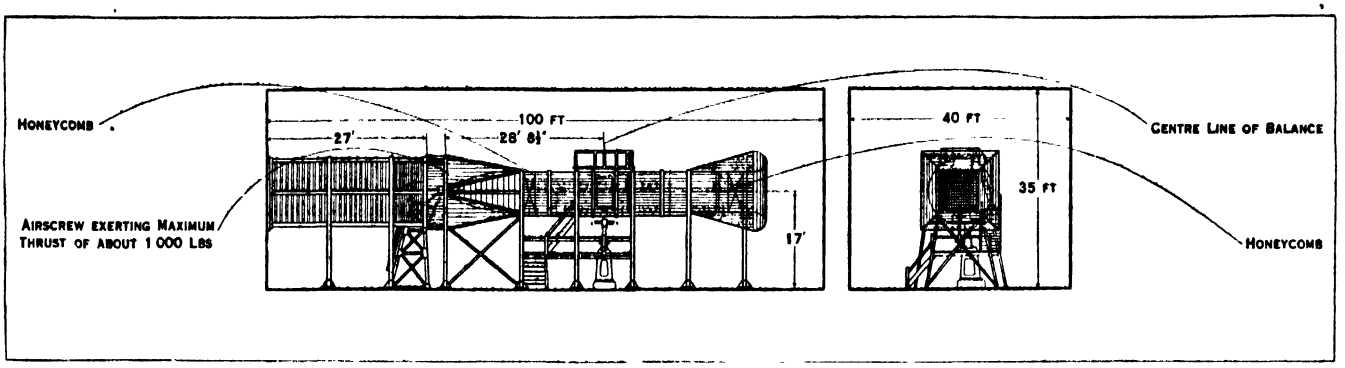


FIG 8.—WIND TUNNEL AT THE NATIONAL PHYSICAL LABORATORY, TEDDINGTON, ENGLAND, ILLUSTRATES THE FORM USUALLY ADOPTED IN GREAT BRITAIN FOR CONDUCTING AERODYNAMIC EXPERIMENTS

In more modern machines much of the main structure is of metal, while in a few, particularly sea-planes and flying boats, metal in the form of a thin sheet is used for the covering of the wings. The need to combine lightness and strength in aircraft has led to much metallurgical and engineering research, and by the use of new alloys many desirable changes in the structure have become possible.

The functions of the various parts of the machine are discussed in full detail in the article AEROPLANE and their use in controlling the flight at the will of the pilot described.

Prevention of Stalling.—By these means, so long as the machine has sufficient speed to produce the necessary lift, it is under control: but, if from any cause stalling incidence is passed, the lift is suddenly reduced, controls cease to be fully effective and the machine falls rapidly If this takes place at a sufficient altitude the pilot may be able to put the machine into action, thus increasing the speed and bringing the controls into full play again or, on the other hand, the machine may develop a spin, which it is difficult to stop, and be wrecked, before the pilot can regain control.

Now we have seen that the stalling speed is inversely proportional to the maximum lift coefficient. By increasing this, we reduce the stalling speed, *i.e*, we enable the machine to be flown at a speed at which it would otherwise be uncontrollable Various attempts have been made to put it into the power of the pilot to increase the lift in case of emergency; the *Handley Page slot* is one of these. This consists of a slot or narrow aperture cut in each wing, parallel to its length; the slot is ordinarily closed but the pilot has the means of opening it and thus the lift is increased In a more recent form, also due to Handley Page, the slot opens automatically when stalling incidence is passed.

The use of the slot alone has certain concurrent disadvantages. These, however, can be overcome by a suitable adjustment of the ailerons, and mechanism has been devised combining the two, so that when the slot is opened the ailerons simultaneously take up the correct position.

Fig 10 (p. 248) shows a wing fitted with a Handley Page slot.

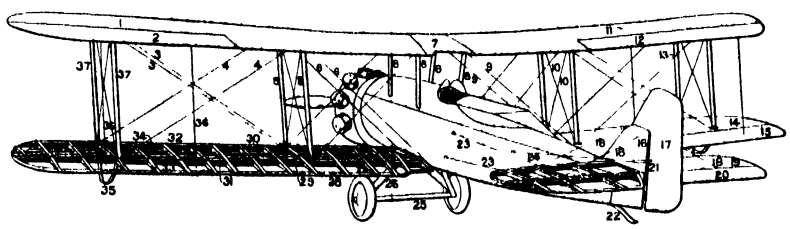
Loading: Load Factor.—In a modern engineering structure the stresses to which each component member will be subjected can usually be calculated and the necessary strength provided. In an aeroplane the stresses depend on the velocity and acceleration of the machine, its position in the air, the gusts of wind to which it may be subjected, etc. While it is possible to calculate them for steady horizontal flight and for certain other definite conditions of motion, the calculation cannot take account of all possible conditions.

To allow for this a load factor determined as the result of experience is assigned to each member of the structure; the calculated stress, including as usual a factor of safety, is multiplied by the load factor and the result is the stress which the member is designed to bear.

METHODS OF PROPULSION

The failure of the early attempts to fly was due in no small degree to the want of a proper engine; there was little knowledge of the power necessary. Models were devised, worked by india-rubber cords or clockwork, and in 1842 Phillips built a steam-driven model which, according to his account, rose to a great altitude and flew across two fields. Steam was used by Henson (1843), and Stringfellow (1847), who, in 1868, obtained a prize of £100 at an exhibition of the aeronautical society held at the Crystal Palace. The engine was estimated to give ⅓ horse power.

1 PORT UPPER MAIN PLANE
2 PORT UPPER AILERON
3 OUTER FLYING WIRES
4 OUTER LANDING WIRES
5 INNER INTERPLANE STRUTS
6 INNER FLYING WIRES
7 CENTRE SECTION UPPER PLANE
8 CENTRE SECTION STRUTS
9 INNER LANDING WIRES
10 INCIDENCE OR STAGGER WIRES
11 STARBOARD UPPER MAIN PLANE
12 STARBOARD UPPER AILERON
13 PRESSURE HEAD
14 STARBOARD LOWER MAIN PLANE
15 STARBOARD LOWER AILERON
16 FIN
17 RUDDER
18 TAIL PLANE BRACING WIRES



19 TAIL PLANE
20 ELEVATOR
21 RUDDER POST
22 TAIL SKID
25 UNDERCARRIAGE AXLE
26 UNDERCARRIAGE REAR STRUT
27 UNDERCARRIAGE FRONT STRUT
28 TRAILING EDGE
29 REAR SPAR
30 FRONT SPAR
31 COMPRESSION RIB
32 LEADING EDGE
33 PORT LOWER AILERON
34 STRINGERS
35 MAIN PLANE SKID
36 AILERON CONNECTING WIRE
37 OUTER INTERPLANE STRUTS

CONTROLS
23 ELEVATOR CONTROL CABLES
24 RUDDER CONTROL CABLES

FIG. 9.—MODERN AEROPLANE SHOWING STRUCTURAL PARTS

The weight of the complete model was under 12 lb. and the area of the wings and tail about ·36 sq. feet.

The steam engine used by Langley (1903) was remarkable; it was designed by Manley and its weight was extremely small for the horse power produced.

In his earlier model the weight of the engine was 60 oz. and the power developed 1h p.; the four boilers weighed 7 lb. each.

Maxim, in his experiments of 1894, employed a pair of two-cylinder compound engines, each weighing 600 lb. and giving 363h.p.

The whole problem was changed by the invention of the internal combustion engine burning petrol.

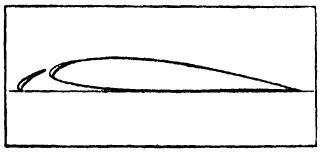


FIG 10.—A WING FITTED WITH A HANDLEY-PAGE SLOT TO PREVENT STALLING WHILE FLYING AT A SPEED AT WHICH THE PLANE WOULD OTHERWISE BE UNCONTROLLABLE

Santos Dumont employed a light and powerful petrol engine in 1906; about a year later Henry Farman used an eight-cylinder Antoinette petrol motor developing 40h p. at 1,100 revolutions per minute.

In 1908, Wilbur Wright, in his notable flights in France, employed a four-cylinder petrol engine of 24h.p., making 1,200 revolutions per minute and connected by chain gearing to two wooden propellors which revolved at 450 revolutions per minute. The weight of this motor was stated to be about 200 lb.

Engine Requirements.—From this time onward progress has been rapid and reference should be made to the article on AERO ENGINES for the details. The problem for the designer has been to reduce the ratio of weight to horse power; and this implies not merely a reduction in the weight of the engine itself but also in that of the fuel consumed.

While an engine of 450h p may weigh 900 lb. or 2 lb. per h p., the fuel it uses may amount in four hours to about the same amount; thus, while the engine weighs 2 lb. per h p. the power unit—engine and fuel for a four hours' flight—comes to 4 lb. per h p.

Again, in the design of an engine, attention must be paid to its head resistance; the aeroplane itself, with its wings, body and under carriage, offers considerable resistance to the motion, and this is increased in a marked degree, unless great care is taken in the design, by the resistance due to the engine itself, placed as it usually is in the extreme front of the machine. In designing a machine it is clearly of great importance to have regard to the engine with which it is to be fitted.

In the endeavour to combine lightness and power many problems await the designer; thermodynamic reasoning shows that the efficiency—the ratio of the energy given to the propeller to the heat, measured as energy, supplied to the engine—increases as the compression in the cylinder is increased, but too great a compression produces detonation—knocking—in the engine, and delicate experiments are required to investigate the cause of this. Something has been done recently by the introduction into the fuel of chemicals—dopes—which in some way reduce the tendency to detonate and permit a higher compression to be used, but the method of action of the dope is by no means clear, and requires further investigation.

Another difficulty arises from the high temperatures involved. A material is needed which will combine strength and the power to resist great heat, especially in the moving parts, the valves and valve spindles exposed to the outrush of the exhaust gases. Some of this difficulty may be met by sleeve valve construction.

The sparking plugs, again, are a source of difficulty; every motorist knows of the trouble caused from time to time by a faulty plug. In a modern high-power aero engine the troubles are multiplied many times, and much care and thought are being spent in devising improvements.

Petrol is a source of danger, and for airships especially the use of a high compression engine of the Diesel type would have marked advantages. Such an engine, if light enough, would also be of undoubted value in an aeroplane.

Power and Height.—The energy fed into an engine comes from the combustion of the oxygen drawn into the cylinder at each alternate stroke of the piston, and the volume drawn in is the same whether the engine be on the ground or at an altitude. But the air density falls as the machine rises. The quantity of oxygen ready for burning in each stroke is thus reduced and the power of the engine falls off. The exact proportion in which this occurs varies with different engines, but approximately the power is proportional to the density of the air drawn into the cylinder.

Supercharging.—To remedy this a device is added in certain cases whereby the density of the air supplied is maintained constant; this takes the form of a blower or pump which forces into the cylinder more air than would normally be drawn in; the engine is said to be supercharged.

Carburation.—The petrol is supplied to the engine through the carburetter and the amount of petrol needed for most efficient working depends on the amount of air drawn in; the ratio of petrol to air should remain constant.

Thus, as the machine rises and the air density falls, it is desirable to reduce the supply of petrol proportionately. Various devices have been proposed to do this automatically, none, however, completely successful, and as the result there is commonly a very considerable waste of petrol

Flow Meters.—The pilot has no ready means of knowing the rate at which petrol is being supplied, and for this a suitable form of meter to indicate the flow is highly desirable

Modern Engines.—The article AERO ENGINE indicates how these numerous requirements are being met; the splendid success achieved by the makers of the engine which won the race for the Schneider cup in 1927 is some measure of the advance that has been made.

Aero engines fall into two main classes: (1) water-cooled and (2) air-cooled; in the one the cylinders are cooled as in an ordinary motor car engine by water which circulates round their jackets and is itself cooled by passing through the radiator, placed usually in the extreme front of the machine, but in the case of modern extra high speed aircraft in the wings.

For an air-cooled engine, the outside of each cylinder is fitted with a number of webs or flanges, thus increasing the cooling surface, and the engine itself is placed in a position in which it is exposed to the full draught of air around the machine. It acts as its own radiator.

The air-cooled engine again falls into two classes; in the one the cylinders are fixed, the motion is conveyed to the airscrew by the shaft; in the other the cylinders rotate about a fixed shaft and carry the propeller round. Details as to a few typical engines are given in Table III. on p. 249.

THE AIRSCREW OR PROPELLER

The use of a screw as an instrument of proportion has long been familiar, and various theories have been proposed to account for its action.

The earliest of these, due originally to Froude and Rankine, is known as the momentum theory; the screw is regarded as a disk which in some way imparts momentum to the column of fluid which passes through it.

Imagine the machine to be at rest and the air where uninfluenced by the screw to be approaching it with velocity V.

In reality, of course, the air is at rest, and the machine moves forward with velocity V_1 but the forces brought into play are identical in the two cases. The velocity of the column of air which passes through the airscrew disk—the area of the circle swept out by its blades—is increased according to Froude by an amount v so that the column leaves the screw with a velocity $V+v$. It follows as a further consequence of the theory that half the additional velocity is acquired before the screw is reached. So that the velocity with which the air arrives at the screw is $V+\frac{1}{2}v$.

Thus we have a column of air of density ρ and area of cross section A approaching the screw with speed $(V+\frac{1}{2}v)$ and the mass which traverses the disk in 1 sec. will thus be $A\rho(V+\frac{1}{2}v)$. This mass gains a velocity v. and the momentum generated in one second is $A\rho(V+\frac{1}{2}v)v$. This must be the force exerted by the

TABLE III. BRITISH BUILT AERO ENGINE DATA

Type.	No.	Cylinders. Bore. M./M.	Bore. Ins.	Stroke. M./M.	Stroke. Ins.	B.H.P. & Crankshaft R.P.M. Rated. B.H.P.	Rated. R.P.M.	Normal. B.H.P.	Normal. R.P.M.	Maximum B.H.P.	Maximum R.P.M.	Compression ratio.	B.M.E.P. at normal.	Piston speed (ft./min.)	Reduction gear ratio.	Fuel Cons^{p} at normal. Lbs. B.H.P./H.R.	Fuel Cons^{p} at normal. Total lbs.	Total oil consumption in lbs.	Weight. Dry lbs.	Weight. Lbs./B.H.P.
Air cooled, 180° opposed twin	2	90	3·54	96·5	3·8	31	2900	32	2900	33·3	3200	5·75·1	116·5	1836·3	Nil	·568	18·17	1·258	96	3·0
Do single row radial	5	101·6	4	101·6	4	65	18·0	72·5	1850	80	2035	5·2 1	123	1233·3	Nil	·577	41·8	2·54	168	2·32
Do	5	127	5	139·7	5·5	125	1620	137	1620	148	1780	5 1	124	1485	Nil	·538	73·67	3·2	308	2·25
Do	7	127	5	139·7	5·5	180	1620	186	1620	202	1780	5 1	120	1485	Nil	·529	98·6	3·9	502·5	2·73
Do double row radial	14	127	5	139·7	5·5	385	1700	410	1700	437	1870	5·1 :1	126	1558·3	Nil	·563	231	9·44	708	1·95
Do single row radial	9	146·05	5·75	190·5	7·5	440	1700	445	1700	480	1870	5·3 :1	118	2125	Nil	·553	246	12·5	747	1·68
Water cooled, broad arrow	12	139·7	5·5	130·17	5·125	525	2350	550	2350	590	2585	6·25·1	127	2007·3	·532:1	·5	275	14·8	980	1·78
Do 60° Vee	12	139·7	5·5	190·5	7·5	650	1900	670	1900	702	2100	5·3 :1	131·5	2376	·477:1	·492	329·5	18·2	1360	2·03
Do X type	16	158 8	6·25	190·5	7·5	975	1900	978	1900	1058	2100	5·16 1	110·5	2376	·49·1	·52	508·5	30·0	2549	2·6

screw on the air and therefore the thrust or force driving the screw through the air.

The Aerofoil Theory.—A more modern theory regards the action of a screw as an aerofoil or aeroplane wing in rapid rotation about one end An aerofoil moving forward in a straight line at right angles to its length experiences a lift perpendicular to the direction of motion and a drag opposing the motion.

Imagine now that the aerofoil, instead of moving uniformly forward, is spinning about one end round an axis parallel to the direction of lift, a similar result will follow, each section perpendicular to the length of the aerofoil is moving forwards, though with a velocity which varies as its distance from the axis; each section therefore experiences a "lift" parallel to the axis and a "drag" acting so as to check the motion of rotation.

The lifts combine to produce a resultant thrust on the aerofoil in the direction of the axis, the drags to form a torque about the same. To maintain the motion a torque must be applied sufficient to overcome the drag and the action of the aerofoil transforms the torque into a thrust on the air. We have an elementary screw

In order that the thrust may act along the axis and not at a point on the aerofoil which changes its position as the blade rotates, a second aerofoil is added on the other side of the axis and with its front edge pointing in the opposite direction to that of the first.

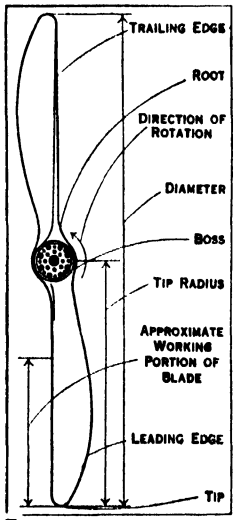


FIG. 11.—AIR SCREW OR PROPELLER

Again, if the blade were of the same section from root to tip, since the tip is moving very much faster than the root, the thrust on an element at the tip would greatly exceed that near the root. To obtain a more uniform grading of the thrust the shape of the blade is altered as we pass from root to tip in such a way that the angle of attack, the angle between the blade and the direction of motion relative to the air, is greater at the root than the tip and thus we arrive at the two-bladed screws in common use.

Reference has been made in the section dealing with aerodynamics to the vortex theory of the aerofoil; this theory has been applied by Glauert to the action of the airscrew with results which explain most of the outstanding difficulties of the earlier theories.

Airscrew Efficiency.—The above account will serve to show in a general way how the energy supplied by the rotation of the engine is transformed into that required to drive the aircraft; by the efficiency of the screw we mean the ratio of the power developed as thrust to the horse power delivered by the engine.

To utilize the power of the engine to the greatest advantage the pitch of the airscrew employed should change with changes in the speed of the machine; for if an airscrew be designed to be most efficient when the engine is running at its normal rate, and the machine flying at full speed, it follows both from theory and experiment that when stationary on the ground the rate of rotation is very appreciably less than that required for efficiency under these conditions and the airscrew is not giving its full thrust; it would be an advantage then to vary the pitch of the screw so as to permit the engine to exert full power on the ground as well as when in flight at various altitudes; efforts are being made to discover a satisfactory solution to the engineering difficulties involved.

In general, airscrews are made of hard wood, but in a number of cases metal has been employed and is likely in time to supersede the use of wood Fig. 11 gives a drawing of a typical airscrew.

NAVIGATION AND INSTRUMENTS

The pilot has to find his way in the air as well as control his machine, and for this, like the sailor, he needs special instruments. These are fixed to the dash board of his cockpit.

Here it must suffice to refer to the more important of these, but before doing this, a difficulty peculiar to flight when the horizon is invisible and the ground cannot be seen, must be noted.

Finding the Vertical.—The pilot, then, has no means of determining the vertical or of knowing for certain whether he is flying straight or in a curve When the machine is at rest on the ground the bubble of the level fixed in the machine at right angles to its length occupies its central position or a pendulum, a heavy bob suspended from some point in the machine hangs vertically. The same is true if the machine is moving horizontally at uniform speed. Again, if the machine still moving in the same way rolls over to one side the pendulum swings to that side and the pilot can correct the list by the proper use of his controls.

But suppose the machine begins to turn in a horizontal plane (say) to the left. The pendulum bob swings outwards to the right until the direction of the string lies along the resultant of the weight and the centrifugal force now acting on the bob. The pilot, ignorant of the change to curved motion, alters his controls to bring the bob back to its central position, thinking thereby to put the machine on even keel. Instead of this, however, he has nearly given the machine the "bank" appropriate to the curve in which he has commenced to fly and proceeds to describe a circle.

Turn Indicator.—To avoid this difficulty an instrument known as a turn indicator has been devised, and this warns the pilot when his machine begins to deviate from its straight course. By the aid of a compass and a turn indicator he can maintain his direction.

Compass, Altimeter, Speedometer and Gauges.—The compass has its own difficulties and for a discussion of these reference must be made to the article on AERIAL NAVIGATION.

To know his height or to fly at constant height the pilot uses an altimeter, a form of aneroid barometer specially designed and corrected for his use (*see* ALTIMETER).

The speed is given by the speedometer, which acts on the principle that the pressure on a surface opposed to wind of velocity V exceeds by $\frac{1}{2}\rho V^2$ that on a surface tangential to the direction of motion. A rotation counter registers the engine revolutions, while there are gauges to indicate the quantity of petrol in the tanks and the temperature of the water in the radiator system.

Sextant: Wireless.—To determine his latitude and longitude when over an unknown country or at sea he must use a sextant and a chronometer. The horizon is often invisible; this and the unsteady movements of the machine make the use of an ordinary sextant difficult, and the R A F. bubble sextant has been devised to overcome these.

Wireless telegraphy also comes to the navigator's aid and, when in touch with direction finding stations, enables him to fix his position.

Instruments for Research.—For research work, the measurement of the forces on the various parts of an aircraft in flight due to the pressure of the air and to its rapid changes of motion, many most valuable recording instruments have been devised, some of which will be found described in the appropriate sections

Seaplanes and Flying Boats.—For seaplanes and flying boats *see* SEAPLANE.

The Hump Speed.—As the speed increases from rest when starting, the resistance on the hull increases rapidly until a certain speed known as the *hump* speed is attained. When this is passed there is a marked drop in the resistance and the machine rises and planes or skims over the surface, the speed increases until the lift on the wings is sufficient to carry the weight, and the aircraft rises from the water and continues its flight through the air The determination of this *hump speed* and the proper adjustment of airscrew and engine to attain a full efficiency at this speed constitute a serious problem for the designer Much work has been done in the William Froude tank at Teddington on seaplane problems, the conditions of stability, the form of float or boats, the hump speed for various designs, the strength obtained by the different methods of construction and other important matters have been investigated in co-operation with the officials of the R A F. station at Felixstowe, while observations in the wind tunnels have been of the utmost value in reducing the air resistance. The great speed attained in the Schneider cup race of 1927 was due to changes in shape made in consequence of such experiments.

(R. T. GL.)

AEROPLANE. The main problem that confronts the designer of any means of transport is to find a working compromise between the various demands of those who maintain and use the service. There is no conflict between the interests of the operator and those of the user. Their common requirements are safety, speed, comfort and adherence to a published time-table. While it cannot yet be maintained that air transport is either as safe, or as comfortable, or as reliable as most other comparable methods, it has nevertheless achieved much in these respects, and in speed and the possibility of uninterrupted transit it has advantages which no other means of transport can equal.

In speed the aeroplane starts, broadly speaking, where the fastest alternative leaves off. For reasons which are explained in the article AERODYNAMICS a normal aeroplane cannot be maintained in flight at a speed *less* than a certain minimum "stalling" speed, which for a modern commercial aeroplane varies between 40 and 65 miles per hour. On the other hand, it is possible to give it an engine powerful enough to drive it at between 90 and 140m p h, while leaving a margin of some 25% of its total weight for passengers or goods. The aeroplane's permanent way, the air, is the only medium of transport which connects without interruption all places on the globe. It may be anticipated that the consequent possibility of transit free from "changes" may prove to be as valuable as the speed which can be maintained.

The cost of air transport is high and it is in terms of cost only that all the four requirements mentioned above can be expressed. The measure of each which will enable air transport to pay its way is not yet known with certainty, though experience is accumulating rapidly. Further information on this matter will be found in the article AVIATION, CIVIL. From the point of view of DESIGN, with which this article deals, *safety* is discussed below; within certain limits *comfort* can be had, as usual, if the traveller is prepared to pay for it; and *reliability* (in so far as it depends on design) presents no special problems.

In what follows we shall discuss (1) the *Minimum Speed of Flight* and its influence on the design of aeroplanes; (2) *The Power Required for Flight,* including both that necessary to drive the aircraft through the air and also—the unique feature of transport by aircraft heavier-than-air—that expended in sustaining it in flight; (3) The possibilities of *Improvement of Performance* by reduction of resistance; (4) the *Origin of Aerodynamic data of Design;* (5) the *Distribution of Weight* among the component parts; (6) the *External Form of Aeroplanes,* commenting on the most conspicuous features of modern aircraft; (7) *Stability* and *Control* and their influence on (8) the *Safety of Air Travel;* concluding with notes on (9) *Structural Design* and (10) *Materials used in Construction.*

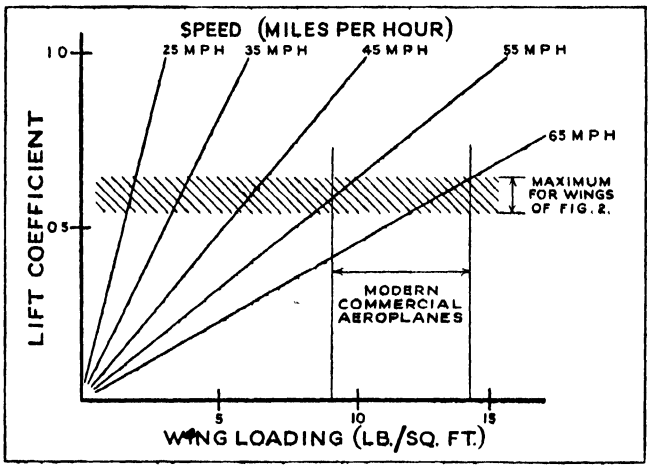


FIG 1.—DIAGRAMS SHOWING HOW THE POWER REQUIRED VARIES WITH IN POUNDS PER SQUARE FOOT, LIFT COEFFICIENT AND SPEED

1. MINIMUM SPEED OF FLIGHT

It is the impossibility of steady flight *below* the stalling speed that constitutes the chief danger of air travel. Many attempts have been made to avoid this source of danger by devising an aeroplane which would be capable, as a whole, of remaining stationary in the air. Such machines have generally employed either flapping or rotating wings, the so-called ORNITHOPTERS and HELICOPTERS. The former have shared the legendary fate of Icarus. Of the latter there is at the moment only one example which offers a prospect of success, the de la Cierva Autogiro or GYROPLANE (*q.v.*).

There is no fundamental obstacle to reducing the minimum speed of a normal aeroplane to some 25m p h., instead of the 40 to 65m p h. quoted above as typical of modern practice In fact the earliest flying machine had minimum speeds of this order. But the general proportions of such a machine would be uneconomical from every other point of view. In particular almost the whole of the available weight would be absorbed by the structure and power plant, leaving no margin for paying load.

The relation between the total weight (W lb.), the area of the wing (S sq. ft.) and the aerodynamic coefficient (k_L) which determines their lift at any given speed (V ft./sec.) (*see* AERODYNAMICS) is

$$W = k_L \rho S V^2,$$

ρ being the density of the air.

This may be put, for average ground level density, in the form

$$V = 14\sqrt{\frac{w}{k_L}} \text{ miles per hour}$$

where $w = W/S$ and is called the wing loading, in pounds per square foot. Fig. 1 shows the possible combinations of w and k_L

which will give any selected speed. Fig. 2 shows the cross section by a vertical plane parallel to the direction of flight of some modern wing sections. For these the maximum value of k_L (which in virtue of the above relation corresponds to the minimum flying speed) is between 0·55 and 0·65, represented by the shaded band in fig. 1. Modern commercial aircraft using such wings have loadings between 9 and 14 lb. per square foot. A reduction in the stalling speed can be made only by reducing the wing loading or by using a shape of wing section which will give a higher maximum value of k_L. The former course leads to a reduction in the paying load. Much attention has therefore been devoted to the latter method.

The most effective of the high lift wing sections which have been devised as yet is the "slotted" wing of F. Handley Page (fig. 3). With this the maximum lift coefficient can be increased some 50% or more. The action of the device is, broadly speaking, to cause the flow characteristic of stalling (*see* AERODYNAMICS) to occur at a larger angle of incidence.[1] The increase in lift is dependent on the relative position of the main and auxiliary wings, *i.e.*, on the size and shape of the slot between them, which can be varied in flight. With the slot closed the characteristics are nearly the same as those of a normal wing. In this respect form *a* (fig. 3) is superior to form *b*, but in practice there are, with both, constructional difficulties in the way of ensuring a smooth and unbroken surface when the slot is closed.

Another method which has been widely used, is to vary the curvature, or "camber," of the wing (fig. 4). In general, the greater the curvature of a wing section the higher is the maximum lift, but the lower the efficiency at high speeds. This device attempts to secure both high lift and high efficiency by enabling the pilot to alter the curvature to suit the conditions of flight. The increase of lift attainable in this way is much less than can be achieved with a slot, the maximum being about 10%. An automatic form of this device has also been used, the trailing flap being held down by elastic cord and therefore rising as the air pressure increases, *i.e.*, as the speed increases. By combining both these methods very high maximum lifts have been obtained, and it is probable that such a combination will be used on civil aircraft in the near future.

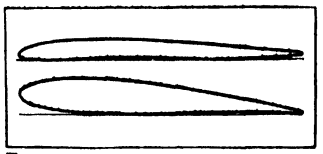


FIG. 2.—CROSS SECTIONS OF RECENT TYPES OF AEROPLANE WINGS

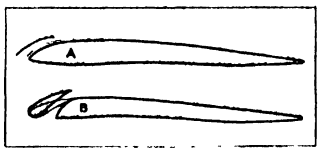


FIG. 3.—CROSS SECTION OF THE HANDLEY PAGE SLOTTED WING. WITH IT THE MAXIMUM LIFT COEFFICIENT CAN BE INCREASED SOME 50% OR MORE

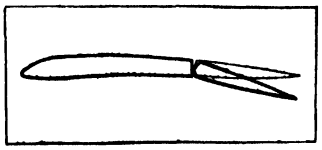


FIG. 4.—METHOD OF VARYING THE CURVATURE OF THE WING. IN GENERAL, THE GREATER THE CURVATURE THE HIGHER IS THE MAXIMUM LIFT

The chief obstacles to the use of these variable wings in commercial aircraft are, first, the increase in weight involved, not only in the devices themselves, but also in the larger control surfaces which they require; second, the lack of a clear demand on the part of those who travel by air for a reduction in stalling speed. The increase in weight is not as great as the increase in lift (at the same speed), but the whole aeroplane is appreciably more costly, and in the absence of adequate credit for the benefits derived it is natural that designers should hesitate to adopt such devices. Further remarks on the application of the slotted wing to improve the control of aeroplanes will be found below (§7) and in the article AILERON.

2. POWER REQUIRED FOR FLIGHT

When an aeroplane of conventional design and normal proportions is flying horizontally (in air of a given density) the power of the engine is disposed of in the following ways:

(*a*) About 25% is lost owing to the inefficiency of the airscrew.

(*b*) From 30% to 45% is used in overcoming the resistance of the air to the passage of the body, including the engine itself, the undercarriage and the exposed part of the wing structure, etc.

(*c*) From 45% to 30% is similarly absorbed by the resistance of the wings.

The choice between the alternative figures in (*b*) and (*c*) depends on the speed of flight, the former corresponding to low, and the latter to high speeds. The resistance of the parts included in (*a*) varies practically as the square of the speed of flight, and

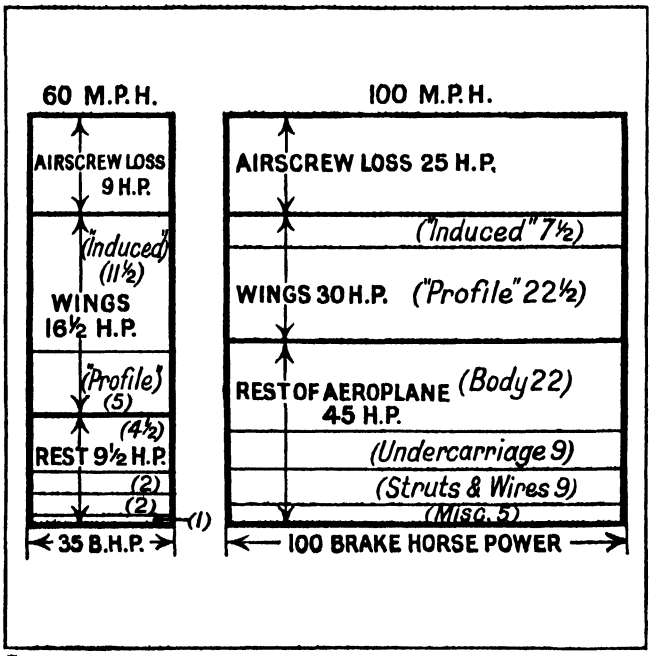


FIG. 5.—DIAGRAMS SHOWING HOW THE POWER REQUIRED VARIES WITH THE SPEED AND THE PROPORTIONS IN WHICH IT IS ABSORBED BY THE LOSS IN THE AIR SCREW AND BY THE RESISTANCE OF THE VARIOUS PARTS OF THE AEROPLANE

the corresponding power therefore as the cube The resistance of the wings (*c*) may be further subdivided as follows:

(*c*. 1) From a third to three-quarters is due to the equivalent of friction of the air on the surface of the wings (the *profile* drag). This varies as the square of the speed, and the power as the cube. If the area of the wing is changed, the profile drag changes in proportion. Each wing section has a typical coefficient of profile drag, and, apart from maximum lift, this is in fact nearly all that distinguishes one section from another.

(*c*. 2) From two-thirds to a quarter is due directly to the action of the wings as generators of a lifting force (the *induced* drag of Prandtl; *see* AERODYNAMICS). This varies inversely as the square of the speed, and the power therefore inversely as the speed. It does not depend on the shape of the wing section, or on the area of the wings, but (for a given lifting force, *i e*, weight) only on their overall width or span, being inversely proportional to the square of the span. This induced resistance is the essential feature in which transport by aircraft heavier than air differs from all other methods, for in no other is it necessary to expend energy in order to sustain the vehicle. About 8% of the fuel used by a normal aeroplane is used in this way (fig 5).

This division of the resistance of the wings into two parts—one of which increases with the speed of flight, while the other decreases, the former dependent (broadly speaking) only on the section and shape of the wings, the latter independent of these factors and governed by the extent to which the span of the wings allows the aeroplane to "grip" the air (*see* AIRSCREW)—was originally suggested by F. W. Lanchester. It lay dormant for some years, largely because there was not forthcoming any adequate theory by means of which it would be given quantitative expression in terms of the dimensions of the wings. This expression has been rendered possible by the work of L. Prandtl of

[1] Angle of the chord to the direction of flight. The chord of the wing sections in fig. 2 is indicated by a broken line.

Göttingen and his collaborators, with great advantage to the technique of aeroplane design. Its chief merit is that it enables a designer to examine the economics of wing proportions without continual resort to model experiments. It has been abundantly verified by comparison with experiments, both in Great Britain and elsewhere, and its applications have been extended by workers in Great Britain, in particular H. Glauert. The experiments made have not enabled its fundamental ideas to be verified directly, but have shown that it adequately accounts for very varied observations. Many engineering theories stand on a similar footing.

In normal flying conditions, as opposed to the special conditions characteristic of arising from and alighting on the ground, the speed of an aeroplane may vary from 1·2 to 2·0 times its stalling speed. The upper of these two figures can be raised by the provision of more power, that given corresponding to a machine having about 60b.h.p. for each 1,000 lb. of total weight, which is a normal figure for a commercial aeroplane. At its top speed the engine is working at its full power, which is not an economical condition from the point of view either of the life of the engine or of fuel consumed per ton-mile. The most economical speed, taking into consideration all the various factors, is about 1·5 times the minimum speed. The diagrams in fig. 5 show the way in which the power required for flight depends on the speed, and incorporate the figures given above relating to the distribution of the power among the various parts. The maximum brake horse-power of the engine has been taken to be 100 and the minimum speed 50m. per hour. These diagrams illustrate the rapid rise of power required with the speed of flight. For such an aeroplane the most economical speed would be about 75m p.h, requiring about 50 brake horse-power.

If the engine throttle is fully opened at the lower of the two speeds considered above, the aeroplane will climb. The angle of climb for modern commercial aeroplanes is from 1 in 10 to 1 in 15. For high-powered war machines it may rise to 1 in 6, or more. When the engine is cut off the aeroplane will lose height, its path being inclined downwards at a corresponding angle, and the necessary power will be supplied by gravity. The angle of descent for a modern aeroplane is from 1 in 6 to 1 in 8 Thus a passenger in an aeroplane will not in general be subjected to greater changes of inclination of the direction of motion than one who travels by road.

3. IMPROVEMENT OF PERFORMANCE

The above proportions apply without material change to most modern commercial aeroplanes. The main directions in which improvements in the efficiency of the machines are being sought are as follow:

Airscrew Efficiency.—A loss of between a quarter and a third of the power of the engine in the transmission gear would hardly be tolerated in road or rail transport. Transport by water, however, is burdened by a loss identical in character and of similar amount. It arises from the fact that the propulsive force is obtained by driving a fluid backwards. (*See* AIRSCREW.)

Resistance of the Body.—The majority of aeroplanes have in the nose of the body either an air-cooled engine, or a water-cooled engine with a radiator. With this arrangement the resistance of the body cannot be separated from that which is incurred in cooling the engine. This latter is equivalent to a reduction in the power of the engine of from 15% to 25% at the cruising speed of a normal commercial aeroplane. At higher speeds the loss is greater.

It is natural to endeavour to recover some of this by placing as much as possible of the load carried (fuel, crew, passengers) behind the radiating surfaces. But a large part of the loss remains, because such parts as these could, at least in principle, be placed in a stream-line body of very low resistance. Such bodies would, however, be heavy, and the conventional tractor aeroplane is by no means a bad compromise, especially when an air-cooled engine is used.

When a very high speed is required, as for example in racing aeroplanes, the cooling resistance can be eliminated by using a water-cooled engine in combination with a radiator whose cooling surface is part of the smooth surface of the wings. Such a radiator is heavy and is exposed to damage, reasons which prevented the development of the scheme during the World War. It has, however, been used in the Schneider Cup and Pulitzer Trophy races, and the high speeds reached have been largely due to the use of the equivalent of about one-third of the wing surface of a normal aeroplane as a radiator. But the consensus of the opinion of designers in Great Britain appears to be that it is as yet unsuitable for employment in commercial aeroplanes.

Resistance of the Undercarriage.—The undercarriage of an aeroplane has a high resistance, mainly due to the wheels. If the wheels could be withdrawn into the body in flight an appreciable gain would result. Mechanical difficulties are involved owing to their large bulk, but the problem is worthy of attention.

Resistance of the Bracing of the Wings.—There has been a tendency, more noticeable in American, Dutch, French and German than in British designs, to eliminate external wing bracing entirely. There is little doubt but that this results in a heavier structure and a relatively less economical aeroplane than one in which a less extreme construction is adopted—an example of a general principle of all engineering design that extremes are seldom economical. The matter is dealt with below (§§ 6 and 9). But it may be remarked that there has been apparent for some time a tendency to reduce the amount of exposed bracing, of all kinds, without entirely eliminating it.

4. ORIGIN OF AERODYNAMIC DATA OF DESIGN

The designer bases his calculations on data derived from four main sources:

(1) Theoretical investigations, such as the Lanchester-Prandtl theory of the action of wings. (2) Experiments on models in wind tunnels. (3) Experiments on full scale aeroplanes in flight. (4) Analysis of the measured performance of aeroplanes. References to the first of these divisions will be found in the article on AERODYNAMICS, where also the principles underlying experiments on models are dealt with.

Wind Tunnel.—The wind tunnel has played a great part in the development of aeronautics. Many manufacturing firms possess their own tunnels, used mainly for measurements of the resistance of aeroplane bodies, etc., with a view to improving performance. National wind tunnels exist in many countries, generally reserved in principle for research on problems of wide interest and application. In Great Britain such tunnels exist at the National Physical Laboratory and the Royal Aircraft establishment, and they form a part of the equipment of most university institutions where the scientific problems of aeronautics are investigated.

The main advantage of model experiments is the ease with which the experimenter can control the conditions. They enable suggestions for improvements to be developed to the stage at which a trial on the full scale is possible.

Full Scale Experiments.—Most of the leading aircraft-producing countries carry out full scale experiments. In Great Britain they are made at the Royal Aircraft establishment under the control of the director of scientific research at the Air Ministry. Owing to the expense involved, private firms can do little work of this kind, but there is active co-operation between them and the Air Ministry, with great benefit to aeronautics. The results of such work will be found in the technical reports of the Aeronautical Research Committee.

Analysis of Performance Tests.—The measurements of speed and climb which are made during the acceptance tests of all aeroplanes are a valuable source of information for the designer. Their analysis enables an overall comparison between various types to be made on a rational basis, but necessarily lacks something in precision. For each type differs from the others in many features, so that, for example, an observed difference in speed cannot safely be ascribed to any one peculiarity. But with suitable precautions reliable information can be obtained in a convenient form. It is found that the factors which have the greatest influence on the speed and climb of an aeroplane are the *horse-power*

per unit of total weight and the *total weight carried per unit of wing surface*. For further details of the method, and its limitations, references given should be consulted.

5. DISTRIBUTION OF WEIGHT

Figure 6 illustrates the relative proportions of the total weight taken up by the various sections into which it is convenient to divide the component parts. The figures apply to an average commercial aeroplane of moderate size. The distribution of weight varies little from one machine to another, even over a consider-

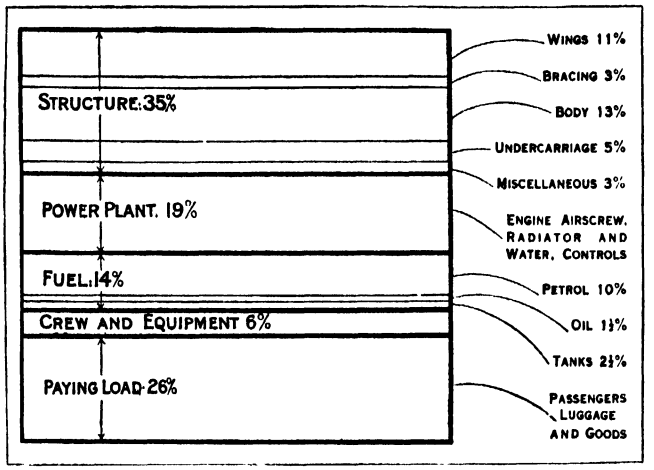


FIG. 6.—DISTRIBUTION OF TOTAL WEIGHT OF COMMERCIAL AEROPLANE

able range of size, provided the minimum speed, the cruising speed and the duration of flight are kept fixed.

Structure.—The "structure" includes a great deal which is not part of the essential structure of the aeroplane. A change in the specified strength affects about 60 to 70% only of the nominal structure weight.

Power Plant.—The weight of the power plant depends mainly on the desired maximum speed of the aeroplane, and on the weight of the engine and its equipment per brake horse-power. There is generally a reduction in this item if an air-cooled engine is used instead of a water-cooled engine.

Fuel, etc.—The weight of fuel and tanks is dependent on the speed and duration of flight specified, and on the standard of fuel economy reached by the engine. The latter factor varies little for modern engines, both air- and water-cooled engines now giving one brake horse-power hour for about ½ lb. of petrol.

Crew, etc.—The crew and equipment tend naturally to absorb a progressively smaller proportion of the total weight as the size of the aeroplane increases.

Paying Load.—The paying load, being the balance after the above items have been accounted for, is from 20 to 30% of the gross loaded weight of the aeroplane. Compared with other means of transport this is a high proportion. For example, a modern motor-car of medium power, weighing some 2,500 lb empty, will carry four passengers and a driver, equivalent to a paying load of some 650 lb. or 20% of the whole. Both a passenger railway train and an ocean liner carry a much smaller percentage of paying load. That all these means of transport are able to offer lower fares than aircraft is due partly to the high running costs of an aeroplane per passenger mile, but mainly to the fact that travellers are not yet convinced that air transport is safe.

The essential need for economy of weight in aircraft is due, not to the fact that only one-quarter of its weight is available for paying load, but to the high cost of carrying this load by air, as compared with other ways. A saving in the weight of some part of the aeroplane of 1% of the whole allows a reduction of the cost of transport by 4%.

6. EXTERNAL FORM OF AEROPLANES

Wings.—There is a striking lack of variation in the appearance as seen in plan of all modern aeroplanes. The main wings have a large span (fig. 7*a*) in relation to their chord, the average ratio of span to chord being about seven. This is a direct consequence of the fact that the resistance due to the generation of lift varies inversely as the square of the span (§2). In some aeroplanes the chord diminishes towards the tip of each wing (fig. 7 *b*) and occasionally the wings, although of uniform chord, are "swept back" (fig. 7 *c*). Neither of these modifications affects the aerodynamic efficiency appreciably.

Near the tip of each wing is an *aileron* or wing flap hinged about axes 1–1 (fig. 7 *a*) and interconnected so that an upward movement of one is accompanied by a downward movement of the other They are operated by a sideways movement of the pilot's control column, and are the means by which the wings are kept level in straight flight, or banked for a turn, as may be required. (*See* also AILERON.)

Tail Plane.—At a distance of some three chords behind the leading edge of the wings is the tail plane, in area about one-ninth that of the wings. In steady flight its function is to balance or trim the aeroplane, *i.e*, to ensure that the resultant of all the air forces on the aeroplane passes through the centre of gravity. (*See* AERODYNAMICS) It is generally in two parts. The front part, some 60% of the whole, is normally fixed, though means are provided by which the pilot can alter its angle of incidence by rotating it about an axis such as 2–2 (fig 7 *a*), thus enabling the aeroplane to be trimmed for flying at various speeds. This operation is analogous to trimming the sails of a ship so that it carries no weather or lee helm. In a modern aeroplane a movable tail plane is generally considered indispensable.

The rear part of the tail, or *elevator*, is hinged on an axis such as 3–3 (fig. 7 *a*), and connected to the control column in such a way that a forward movement of the pilot's hand depresses the trailing edge of the elevator and causes the machine to dive, and vice versa. The elevator is the primary control organ of an aeroplane, since by it the pilot alters the angle of incidence of the wings and hence controls the speed. (Fig. 9 of article AERONAUTICS shows control organs, and the forms which they take in more modern machines will be seen in the articles, AERIAL NAVIGATION; AVIATION, CIVIL

Number of Planes.—The appearance of aeroplanes in front and side elevation is more varied than that in plan, owing mainly to the use of one or more planes. As many as four planes have been used on comparatively modern aeroplanes, but the great majority of existing machines had in 1928 either one or two planes.

An analysis of the aeroplanes described in Jane's *All the World's Aircraft* for 1927 shows that, out of a total of nearly 600 types,

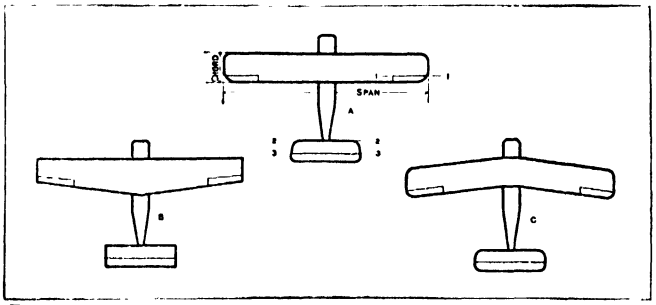


FIG 7.—THE RELATIVE SIZES AND AREAS OF AEROPLANES, SHOWING THE SPAN OF THE MAIN WINGS IN RELATION TO THEIR CHORD, WHENCE THE AVERAGE RATIO OF SPAN TO CHORD MAY BE DEDUCED

31% were monoplanes and 69% biplanes, with no triplanes or quadruplanes. A similar analysis for 1922 gives, for rather more than one-third the number of aeroplanes, 22% monoplanes, 78% biplanes, with eight triplanes and one quadruplane. These figures show that the biplane is still the preponderating type, though the proportion of monoplanes is increasing. The increase during the five years covered is divided between biplanes and monoplanes in the ratio of 9 to 5 approximately. This trend is due partly to the development of wing sections of great depth in relation to their chord, and partly to a desire to eliminate external wing bracing.

It is more conspicuous in foreign than in British design, as will be seen from fig. 8, in which separate analyses are shown diagrammatically for aeroplanes produced in Great Britain, France, Germany, the United States and other countries. It should be noted that the figures given above refer to *types* and include both commercial and war aeroplanes and seaplanes. Some of these naturally exist only in small numbers, and some may be confined even to one experimental machine, but there is evidence that all have actually been made and flown There is no room for doubt that had the above analyses dealt with numbers of aeroplanes, instead

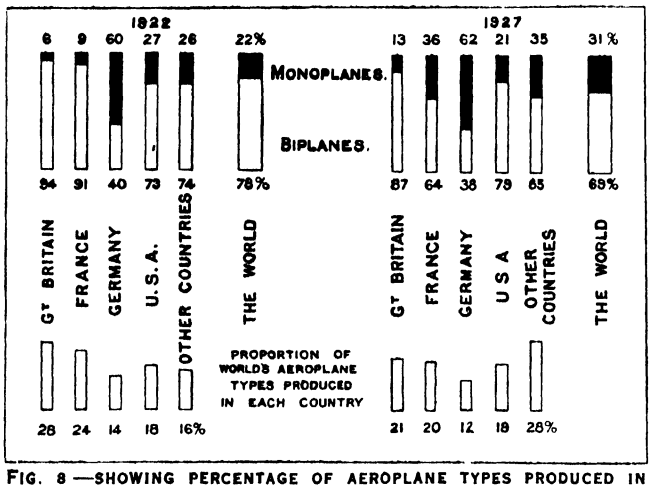


FIG. 8.—SHOWING PERCENTAGE OF AEROPLANE TYPES PRODUCED IN 1922 AND 1927

of types, the preponderance of the biplane would have been much greater.

Confining attention to monoplanes and biplanes, the chief variations in front elevation are shown in fig. 9 The *parasol* monoplane (*a*) is used mainly where it is desired to have some of the advantages of external bracing. The monoplane with body above the wing (*b*) has rather less resistance and is less liable to damage by wind when on the ground, an important advantage. The former type is the more numerous, in the ratio of about 3 to 1, but the latter is favoured by the German firm of Junkers which has supplied a large proportion of the machines used on German air lines.

The biplane with wings of equal span (*c*) is the most common form of aeroplane, but wings of unequal span (*d*) (sometimes called *sesquiplane, i.e.*, 1½ plane) have many advantages. The proportion between types (*c*) and (*d*) is about 7 to 1. Fig. 9 (*e*) shows a large biplane with two or more engines. The right and left hand wings are generally not in line, but form a very flat upward Vee. This *dihedral angle* (which is generally given as the angle between either wing and the horizontal, and varies from 0° to 5°) is introduced in order to improve the lateral stability of the machine.

The corresponding side elevations of these aeroplanes are given in fig. 10 In a biplane the relative position of the planes as seen in this view varies as shown in (*c*), (*d*) and (*e*). In (*c*) and (*d*) the planes are *staggered, i.e.*, the line joining the leading edge of the upper and lower planes is not perpendicular to their chords. The angle of stagger is generally between 0° and 30° and a variation over this range has little if any effect on the efficiency of the wings. In (*d*) the chord of the lower wing is smaller than that of the upper wing, a common variant, especially when the spans are also unequal (fig. 9). In (*e*) the wings have equal chords and no stagger. The tail plane is here shown as a biplane, in which form its weight can be made low for a considerable area.

Set of the Wings.—The angle at which the chord of the wings is set in relation to the centre line of the body is generally about five degrees. Though often termed the "angle of incidence," it has no connection with the accepted sense of that term (*see* § 1). Its magnitude is the result of a compromise between a number of conflicting requirements, a not unimportant one being the comfort of the passengers. The true angle of incidence being determined by the speed of flight, it is desirable that the relative position of wings and body shall be such that in horizontal flight at cruising speed the body may be nearly horizontal. But the attitude of the body in relation to the wings has no effect whatever on their angle of incidence relative to the direction of flight. Failure to realize this has been responsible for many fruitless inventions of wings whose angular position on the body can be varied.

Fin and Rudder.—The vertical stabilizing and controlling surfaces, a fixed fin and a movable rudder connected to a rudder bar on which the pilot's feet rest, are situated near the tail plane. They perform practically the same function as the rudder of a boat and can be seen in more detail in fig. 9 of article AERONAUTICS.

Position of Airscrews and Engines.—In the three sketches the airscrews indicate the position of the engines. In modern aeroplanes the "pusher" position of the airscrew is seldom used except in single-engined flying boats, the vast majority of modern aeroplanes using tractor airscrews. When two or more engines are used, it is customary to distribute them along the wings, as the transmission of their power by means of shafts and gearing from a central engine-room to airscrews in suitable positions involves a prohibitive weight, generally not less than 1½ lb. per h.p. transmitted, or about half the weight of the engine itself. As seen in front elevation the arrangements shown in fig. 11 have been used Considerations of rudder control in the event of the failure of one engine make it desirable to place the engines as near to one another as the airscrews permit. Overlapping airscrews have been used, but have generally given rise to troublesome vibrations It is also desirable that the axes of the airscrews should be, as far as possible, on the same horizontal level as the centre of gravity, in order to avoid giving rise to couples tending to make the aeroplane rotate in a vertical plane when the throttles are altered (*see* fig 11)

7. STABILITY AND CONTROL

The general principles of stability and control are dealt with in the article AERODYNAMICS, and the stabilizing and controlling surfaces have been referred to above. The necessary disposition and dimensions of these surfaces are decided in practice chiefly by direct comparison with previous designs. Since, however, aeroplanes are not merely scale copies of one type, some rational means of using the accumulated experience of previous work is essential, and it is this that research into the fundamentals of stability and control is able to supply. Needless to say, even these methods break down when the aeroplane in question is not broadly similar to those from which the data are derived, and then nothing short of a thorough investigation, assisted by model experiments, will suffice. Very often, even with the best that can be done in this way, uncertainties remain, and the designer is

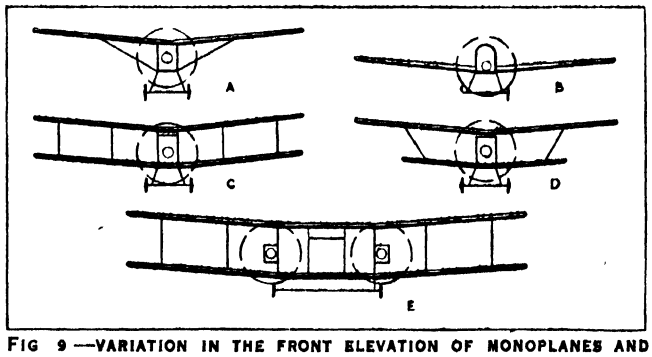


FIG 9.—VARIATION IN THE FRONT ELEVATION OF MONOPLANES AND BIPLANES

forced, as in other branches of engineering design, to rely upon his ability to draw conclusions from insufficient premises.

Stability.—Stability, the property of returning to a steady state of motion when deliberately or accidentally disturbed, implies as a necessary preliminary the existence of equilibrium, or "trim," in that state. An aeroplane is trimmed for a steady condition of flight by an adjustment of its tail plane, the elevators being left free. The degree of stability generally considered desirable for a commercial aeroplane can be attained by arranging

the size of tail plane and the fore and aft position of the centre of gravity within certain limits. The further back the centre of gravity, the larger is the necessary tail area. The fore and aft position of the centre of gravity in relation to the wing is defined by its distance from a plane passing through the leading edge of the wing perpendicular to the chord, for a monoplane; for a biplane an equivalent monoplane wing is substituted. In normal aeroplanes this distance is usually about one-third the chord, though it has varied between one-quarter and one-half. The height of the centre of gravity of an aeroplane in relation to the wings has a secondary effect on its stability. In particular a low centre of gravity is not necessary for stability. With the centre

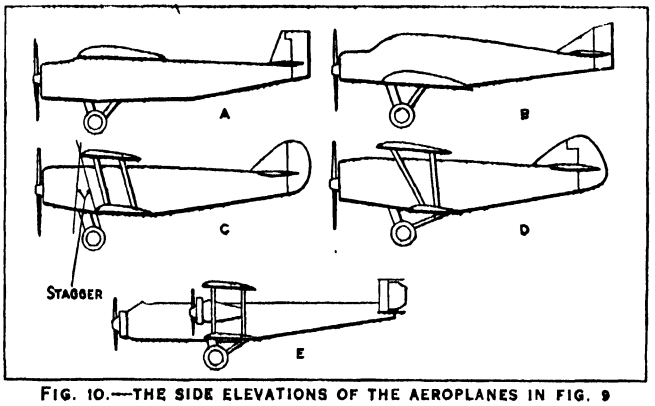


FIG. 10.—THE SIDE ELEVATIONS OF THE AEROPLANES IN FIG. 9

of gravity in the first-mentioned position, stability will be secured providing the product of the ratios

$$\frac{\text{area of tail plane and elevator}}{\text{area of wings}} \text{ and}$$

$$\frac{\text{distance of tail plane from centre of gravity}}{\text{chord of wings}}$$

is greater than about 0·35. The latter ratio is usually about 3, and the former one-eighth

The fore and aft control required can generally be obtained if the ratio $\frac{\text{area of elevator}}{\text{area of fixed tail plane}}$ is about two-thirds.

Lateral stability depends mainly on the provision of an adequate fin and dihedral angle. While desirable for the comfort of the pilot, lateral stability is of minor importance compared with lateral control

Aileron Control.—Ailerons of an area between $\frac{1}{12}$ and $\frac{1}{8}$ of that of the wings are usually provided, and give adequate control at all normal flying speeds. At low speeds, however (more accurately, at angles of incidence of the wings in the neighbourhood of stalling), not only are normal ailerons ineffective, but they may actually become a source of danger, their use aggravating an inherent tendency of the stalled wings to force the aeroplane into a spiral dive or spin. (*See* AILERON.)

Rudder Control.—An effective rudder is as essential for safety at low speeds as effective ailerons. The efficiency of any given rudder depends on its being arranged so that the body does not shield it, but it is generally found that when the product of the ratios

$$\frac{\text{area of rudder and fin}}{\text{area of wings}},$$

and

$$\frac{\text{distance of rudder from centre of gravity}}{\text{semi-span of wings}}$$

is above 1/20, a satisfactory control is obtained. The latter ratio is usually about 1, so that the former should not be less than one-twentieth. The area of the rudder is generally about $\frac{1}{3}$ that of the rudder and fin combined.

8. SAFETY OF AIR TRAVEL

The risks to which those who travel by air are exposed are probably the chief influence which hinders the development of air transport. These risks are associated with the following causes: (1) physical failure of the pilot, (2) fire when in flight, (3) collision when in flight, (4) breakage of the structure, (5) forced landing. Dangers of the first four types are not peculiar to aircraft and the precautions they involve are common to transport by road, rail and sea. The measures adopted in air transport have practically eliminated them. It is mainly the dangers which may arise when an aeroplane is forced to land that loom large in the minds of those who might otherwise travel by air. While it cannot be said that these fears are unwarranted, yet in so far as the design of aircraft is involved the position is rapidly improving.

Forced Landings.—The need for a forced landing arises primarily from failure of the power plant, generally due to a defect developing in some minor part and not to a breakage in the engine itself. Deprived of its power an aeroplane must eventually descend. In practice, from the height at which most civil flying takes place (about 3,000ft), about three minutes are available in which the pilot may choose a landing place. If the failure occurs before the aeroplane has reached its working height, the time and the corresponding area of ground in which this landing place is to be found are reduced in proportion. These considerations unfortunately result in the pilot having to execute somewhat sharp turns in order to place the aeroplane correctly, and it is during these that the controllability of the machine is most severely tested. The ultimate danger lies in the fact that the speed of horizontal travel at the moment of landing cannot possibly be less than the stalling speed. In practice with a typical commercial aeroplane it will be between 65 and 75m per hour. The pilot, therefore, endeavours to make the most of what space is available. This consideration, combined with the psychological effect of the apparent increase in the aeroplane's speed as the ground is approached,[1] lead him to carry out manoeuvres at a low speed, where the inherent characteristics of the aeroplane are least favourable and the controls least powerful (*see* above § 7).

The dangers associated with a forced landing may be reduced in three ways:

(1) The probability of complete failure of the power plant may be reduced by subdivision. Machines with three engines are coming into favour, capable of maintaining their height with any two engines and of greatly prolonging the time of descent with one engine only working (2) The controls may be so arranged that they give the pilot complete command over the attitude of the aeroplane right down to the stalling speed. (3) The stalling speed

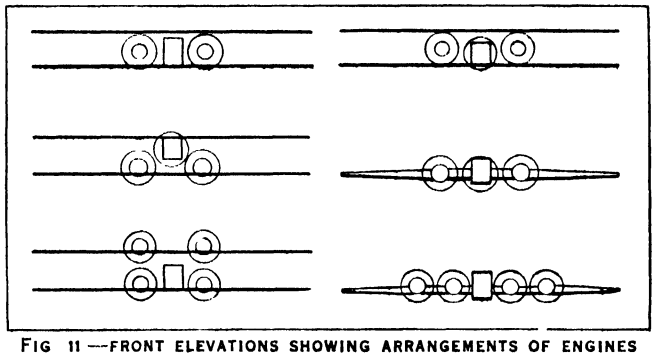


FIG 11.—FRONT ELEVATIONS SHOWING ARRANGEMENTS OF ENGINES

may be reduced so that the space required for landing, and the consequent need for sharp turns, etc., are also reduced.

Reference has been made to what is now possible in the arrangement of controls. But even with controls as normally arranged, there is little room for doubt but that a limitation of the stalling speed of civil aircraft to some 50m p.h. would greatly reduce the principal danger of flying. A reduction in stalling speed reduces the space required for landing and therefore increases the proportion of the accessible ground which is suitable. It reduces the danger in the event of over-running the selected

[1] To a passenger in an aeroplane 1,000 or 2,000ft. up, there is generally no sensation of speed relative to the ground.

landing ground, and it reduces the psychological effect on the pilot of the approach of the ground, in the opinion of some by no means the least valuable advantage. Such a limitation would probably involve for a time an increase in fares, since aeroplanes would be more costly. This might temporarily retard the development of flying, but in the end the gain in safety could react only to its advantage.

9. STRUCTURAL DESIGN

The General Problem.—The aeroplane shown in fig. 9, article AERONAUTICS, was designed about 1914; in general aerodynamic and structural design it is not fundamentally different from most modern aeroplanes. Regarded as a problem in structural design, a normal aeroplane wing, such as that illustrated, is a double cantilever, *i.e.*, two similar cantilevers joined at their roots, carrying a load distributed approximately uniformly over its span. The intensity of the loading begins to diminish appreciably at about one chord from the tip, but is still $\frac{2}{3}$ of its value at the centre, at a distance of $\frac{1}{3}$ chord from the tip. The wing itself is essentially a lamina, the wing sections most commonly used (*see* fig. 2) having a greatest depth of from $\frac{1}{14}$ to $\frac{1}{8}$ chord. The resultant loading is nearly perpendicular to the chord, but its line of action (as seen in side elevation) intersects the chord at a point (the so-called "centre of pressure") whose distance from the leading edge of the wing varies from $\frac{1}{3}$ to $\frac{1}{2}$ chord in normal flight, but may travel much further to the rear—even beyond the trailing edge—in special conditions. As a whole, therefore, the wing structure must be capable of taking torsion.

From general principles it would appear that the lightest way of bracing such a lamina would be to stiffen it internally by longitudinal and transverse beams (spars and ribs), and to support these by external bracing. The arrangement of two planes, one above the other, connected by struts and wires to form a braced tubular girder, suggested itself to the earliest experimenters in flight. Such a solution (*see* fig. 9 of AERONAUTICS) is typical of the majority of modern aeroplanes.

Alternatively, by tapering the wing in plan (fig. 7 *b*) and thus both reducing the intensity of loading outwards from the centre (though not, it appears, in proportion to the reduction of the chord), and increasing the available depth at the root, the whole of the necessary structure could be contained inside the covering. This is the principle of the internally braced wing characteristic of many foreign designers. It has the advantage of avoiding the resistance of the exposed bracing which is involved in the first solution.

Comparison of Monoplane and Biplane.—Many variants of these two main schemes have been used, but in general there is a clear division between them. The first undoubtedly produces a lighter structure and a more compact aeroplane For, with the same total weight and wing area, the biplane has a smaller span and chord and requires a shorter body and smaller tail.

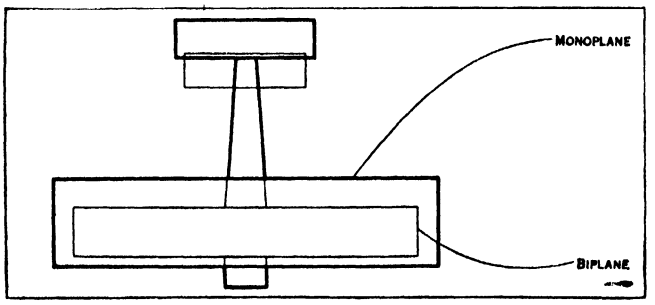


FIG. 12.—COMPARISON OF PLAN VIEWS OF MONOPLANE AND BIPLANE OF SAME TOTAL WEIGHT AND PERFORMANCE

With the aid of the Prandtl theory it is possible to arrive at comparative overall dimensions for a normal biplane and a monoplane of otherwise similar characteristics. Such a comparison is shown in fig. 12. The span of the monoplane (full lines) is about 10% larger than that of the biplane (broken lines), and its chord 65% larger. Both the length of the body and the tail area required by the monoplane are greater by about 28%. Each type has other advantages and disadvantages, but the mere existence of many examples of each indicates that technical opinion is divided on their merits, and experience in the design and manufacture of one or the other is a dominating factor in the choice between them. (*See* also BIPLANE and MONOPLANE.)

Refinement in Details.—The details of the structural design depend largely on the materials used (*see* below). But the main problems are not essentially different from those of the design of ordinary engineering structures, except in one particular. The importance of saving weight in every item of an aeroplane (§ 5) makes it economically possible to carry refinement in design to a point not usually attempted in any other structure. For the same reason elaborate calculations are made during the design, and the effect of every minor strengthening is carefully considered. All aeroplane structures are highly redundant and initial stresses are imposed on the members by tightening the bracing wires, in order to increase the stiffness of the structure. The design of modern aeroplane structure takes account of these features as far as it is possible to do so, in contrast to the general tendency of modern bridge design, for example, which tends to avoid them as sources of uncertainty (*see* BRIDGES). Where saving of weight is a prime consideration such a course is not possible.

Strength of Aeroplane Structures.—Since an aeroplane must be able to manoeuvre rapidly, many systems of air pressure, differing both in distribution and in intensity, must be taken into account. How rapidly it should manoeuvre depends on its class, *e.g.*, a small war machine must be able to execute safely any manoeuvre of which an aeroplane is capable, whereas less exacting conditions suffice for a large commercial machine Spins, rolls, loops have all to be considered and experiments have been made in order to ascertain the distribution of the air pressure in such manoeuvres. The fundamental manoeuvre is, however that of rapid recovery from a steep dive at a high speed, and here the combined effect of centrifugal force and gravity produces an "equivalent gravity" (*see* AERODYNAMICS) several times the normal. It can be shown that, given the necessary control power and indifference to his own safety, the pilot of an aeroplane could impose in this way forces up to 10 or 12 times those which the structure has to bear in the normal flight. As much as seven times normal gravity has been recorded in experiments under war conditions.

This number, the ratio between the effective and the normal value of gravity, is termed the *load factor* for the whole machine under the stated conditions. A normal commercial aeroplane need never experience a load factor of as much as two in flight In practice it is designed to bear a factor of from four to six dependent on its size and class. The ratio between the maximum load factor considered in the design, for any stated form of distribution of air pressure, and the factor in any actual condition of flight appropriate to that distribution, is the nearest approach to the *factor of safety* commonly used in engineering.

For a commercial aeroplane the factor of safety, as thus defined, seldom falls below three. In normal level flight it is of the order of five. For a war aeroplane it may fall to $1\frac{1}{2}$, so that the most highly stressed member is loaded to two-thirds of its breaking load, or even more, but only in extremely rapid manoeuvres.

A commercial aeroplane has a *true* factor of safety, a margin of strength not called upon under the worst conditions which it normally experiences. The load factors corresponding to irregularities in the air are very small. So long as it is in the air, an aeroplane is exposed to much smaller risk of the failure of its structure from stress of weather than is a ship at sea. Any commercial aeroplane which conforms to the official criterion of strength, and has thereby secured an air-worthiness certificate without which it may not carry passengers, is capable of performing many manoeuvres such as looping and spinning with complete safety.

10. MATERIALS USED IN CONSTRUCTION

Composite Structures.—The materials which have been most commonly used hitherto for the main structural members of aeroplanes are wood and steel, with a fabric covering for

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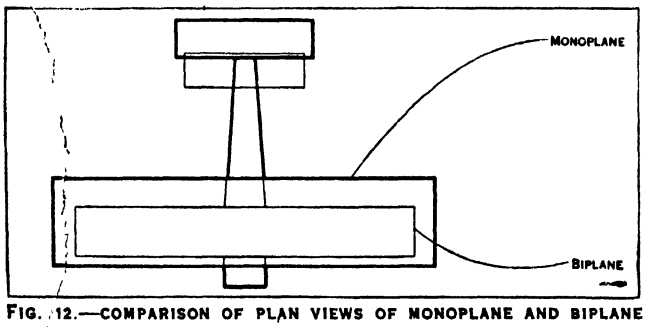

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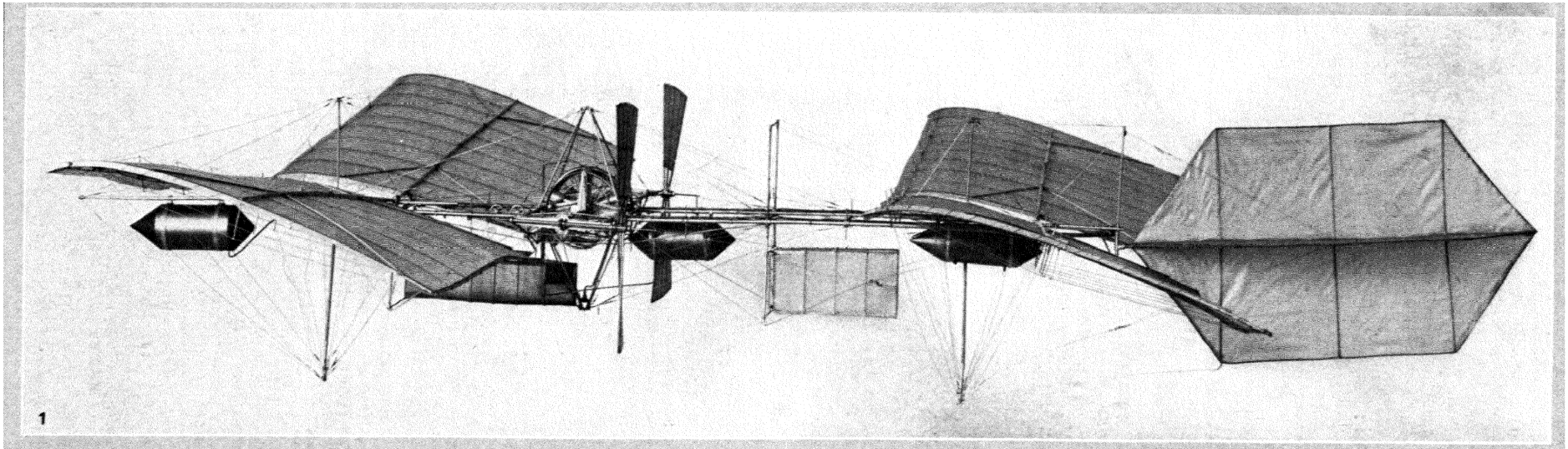
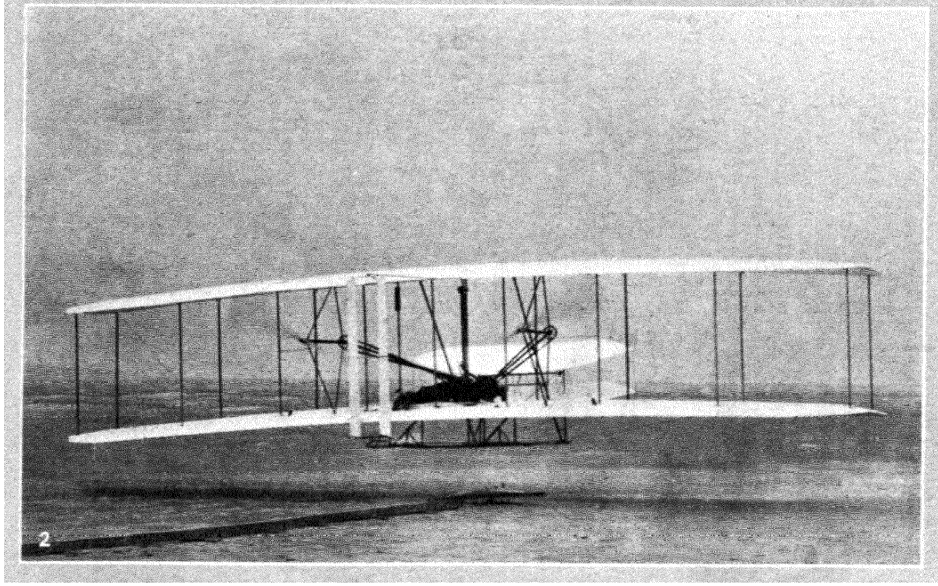
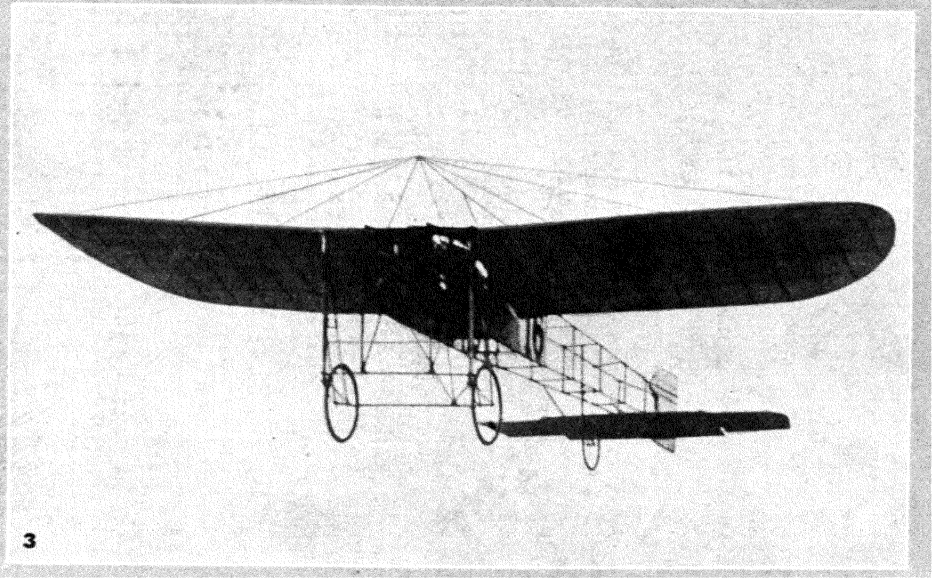


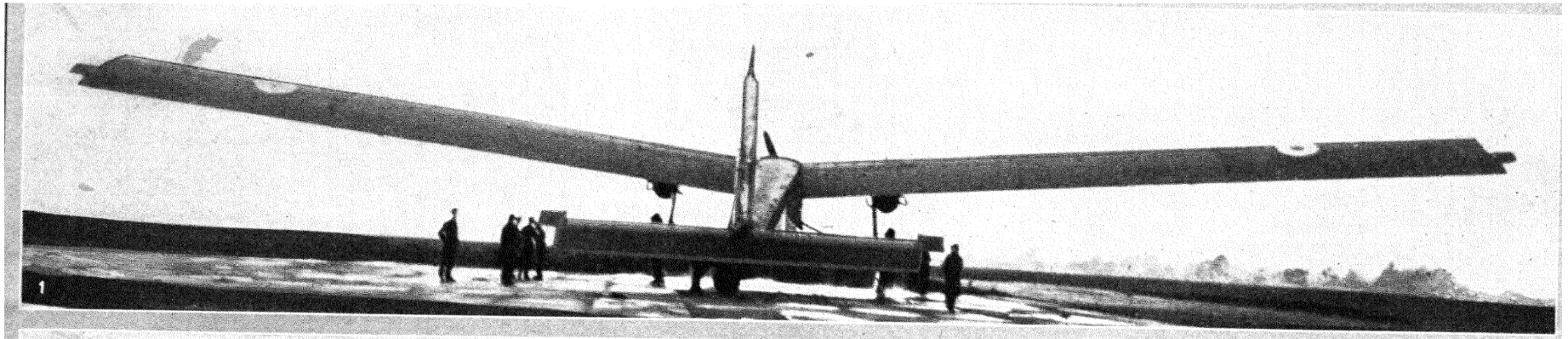




BY COURTESY OF (1, 2) THE DIRECTOR OF THE SCIENCE MUSEUM, LONDON, (3) THE AERONAUTICAL CHAMBER OF COMMERCE

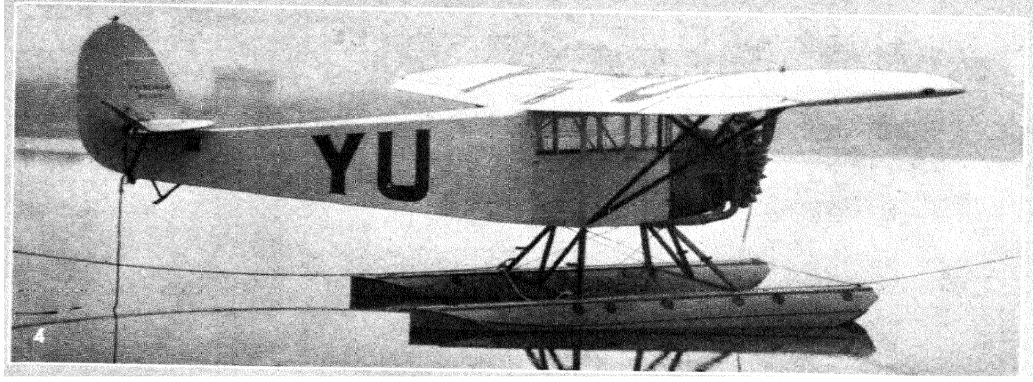
LANGLEY, WRIGHT AND BLÉRIOT MACHINES

1. Langley's "Aerodrome," 1903, characterized by lightness and extensive flying surfaces. This machine crashed in two attempted launchings and never made a successful flight
2. Biplane of the Wright brothers, rising from its slipway at Dayton, Ohio, December 17th, 1903. Several successful flights were made in the United States and France
3. Monoplane of Louis Blériot which crossed the English Channel on July 25, 1909











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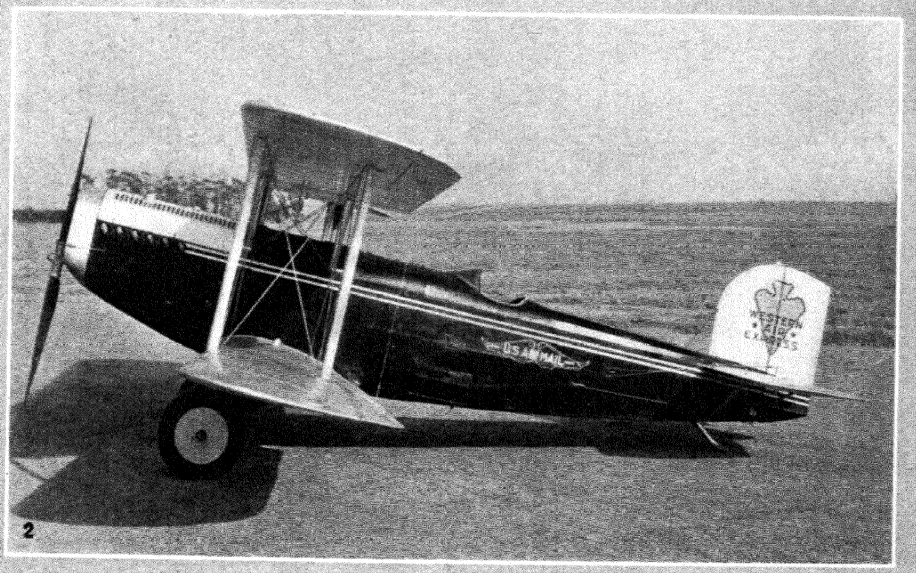
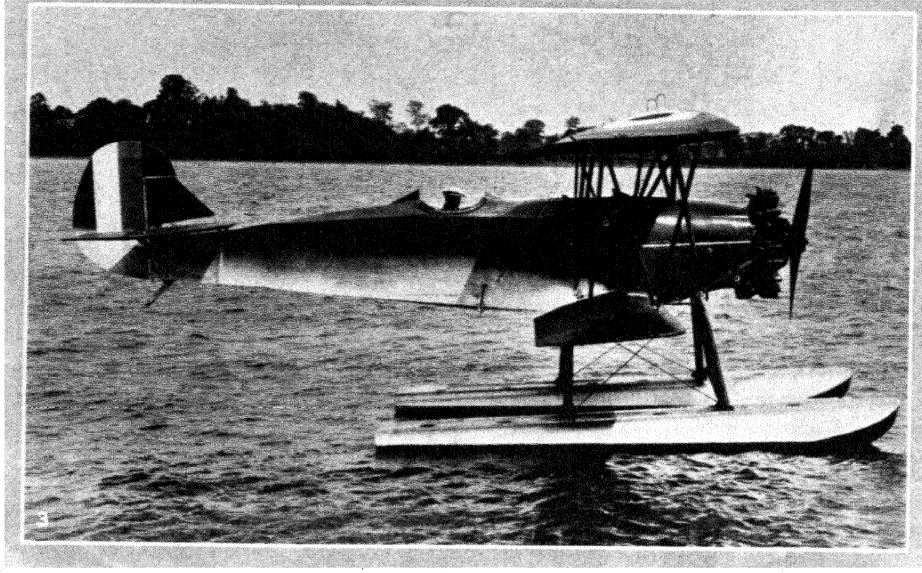
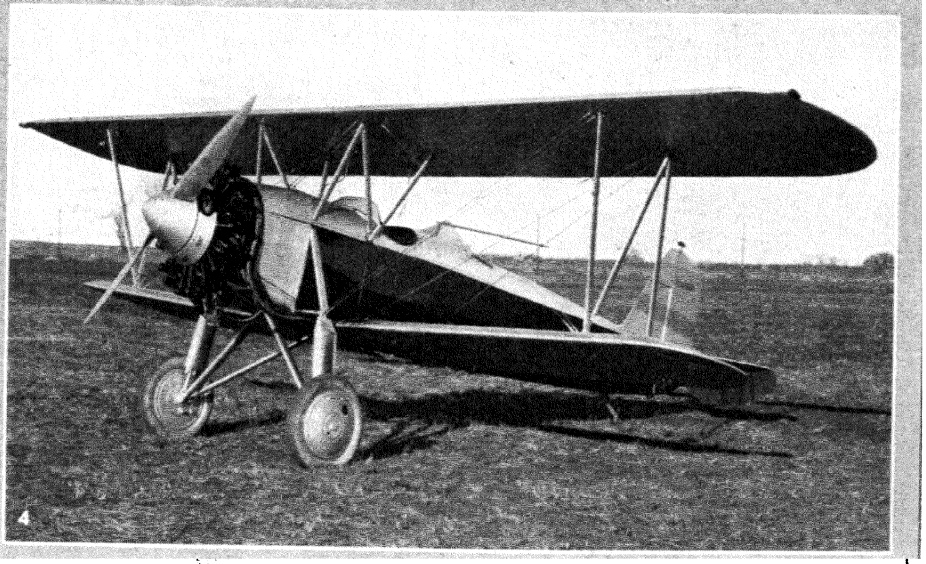
RECENT CIVIL AND MILITARY AEROPLANES

1. English Beardmore "Inflexible," 1928. The wing span is 150 ft., and it is fitted with three Rolls-Royce 650 h.p. "Condors"
2. Junker G. 31, an all metal 20-passenger aeroplane capable of flying 1,000 kilometres without landing
3. Vickers "Wibault," all metal single seater fighter
4. Fairchild aeroplane on pontoons, fitted with a Wasp engine
5. Hamilton all metal monoplane, combination mail carrier and passenger machine





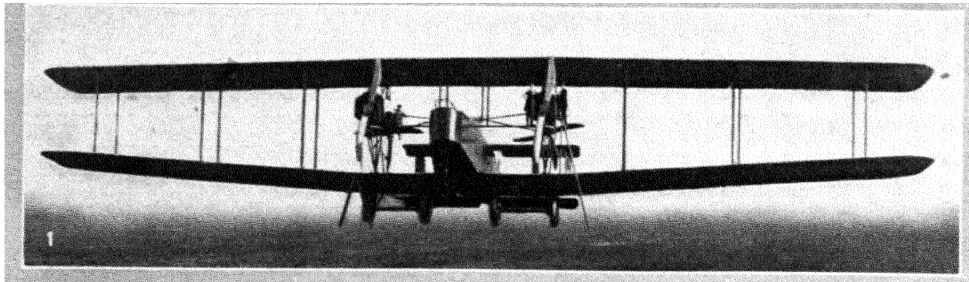


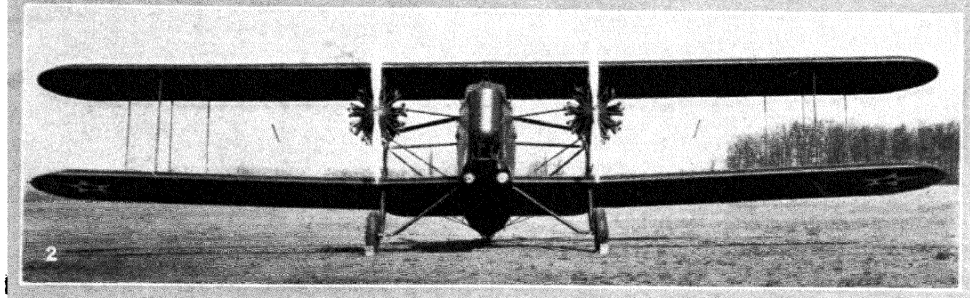


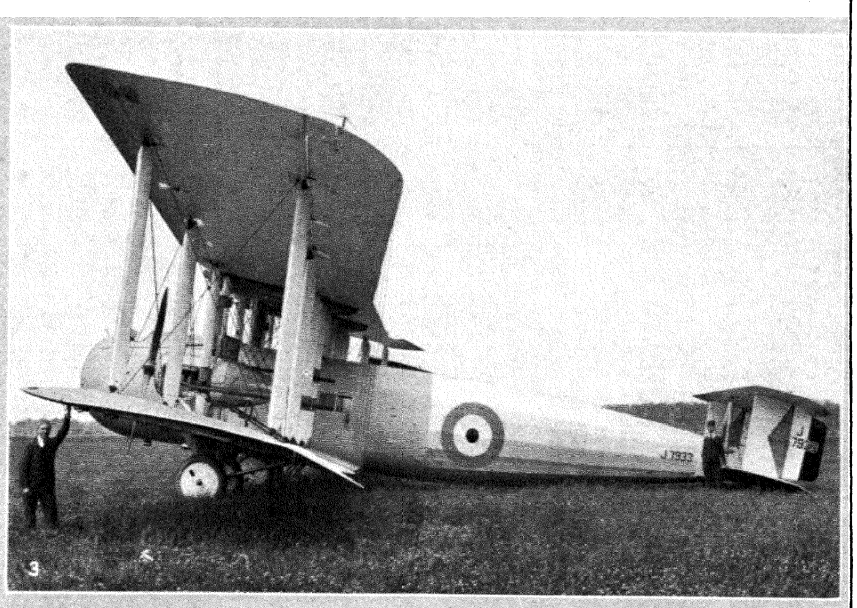
BY COURTESY OF (1, 2, 3, 4) THE AERONAUTICAL CHAMBER OF COMMERCE

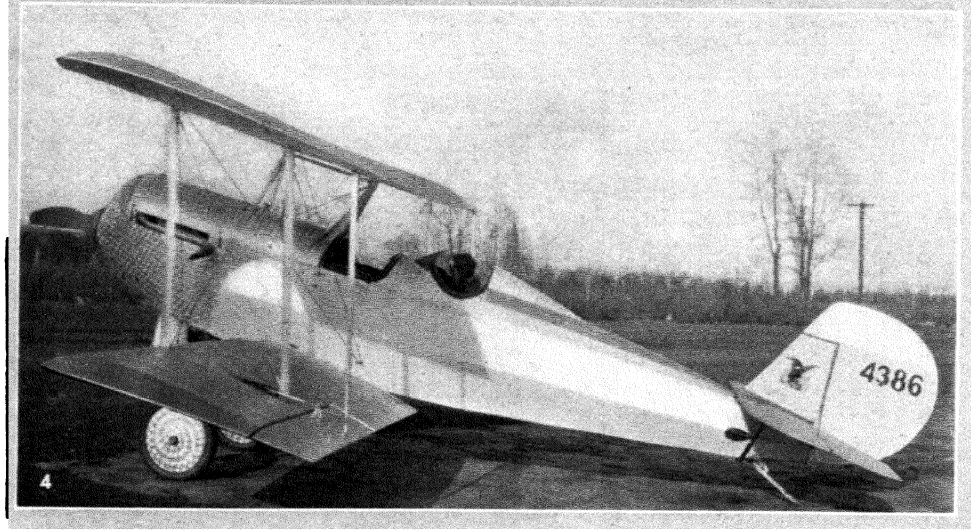
LAND AND SEA BIPLANES

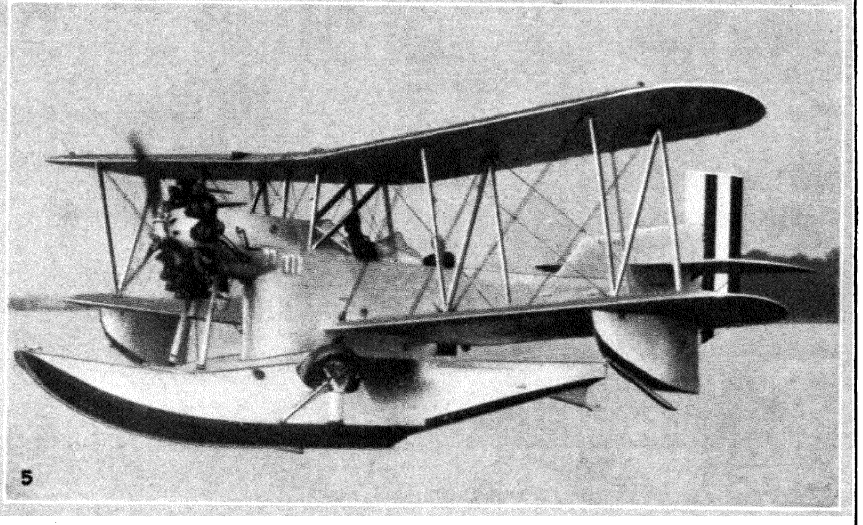
1. Curtiss Hawk equipped with a V-1550 motor
2. Curtiss Hawk two seated biplane
3. Keystone seaplane equipped with "Whirlwind" motor
4. Stearman biplane fitted with Wright "Whirlwind" motor











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CIVIL AND MILITARY BIPLANES

1. Handley-Page "V" 1,500, built in 1918. The wing span is 126 feet
2. Keystone two motored biplane, Model XLB-6
3. Vickers "Victoria," troop carrier, capable of transporting 24 men
4. American Eagle, a two seated biplane fitted with a 90 h.p. Curtiss OX-5 engine
5. Leoning "Amphibian," a recent addition to the U.S. Navy

wings. The wood used is chiefly spruce of the highest grade, and in many aeroplanes the whole of the main structure, with the exception of ties and joints, is of this material. Ties and the joints or fittings by which they are attached to the other members are generally of steel. Steel tubes are used in some parts, either, as in the undercarriage, on account of their robustness, or, as in the control mechanism, because of their efficiency in transmitting torsion.

The arrangement of the members of a conventional aeroplane structure of this composite character will be seen in fig. 9 of AERONAUTICS. The cross section of the wing spars has the I section used in general structural engineering, though the thickness of the web and flanges is much larger in proportion to the overall dimensions of the section than is usual in steel I girders.

The wings of the aeroplane shown in fig. 9 are in biplane form with external bracing. Composite construction has also been applied to wings with no external bracing, generally, but not invariably, monoplanes. The Dutch firm of Fokker is the chief European exponent of such methods. Their wing structures are built mainly of wood, the spars being box girders. The covering of the wings is of three-ply wood, which also enters largely into the ribs and spars.

In aeroplane construction the primary requirement is lightness, and a modern composite aeroplane structure is on the whole nearly as light as one of any other type of construction so far developed, for the same strength. At present it is also cheaper. Nevertheless, in so far as it embodies wood it suffers from the following disadvantages:

(1) Wood of a suitable grade cannot be freely obtained. (2) When exposed to the atmosphere, particularly to large changes in temperature and humidity, wood deteriorates more rapidly than steel or other metals. (3) Wood is not a reliable material. Its external appearance is often misleading as an indication of its internal condition. (4) In aeroplane structures glue and woodscrews cannot be entirely avoided. Both are sources of weakness and uncertainty (5) When a wooden structure is involved in an accident, many of its members break completely and splinter, and the structure disintegrates, whereas metal members often merely bend, and an all-metal structure generally preserves much of its original shape. The passengers in a wooden aeroplane are thus exposed to greater danger in case of an accident. (6) Wood has no inherent resistance to fire and cannot be rendered fire-resisting.

These disadvantages of wood have been the chief incentive to the development of all-metal construction for aeroplanes.

All-metal Structures.—The development of all-metal structures by British designers has been mainly confined to replacing each of the wooden members of the composite structure described above by a metal member, using either steel or duralumin. In such a structure the load to be borne by each member is of a fairly simple character and can be estimated fairly closely. Hence a comparison of the merits of a composite and an all-metal structure on these lines can be reduced to a comparison of typical members.

On the other hand European and American designers have used all-metal construction chiefly for monoplanes with no external bracing. The most prominent example is the German firm of Junkers. A wing of this kind cannot readily be considered in detail. In fact it is definitely regarded by its designer as a structural whole. Its structure is highly redundant in character and the corrugated metal covering combines the function of the ribs and fabric found in most other aeroplanes, and in addition contributes largely to the torsional stiffness of the whole wing, a function which in a biplane is performed mainly by the wire bracing. The relative advantages and disadvantages of these two distinct types of aeroplanes are concerned more with their general characteristics than with the materials of their structures (§§ 6 and 9).

Relative Cost of Wood and Metal.—The world's demand for aeroplanes is uneconomical in character. The total volume of the demand is small and it is spread over a large number of types. This reacts to the disadvantage of all-metal aeroplanes in particular. Wood is an economical material when small quantities of many types of articles have to be manufactured. The same raw material is required, and it can readily be shaped to efficient sections by the same simple tools and equipment. With metal, the raw material must be prepared by special plant into the necessary forms (tubes, strip, wire, etc.) and these processes are economical only when large quantities of one form are required. But given the demand for a standard article, metal is cheaper than wood.

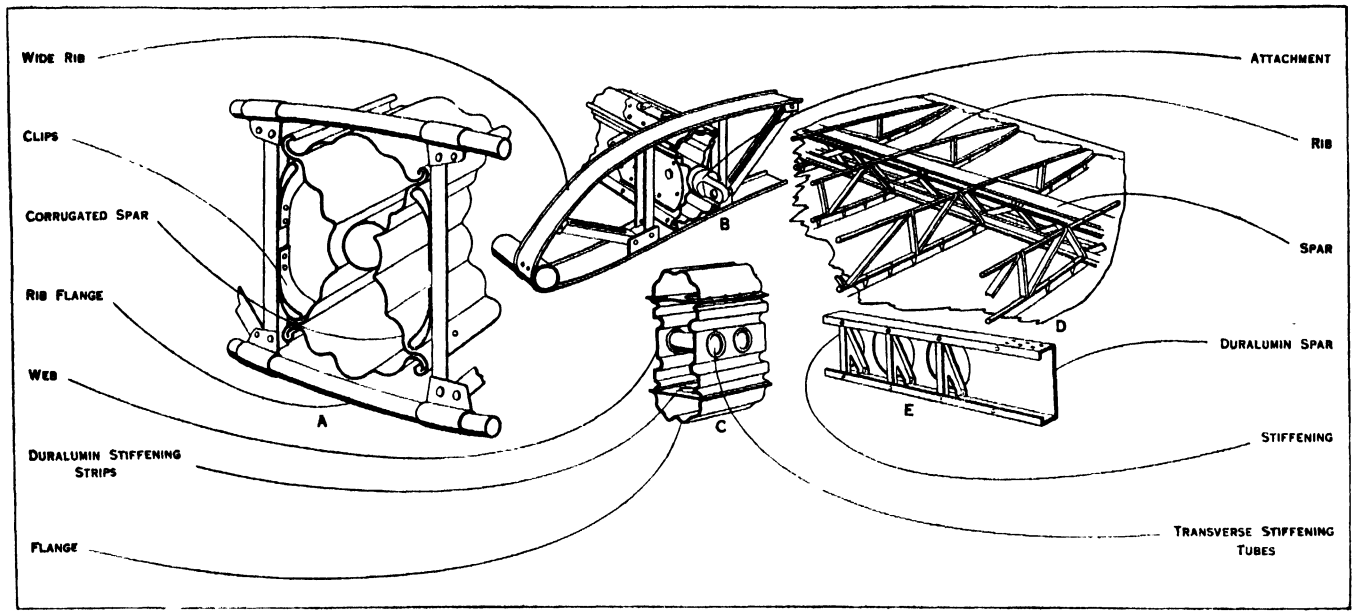
Many of the metal details of aeroplanes have been standardized since early in the War, and nearly all the raw materials are now the subject of specifications issued by the British Engineering Standards Association. But there is little as yet to correspond with the standard sizes of steel beams (I, angle, channel, etc.) which are essential to economy in general structural engineering, though design is now approaching the stage when such a step will be possible. Against the high first cost, however, must be offset the longer life and greater reliability of metal, and it cannot be doubted that wood as a material for the construction of aircraft is rapidly becoming obsolete.

Physical Properties of Materials.—The disadvantages of wood as a material for the structure of an aeroplane, outlined above, give an idea of what should be the characteristics of a satisfactory material. There is the usual difficulty, common to most problems of engineering design, of assessing the relative importance of each of these characteristics. In fact, their relative positions in the scale change with time and circumstances. But, owing to the low weight of the composite structures characteristic of modern aeroplanes, the technical problem is simplified into that of finding means of making, at the worst equally light, and preferably lighter structures from materials that do not share with wood the disadvantages mentioned. Table I. (p. 258) gives the strength and specific gravity of various materials which have been, or are likely to be, used for the main structural members of aircraft. They fall into three classes: wood, steel and light non-ferrous metals. The comparatively short life of wood has been quoted as one of its main disadvantages. Both steel and aluminium alloys need protection against corrosion (probably the most promising metal from this point of view is stainless steel). Although it would be misleading to suggest that all the problems of protection of metal structures have been solved, the experience gained suggests that effective protection can be given against all the ordinary causes of corrosion.

Struts and Beams of Thin Metal.—It is customary to regard the single figure obtained by dividing the strength by the specific gravity as a figure of merit on which the material can be judged. Such figures are not given in Table I. as they are not, in fact, a reliable criterion for all types of structural members.

The types of members responsible for the larger part of the weight of the structure of an aeroplane are two, struts and beams, the latter very often having to serve also as struts. Such members have essentially a *variation of stress* over their cross section, so that when the most heavily stressed point reaches the *limiting stress* of the material (this may be taken to mark the failure of the member as a whole), the majority of the material is under a lower stress. Hence the density of the material divided by its limiting stress is not in general proportional to the weight of the member.

In general, for a given area of cross section and a given limiting stress, the more the material can be spread out, *e.g.*, in the form of a circle, the greater will be the strength of the strut or beam, but the thinner will the material become. It appears, however, that a limit is reached for steel when the thickness is about $\frac{1}{30}$ the radius, beyond which an increase in the radius causes a decrease in strength. The member will then fail owing to local buckling of the material, at a load which corresponds to a maximum stress in the material, as calculated in the conventional way, which is below the limiting stress. The design of metal structures for aircraft hinges round the discovery of shapes of cross section which will enable the limiting stress of the material to be reached, and will be convenient for manufacture. The members must also be robust enough to ensure that ordinary handling does not damage them, a serious problem with thin sheets or tubes.



A AND B BY COURTESY OF ARMSTRONG WHITWORTH AIRCRAFT C BY COURTESY OF BOULTON AND PAUL D AND E BY COURTESY OF VICKERS

FIG 13—EXAMPLES OF METAL CONSTRUCTION OF SPARS AND RIBS FOR AEROPLANE WINGS

A. Section of corrugated steel spar, showing method of attaching rib by means of spring steel clips riveted to struts, pressing into corrugations in the spar
B. Inner end of wing in steel, showing wide rib and attachment of wing to aeroplane
C. Corrugated steel spar using transverse tubes to stiffen webs, and duralumin strips to stiffen flanges
D. Internal construction of wing in duralumin. Spar built up from sheet and angles. Ribs made from tube and channels
E. Simplified wing spar in duralumin. The greatest depth of each of the spars is about 5 inches

Limiting Stress.—The limiting stress in question is probably what is termed the yield point in compression, the stress at which plastic strain begins, for materials such as mild steel. For high tensile steel and light alloys (in practice the aluminium alloy known as *duralumin* is the one most used), there is no definite yield point and the limiting stress is accordingly somewhat uncertain. Shapes for members (*see* fig. 13) have been devised in which the greatest stress at failure is some 60 to 70% of the ultimate tensile strength of the materials (*see* Table I., column

TABLE I

Material.	Specific gravity	Ultimate Tensile Strength (tons/sq. in.)	Effective strength in compression (tons/sq. in.)
Wood—			
Spruce	0 45	about 3	2
Steel—			
Mild (soft)	7 8	26	15
Plain carbon steel bar for ties (cold-rolled)	7·8	70	
Plain carbon steel strip (cold-rolled and blued)	7 8	60	50
3½% nickel steel strip (hardened and tempered)	7·8	90	60
Light metals—			
Aluminium (cold-rolled)	2·6	10	8
Duralumin	2 85	27	17

headed "Effective Strength in Compression"), and there is reason to suppose that this is not far from the best that can be achieved. Some improvement may be anticipated from an extension of these results to still higher grades of steel, or from the development of a light alloy stronger than duralumin, but at the present time attention is concentrated mainly on the improvement of manufacturing methods

The ruling principle in the shapes of cross section which have achieved these results with steel is *corrugation* of the thin sheet material used. The theory of the collapse of corrugated material awaits development, design being at present largely empirical. But the general nature of the strengthening effect of corrugation is well understood. A flat sheet of thin metal buckles readily under compressive stresses. Corrugation, in any direction which does not make too great an angle with the direction of the stress, stiffens it against such buckling. Moreover, it greatly reduces the influence of the inevitable local irregularities in actual materials, and gives robustness to what would otherwise be a very easily damaged member. It has been found essential in struts and beams of thin metal, to corrugate *longitudinally*. Transverse corrugations have proved ineffective.

Steel strip of thickness as low as $\frac{1}{100}$in. has been used in aeroplane spars and ribs The material is either cold-rolled medium carbon steel, whose essential properties have been improved by a process known as blueing (heating to some 350°C), but is otherwise not heat treated, or a nickel chromium alloy steel, hardened and tempered. Hitherto the strip has been formed into the final shape cold and without any subsequent treatment. This restricts the sections which can be produced and the materials which can be used owing to the need for ductility in order to avoid cracks. Progress has been made in the direction of forming the shapes while the material is in an annealed state and heat treating subsequently. This method will probably supersede "hard" drawing and rolling.

For spars of the size shown in fig. 13, it has been found that the low specific gravity of duralumin makes it possible to use material of such a thickness that corrugation is not always necessary. The resulting shapes resemble those used in bridge construction, though the lattice girder seen in fig. 13 *d* is found in practice to be heavier than the simpler shape in *e*. It is probable that, for the size of spar required in the largest present-day aeroplanes of the type under discussion, it is more economical of weight to use a spar composed of a few parts (such as *a, c* and *e*) than to build it up from many pieces. On the other hand for larger beams, such as are used in airships, a lattice construction is lighter. Probably the lightest all-metal construction for a wing structure using spars and ribs, etc., combines both steel and duralumin, the former for the main members (spars and struts) and the latter for the subsidiary ribs and edges. With the methods outlined above it is now possible to make an all-metal aeroplane certainly as light as, and sometimes lighter than, the corresponding composite machine.

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struction (1920); H. Glauert, *Aerofoil Theory* (1926); H. Harper, *Steel Construction of Aircraft;* F. T. Jane, *All the World's Aircraft* (published annually), and the *Proceedings of the Royal Aeronautical Society* (monthly). *See* also the publications of the Aeronautical Research Committee (Great Britain) and the National Advisory Committee for Aeronautics (U.S.A.), particularly in reference to §1 (A.R.C.) 677, 930; §2 (N.A.C.A.) 116; §4 (A.R.C.) 300 (N.A.C.A.) 221; §5 (A.R.C.) 676; §7 (A.R.C.) 678, 740, 747, 836; §§9 and 10 (A.R.C.) 476, 673, 776 (N.A.C.A.) 203. (W. S. F.)

AEROTHERAPEUTICS. In addition to the general use of open air and sunshine, there are several particular ways of using air for therapeutic purposes. Thus oxygen enriched air is used for those made ill through breathing irritant gases such as were used in warfare. These gases evoke oedema of the lungs and danger of suffocation through want of oxygen. So, too, in cases of pneumonia, shock and failing circulation, oxygen inhalation is useful. It is administered either by a mask or in a special chamber in which the patient is put. In the latter case great precaution must be taken against the danger of fire.

Oxygen containing 5% of carbon dioxide provokes deep breathing, and is useful in cases when the lungs require expanding, as after operations for empyema, when hypostatic congestion of the lungs threatens, and in cases of poisoning by carbon monoxide, as in ordinary coal-gas poisoning, etc. This mixture is particularly useful for breathing during induction of and after anaesthesia with ether, since the deep respiration induces anaesthesia quickly, and washes the ether out of the body at the end of the anaesthetic period. The breathing of nitrous oxide and oxygen in a compressed air chamber at half an atmosphere extra pressure gives deep and safe anaesthesia.

Certain dusts in the air act as irritants to those affected with hay fever and asthma, *e.g.*, the pollen of plants, spores of aspergillus mould. It has been found possible to relieve such patients by sending them to the high Alps.

In a mercurial or sulphur bath, the patient, enveloped in a sheet, sits on a chair beneath which a lamp is placed both to volatilize the drug and produce a steamy atmosphere. The vapour is absorbed by the skin. This treatment is used for syphilis and also for scabies and other affections of the skin. (*See* THERAPEUTICS.)

Air at a low pressure is used locally for cupping and thus producing local congestion, the blood being drawn into the part to which the cupping apparatus is applied at the expense of other organs. A similar result is got by local application of heat, poultices, etc. In operations where the chest cavity is opened air is blown into the lungs through a tube introduced through the larynx in order to keep the lungs distended.

Ozonized Air.—Ozonized air has been used in treatment of phthisis and wounds. Ozone is an irritant to the lungs and can be used safely only in very weak concentrations, *e.g.*, in a concentration just perceptible to the smell. It takes away the power to smell bad odours, but otherwise has no valuable properties which have been proven. Its chief use, then, is for deodorizing offensive smells. (L. E. H.)

BIBLIOGRAPHY.—"Aerotherapeutics," *American Journal of Physical Therapy*, vol. 3, 1926–27.

AERSCHOT, PHILIPPE DE CROY, DUKE OF (1526–1595), prince of Chimay, governor-general of Flanders, was born at Valenciennes, and inherited the estates of the ancient and wealthy family of Croy. He was appointed governor of the citadel of Antwerp when the Spanish troops withdrew in 1577. After a period of vacillation he deserted Don John towards the end of that year. Jealous of the prince of Orange, he was then the head of the party which induced the archduke Matthias (afterwards emperor) to undertake the sovereignty of the Netherlands, and soon afterwards was appointed governor of Flanders by the state council. A strong party, including the burghers of Ghent, distrusted the new governor; and Aerschot, who was taken prisoner during a riot at Ghent, was only released on promising to resign his office. He then sought to regain the favour of Philip of Spain, and having been pardoned by the king in 1580 shared in the government of the Netherlands; but he refused to serve under the count of Fuentes when he became governor-general in 1594, and retired to Venice, where he died on Dec. 11, 1595.

See J. L. Motley, *The Rise of the Dutch Republic.*

AERTSZEN (or AARTSEN), **PIETER** (1507–1573), called "long Peter" on account of his height, Dutch historical painter, was born and died at Amsterdam. When a youth he distinguished himself by painting homely scenes, in which he reproduced articles of furniture, cooking utensils, etc., with marvellous fidelity. An excellent specimen of his style on a small scale, a picture of the Crucifixion, may be seen in the Antwerp Museum. Aertszen was a member of the Academy of St. Luke, in the books of which he is entered as *Langhe Peter, schilder.* Three of his sons attained to some note as painters.

AESCHINES (5th century B.C.), an Athenian philosopher and orator and a friend of Socrates. Diogenes Laertius preserves a tradition that it was he, not Crito, who offered to help Socrates to escape from prison. He was always a poor man. He started a perfumery shop in Athens on borrowed capital, became bankrupt and retired to the Syracusan court. According to Diog. Laert. (ii. 61), Plato, then at Syracuse, pointedly ignored Aeschines, but this does not agree with Plutarch *De adulatore et amico* (c. 26). On the expulsion of the younger Dionysius, Aeschines returned to Athens, and, finding it impossible to profess philosophy publicly owing to the contempt of Plato and Aristotle, was compelled to teach privately. Besides forensic speeches, noted for their purity of style, he wrote several philosophical dialogues. (1) *Concerning virtue, whether it can be taught;* (2) *Eryxias, or Erasistratus: concerning riches, whether they are good;* (3) *Axiochus: concerning death, whether it is to be feared,*—but those extant are not genuine remains.

J. le Clerc has given a Latin translation of them, with notes and several dissertations, entitled *Sylvae Philologicae,* and they have been edited by S. N. Fischer (Leipzig, 1786), and K. F. Hermann *De Aeschin. Socrat. relig.* (Gott. 1850). An amusing passage of a genuine dialogue is quoted by Cicero in the *De inventione* (i. 31). Hirzel *Der Dialog* i. 129–140; T. Gomperz *Greek Thinkers,* vol. iii. p. 342 (Eng. trans. G. G. Berry, London, 1905).

AESCHINES (389–314 B.C.) Athenian orator, the political opponent of Demosthenes. Aeschines and Demosthenes were both members of the first embassy to Philip (Feb.–March 346 B.C.). Philip's envoys appeared in the Assembly on April 15 and 16, and between these two meetings Aeschines appears to have been won over to Philip's interest; on the 15th he refused, with Demosthenes, to accept a clause excluding Phocis; on the 16th he supported a peace in which the question was left vague. The same ambassadors went to administer the oaths to Philip, but, after so delaying on their journey that Philip had time to make conquests in Thrace, Philocrates and Aeschines (out-voting Demosthenes), allowed him to exclude the Phocians. But on his return Aeschines falsely assured the Assembly that he had private information that Philip meant to support Phocis. The Athenians believed him and Phocis, left without support, surrendered.

In 345, Demosthenes accused Aeschines of misconduct, but Aeschines saved himself by an attack on Demosthenes' supporter (*in Timarchum*). In 343, Demosthenes renewed the attack, and Aeschines secured a bare acquittal (*De Falsa Legatione*).

In 340, war broke out again with Philip, and thanks to Aeschines, who stirred up a Sacred War in 339, he managed to enter Greece unopposed, as general of the Amphictyonic forces. Athens and Thebes, united by Demosthenes, resisted desperately, but were decisively defeated at Chaeroneia (338).

Aeschines' party secured favourable terms from Philip, and prosecuted Demosthenes on various charges, but the Athenians loyally supported him, and in 337 it was proposed to crown him for public services. Aeschines brought a *graphē paranomōn* against the proposer (*in Ctesiphontem*), but the case was not tried till 330. Demosthenes' speech on the Crown (a vindication of his whole policy) secured the condemnation of Aeschines, who withdrew to Rhodes.

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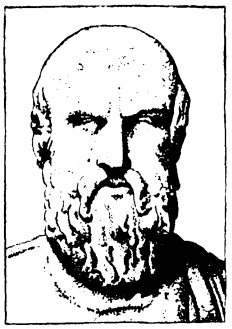
Biddle (1881), Adams (Loeb series, 1919), and others. *See* also Stechow, *Aeschinis Oratoris vita* (1841); Marchand, *Charakteristik des Redners Äschines* (1876); Castets, *Eschine, l'Orateur* (1875); for the political problems *see* histories of Greece, esp. A. Holm, vol. iii., Eng. trans. 1896; A. Schäfer, *Demosth. und seine Zeit* (Leipzig, 1856–58); also DEMOSTHENES.

AESCHYLUS (525–456 B.C.), Greek poet, the first of the only three Attic tragedians of whose work entire plays survive, and in a very real sense the founder of the Greek drama, was born at Eleusis in 525 B.C. His father, Euphorion, belonged to the "Eupatridae" or old nobility of Athens, as we know on the authority of the short *Life* of the poet given in the Medicean Manuscript (*see* note on "Authorities" at the end). According to the same tradition he took part as a soldier in the great struggle of Greece against Persia; and was present at the battles of Marathon, Artemisium, Salamis and Plataea, in the years 490–479. At least one of his brothers, Cynaegirus, fought with him at Marathon, and was killed in attempting a conspicuous act of bravery; and the brothers' portraits found a place in the national picture of the battle which the Athenians set up as a memorial in the Stoa Poecile (or "Pictured Porch") at Athens.



AESCHYLUS, FATHER OF THE GREEK DRAMA
Head now in the Capitoline Museum, Rome, believed to be that of Aeschylus, probably of about the 5th century, B.C.

The vigour and loftiness of tone which mark Aeschylus' poetic work were partly inspired by the personal share he took in the great actions of a heroic national uprising. In the same way, the poet's brooding thoughtfulness on deep questions—the power of the gods, their dealings with man, the dark mysteries of fate, the future life in Hades—though largely due to his turn of mind and temperament, was doubtless connected with the place where his childhood was passed. Eleusis was the centre of the most famous worship of Demeter which was intimately connected with the Greek beliefs about the human soul and the underworld.

His dramatic career began in 499 B.C. when he first exhibited at Athens; and his last work, the trilogy of the *Oresteia*, was exhibited in 458. The total number of his plays is stated by Suidas to have been 90; and the seven extant plays, with the dramas named or nameable which survive only in fragments, amount to over 80, so that Suidas' figure is probably based on reliable tradition. In the 5th century each exhibitor at the tragic contests produced four plays; and Aeschylus must therefore have competed (between 499 and 458) more than 20 times. His first victory is recorded in 484, 15 years after his earliest appearance on the stage; but in the remaining 26 years of his dramatic activity at Athens he was successful at least 12 times. Perhaps the most striking evidence of his exceptional position among his contemporaries is the well-known decree passed shortly after his death that whosoever desired to exhibit a play of Aeschylus should "receive a chorus," *i.e.*, be officially allowed to produce the drama at the Dionysia. The existence of this decree, mentioned in the *Life*, is strongly confirmed by two passages in Aristophanes: first in the prologue of the *Acharnians* (acted in 425), where the citizen relates his great disappointment, when he took his seat in the theatre "expecting Aeschylus," to find that when the play came on it was Theognis; and secondly in a scene of the *Frogs* (acted 405 B.C.), where the throne of poetry is contested in Hades between Aeschylus and Euripides, the former complains (*Fr.* 866) that "the battle is not fair, because my own poetry has not died with me, while Euripides' has died, and therefore *he will have it with him to recite*"—a clear reference, as the scholiast points out, to the continued production at Athens of Aeschylus' plays after his death.

The only other incidents recorded of the poet's life that deserve mention are connected with his Sicilian visits, and the charge preferred against him of revealing the "secrets of Demeter." This tale is mentioned by Aristotle (*Eth.* iii. 2), and Eustratius (12th century) quotes from one Heracleides Pontius the following version:

The poet was acting in one of his own plays, where there was a reference to Demeter. The audience suspected him of revealing the inviolable secrets, and rose in fury; the poet fled to the altar of Dionysus in the orchestra and so saved his life for the moment. He was afterwards charged with the crime before the Areopagus; and his plea "that he did not know that what he said was secret" secured his acquittal. The commentator adds that the prowess of the poet (and his brother) at Marathon was the real cause of the leniency of his judges. In the above shape the story dates back to the 4th century; and as the main fact seems accepted by Aristotle, it is probably authentic.

As to his foreign travel, the suggestion has been made that certain descriptions in the *Persae*, and the fact that he wrote a trilogy on the story of the Thracian king, Lycurgus, seems to point to his having visited Thrace. This, however, remains at best a conjecture. For his repeated visits to Sicily, on the other hand, there is conclusive ancient evidence. Hieron the First, tyrant of Syracuse (478–467), who invited to his court famous poets and men of letters, had founded a new town, Aetna, on the site of Catana. About 476 Aeschylus was entertained by him, and at his request wrote and exhibited a play called *The Women of Aetna* in honour of the new town. He paid a second visit about 472, the year in which he had produced the *Persae* at Athens; and the play is said to have been repeated at Syracuse at his patron's request. Hieron died in 467, the year of the *Seven against Thebes;* but after 458, when the *Oresteia* was exhibited at Athens, we find the poet again in Sicily for the last time. In 456 he died, and was buried at Gela; and on his tomb was placed an epitaph in two elegiac couplets saying: "Beneath this stone lies Aeschylus, son of Euphorion, the Athenian, who perished in the wheat-bearing land of Gela; of his noble prowess the grove of Marathon can speak, or the long-haired Persian who knows it well." The *Life* says this epitaph was inscribed on his grave by the people of Gela, while Athenaeus and Pausanias attribute it to Aeschylus. Probably most people would agree that only the poet himself could have praised the soldier and kept silence about the poetry.

Of the marvellous traditions which gathered round his name little need be said. Pausanias' tale, how Dionysus appeared to the poet when a boy and bade him write a tragedy—or the account in the *Life*, how he was killed by an eagle letting fall on his head a tortoise—clearly belong to the same class of legends as the story that Plato was son of Apollo. Less supernatural, but hardly more historical, is the statement in the *Life* that the poet left Athens for Sicily in consequence of his defeat in the dramatic contest of 468 by Sophocles; or alternatively because Simonides' elegy on the heroes slain at Marathon was preferred to his own. Neither story fits the facts; for in 467, the next year after Sophocles' success, we know that Aeschylus won the prize of tragedy with the *Septem;* and the Marathon elegy must have been written in 490 about 14 years before his first visit to Sicily.

Aeschylus' Plays.—In passing from Aeschylus' life to his work, we have obviously far more trustworthy data, in the seven extant plays (with the fragments of more than 70 others), and particularly in the invaluable help of Aristotle's *Poetics*. The real importance of our poet in the development of the drama (*see* DRAMA: *Greek*) as compared with his predecessors is shown by the fact that Aristotle, in his brief review of the rise of tragedy (*Poet.* iv. 13), names no one before Aeschylus.

Tragedy grew out of the old choric song to Dionysus, to which was added first a spoken interlude by the chorus-leader, and later one actor (at first the poet), whom the mask enabled to appear in more than one part. But everything points to the fact that in the development of the drama Aeschylus was the decisive innovator. The two things that were important, when the 5th century began, if tragedy was to realize its possibilities, were (1) the disentanglement of the dialogue from its position as an interlude in an artistic and religious pageant that was primarily lyric; and (2) its general elevation of tone. Aeschylus, as we know on the express authority of Aristotle (*Poet.* iv. 13), achieved the first by the introduction of the second actor; and though he did not begin the second he gave to it the decisive impulse and consum-

mation by the overwhelming effect of his serious thought, the stately splendour of his style, his high dramatic purpose, and the artistic grandeur and impressiveness of the construction and presentment of his tragedies.

As to the importance of the second actor no argument is needed. The interacting personal influences of different characters on each other are indispensable to anything that can be called a play, as we understand the word; and, without two "personae dramatis" at the least, the drama in the strict sense is clearly impossible. The number of actors was afterwards increased; but to Aeschylus is due the essential step; and therefore, as was said above, he deserves, in a very real sense, to be called the founder of Athenian tragedy.

Of the seven extant plays, *Supplices, Persae, Septem contra Thebas, Prometheus, Agamemnon, Choephoroe* and *Eumenides*, five can be dated with certainty, as the archon's name is preserved in the Arguments; and the other two approximately. The dates rest, in the last resort, on the *didaskalia*, or the official records of the contests, of which Aristotle (and others) compiled catalogues; and some actual fragments have been recovered The order of the plays is probably that given above; and certainly the *Persae* was acted in 472, *Septem* in 467, and the trilogy in 458. The *Supplices* is generally regarded as the oldest; and the best authorities tend to place it not far from 490. The early date is strongly confirmed by three things: the extreme simplicity of the plot, the choric (instead of dramatic) opening, and the fact that the percentage of lyric passages is 54, or the highest of all the seven plays. The chief doubt is in regard to *Prometheus*, but the very low percentage of lyrics (only 27, or roughly a quarter of the whole), and still more the strong characterization, a marked advance on anything in the first three plays, point to its being later than any except the trilogy, and suggest a date somewhere about 460, or perhaps a little earlier. A few comments on the extant plays will help to indicate the main points of Aeschylus' work.

Supplices.—The exceptional interest of the *Supplices* is due to its date. Being nearly 20 years earlier than any other extant play, it furnishes evidence of a stage in the evolution of Attic drama which would otherwise have been unrepresented. It probably resembles in general structure the lost works of Choerilus, Phrynichus, Pratinas and the 6th century pioneers of drama.

The plot is briefly as follows: the 50 daughters of Danaus (who are the chorus), betrothed by Aegyptus (their father's brother) to his 50 sons, flee with Danaus to Argos, to escape the marriage. They claim the protection of the Argive king, Pelasgus; and he (by a pleasing anachronism) refers the matter to the people, who agree to protect the fugitives. The pursuing fleet of suitors is seen approaching; the herald arrives, orders off the cowering Danaids to the ships and finally attempts to drag them away Pelasgus interposes with a force, drives off the Egyptians and saves the suppliants Danaus urges them to prayer, and the grateful chorus pass away to the shelter offered by their protectors.

It is clear that we have here the drama just developing out of the lyric pageant The interest still centres round the chorus. Character and plot—the two essentials of drama—are both here rudimentary. The play is a single situation. It should not be forgotten, indeed, that the play is one of a trilogy—an act, therefore, rather than a complete drama. But we have only to compare it with those later plays of which the same is true, to see the difference. Even in a trilogy, each play is a complete whole in itself, though also a portion of a larger whole.

Persae.—The next play that has survived is the *Persae*, the only extant Greek historical drama. The plot is still severely simple, though more developed than that of the *Supplices*. The opening is still lyric, and the first quarter of the play brings out, by song and speech, the anxiety of the people and queen as to the fate of Xerxes' huge army. Then comes the messenger with the news of Salamis, including a description of the sea-fight itself which can only be called magnificent. The play is not a tragedy in the true Greek sense; its real aim is not the "pity and terror" of the developed drama; it is the triumphant glorification of Athens, the exultation of the whole nation gathered in one place, over the ruin of their foe, and one effective incident is the raising of Darius's ghost, and his prophecy of the disastrous battle of Plataea. But in the ghost's revelations there is a mixture of audacity and naïveté, characteristic at once of the poet and the early youth of the drama.

Septem Contra Thebas.—Five years later came the Theban tragedy, which is (like the *Supplices*) one of a connected series, dealing with the evil fate of the Theban house, and traces the fate through three generations, Laius, Oedipus and the two sons who die by each other's hands in the fight for the Theban sovereignty. This family fate, where one evil deed leads to another after many years, is a larger conception, strikingly suited to Aeschylus' genius, and constitutes a notable stage in the development of the Aeschylean drama. In the last extant work, the *Oresteia*, the poet traces the tragedy of the Pelopid family, from Agamemnon's first sin to Orestes' vengeance and purification. And the names of several lost plays point to similar handling of the tragic trilogy

The *Seven against Thebes* is the last play of its series; and again the plot is severely simple Father and grandfather have both perished miserably; and the two princes both claim the kingdom. Eteocles has driven out Polyneices, who fled to Argos, gathered a host under seven leaders (himself being one), and when the play opens has begun the siege of his own city. The king appears, warns the people, chides the clamour of women, appoints seven Thebans, including himself, to defend the seven gates, departs to his post, meets his brother in battle and both are killed. The other chieftains are all slain, and the enemy beaten off. The two dead princes are buried by their two sisters, who alone are left of the royal house.

Various signs of the early drama are here manifest. Half the play is lyric; there is no complication of plot; the whole action is recited by messengers; and the predicted mutual slaughter of the princes is brought about by no accidental stroke of destiny, but by the choice of the king, Eteocles himself On the other hand, the opening is no longer lyric (like the two earlier plays) but dramatic; the main scene, where the king appoints the seven defenders, must have been an impressive spectacle. One novelty should not be overlooked There is here the first passage of *dianoia*, or general reflection of life, which later became a regular feature of tragedy. Eteocles muses on the fate which involves an innocent man in the company of the wicked so that he shares unjustly their deserved fate (*Theb.* 597–608). The whole part of Eteocles shows a new effort of the poet to draw character, which may have something to do with the rise of Sophocles, who in the year before (468) won the prize of tragedy. There remain only the *Prometheus* and the *Oresteia*, which show such marked advance that (it may almost be said) when we think of Aeschylus it is these four plays we have in mind.

Prometheus.—The Prometheus-trilogy consisted of three plays: *Prometheus the Fire-bringer, Prometheus Bound, Prometheus Unbound.* The two last necessarily came in that order; the *Fire-bringer* is probably the first of the trilogy. That Prometheus sinned against Zeus, by stealing fire from heaven; that he was punished by fearful tortures for ages; that he was finally reconciled to Zeus and set free—all this was the ancient tale indisputably. Those who hold the *Fire-bringer* (Πυρφόρος) to be the final play, conjecture that it dealt with the establishment of the worship of Prometheus under that title, which is known to have existed at Athens. But the other order is on all grounds more probable; it keeps the natural sequence—crime, punishment, reconciliation, which is also the sequence in the *Oresteia*. And if the reconciliation was achieved in the second play, no scheme of action sufficing for the third drama seems even plausible.[1]

The play that survives is a poem of unsurpassed force and impressiveness. Nevertheless, from the point of view of the

[1]The *Eumenides* is quoted as a parallel, because there the establishment of this worship at Athens concludes the whole trilogy; but it is forgotten that in *Eumenides* there is much besides—the pursuit of Orestes, the refuge at Athens, the trial, the acquittal, the conciliation by Athena of the Furies; while here the story would be finished before the last play began.

development of drama, there seems at first sight little scope in the story for the normal human interest of a tragedy, since the actors are all divine, except Io; and between the opening where Prometheus is nailed to the Scythian rock, and the close where the earthquake engulfs the rock, the hero and the chorus, action in the ordinary sense is *ipso facto* impossible. This is just the opportunity for the poet's bold inventiveness and fine imagination.

Oceanus, the well-meaning palavering old mentor, and Hermes, the blustering and futile jack-in-office, gods though they be, are vigorous, audacious and very human character-sketches; the soft entrance of the consoling nymphs is unspeakably beautiful; and the prophecy of Io's wanderings is a striking example of that new keen interest in the world outside which was felt by the Greeks of the 5th century, as it was felt by the Elizabethan English in a very similar epoch of national spirit and enterprise 2,000 years later Thus, though dramatic action is by the nature of the case impossible for the hero, the visitors provide real drama.

Another important point in the development of tragedy is what we may call the "balanced issue" The hero is both a victim and a rebel. He is punished for his benefits to man; but though Zeus is tyrannous, the hero's reckless defiance is shocking to Greek feeling As the play goes on, this is subtly indicated by the attitude of the chorus They enter overflowing with pity They are slowly alienated by the hero's impiety; but they decline, at the last crisis, the mean advice of Hermes to desert Prometheus; and in the final crash they share his fate

Oresteia.—The last and greatest work of Aeschylus is the *Oresteia,* which also has the interest of being the only complete trilogy preserved to us. As in *Prometheus,* the plot, at first sight, is such that the conditions of drama seem to exclude much development in character-drawing The gods are everywhere at the root of the action. The inspired prophet, Calchas, has demanded the sacrifice of the king's daughter, Iphigeneia, to appease the offended Artemis The inspired Cassandra, brought in as a spear-won slave from conquered Troy, reveals the murderous past of the Pelopid house, and the imminent slaughter of the king by his wife. Apollo orders the son, Orestes, to avenge his father by killing the murderess, and protects him when after the deed he takes sanctuary at Delphi The Erinnyes ("Furies") pursue him over land and sea; and at last Athena gives him shelter at Athens, summons an Athenian council to judge his guilt, and when the court is equally divided gives her casting vote for mercy. The last act ends with the reconciliation of Athena and the Furies; and the latter receive a shrine and worship at Athens, and promise favour and prosperity to the great city. The scope for human drama seems deliberately restricted by such a story so handled. Nevertheless, the growth of characterization is not only visible but remarkable Clytaemestra is one of the most powerfully presented characters of the Greek drama And there is one other noticeable point In this trilogy, Aeschylus, for the first time, has attempted some touches of character in two of the humbler parts, the watchman in *Agamemnon,* and the nurse in the *Choephoroe.* These two are veritable figures drawn from contemporary life; and though both appear only once, the innovation is most significant, and especially as adopted by Aeschylus.

Aeschylus' Characteristics.—It remains to say a word on two more points: the religious ideas of Aeschylus and some of the main characteristics of his poetry. The religious aspect of the drama in one sense was prominent from the first. But the new spirit imported by the genius of Aeschylus was religious in a profounder meaning of the term. The sadness of human lot, the power and mysterious dealings of the gods, their terrible and inscrutable wrath and jealousy (*aga* and *phthonos*), their certain vengeance upon sinners, all the more fearful if delayed—such are the poet's constant themes, especially in the *Oresteia* And at times, particularly in the *Trilogy,* in his reference to the divine power of Zeus, he almost approaches a stern and sombre monotheism.

One specially noteworthy point in the *Agamemnon* is his explicit repudiation of the common Hellenic view that prosperity brings ruin. In other places he seems to share the feeling; but here (*Ag.* 730) he goes deeper, and declares that it is not ὄλβος but always wickedness that brings about men's fall. All through there is a recurring note of *fear* in his view of man's destiny. In one remarkable passage of the *Eumenides* (517–525) this fear is extolled as a moral power which ought to be enthroned in men's hearts, to deter them from impious acts or from the pride that impels them to such sins.

Of the poetic qualities of Aeschylus' drama and diction, both in the lyrics and the dialogue, the briefest word must here suffice. He is everywhere distinguished by grandeur and power of conception, presentation and expression, and most of all in the latest works, the *Prometheus* and the *Trilogy.* He is pre-eminent in depicting the slow approach of fear, as in the *Persae;* the imminent horror of impending fate, as in the broken cries and visions of Cassandra in the *Agamemnon* (1072–1177), the long lament and prayers to the nether powers in the *Choephoroe* (315–478), and the gradual rousing of the slumbering Furies in the *Eumenides* (117–139) The fatal end in these tragedies is foreseen, but the effect is due to its measured advance, to the slowly darkening suspense which no poet has more powerfully rendered. Again, he is a master of contrasts, as when the floating vision of consoling nymphs appears to the tortured Prometheus (115–135); or the unmatched lyrics which tell (in the *Agamemnon,* 228–247) of the death of Iphigeneia; or the vision of his lost love that the night brings to Menelaus (410–426). And not least noticeable is the extraordinary range force and imaginativeness of his diction. One example of his lyrics may be given which will illustrate more than one of these points It is taken from the lament in the *Septem,* sung by the chorus and the two sisters, while following the funeral procession of the princes. (*Sept.* 854–860).—

> Nay, with the wafting gale of your sighs, my sisters,
> Beat on your heads with your hands the stroke as of oars,
> The stroke that passes ever across Acheron,
> Speeding on its way the black-robed sacred bark,—
> The bark Apollo comes not near,
> The bark that is hidden from the sunlight—
> To the shore of darkness that welcomes all! (A. Sl.)

Bibliography.—*Authorities.* The chief authority for the text is a single ms. at Florence, of the early 11th century, known as the Mediccan or M, written by a professional scribe and revised by a contemporary scholar, who corrected the copyist's mistakes, added the scholia, the arguments and the *dramatis personae* of three plays (*Theb, Agam, Eum*), and at the end of the *Life of Aeschylus* and the *Catalogue* of his dramas. The ms. has also been further corrected by later hands. In 1896 the Italian Ministry of Public Instruction published the ms. in photographic facsimile, with an instructive preface by Signor Rostagno. Besides M. there are some eight later mss. (13th to 15th century), and numerous copies of the three select plays (*Sept, Pers, Prom*) which were most read in the later Byzantine period. These later mss. are of little value.

Editions.—The three first printed copies (Aldine, 1518; Turnebus and Robortello, 1552) give only those parts of *Agamemnon* found in M, from which ms. some leaves were lost; in 1557 the full text was restored by Vettori (Victorius) from later mss. After these four, the chief editions of the seven plays were those of Schutz, Porson, Butler, Wellauer, Dindorf, Bothe, Ahrens, Paley, Hermann, Hartung, Weil, Merkel, Kirchhoff and Wecklein. Editions of separate plays, special studies, etc. Wilamowitz-Moellendorf, Enger, Conington, Blaydes, Cobet, Meineke, Madvig, Ellis, W. Headlam, Davies, Tucker, Verrall, Haigh and Hoernle. The *Fragments* have been edited by Nauck and also by Wecklein. The Aeschylean staging is discussed in Albert Müller's *Lehrbuch der griechischen Buhnenalterthumer;* in "Die Bühne des Aeschylos," by Wilamowitz (*Hermes,* xxi.); in Smith's *Dict. of Antiquities,* art. "Theatrum" (R. C. Jebb); in Dorpfeld and Reisch (*Das griechische Theater*), Haigh's *Attic Theatre,* and Gardner and Jevons' *Manual of Greek Antiquities.* English verse translations: *Agamemnon,* Milman and R. Browning; *Oresteia, Suppliants, Persae, Seven against Thebes, Prometheus Vinctus,* by E. D. A. Morshead; *Prometheus,* E. B. Browning; the whole seven plays, Lewis Campbell. *Oresteia* by G. Murray, by R. C. Trevelyan, by G. M. Cookson; prose translation by W. G. and C. E. S. Headlam.

AESCULAPIUS, the Latin form of Asklepios (Ἀσκλήπιος) the name of the Greek god of medicine, the son of Apollo and the nymph Coronis. He probably came from Thessaly. The centaur Cheiron taught him the art of healing. At length Zeus, who, being afraid that he might render all men immortal, slew him with a thunderbolt (Apollodorus iii. 10; Pindar, *Phthia,* 3; Diod. Sic. iv.

71). Homer mentions him as a skilful physician, whose sons, Machaon and Podaleirius, are physicians in the Greek camp before Troy (*Iliad*, ii. 731). Temples were erected to Asklepios in many parts of Greece, near healing springs or on high mountains. The practice of sleeping (*incubatio*) in these sanctuaries was very common, it being supposed that the god effected cures or prescribed remedies to the sick in dreams. All who were healed offered sacrifice (especially a cock) and hung up votive tablets, recording their names, their diseases, and the manner in which they had been cured. Many of these tablets have been discovered at Epidaurus, the god's most famous shrine. Herodas (*Mimes*, 4) gives a description of one of his temples, and of the offerings made to him. The cult of Asklepios was introduced into Rome by order of the Sibylline books (293 B.C.), to avert a pestilence. The god was fetched from Epidaurus in the form of a snake and a temple assigned him on an island in the Tiber (Livy x 47; Ovid, *Metam.* xv. 622). Asklepios is commonly represented standing, dressed in a long cloak, with bare breast; his usual attribute is a club-like staff with a serpent coiled round it. He is often accompanied by Telesphorus, the boy genius of healing, and his daughter, Hygieia, the goddess of health. Votive reliefs representing such groups have been found near the temple of Asklepios at Athens.

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AESERNIA (mod. *Isernia*), a Samnite town 58m. N E of Beneventum on the road to Corfinium, at the junction of a road past Venafrum to the Via Latina. These routes are all followed by railways to Campobasso, Sulmona and Caianello. A Roman colony from 263 B.C., it became the headquarters of the Italian revolt after the loss of Corfinium, and was only recovered by Sulla at the end of the war, in 80 B.C. Massive ancient walls serve as foundation to modern ones

AESOP (Gr. Αἴσωπος), author of *Fables* about animals, generally with a didactic purpose, which have given their name to a whole class of stories, is supposed to have lived from about 620 to 560 B.C. The place of his birth is uncertain. He was the slave of Iadmon of Samos and met with a violent death at the hands of the inhabitants of Delphi. When a pestilence came upon them, the Delphians offered compensation for his death, and the award was claimed by Iadmon, grandson of his old master. Herodotus, who is authority for this (ii. 134), does not state the cause of Aesop's death; various reasons are assigned by later writers—his insulting sarcasms, the embezzlement of money entrusted to him by Croesus for distribution at Delphi (Schol. Ar. Vesp. 1446), the theft of a silver cup.



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AESOP, SITTING IN THE DOORWAY, RECOUNTING ONE OF HIS FAMOUS TALES

Reproduced after the woodcut in "Aesopi vita latine cum versione italica," etc., printed in Venice, March 27, 1492

Aesop must have been freed by Iadmon, or he could not have conducted the public defence of a Samian demagogue (Aristotle, *Rhetoric*, ii. 20). Legend says that he afterwards lived at the court of Croesus, where he met Solon, and dined in the company of the Seven Sages of Greece with Periander at Corinth. But it is impossible to say whether there is any grain of fact in this confused chronology. During the reign of Peisistratus he is said to have visited Athens, on which occasion he related the fable of *The Frogs asking for a King*, to dissuade the citizens from changing Peisistratus for another ruler.

The current stories about him are derived from a life, or rather romance, prefixed to a book of fables, purporting to be his, collected by Maximus Planudes, a monk of the 14th century. This describes him as ugly and deformed, as he is represented in the marble figure in the Villa Albani at Rome. That this life, however, was in existence a century before Planudes, appears from a 13th-century ms. of it found at Florence. In Plutarch's *Symposium of the Seven Sages*, at which Aesop is a guest, there are jests on his original servile condition, but nothing derogatory is said about his personal appearance. We are further told that the Athenians set up a noble statue of him by Lysippus, which furnishes a strong argument against the fiction of his deformity. The obscurity in which the history of Aesop is involved has induced some scholars to deny his existence altogether.

It is probable that Aesop did not commit his fables to writing (*Wasps*, 1259; Plato, *Phaedo*, 61 b). Demetrius of Phalerum (345–283 B.C.) made a collection in ten books, probably in prose, which has been lost. Next appeared an edition in elegiac verse, cited by Suidas, but the author's name is unknown. Babrius, a Roman, turned the fables into choliambics in the earlier part of the 3rd century A.D. The most celebrated of the Latin adapters is Phaedrus, a freedman of Augustus. Avianus (of uncertain date, perhaps the 4th century) translated 42 fables into Latin elegaics. The collections, which we possess under the name of *Aesop's Fables*, are late renderings of Babrius's version, or Babrius was translated into Syriac, and back again into Greek. Ignatius Diaconus, in the 9th century, made a version of 53 fables in choliambic tetrameters. Stories from Oriental sources were added, and from these collections Maximus Planudes made and edited the collection which has come down to us under the name of Aesop, and from which the popular fables of modern Europe have been derived.

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AESOPUS, a Greek historian who wrote a history of Alexander the Great, a Latin translation of which, by Julius Valerius, was discovered by Mai in 1816. He is known as the pseudo-Callisthenes.

(*See* the references *s.v.* CALLISTHENES.)

AESOPUS, CLODIUS, Roman tragedian, flourished in the first century B.C. Cicero was on friendly terms with him. Aesopus made a last appearance in 55 B.C.—when Cicero tells us that he was advanced in years—on the occasion of the splendid games given by Pompey at the dedication of his theatre. Horace (*Sat.* iii. 3, 239) mentions his taking a pearl from the ear-drop of Caecilia Metella and dissolving it in vinegar, that he might have the satisfaction of swallowing eight thousand pounds' worth at a draught.

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AESTHESIOMETER: *see* EXPERIMENTAL PSYCHOLOGY.

AESTHETICS. If we examine a poem in order to determine what it is that makes us feel it to be a poem, we at once find two constant and necessary elements: a complex of *images*, and a *feeling* that animates them. Let us, for instance, recall a passage learnt at school: Virgil's lines (*Aeneid*, iii., 294, *sqq.*), in which Aeneas describes how on hearing that in the country to whose shores he had come the Trojan Helenus was reigning, with Andromache, now his wife, he was overcome with amazement

and a great desire to see this surviving son of Priam and to hear of his strange adventures Andromache, whom he meets outside the walls of the city, by the waters of a river renamed Simois, celebrating funeral rites before a cenotaph of green turf and two altars to Hector and Astyanax, her astonishment on seeing him, her hesitation, the halting words in which she questions him, uncertain whether he is a man or a ghost; Aeneas's no less agitated replies and interrogations, and the pain and confusion with which she recalls the past—how she lived through scenes of blood and shame, how she was assigned by lot as slave and concubine to Pyrrhus, abandoned by him and united to Helenus, another of his slaves, how Pyrrhus fell by the hand of Orestes and Helenus became a free man and a king; the entry of Aeneas and his men into the city, and their reception by the son of Priam in this little Troy, this mimic Pergamon with its new Xanthus, and its Scaean Gate whose threshold Aeneas greets with a kiss—all these details, and others here omitted, are images of persons, things, attitudes, gestures, sayings, joy and sorrow, mere images, not history or historical criticism, for which they are neither given nor taken. But through them all there runs a feeling, a feeling which is our own no less than the poet's, a human feeling of bitter memories, of shuddering horror, of melancholy, of homesickness, of tenderness, of a kind of childish *pietas* that could prompt this vain revival of things perished, these playthings fashioned by a religious devotion, the *parva Troia,* the *Pergama simulata magnis,* the *arentem Xanthi cognomine rivum:* something inexpressible in logical terms, which only poetry can express in full. Moreover, these two elements may appear as two in a first abstract analysis, but they cannot be regarded as two distinct threads, however intertwined; for, in effect, the feeling is altogether converted into images, into this complex of images, and is thus a feeling that is contemplated and therefore resolved and transcended. Hence poetry must be called neither feeling, nor image, nor yet the sum of the two, but "contemplation of feeling" or "lyrical intuition" or (which is the same thing) "pure intuition"—pure, that is, of all historical and critical reference to the reality or unreality of the images of which it is woven, and apprehending the pure throb of life in its ideality Doubtless, other things may be found in poetry besides these two elements or moments and the synthesis of the two; but these other things are either present as extraneous elements in a compound (reflections, exhortations, polemics, allegories, etc), or else they are just these image-feelings themselves taken in abstraction from their context as so much material, restored to the condition in which it was before the act of poetic creation In the former case, they are non-poetic elements merely interpolated into or attached to the poem, in the latter, they are divested of poetry, rendered unpoetical by a reader either unpoetical or not at the moment poetical, who has dispelled the poetry, either because he cannot live in its ideal realm, or for the legitimate ends of historical enquiry or other practical purposes which involve the degradation —or rather, the conversion—of the poem into a document or an instrument.

Artistic Qualities.—What has been said of "poetry" applies to all the other "arts" commonly enumerated, painting, sculpture, architecture, music Whenever the artistic quality of any product of the mind is discussed, the dilemma must be faced, that either it is a lyrical intuition, or it is something else, something just as respectable, but not art. If painting (as some theorists have maintained) were the imitation or reproduction of a given object, it would be, not art, but something mechanical and practical; if the task of the painter (as other theorists have held) were to combine lines and lights and colours with ingenious novelty of invention and effect, he would be, not an artist, but an inventor; if music consisted in similar combinations of notes, the paradox of Leibniz and Father Kircher would come true, and a man could write music without being a musician; or alternatively we should have to fear (as Proudhon did for poetry and John Stuart Mill for music) that the possible combinations of words or notes would one day be exhausted, and poetry or music would disappear. As in poetry, so in these other arts, it is notorious that foreign elements sometimes intrude themselves; foreign either *a parte objecti* or *a parte subjecti,* foreign either in fact or from the point of view of an inartistic spectator or listener. Thus the critics of these arts advise the artist to exclude, or at least not to rely upon, what they call the "literary" elements in painting, sculpture and music, just as the critic of poetry advises the writer to look for "poetry" and not be led astray by mere literature. The reader who understands poetry goes straight to this poetic heart and feels its beat upon his own; where this beat is silent, he denies that poetry is present, whatever and however many other things may take its place, united in the work, and however valuable they may be for skill and wisdom, nobility of intellect, quickness of wit and pleasantness of effect. The reader who does not understand poetry loses his way in pursuit of these other things He is wrong not because he admires them, but because he thinks he is admiring poetry.

Other Forms of Activity As Distinct from Art.—By defining art as lyrical or pure intuition we have implicitly distinguished it from all other forms of mental production If such distinctions are made explicit, we obtain the following negations

1. *Art is not philosophy,* because philosophy is the logical thinking of the universal categories of being, and art is the unreflective intuition of being Hence, while philosophy transcends the image and uses it for its own purposes, art lives in it as in a kingdom It is said that art cannot behave in an irrational manner and cannot ignore logic; and certainly it is neither irrational nor illogical; but its own rationality, its own logic, is a quite different thing from the dialectical logic of the concept, and it was in order to indicate this peculiar and unique character that the name "logic of sense" or "aesthetic" was invented The not uncommon assertion that art has a logical character, involves either an equivocation between conceptual logic and aesthetic logic, or a symbolic expression of the latter in terms of the former

2 *Art is not history,* because history implies the critical distinction between reality and unreality; the reality of the passing moment and the reality of a fancied world the reality of fact and the reality of desire For art, these distinctions are as yet unmade; it lives, as we have said, upon pure images The historical existence of Helenus, Andromache and Aeneas makes no difference to the poetical quality of Virgil's poem. Here, too, an objection has been raised namely that art is not wholly indifferent to historical criteria, because it obeys the laws of "verisimilitude"; but, here again, "verisimilitude" is only a rather clumsy metaphor for the mutual coherence of images, which without this internal coherence would fail to produce their effect as images, like Horace's *delphinus in silvis* and *aper in fluctibus.*

3 *Art is not natural science,* because natural science is historical fact classified and so made abstract; nor is it *mathematical science,* because mathematics performs operations with abstractions and does not contemplate The analogy sometimes drawn between mathematical and poetical creation is based on merely external and generic resemblances; and the alleged necessity of a mathematical or geometrical basis for the arts is only another metaphor, a symbolic expression of the constructive, cohesive and unifying force of the poetic mind building itself a body of images.

4. *Art is not the play of fancy,* because the play of fancy passes from image to image, in search of variety, rest or diversion, seeking to amuse itself with the likenesses of things that give pleasure or have an emotional and pathetic interest; whereas in art the fancy is so dominated by the single problem of converting chaotic feeling into clear intuition, that we recognize the propriety of ceasing to call it fancy and calling it imagination, poetic imagination or creative imagination. Fancy as such is as far removed from poetry as are the works of Mrs Radcliffe or Dumas *père.*

5. *Art Is Not Feeling in Its Immediacy.*—Andromache, on seeing Aeneas, becomes *amens, diriguit visu in medio, labitur, longo vix tempore fatur,* and when she speaks *longos ciebat incassum fletus;* but the poet does not lose his wits or grow stiff as he gazes; he does not totter or weep or cry; he expresses himself in harmonious verses, having made these various perturbations the object of which he sings. Feelings in their immediacy are "expressed"

for if they were not, if they were not also sensible and bodily facts ("psycho-physical phenomena," as the positivists used to call them) they would not be concrete things, and so they would be nothing at all Andromache expressed herself in the way described above. But "expression" in this sense, even when accompanied by consciousness, is a mere metaphor from "mental" or "aesthetic expression" which alone really expresses, that is, gives to feeling a theoretical form and converts it into words, song and outward shape. This distinction between contemplated feeling, or poetry, and feeling enacted or endured, is the source of the power, ascribed to art, of "liberating us from the passions" and "calming" us (the power of *catharsis*), and of the consequent condemnation, from an aesthetic point of view, of works of art, or parts of them, in which immediate feeling has a place or finds a vent. Hence, too, arises another characteristic of poetic expression—really synonymous with the last—namely its "infinity" as opposed to the "finitude" of immediate feeling or passion; or, as it is also called, the "universal" or "cosmic" character of poetry Feeling, not crushed but contemplated by the work of poetry, is seen to diffuse itself in widening circles over all the realm of the soul, which is the realm of the universe, echoing and re-echoing endlessly. joy and sorrow, pleasure and pain, energy and lassitude, earnestness and frivolity, and so forth, are linked to each other and lead to each other through infinite shades and gradations; so that the feeling, while preserving its individual physiognomy and its original dominating motive, is not exhausted by or restricted to this original character. A comic image, if it is poetically comic, carries with it something that is not comic, as in the case of Don Quixote or Falstaff; and the image of something terrible is never, in poetry, without an atoning element of loftiness, goodness and love.

6 *Art is not instruction or oratory:* it is not circumscribed and limited by service to any practical purpose whatever, whether this be the inculcation of a particular philosophical, historical or scientific truth, or the advocacy of a particular way of feeling and the action corresponding to it Oratory at once robs expression of its "infinity" and independence, and, by making it the means to an end, dissolves it in this end Hence arises what Schiller called the "non-determining" character of art, as opposed to the "determining" character of oratory; and hence the justifiable suspicion of "political poetry"—political poetry being, proverbially, bad poetry.

7 As art is not to be confused with the form of practical action most akin to it, namely instruction and oratory, so *a fortiori,* it must not be confused with other forms directed to the production of certain effects, whether these consist in pleasure, enjoyment and utility, or in goodness and righteousness. We must exclude from art not only meretricious works, but also those inspired by a desire for goodness, as equally, though differently, inartistic and repugnant to lovers of poetry Flaubert's remark that indecent books lacked *vérité,* is parallel to Voltaire's gibe that certain "poésies sacrées" were really "sacrées, car personne n'y touche "

Art in Its Relations.—The "negations" here made explicit are obviously, from another point of view, "relations"; for the various distinct forms of mental activity cannot be conceived as separate each from the rest and acting in self-supporting isolation. This is not the place to set forth a complete system of the forms or categories of the mind in their order and their dialectic; confining ourselves to art, we must be content to say that the category of art, like every other category, mutually presupposes and is presupposed by all the rest: it is conditioned by them all and conditions them all. How could the aesthetic synthesis, which is poetry, arise, were it not preceded by a state of mental commotion? *Si vis me flere, dolendum est,* and so forth. And what is this state of mind which we have called feeling, but the whole mind, with its past thoughts, volitions and actions, now thinking and desiring and suffering and rejoicing, travailing within itself? Poetry is like a ray of sunlight shining upon this darkness, lending it its own light and making visible the hidden forms of things. Hence it cannot be produced by an empty and dull mind; hence those artists who embrace the creed of pure art or art for art's sake, and close their hearts to the troubles of life and the cares of thought, are found to be wholly unproductive, or at most rise to the imitation of others or to an impressionism devoid of concentration. Hence the basis of all poetry is human personality, and, since human personality finds its completion in morality, the basis of all poetry is the moral consciousness. Of course this does not mean that the artist must be a profound thinker or an acute critic; nor that he must be a pattern of virtue or a hero; but he must have a share in the world of thought and action which will enable him, either in his own person or by sympathy with others, to live the whole drama of human life. He may sin, lose the purity of his heart, and expose himself, as a practical agent, to blame; but he must have a keen sense of purity and impurity, righteousness and sin, good and evil. He may not be endowed with great practical courage; he may even betray signs of timidity and cowardice; but he must feel the dignity of courage Many artistic inspirations are due, not to what the artist, as a man, is in practice, but to what he is not, feels that he ought to be, and admires and envies the qualities he lacks when he sees them in others. Many, perhaps the finest, pages of heroic and warlike poetry are by men who never had the nerve or the skill to handle a weapon On the other hand, we are not maintaining that the possession of a moral personality is enough to make a poet or an artist To be a *vir bonus* does not make a man even an orator, unless he is also *dicendi peritus* The *sine qua non* of poetry is poetry, that form of theoretical synthesis which we have defined above; the spark of poetical genius without which all the rest is mere fuel, not burning because no fire is at hand to light it. But the figure of the pure poet, the pure artist, the votary of pure Beauty, aloof from contact with humanity, is no real figure but a caricature.

That poetry not only presupposes the other forms of human mental activity but is presupposed by them, is proved by the fact that without the poetic imagination which gives contemplative form to the workings of feeling, intuitive expression to obscure impressions, and thus becomes representations and words, whether spoken or sung or painted or otherwise uttered, logical thought could not arise. Logical thought is not language, but it never exists without language, and it uses the language which poetry has created, by means of concepts, it discerns and dominates the representations of poetry, and it could not dominate them unless they, its future subjects, had first an existence of their own Further, without the discerning and criticizing activity of thought, action would be impossible; and if action, then good action, the moral consciousness, duty Every man, however much he may seem to be all logical thinker, critic, scientist, or all absorbed in practical interests or devoted to duty, cherishes at the bottom of his heart his own private store of imagination and poetry; even Faust's pedantic *famulus,* Wagner, confessed that he often had his "grillenhafte Stunden" Had this element been altogether denied him, he would not have been a man, and therefore not even a thinking or acting being This extreme case is an absurdity; but in proportion as this private store is scanty, we find a certain superficiality and aridity in thought, and a certain coldness in action.

The Science of Art, or Aesthetics, and Its Philosophical Character.—The concept of art expounded above is in a sense the ordinary concept, which appears with greater or less clarity in all statements about art, and is constantly appealed to, explicitly or implicitly, as the fixed point round which all discussions on the subject gravitate. and this, not only nowadays, but at all times, as could be shown by the collection and interpretation of things said by writers, poets, artists, laymen and even the common people. But it is desirable to dispel the illusion that this concept exists as an innate idea, and to replace this by the truth, that it operates as an *a priori* concept. Now an *a priori* concept does not exist by itself, but only in the individual products which it generates Just as the *a priori* reality called Art, Poetry or Beauty does not exist in a transcendent region where it can be perceived and admired in itself, but only in the innumerable works of poetry, of art and of beauty which it has formed and continues to form, so the logical *a priori* concept of art exists nowhere but in the par-

ticular judgments which it has formed and continues to form, the refutations which it has effected and continues to effect, the demonstrations it makes, the theories it constructs, the problems and groups of problems, which it solves and has solved. The definitions and distinctions and negations and relations expounded above have each its own history, and have been progressively worked out in the course of centuries, and in them we now possess the fruits of this complex and unremitting toil. Aesthetic, or the science of art, has not therefore the task (attributed to it by certain scholastic conceptions) of defining art once for all and deducing from this conception its various doctrines, so as to cover the whole field of aesthetic science; it is only the perpetual systematization, always renewed and always growing, of the problems arising from time to time out of reflection upon art, and is identical with the solutions of the difficulties and the criticisms of the errors which act as stimulus and material to the unceasing progress of thought. This being so, no exposition of aesthetic (especially a summary exposition such as can alone be given here) can claim to deal exhaustively with the innumerable problems which have arisen and may arise in the course of the history of aesthetics; it can only mention and discuss the chief, and among these, by preference, those which still make themselves felt and resist solution in ordinary educated thought; adding an implied "et cetera," so that the reader may pursue the subject according to the criteria set before him, either by going again over old discussions, or by entering into those of to-day, which change and multiply and assume new shapes almost daily. Another warning must not be omitted: namely that aesthetics, though a special philosophical science, having as its principle a special and distinct category of the mind, can never, just because it is philosophical, be detached from the main body of philosophy; for its problems are concerned with the relations between art and the other mental forms, and therefore imply both difference and identity. Aesthetics is really the whole of philosophy, but with special emphasis on that side of it which concerns art. Many have demanded or imagined or desired a self-contained aesthetics, devoid of any general philosophical implications, and consistent with more than one, or with any, philosophy; but the project is impossible of execution because self-contradictory. Even those who promise to expound a naturalistic, inductive, physical, physiological or psychological aesthetics—in a word, a non-philosophical aesthetics —when they pass from promise to performance surreptitiously introduce a general positivistic, naturalistic or even materialistic philosophy. And anyone who thinks that the philosophical ideas of positivism, naturalism and materialism are false and out of date, will find it an easy matter to refute the aesthetic or pseudo-aesthetic doctrines which mutually support them and are supported by them, and will not regard their problems as problems still awaiting solution or worthy of discussion—or, at least, protracted discussion. For instance, the downfall of psychological associationism (or the substitution of mechanism for *a priori* synthesis) implies the downfall not only of logical associationism but of aesthetics also, with its association of "content" and "form," or of two "representations," which (unlike Campanella's *tactus intrinsecus,* effected *cum magna suavitate*) was a *contactus extrinsecus* whose terms were no sooner united than they *discedebant.* The collapse of biological and evolutionary explanations of logical and ethical values implies the same collapse in the case of aesthetic value. The proved inability of empirical methods to yield knowledge of reality, which in fact they can only classify and reduce to types, involves the impossibility of an aesthetics arrived at by collecting aesthetic facts in classes and discovering their laws by induction.

Intuition and Expression.—One of the first problems to arise, when the work of art is defined as "lyrical image," concerns the relation of "intuition" to "expression" and the manner of the transition from the one to the other At bottom this is the same problem which arises in other parts of philosophy: the problem of inner and outer, of mind and matter, of soul and body, and, in ethics, of intention and will, will and action, and so forth. Thus stated, the problem is insoluble; for once we have divided the inner from the outer, body from mind, will from action, or intuition from expression, there is no way of passing from one to the other or of reuniting them, unless we appeal for their reunion to a third term, variously represented as God or the Unknowable Dualism leads necessarily either to transcendence or to agnosticism. But when a problem is found to be insoluble in the terms in which it is stated the only course open is to criticize these terms themselves, to inquire how they have been arrived at, and whether their genesis was logically sound. In this case, such inquiry leads to the conclusion that the terms depend not upon a philosophical principle, but upon an empirical and naturalistic classification, which has created two groups of facts called internal and external respectively (as if internal facts were not also external, and as if an external fact could exist without being also internal), or souls and bodies, or images and expressions; and everyone knows that it is hopeless to try to find a dialectical unity between terms that have been distinguished not philosophically or formally but only empirically and materially The soul is only a soul in so far as it is a body, the will is only a will in so far as it moves arms and legs, or is action; intuition is only intuition in so far as it is, in that very act, expression An image that does not express, that is not speech, song, drawing, painting, sculpture or architecture—speech at least murmured to oneself, song at least echoing within one's own breast, line and colour seen in imagination and colouring with its own tint the whole soul and organism—is an image that does not exist. We may assert its existence, but we cannot support our assertion; for the only thing we could adduce in support of it would be the fact that the image was embodied or expressed. This profound philosophical doctrine, the *identity of intuition and expression* is, moreover, a principle of ordinary common sense, which laughs at people who claim to have thoughts they cannot express or to have imagined a great picture which they cannot paint. *Rem tene, verba sequentur;* if there are no *verba,* there is no *res.* This identity, which applies to every sphere of the mind, has in the sphere of art a clearness and self-evidence lacking, perhaps, elsewhere. In the creation of a work of poetry, we are present, as it were, at the mystery of the creation of the world; hence the value of the contribution made by aesthetics to philosophy as a whole, or the conception of the One that is All. Aesthetics, by denying in the life of art an abstract spiritualism and the resulting dualism, prepares the way and leads the mind towards idealism or absolute spiritualism.

Expression and Communication.—Objections to the identity of intuition and expression generally arise from psychological illusions which lead us to believe that we possess at any given moment a profusion of concrete and lively images, when in fact we only possess signs and names for them, or else from faulty analysis of cases like that of the artist who is believed to express mere fragments of a world of images that exists in his mind in its entirety, whereas he really has in his mind only these fragments, together with—not the supposed complete world, but at most an aspiration or obscure working towards it, towards a greater and richer image which may take shape or may not. But these objections also arise from a confusion between *expression* and *communication,* the latter being really distinct from the image and its expression. Communication is the fixation of the intuition-expression upon an object metaphorically called material or physical; in reality, even here we are concerned not with material or physical things but with a mental process. The proof that the so-called physical object is unreal, and its resolution into terms of mind, is primarily of interest for our general philosophical conceptions, and only indirectly for the elucidation of aesthetic questions; hence for brevity's sake we may let the metaphor or symbol stand and speak of matter or nature. It is clear that the poem is complete as soon as the poet has expressed it in words which he repeats to himself. When he comes to repeat them aloud, for others to hear, or looks for someone to learn them by heart and repeat them to others as in a *schola cantorum,* or sets them down in writing or in printing, he has entered upon a new stage, not aesthetic but practical, whose social and cultural importance need not, of course, be insisted upon. So with the painter; he paints on his panel or canvas, but

he could not paint unless at every stage in his work, from the original blur or sketch to the finishing touches, the intuited image, the line and colour painted in his imagination, preceded the brush-stroke. Indeed, when the brush-stroke outruns the image, it is cancelled and replaced by the artist's correction of his own work The exact line that divides expression from communication is difficult to draw in the concrete case, for in the concrete case the two processes generally alternate rapidly and appear to mingle, but it is clear in idea, and it must be firmly grasped. Through overlooking it, or blurring it through insufficient attention, arise the confusions between *art* and *technique*. Technique is not an intrinsic element of art but has to do precisely with the concept of communication. In general it is a cognition or complex of cognitions disposed and directed to the furtherance of practical action; and, in the case of art, of the practical action which makes objects and instruments for the recording and communicating of works of art; *e.g*, cognitions concerning the preparation of panels, canvases or walls to be painted, pigments, varnishes, ways of obtaining good pronunciation and declamation and so forth. Technical treatises are not aesthetic treatises, nor yet parts or chapters of them. Provided, that is, that the ideas are rigorously conceived and the words used accurately in relation to them it would not be worth while to pick a quarrel over the use of the word "technique" as a synonym for the artistic work itself, regarded as "inner technique" or the formation of intuition-expressions The confusion between art and technique is especially beloved by impotent artists, who hope to obtain from practical things and practical devices and inventions the help which their strength does not enable them to give themselves.

Artistic Objects: the Theory of the Special Arts, and the Beauty of Nature.—The work of communicating and conserving artistic images, with the help of technique, produces the material objects metaphorically called *"artistic objects"* or *"works of art"*: pictures, sculptures and buildings, and, in a more complicated manner, literary and musical writings, and, in our own times, gramophones and records which make it possible to reproduce voices and sounds But neither these voices and sounds nor the symbols of writing, sculpture and architecture, are works of art; works of art exist only in the minds that create or recreate them. To remove the appearance of paradox from the truth that beautiful objects, beautiful things, do not exist, it may be opportune to recall the analogous case of economic science, which knows perfectly well that in the sphere of economics there are no naturally or physically *useful* things, but only demand and labour, from which physical things acquire, metaphorically, this epithet. A student of economics who wished to deduce the economic value of things from their physical qualities would be perpetrating a gross *ignoratio elenchi*.

Yet this same *ignoratio elenchi* has been, and still is, committed in aesthetic, by the theory of special *arts*, and the limits or peculiar aesthetic character of each The divisions between the arts are merely technical or physical, according as the artistic objects consist of physical sounds, notes, coloured objects, carved or modelled objects, or constructed objects having no apparent correspondence with natural bodies (poetry, music, painting, sculpture, architecture, etc). To ask what is the artistic character of each of these arts, what it can and cannot do, what kinds of images can be expressed in sounds, what in notes, what in colours, what in lines, and so forth, is like asking in economics what things are entitled by their physical qualities to have a value and what are not, and what relative values they are entitled to have; whereas it is clear that physical qualities do not enter into the question, and anything may be desired or demanded or valued more than another, or more than anything else at all, according to circumstances and needs Even Lessing found himself slipping down the slope leading to this truth, and was forced to such strange conclusions as that actions belonged to poetry and bodies to sculpture; even Richard Wagner attempted to find a place in the list for a comprehensive art, namely Opera, including in itself by a process of aggregation the powers of all the arts A reader with any artistic sense finds in a single solitary line from a poet at once musical and picturesque qualities, sculpturesque strength and architectural structure; and the same with a picture, which is never a mere thing of the eyes but an affair of the whole soul, and exists in the soul not only as colour but as sound and speech. But when we try to grasp these musical or picturesque or other qualities, they elude us and turn into each other, and melt into a unity, however we may be accustomed to distinguish them by different names, a practical proof that art is one and cannot be divided into arts One, and infinitely varied; not according to the technical conceptions of the several arts, but according to the infinite variety of artistic personalities and their states of mind.

With this relation (and confusion) between artistic creations and instruments of communication or *objets d'art* must be connected the problem of *natural beauty* We shall not discuss the question, raised by certain aestheticians, whether there are in nature other poets, other artistic beings, beside man; a question which ought to be answered in the affirmative not only out of respect for the song-birds, but, still more, out of respect for the idealistic conception of the world as life and spirituality throughout, even if (as the fairy-tale goes) we have lost the magic herb which when we put it in our mouth, gives us the power of understanding the language of animals and plants. The phrase *natural beauty* properly refers to persons, things and places whose effect is comparable to that of poetry, painting, sculpture and the other arts There is no difficulty in allowing the existence of such "natural *objets d'art*," for the process of poetic communication may take place by means of objects naturally given as well as by means of objects artificially produced The lover's imagination creates a woman beautiful to him, and personifies her in Laura; the pilgrim's imagination creates the charming or sublime landscape, and embodies it in the scene of a lake or a mountain; and these creations of theirs are sometimes shared by more or less wide social circles, thus becoming the "professional beauties" admired by everyone and the famous "views" before which all experience a more or less sincere rapture No doubt, these creations are mortal; ridicule sometimes kills them, satiety may bring neglect, fashion may replace them by others, and—unlike works of art—they do not admit of authentic interpretation The bay of Naples, seen from the height of one of the most beautiful Neapolitan villas, was after some time described by the Russian lady who owned the villa as *une cuvette bleue*, whose blue encircled by green so wearied her that she sold the villa But even the *cuvette bleue* was a legitimate poetical creation

Literary Kinds and Aesthetic Categories.—Effects at once greater and more detrimental upon the criticism and historical study of art and literature have been produced by a theory of similar but slightly different origin, the theory of *literary and artistic kinds* This, like the foregoing, is based on a classification in itself justifiable and useful The foregoing is based on a technical or physical classification of artistic objects; this is based on a classification according to the feelings which form their content or motive, into *tragic, comic, lyrical, heroic, erotic, idyllic, romantic* and so on, with divisions and subdivisions It is useful in practice to distribute an artist's works, for purposes of publication, into these classes, putting lyrics in one volume, dramas in another, poems in a third and romances in a fourth; and it is convenient, in fact, indispensable, to refer to works and groups of works by these names in speaking and writing of them. But here again we must deny and pronounce illegitimate the transition from these classificatory concepts to the poetic laws of composition and aesthetic criteria of judgment, as when people try to decide that a tragedy must have a subject of a certain kind, characters of a certain kind, a plot of a certain kind and a certain length; and, when confronted by a work, instead of looking for and appraising its own poetry, ask whether it is a tragedy or a poem, and whether it obeys the "laws" of one or other "kind." The literary criticism of the 19th century owed its great progress largely to its abandonment of the criteria of kinds, in which the criticism of the Renaissance and the French classicists had always been entangled, as may be seen from the discussions arising out of the poems of Dante, Ariosto and Tasso, Guarini's *Pastor fido*, Corneille's *Cid*, and Lope de Vega's *comedias*. Artists have profited by this liberation less than critics; for anyone with

artistic genius bursts the fetters of such servitude, or even makes them the instruments of his power; and the artist with little or no genius turns his very freedom into a new slavery.

It has been thought that the divisions of kinds could be saved by giving them a philosophical significance; or at any rate one such division, that of lyric, epic and dramatic, regarded as the three moments of a process of objectification passing from the lyric, the outpouring of the ego, to the epic, in which the ego detaches its feeling from itself by narrating it, and thence to the drama, in which it allows this feeling to create of itself its own mouthpieces, the *dramatis personae* But the lyric is not a pouring-forth; it is not a cry or a lament; it is an objectification in which the ego sees itself on the stage, narrates itself, and dramatizes itself; and this lyrical spirit forms the poetry both of epic and of drama, which are therefore distinguished from the lyric only by external signs. A work which is altogether poetry, like *Macbeth* or *Antony and Cleopatra*, is substantially a lyric in which the various tones and successive verses are represented by characters and scenes.

In the old aesthetics, and even to-day in those which perpetuate the type, an important place is given to the so-called categories of beauty: the *sublime*, the *tragic*, the *comic*, the *graceful*, the *humorous* and so forth, which German philosophers not only claimed to treat as philosophical concepts, whereas they are really mere psychological and empirical concepts, but developed by means of that dialectic which belongs only to pure or speculative concepts, philosophical categories. Thus they arranged them in an imaginary progress culminating now in the Beautiful, now in the Tragic, now in the Humorous. Taking these concepts at their face value, we may observe their substantial correspondence with the concepts of the literary and artistic kinds; and this is the source from which, as excerpts from manuals of literature, they have found their way into philosophy As psychological and empirical concepts, they do not belong to aesthetics; and as a whole, in their common quality, they refer merely to the world of feelings, empirically grouped and classified, which forms the permanent matter of artistic intuition

Rhetoric, Grammar and Philosophy of Language.—Every error has in it an element of truth, and arises from an arbitrary combination of things which in themselves are legitimate. This principle may be confirmed by an examination of other erroneous doctrines which have been prominent in the past and are still to a less degree prominent to-day It is perfectly legitimate, in teaching people to write, to make use of distinctions like that between simple style, ornate style and metaphorical style and its forms, and to point out that here the pupil ought to express himself literally and there metaphorically, or that here the metaphor used is incoherent or drawn out to excessive length, and that here the figure of "preterition," there "hypotyposis" or "irony," would have been suitable. But when people lose sight of the merely practical and didactic origin of these distinctions and construct a philosophical theory of form as divisible into simple form and ornate form, logical form and affective form, and so forth, they are introducing elements of rhetoric into aesthetics and vitiating the true concept of expression. For expression is never logical, but always affective, that is, lyrical and imaginative; and hence it is never metaphorical but always "proper"; it is never simple in the sense of lacking elaboration, or ornate in the sense of being loaded with extraneous elements; it is always adorned with itself, *simplex munditiis*. Even logical thought or science, so far as it is expressed, becomes feeling and imagination, which is why a philosophical or historical or scientific book can be not only true but beautiful, and must always be judged not only logically but also aesthetically. Thus we sometimes say that a book is a failure as theory, or criticism, or historical truth, but a success as a work of art, in view of the feeling animating it and expressed in it. As for the element of truth which is obscurely at work in this distinction between logical form and metaphorical form, dialectic and rhetoric, we may detect in it the need of a science of aesthetics side by side with that of logic; but it was a mistake to try to distinguish the two sciences within the sphere of expression which belongs to one of them alone.

Another element in education, namely the teaching of languages, has no less legitimately, ever since ancient times, classified expressions into periods, propositions and words, and words into various species, and each species according to the variations and combinations of roots and suffixes, syllables and letters; and hence have arisen alphabets, grammars and vocabularies, just as in another way for poetry has arisen a science of prosody, and for music and the figurative and architectural arts there have arisen musical and pictorial grammars and so forth. But here, too, the ancients did not succeed in avoiding an illegitimate transition *ab intellectu ad rem*, from abstractions to reality, from the empirical to the philosophical, such as we have already observed elsewhere; and this involved thinking of speech as an aggregation of words, and words as aggregations of syllables or of roots and suffixes; whereas the *prius* is speech itself, a continuum, resembling an organism, and words and syllables and roots are a *posterius*, an anatomical preparation, the product of the abstracting intellect, not the original or real fact If grammar, like rhetoric in the case above considered, is transplanted into aesthetic, the result is a distinction between expression and the means of expression, which is a mere reduplication; for the means of expression are just expression itself, broken into pieces by grammarians. This error, combined with the error of distinguishing between simple and ornate form, has prevented people from seeing that the philosophy of language is not a philosophical grammar, but is wholly devoid of grammatical elements It does not raise grammatical classifications to a philosophical level; it ignores them, and, when they get in its way, destroys them. The philosophy of language, in a word, is identical with the philosophy of poetry and art, the science of intuition-expression, aesthetics; which embraces language in its whole extension, passing beyond the limits of phonetic and syllabic language, and in its unimpaired reality as living and completely significant expression

Classical and Romantic.—The problems reviewed above belong to the past—a past extending through centuries—rather than to the present; of their mis-stated questions and misconceived solutions there now remain mere relics and superstitions which affect academic treatises more than they do the consciousness and culture of ordinary people. But it is necessary to watch carefully for new shoots from the old stock, which still appear from time to time, in order to cut them down Such is, in our own time, the theory of styles applied to the history of art (Wölfflin and others) and extended to the history of poetry (Strick and others), a new irruption of rhetorical abstractions into the judgment and history of works of art. But the chief problem of our time, to be overcome by aesthetics, is connected with the crisis in art and in judgments upon art produced by the romantic period. Not that this crisis was not foreshadowed by precedents and parallels in earlier history, like Alexandrian art and that of the late Roman period, and in modern times the Baroque art and poetry which followed upon that of the Renaissance. The crisis of the romantic period, together with sources and characteristics peculiar to itself, had a magnitude all of its own. It asserted an antithesis between *naive* and *sentimental* poetry, *classical* and *romantic* art, and thus denied the unity of art and asserted a duality of two fundamentally different arts, of which it took the side of the second, as that appropriate to the modern age, by upholding the primary importance in art of feeling, passion and fancy. In part this was a justifiable reaction against the rationalistic literature of classicism in the French manner, now satirical, now frivolous, weak in feeling and imagination and deficient in a deep poetic sense; but in part, *romanticism* was a rebellion not against *classicism* but against the classical as such: against the idea of the serenity and infinity of the artistic image, against catharsis and in favour of a turbid emotionalism that could not and would not undergo purification. This was very well understood by Goethe, the poet both of passion and of serenity, and therefore, because he was a poet, a classical poet; who opposed romantic poetry as "hospital poetry." Later, it was thought that the disease had run its course and that romanticism was a thing of the past; but though some of its contents and some of its forms were dead, its soul was not: its soul consisting in this tendency on the part of art towards

an immediate expression of passions and impressions. Hence it changed its name but went on living and working. It called itself "realism," "verism," "symbolism," "artistic style," "impressionism," "sensualism," "imagism," "decadentism," and nowadays, in its extreme forms, "expressionism" and "futurism." The very conception of art is attacked by these doctrines, which tend to replace it by the conception of one or other kind of non-art; and the statement that they are fighting against art is confirmed by the hatred of the extremists of this movement for museums and libraries and all the art of the past—that is, for the idea of art which on the whole corresponds with art as it has been historically realized. The connection of this movement, in its latest modern form, with industrialism and the psychology produced and fostered by industrialism is obvious. What art is contrasted with is practical life as lived to-day; and art, for this movement, is not the expression of life and hence the transcending of life in the contemplation of the infinite and universal, but the cries and gesticulations and broken colours of life itself. The real poets and artists, on the other hand, rare at any time, naturally continue, nowadays as always, to work according to the old and only idea of what art is, expressing their feelings in harmonious forms; and the real connoisseurs (rarer, these also, than people think) continue to judge their work according to this same idea. In spite of this, the tendency to destroy the idea of art is a characteristic of our age; and this tendency is based on the *proton pseudos* which confuses mental or aesthetic expression with natural or practical expression—the expression which passes confusedly from sensation to sensation and is a mere effect of sensation, with the expression which art elaborates, as it builds, draws, colours or models, and which is its beautiful creation The problem for aesthetics to-day is the reassertion and defence of the classical as against romanticism: the synthetic, formal theoretical element which is the *proprium* of art, as against the affective element which it is the business of art to resolve into itself, but which to-day has turned against it and threatens to displace it. Against the inexhaustible fertility of creative mind, the gates of hell shall not prevail; but the hostility which endeavours to make them prevail is disturbing, even if only in an incidental manner, the artistic taste, the artistic life and consequently the intellectual and moral life of to-day

The Criticism and History of Art and Literature.—Another group of questions raised in works on aesthetics, though not unsuitable to such works, properly belongs to logic and the theory of historical thought These concern the aesthetic judgment and the history of poetry and the arts. By showing that the aesthetic activity (or art) is one of the forms of mind, a value, a category, or whatever we choose to call it, and not (as philosophers of various schools have thought) an empirical concept referable to certain orders of utilitarian or mixed facts, by establishing the *autonomy of aesthetic value,* aesthetics has also shown that it is the predicate of a special judgment, the *aesthetic judgment,* and the subject-matter of history, of a special history, the history of poetry and the arts, *artistic and literary history.*

The questions that have been raised concerning the aesthetic judgment and artistic and literary history are making allowance for the peculiar character of art, identical with the methodological questions that arise in every field of historical study. It has been asked whether the aesthetic judgment is *absolute* or *relative;* but every historical judgment (and the aesthetic judgment affirming the reality and quality of aesthetic facts is an historical judgment) is always both absolute and relative at once: absolute, in so far as the category involved in the construction possesses universal truth; relative, in so far as the object constructed by that category is historically conditioned: hence in the historical judgment the category is individualized and the individual becomes absolute. Those who in the past have denied the absoluteness of the aesthetic judgment (sensationalistic, hedonistic or utilitarian aestheticians) denied in effect the quality, reality and autonomy of art. It has been asked whether a knowledge of the history of the time—the whole history of the time in question—is necessary for the aesthetic judgment of the art of that time; it certainly is, because, as we know, poetic creation presupposes all the rest of the mind which it is converting into lyrical imagery, and the one aesthetic creation presupposes all the other creations (passions, feelings, customs, etc.) of the given historical moment. Hence may be seen the error both of those who advocate a merely historical judgment upon art (historical critics) and of those who advocate a merely aesthetic (aesthetic critics). The former would find in art all the rest of history (social conditions, biography of the artist, etc.), but would omit that part which is proper to art; the latter would judge the work of art in abstraction from history. depriving it of its real meaning and giving it an imaginary meaning or testing it by arbitrary standards. Lastly, there has appeared a kind of scepticism or pessimism as to the possibility of understanding the art of the past; a scepticism or pessimism which in that case ought to extend to every part of history (history of thought, politics, religion and morality), and refutes itself by a *reductio ad absurdum,* since what we call contemporary art and history really belong to the past as much as those of more distant ages, and must, like them, be re-created in the present, in the mind that feels them and the intellect that understands them. There are artistic works and periods that remain to us unintelligible; but this only means that we are not now in a position to enter again into their life and to understand them, and the same is true of the ideas and customs and actions of many peoples and ages. Humanity, like the individual, remembers some things and forgets many others; but it may yet, in the course of its mental development, reach a point where its memory of them revives.

A final question concerns the form proper to artistic and literary history, which, in the form that arose in the romantic period, and still prevails to-day, expounds the history of works of art as a function of the concepts and social needs of its various periods, regarding them as aesthetic expressions of these things and connecting them closely with civil history This tends to obscure and almost to render invisible the peculiar character of the individual work of art, the character which makes it impossible to confuse one work of art with any other, and results in treating them as documents of social life. In practice no doubt this method is tempered by what may be called the "individualizing" method, which emphasizes the individual character of the works; but the mixture has the defects of all eclecticism. To escape this, there is nothing to do but consistently to develop individualizing history, and to treat works of art not in relation to social history but as each a world in itself, into which from time to time the whole of history is concentrated, transfigured and imaginatively transcended in the individuality of the poetic work, which is a creation, not a reflection, a monument, not a document. Dante is not simply a document of the middle ages, nor Shakespeare of the English Renaissance; as such, they have many equals or superiors among bad poets and non-poets. It has been objected that this method imposed on artistic and literary history the form of a series of disconnected essays or monographs; but, obviously, the connection is provided by human history as a whole, of which the personalities of poets constitute a part, and a somewhat conspicuous part (Shakespearian poetry is an event no less important than the Reformation or the French Revolution), and, precisely because they are a part of it, they ought not to be submerged and lost in it, that is, in its other parts, but ought to retain their proper proportions and their original character.

History of Aesthetics.—From the character of aesthetics as a philosophical science (*see* above) it follows that its history cannot be separated from that of philosophy at large, from which aesthetics receives light and guidance, and gives back light and guidance in its turn. The so-called subjectivist tendency which modern philosophy acquired with Descartes, for instance, by promoting enquiry into the creative power of the mind, indirectly promoted enquiry into the aesthetic power; and conversely, as an example of the influence of aesthetic on the rest of philosophy, it is enough to recall the effect which the mature consciousness of creative imagination and poetic logic had in liberating philosophical logic from the traditional intellectualism and formalism, and raising it to the level of speculative or dialectical logic in

the philosophies of Schelling and Hegel. But if the history of aesthetics must be seen as a part of the entire history of philosophy, it must on the other hand be enlarged beyond its boundaries as ordinarily defined, which would restrict it almost entirely to the series of works by so-called professional philosophers and of the academic treatises known as "systems of philosophy." Genuine and original philosophical thought is often to be found, alive and energetic in books not written by professional philosophers and not outwardly systematic; ethical thought, in works of asceticism and religion; political, in the works of historians; aesthetic, in those of art-critics, and so forth. Further, it must be remembered that, strictly speaking, the subject-matter of the history of aesthetics is not the problem, the single problem, of the definition of art, a problem exhausted when that definition has been or shall have been attained; but the innumerable problems which are perpetually springing up in connection with art, in which this one problem, the problem of defining art, acquires particularity and concreteness, and in which alone it truly exists. Subject to these warnings, which must be carefully borne in mind, a general sketch of the history of aesthetics may be given, to provide a preliminary orientation, without running the risk of being understood in an unduly rigid and simplificatory manner.

A sketch of this kind must accept, not merely as convenient for purposes of exposition but as historically true, the common statement that aesthetics is a modern science. Graeco-Roman antiquity did not speculate about art, or speculated very little; its chief concern was to create a method of artistic instruction, not a "philosophy" but an "empirical science" of art Such are the ancient treatises on "grammar," "rhetoric," "institutions of oratory," "architecture," "music," "painting" and "sculpture"; the basis of all later methods of instruction, even those of to-day, in which the old principles are restated and interpreted *cum grano salis*, but not abandoned, because in practice they are indispensable. The philosophy of art did not find favourable or stimulating conditions in ancient philosophy, which was primarily "physics" and "metaphysics," and only secondarily and intermittently "psychology" or more precisely "philosophy of mind" To the philosophical problems of aesthetics it only referred in passing, either negatively, in Plato's denial of the value of poetry, or positively, in Aristotle's defence, which attempted to secure for poetry a realm of its own between that of history and that of philosophy, or again in the speculations of Plotinus, who for the first time united the previously disconnected concepts of "art" and "the beautiful." Other important thoughts of the ancients were that to poetry belonged "tales" (μύθοι) and not "arguments" (λόγοι), and that "semantic" (rhetorical or poetical) propositions were to be distinguished from "apophantic" (logical). Lately an almost wholly unexpected strain of ancient aesthetic thought has come to light, in the Epicurean doctrines expounded by Philodemus, in which imagination is conceived in what seems almost a romantic way. But these observations remained, for the time being, practically sterile; and the ancients' firm and sure judgment in artistic matters was never raised to the level and consistency of a theory, owing to an obstacle of a general nature—the objectivistic or naturalistic character of ancient philosophy, whose removal was only commenced, or demanded, by Christianity when it brought the problems of the soul into the focus of thought.

But even Christian philosophy, partly through its predominating transcendence, mysticism and asceticism, partly through the scholastic form which it borrowed from ancient philosophy and with which it remained content, while it raised the problems of morality in an acute form, and handled them with delicacy, did not penetrate deeply into the mental region of imagination and taste, just as it avoided the region which corresponds to it in the sphere of practice, the region of passions, interests, utility, politics and economics. Just as politics and economics were conceived moralistically, so art was subordinated to moral and religious allegory; and the germs of aesthetics scattered through the ancient writers were forgotten or only superficially remembered. The philosophy of the Renaissance, with its return to naturalism, revived, interpreted and adapted the ancient poetics and rhetorics and treatises on the arts; but though it laboured long at "verisimilitude" and "truth," "imitation" and "the idea," "beauty" and the mystical theory of beauty and love, "catharsis" or the purgation of passion, and the problems of the literary kinds, traditional and modern, it never reached a new and fruitful principle. No thinker arose capable of doing for the Renaissance treatises on poetry and art what Machiavelli did for political science, asserting with emphasis, not merely by the way and as an admission, its original and autonomous character.

Much more important in this respect, though its importance was long overlooked by historians, was the thought of the later Renaissance, known in Italy as the *seicento*, Baroque, or the literary and artistic decadence. This was the time at which the distinction was first insisted upon between the "intellect" and a faculty called *ingegno, ingenium*, "wit" or "genius," as especially inventive of art; and, corresponding to this, a faculty of judgment, which was not ratiocination or logical judgment, because it judged "without discourse" or "without concepts," and came to be called "taste." These terms were reinforced by another, which appeared to denote something not determinable in logical concepts and in some way mysterious: *"nescio quid"* or *"je ne sais quoi"*; an expression particularly frequent in Italy (*non so che*), and imitated in other countries. At the same time were sung the praises of the enchantress "imagination," of the "sensible" or "sensuous" element in poetic imagery, and of the miracles of "colour," in painting, as opposed to "drawing" which seemed not altogether free from an element of cold logic These new intellectual tendencies were somewhat turbid, but at times were purified and raised to the level of reasoned theory, *e.g.*, Zuccolo (1623), who criticized "metric art" and replaced its criteria by the "judgment of sense," which to him meant not the eye or the ear but a higher power united to the senses; Mascardi (1636), who rejected the objective and rhetorical distinction between the styles, and reduced style to the particular individual manner arising out of the particular "wit" of each writer, thus asserting the existence of as many styles as there are writers; Pallavicino (1644), who criticized "verisimilitude" and assigned to poetry as its proper domain that of "first apprehensions" or imaginations, "neither true nor false"; and Tesauro (1654), who tried to work out a logic of rhetoric as opposed to the logic of dialectic, and extended the rhetorical forms beyond merely verbal form, to pictorial and plastic form.

Cartesianism, to which we have already referred, though, in the hands of Descartes and his successors, hostile to poetry and imagination, from another point of view, as stimulating enquiry into the subject or the mind, helped these scattered efforts (as we have said) to consolidate themselves into a system and to search for a principle to which the arts could be reduced; and here too the Italians, welcoming Descartes' method but not his rigid intellectualism or his contempt for poetry, art and imagination, wrote the first treatises on poetry in which the concept of imagination played a central or leading part (Calopreso 1691, Gravina 1692 and 1708, Muratori 1704 and others) These had considerable influence on Bodmer and the Swiss school, and, through them, on the new German criticism and aesthetics and that of Europe at large; so that a recent writer (Robertson) could speak of "the Italian origin of romantic aesthetics."

These minor theorists led to the work of G. B. Vico, who in his *Scienza nuova* (1725–1730) propounded a "poetic logic" which he distinguished from "intellectual logic"; regarded poetry as a mode of consciousness or theoretic form preceding the philosophical or reasoning form, and asserted as its sole principle the imagination, which is strong in proportion as it is free from ratiocination, its enemy and destroyer; praised as father and prince of all true poets the barbaric Homer, and with him, though impaired by theological and scholastic culture, the half-barbaric Dante; and attempted, though without success, to discern English tragedy and Shakespeare, who, though undiscovered by Vico, would, had he known him, certainly have been his third barbaric and supreme poet. But in aesthetics as elsewhere, Vico in his lifetime founded no school, because he was before his time, and also because his philosophical thought was concealed

beneath a kind of historical symbolism. "Poetic logic" only began to make progress when it reappeared in a far less profound shape, but in a more favourable environment, in the works of Baumgarten, who systematized an aesthetics of a somewhat hybrid Leibnitzian origin, and gave it various names, including *ars analogi rationis, scientia cognitionis sensitivae, gnoseologia inferior,* and the name it has retained, *aesthetica* (*Meditationes,* 1735; *Aesthetica,* 1750–58).

The school of Baumgarten, or (more correctly) of Leibnitz, which both did and did not distinguish imaginative from logical form (for it regarded it as *cognitio confusa* and none the less ascribed to it a *perfectio* of its own), and the current of English aesthetics (Shaftesbury, Hutcheson, Hume, Home, Gerard, Burke, Alison, etc), together with the essays on beauty and art which abounded at this time, and the theoretical and historical works of Lessing and Winckelmann, contributed to provide the stimulus, partly positive and partly negative, to the formation of the other masterpiece of 18th century aesthetics, the *Critique of Judgment* (1790) by Immanuel Kant, in which the author (after doubting it in the first *Critique*) discovered that beauty and art afford subject-matter for a special philosophical science—in other words, discovered the autonomy of the aesthetic activity. As against the utilitarians he showed that the beautiful pleases "without interest" (*i.e.*, utilitarian interest); against the intellectualists, that it pleases "without concepts"; and further, against both, that it has "the form of purposiveness" without "representation of a purpose"; and, against the hedonists, that it is "the object of a universal pleasure." In substance, Kant never went further than this negative and generic assertion of the beautiful, just as, in the *Critique of Practical Reason,* once he had vindicated the moral law, he did not go beyond the generic form of duty. But the principles he had laid down were laid down once for all After the *Critique of Judgment,* a return to hedonistic and utilitarian explanations of art and beauty could (and did) take place only through ignorance of Kant's demonstrations. Even the return to Leibnitz and Baumgarten's theory of art as confused or fanciful thinking would have been impossible, had Kant been able to link up his own theory of the beautiful, as pleasing apart from concepts, and as purposiveness without representation of purpose, with Vico's imperfect and inconsistent but powerful theory of the logic of imagination, which was to some extent represented in Germany at this time by Hamann and Herder. But Kant himself prepared the way for the reassertion of the "confused concept" when he ascribed to genius the virtue of combining intellect and fancy, and distinguished art from "pure beauty" by defining it as "adherent beauty."

This return to the tradition of Baumgarten is apparent in post-Kantian philosophy when it regards poetry and art as a form of the knowledge of the Absolute or the Idea, whether equal to philosophy, inferior and preparatory to it, or superior to it as in Schelling's philosophy (1800) where it becomes the organ of the Absolute. In the richest and most striking work of this school, the *Lectures on Aesthetic* of Hegel (1765–1831), art, with religion and philosophy, is placed in the "sphere of absolute mind," where the mind is set free from empirical knowledge and practical action, and enjoys the beatific thought of God or the Idea. It remains doubtful whether the first moment in this triad is art or religion; different expositions of his doctrine by Hegel himself differ in this respect; but it is clear that both, art and religion alike, are at once transcended and included in the final synthesis which is philosophy. This means that art, like religion, is substantially an inferior or imperfect philosophy, a philosophy expressed in imagery, a contradiction between a content and a form inadequate to it which only philosophy can resolve. Hegel, who tended to identify the system of philosophy, the dialectic of concepts, with actual history, expressed this by his famous paradox of the death of art in the modern world, as incapable of subserving the highest interests of the age.

This conception of art as philosophy, or intuitive philosophy, or a symbol of philosophy, or the like, reappears throughout the idealistic aesthetics of the first half of the 19th century, with rare exceptions, *e.g.*, Schleiermacher's *Lectures on Aesthetic* (1825, 1832–33) which we possess in a very incomplete form. In spite of the high merit of these works, and the enthusiasm for poetry and art which they express, the reaction against this type of aesthetics was not, at bottom, a reaction against the artificial character of the principle on which they were based. This reaction took place in the second half of the century, simultaneously with the general reaction against the idealistic philosophy of the great post-Kantian systems. This anti-philosophical movement certainly had its significance as a symptom of discontent and of a desire to find new paths; but it did not produce an aesthetics correcting the errors of its predecessors and carrying the problem a stage further. In part, it was a breach in the continuity of thought; in part, a hopeless attempt to solve the problems of aesthetics, which are philosophical problems, by the methods of empirical science (*e g.,* Fechner); in part, a revival of hedonistic and utilitarian aesthetic by a utilitarianism resting on association of ideas, evolution and a biological theory of heredity (*e g* , Spencer). Nothing of real value was added by the *epigoni* of idealism (Vischer, Schaster, Carriere, Lotze, etc), or the followers of the other early 19th century philosophical movements, *e g* , the so-called formalistic aesthetics (Zimmermann) derived from Herbart, or the eclectics and psychologists, who, like all the rest, laboured at two abstractions, "content" and "form" ("aesthetics of content" and "aesthetics of form"), and sometimes tried to fasten the two together, failing to see that by so doing they were only uniting two fictions into a third. The best thoughts on art in this period are to be found not in the professional philosophers or aestheticians but in the critics of poetry and art, *e.g* , De Sanctis in Italy, Baudelaire and Flaubert in France, Pater in England, Hanslick and Fiedler in Germany, Julius Lange in Holland, etc. These writers alone make amends for the aesthetic trivialities of the positivistic philosophers and the empty artificiality of the so-called idealists.

The general revival of speculative thought led to greater successes in aesthetics in the first decades of the 20th century. Especially noteworthy is the union which is taking place between aesthetics and the philosophy of language, facilitated by the difficulties under which linguistic, conceived as the naturalistic and positivistic science of the phonetic laws of language and similar abstractions, is labouring. But the most recent aesthetic productions, because they are recent and still in process of development, cannot as yet be historically placed and judged.

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(B. Cr.)

AESTHETICS, EXPERIMENTAL. Great artists throughout the centuries have contributed to an empirical aesthetic in the broad sense of the term. Some of them have given us extensive treatises based upon an analysis of their own methods of artistic production, or upon an investigation of existing works of art. Hogarth, for example, examined many forms of architecture, as well as the lines of the human figure, in a search for a norm of beauty which he thought eventually he had found in the serpentine line, and Goethe in his *Farbenlehre* has made keen observations in regard to the aesthetics of colour. From the long list of names might also be mentioned Leonardo da Vinci, Sir Joshua Reynolds and M. E. Chevreul. G. Th. Fechner, however, is generally considered the founder of experimental aesthetics. He not only discussed the formal, or direct, and the associative factors underlying beauty on the basis of his experience of works of art, but he devised experiments in order to settle scientifically the question of the most pleasing proportions in geometrical forms and in line division. This problem had engaged the attention of a number of writers, whose results are in strong disagreement Wolff insisted upon the proportion of 1·1, while Adolf Zeising thought the proportion of the golden section (1 1 618) to be the most pleasing, on the principle that it gives the greatest possible diversity in a harmonious unity. It was the proportion of the golden section that Fechner desired to put to experimental proof. He spread figures of different sizes, such as ellipses, before the observer, with instructions to choose the one which seemed the most pleasing, or he had the person construct a figure according to the most pleasing proportion. It was these two methods of choice and construction, together with that of use, which he proposed as the proper empirical methods of investigation, and these methods have continued to be employed up to the present day. Fechner found the golden section to hold in many instances, but he also found the proportions of 1:1 and 1:3 to be pleasing under certain circumstances. Lightner Witmer thought that Fechner used too few figures, and that the experiments were not properly controlled. He therefore used a serial order of figures with the least perceptible difference of proportion between them. He also had the figures compared in pairs. His results do not always agree with those of Fechner, but he established the importance of the golden section for rectangles and ellipses and line division. An interesting fact came to light in experiments conducted by R. P. Angier. His subjects divided a line at what seemed to them the most pleasing point. Although several persons came near the golden section, no one actually chose it. Nevertheless, the average of all observers was almost exactly the golden section. His results served as a warning not to place too much weight upon averages in the search for an aesthetic norm. In general, however, it may be said that the golden section and symmetry are pleasing, that a division very near the middle and one which makes the shorter line less than a quarter of the length of the whole line are displeasing.

Numerous experiments have been made upon form and balance, with the principal aim of obtaining a psychological explanation of the pleasing effects. T. H. Haines and A. E. Davies, from their work with a series of cards having a constant length and varying width, decided that eye-movements, associations, balance between forces of attention, and suggestion, were the factors which determined the aesthetic effect. Ethel D. Puffer made an extensive study of balance by the use, among other objects, of lines of various sizes and in various positions. She found that the best aesthetic balance generally corresponded to the mechanical balance, and explained the results in terms of interest which, in the last analysis, meant for her a balance of motor impulses. L. J. Martin asserted that our preference for lines and shapes depends very much upon our attitude toward the objects we are judging. A slanting line, when interpreted as a bad vertical, is displeasing, but when we think of it as a horizontal line which is raising itself to a vertical, it is pleasing F. Sander believes that absence of feelings of tension produces a restful effect such as is experienced in viewing Greek architecture, while vivid tensions underlie our reactions to Romanesque and Gothic architecture. Th. Lipps's theory of empathy has also frequently been offered as an explanation of aesthetic pleasure in form. It has further been shown that straight, curved or zigzag lines not only give us varying degrees of pleasure, but arouse in us distinct moods.

Colour.—Goethe in his *Farbenlehre* discussed the moods aroused by colours, and the different psychological effects of different colour combinations. Chevreul studied colours from the aesthetic standpoint, and remarked that complementary colours form the most pleasing combinations, as there is a harmony in the contrast, and half a century later Bezold stated that the colours which are very nearly, but not quite, complementary form the best combinations. Towards the end of the last century, Jonas Cohn and August Kirschmann performed controlled experiments on colour in the manner advocated by Fechner. Both men found contrast to be pleasing, and Cohn's results led him to conclude that saturated colours are in most instances preferred. From about this time the number of treatises on colour preferences began to grow rapidly, and the papers have covered a large field of investigation. The effects of hue, saturation and brightness, together with such factors underlying preference as the time of exposure of the colours, suggestion and association, have been studied. A large number of treatises deal with the colour preferences of infants and school children, and the changes in colour preference which occur with age. Comparative studies have also been made of the colour preferences of the sexes and of races. The experiments were done under such widely different conditions that in many cases they are hardly comparable, and the results are so numerous and varied that they are difficult to summarize. In no instance was there any great agreement in regard to the preference either for single colours or for combinations, and often there was not even a great constancy in the choice of the individual observer. All that one can indicate are general tendencies. Red and blue seem to be the favourite colours, and orange and yellow usually rank low. It appears from the mass of information that has been collected that men have the strongest preference for blue and women for red. A typical order of preference is blue, red, purple, green, orange, yellow, which would mean that the colours at the ends of the spectrum have the best chance of being chosen as the most pleasing. Also, saturated colours have a strong attraction, but are not always preferred. As Titchener has remarked, there seem to be two types of observers, one of which prefers saturated colours, the other definitely prefers unsaturated or what are popularly called artistic colours. E. Bullough has made an analysis of the psychological attitude of persons toward colours, and has found that there are four main types of judgments: the objective, where the peculiarities of the colours such as clarity are observed; the physiological, where the aspects of warmth, hardness, etc., are noted; the associative, where the col-

ours remind the observer of some experience; and the character judgment, where the colours are expressive of mood. It seems, then, that our preference depends very much upon our attitude. Indeed, as von Allesch has stated, the old talk of beauty and ugliness of colours has only relative meaning. All colours can be all things at the right moment and at the right place. Nevertheless, we may say that in general complementary colours seem to be pleasing in combination, and probably also those colours which are nearly complementary. On the other hand, colours which are neighbouring in the spectrum do not seem to go together. Harmony, however, can generally be obtained from the inharmonious combination of two colours by the proper selection of a third colour to form a triad.

William Preyer made one of the first investigations of the colour sense of infants. He found yellow to be preferred to blue. William McDougall found that in the fifth month the child's order of preference was red, green, blue. C. S Myers found that red and green were distinctly preferred to the other colours and to greys. The child examined by C. W. Valentine preferred yellow, then white and pink and then red T. R. Garth made an investigation of 1,000 white children, and found the order of preference to be blue, green, red, violet, orange, yellow, white In the investigation of full-blooded Indians, he found the order to be red, blue, violet, green, orange, yellow, white.

Sound.—The most important work on the psychology of music is that of Carl Stumpf. His book *Tonpsychologie* (1890) is a classic in this field and contains, among many theories and facts of importance, his psychological theory of consonance, which is based upon an empirical study of the perception of tonal combinations. For Stumpf, degree of consonance is correlated with degree of fusion of the two tones of a musical interval In his subsequent writings, he has vigorously attacked the physical theory of consonance of Herman v. Helmholtz and F. E Krüger. Stumpf has also done extensive work upon the tonal quality of vowels and consonants. One of his latest investigations in the auditory field is a comparison of singing and talking, which he finds not fundamentally different. In speaking we use for the most part a continuous change in tone, while in singing we use discrete tonal steps. H. T. Moore has shown experimentally that, up to a certain point, the pleasantness of tonal intervals grows with our experience of them, which accounts for the gradual change in our attitude toward consonance and dissonance. O. Abraham and E M von Hornbostel, in their analysis of tonal intervals, have discovered two factors underlying the experience, one a qualitative, the other a quantitative, which they call distance or width of interval, and accord quality, respectively. C. E Seashore has devised a series of tests which can be given by means of phonograph records. In his latest work he describes the results obtained by photographing the vibrations of the singing voice. He has detected the presence of the vibrato, or synchronous oscillations of pitch and intensity at the rate of five to eight per second in artistic singing.

In experiments upon the appreciation of pictures the introspective method has usually been employed. O Kulpe showed pictures for three seconds each to a number of persons, and recorded their reports. He did not find evidence of empathy to support Lipps's theory. On the other hand, muscular sensations in a form which, according to Karl Groos, is called inner mimicry are present at times, but not always. A unique method of investigating the effect of pictures upon children was used by R. Schultze, who photographed the children while they were looking at the pictures. One was often able to judge from the photographs which picture the child had been looking at, as well as the mood which had been aroused.

A laboratory research in the field of literature which is suggestive, both from the point of view of method and content, is that of R. C. Givler. He showed conclusively the importance of the mere sound of words in conveying the meaning as well as the moods of poetry. Most of the investigations of the aesthetics and psychology of prose and poetry, however, have been in the nature of a direct analysis of the works themselves, or a study of the life of the artist, and do not come under experimental aesthetics in the narrow sense of that term, as used in this article. J. L. Lowes' *The Road to Xanadu* (1927) might, however, be mentioned as a model piece of research of this nature. Comparing the contents of a note-book left by Coleridge with the text of *The Rhyme of the Ancient Mariner* and *Kubla Khan*, Lowes has been able to analyze most convincingly the subconscious mind of that poet. Freud and his followers have also made numerous analyses of the subconscious minds of artists. Their results will undoubtedly be of interest to those persons who believe in the psychoanalytic method, and even the sceptic will find some suggestive material in their writings.

BIBLIOGRAPHY.—For a history of experimental aesthetics up to 1899 the reader is referred to J. Larguier des Bancels's article "Les Méthodes de l'esthétique experimentale" in *L'Année Psychologique*, VI., pp. 144–190 (1899). C. W. Valentine's little work, *An Introduction to the Experimental Psychology of Beauty* (1913), describes a few typical experiments upon colour, form, balance and symmetry, and the aesthetic contemplation of pictures. C. S. Myers's *Text-book of Experimental Psychology*, pt. I, ch. XXIV. (1922), deals primarily with the methods employed in experimental aesthetics For a general treatment of psychological aesthetics *see* W. Wundt, *Physiologische Psychologie*, III., pp 123–209 (5th ed., Leipzig, 1902) For a summary of the work on aesthetics of colour *see* J. H. Parsons, *An Introduction to the Study of Colour Vision* (1924) and M Luckiesh, *The Language of Colour* (1920). For a history of the problem of tonal intervals *see* M. Guernsey, "The Rôle of Consonance and Dissonance in Music," *Amer. J. Psychol.*, XL, pp 173–204 (1928) The articles of Carl E Seashore and his pupils upon the experimental psychology of music are to be found in the Iowa Studies in Psychology, *Psychol Rev Monog. Supl*, Nos. 69, 108, 140, 167, 168. A comprehensive view of the literature upon the dynamic effect of music may be obtained in C M Diserens, *The Influence of Music on Behavior* (Princeton, 1926). For the psychology of rhythm *see* C. M Ruckmick, "A Bibliography of Rhythm," *Amer. J Psychol.*, XXIV., pp 508–519 (1913); XXVI., pp. 457–459 (1915); XXIX, pp. 214–218 (1918), XXXV, pp. 407–413 (1924). (H. S. L.)

AESTIVATION, literally "summer residence," a term used in zoology for the condition of torpor into which certain animals pass during the hottest season in hot and dry countries, contrasted with the similar winter condition, hibernation (*q v*) In botany the word is used of the folded arrangement of the petals in a flower before expansion in the summer, contrasted with "vernation" of leaves which unfold in the spring.

AETA, a Negrito tribe of the Philippine Islands, woolly-haired, dark-skinned, dwarfish (the male stature is about 4ft 9in) inhabiting the mountainous districts of the larger islands and some of the smaller. They are characterized by a large and clumsy foot with abnormally divergent great toe. The social unit is the family; polygamy is permitted, but monogamy prevails. The dead are normally buried, but the bodies of those whom it is wished to honour are exposed on platforms or in trees Bows and poisoned arrows are used, long spears and darts barbed with flint or shell. Fire is made by means of a flexible thong pulled to and fro in a notch in a cleft stick. They pray to a great serpent to show them yams and honey.

The Aeta were long recognized as the owners of the soil in spite of the arrival of Malayan settlers, and in Luzon they levied taxes upon the Tagalog and other tribes (until these arrived in such numbers as to push them back into the hills) taking the heads of defaulters. For much longer, perhaps even yet, they kept a debit and credit account of heads with the Igorots and other neighbours

See Reed, *Negritos of Zambales*, Ethnolog. Survey of the Philippines, II. (1904); Worcester, *Non-Christian tribes of N. Luzon*, Philippine Jnl. of Science, I. (1906); A L. Kroeber, *Peoples of the Philippines*, American Museum of Natural History (1919). (J. H. H.)

AETHELBALD, king of Mercia, succeeded Ceolred, A D 716, at the beginning of the period of Mercian supremacy. His activities as a warrior were slight; in 733 he raided Somerset as far as Somerton, and led unimportant campaigns against the Northumbrians and the Welsh. In 752 Cuthred of Wessex led a successful raid into Oxfordshire against him Aethelbald encouraged the development of the church, making large grants of land, and publishing a decree in 749 which freed ecclesiastical lands from all obligations to the king except the *trinoda necessitas*.

See Bede, *Hist. Ecc.* (ed. Plummer), V 23 and Continuatio *s a.* 740, 750, 757; *Saxon Chronicle* (Earle and Plummer), *s a.* 716, 733, 737,

740, 741, 743, 755; Mabillon, *Acta Sanctorum*, ii. pp. 264, 275–276, 279, 283–284; P. Jaffé, *Monumenta Moguntiaca*, iii. pp. 168–177; W. de G. Birch, *Cartul. Saxon.*, 178 (1885–93).

AETHELBALD, king of Wessex, was the son of Aethelwulf, with whom he led the West Saxons to victory against the Danes at Aclea, 851. According to Asser he rebelled against his father on the latter's return from Rome in 856, and deprived him of Wessex, which he ruled until his death in 860. On his father's death in 858 he married his widow, Judith.

See Asser, *Life of Alfred* (W. H. Stevenson, 1904), 12; *Saxon Chronicle, s.a.* 851, 855, 860.

AETHELBERT, king of Kent, son of Eormenric, came to the throne in A.D. 560. Aethelbert's supremacy, described by Bede as extending in 597 to the Humber, can have been little more than nominal, though he exercised stricter sway over Essex, where his nephew, Sabert, was king. An attempt to extend his kingdom westwards was defeated in 568 by Ceawlin at Wibbandune. Aethelbert's reign is chiefly remarkable for the introduction of Christianity. He married a Christian princess, Berta, daughter of Charibert, king of Paris, who brought over a bishop as private confessor. When in 597 Augustine landed in Thanet, the king treated his mission tolerantly, gave him a dwelling in Canterbury and allowed monks to preach there, afterwards being baptized himself, but making no attempt to force conversion on his subjects. In 604 he founded the see of Rochester, and his influence established Mellitus at London in the same year. He published a code of laws, the first of its kind, containing a list of money fines for various offences against the clergy.

BIBLIOGRAPHY.—*See* Stubbs, *Dict. of Christian Biog. Ethelbert;* Bede, *Hist Ecc.* (Plummer i. 25, 26, ii. 3, 5); *Saxon Chronicle* (Earle and Plummer), *s.a.* 568.

AETHELBERT, king of the West Saxons, succeeded to the under-kingdom of Kent during the lifetime of his father, Aethelwulf, and retained it until the death of his elder brother, Aethelbald, in 860, when he became sole king of Wessex and Kent till his death in 865. His reign was marked by two serious attacks by the Danes, who were repelled in 860 by the levies of Hampshire and Berkshire, though not before they had sacked Winchester, while in 865 they ravaged Kent after agreeing to take money for peace. Aethelbert was buried at Sherborne.

BIBLIOGRAPHY.—*See* the *Saxon Chronicle* (Earle and Plummer), *s.a.* 860, 865; *King Alfred's Will;* W. de G Birch, *Cartul. Saxon*, 553

AETHELFLAED or **ETHELFLEDA,** the "Lady of the Mercians," the eldest child of Alfred the Great, was married about 886 to Aethelred, earl of Mercia, to whom Alfred entrusted the control of Mercia. On the accession of her brother Edward, Aethelflaed and her husband continued to hold Mercia In 907 they fortified Chester, and in 909 and 910 either Aethelflaed or her husband must have led the Mercian host at the battles of Tettenhall and Wednesfield (or Tettenhall-Wednesfield, if these battles are one and the same). It was probably about this time that Aethelred fell ill, and the Norwegians and Danes from Ireland unsuccessfully besieged Chester. Aethelflaed won the support of the Danes against the Norwegians, and seems also to have entered into an alliance with the Scots and the Welsh against the pagans.

In 911 Aethelred died, and Edward took over Middlesex and Oxfordshire. Except for this, Aethelflaed's authority remained unimpaired. In 912 she fortified "Scergeat" and Bridgnorth, Tamworth and Stafford in 913, Eddisbury and Warwick in 914, Cherbury, "Weardbyrig" and Runcorn in 915. In 916 she sent an expedition against the Welsh, which advanced as far as Brecknock. In 917 Derby was captured from the Danes, and the next year Leicester and York both submitted to her. She died in 918 at Tamworth (June 12), and was buried in St. Peter's Church at Gloucester. This noble queen, whose career was as distinguished as that of her father and brother, left one daughter, Aelfwyn. For some 18 months Aelfwyn seems to have wielded her mother's authority, and then, just before the Christmas of 919, Edward took Mercia into his own hands, and Aelfwyn was "led away" into Wessex. Aethelflaed and her husband wielded almost kingly authority; the royal title is often given them by the chroniclers.

See *The Saxon Chronicle, s.a.* (especially the Mercian register in MSS. B, C and D); Florence of Worcester, *Fragments of Irish Annals* (ed. O'Conor), pp. 227–237, D.N.B., *s.v.* (A. M.)

AETHELFRITH, king of Northumbria, is said to have come to the throne in A.D. 593, being the son of Aethelric (probably reigned 568–72). He married Acha, daughter of Ella (Aelle), king of Deira, whom he succeeded, probably in 605, expelling his son Edwin. In 603 he repelled the attack of Aidan, king of the Dalriad Scots, at Daegsastan, defeating him with great loss. Later in his reign, probably in 614, he defeated the Welsh in a great battle at Chester, and massacred the monks at Bangor who were assembled to aid them by their prayers. This war had a strategic importance in the separation of the North Welsh from the Strathclyde Britons In 617 Aethelfrith was defeated and slain at the river Idle by Raedwald of East Anglia, whom Edwin had persuaded to take up his cause

See Bede, *Chronica Maiora*, §531; *Hist Ecc* (Plummer) i 34, ii 2; *Saxon Chronicle, s a* 593, 603, 605, 616; *Hist Brittonum*, §§57, 63; *Annales Cambriae, s a* 613.

AETHELING, an Anglo-Saxon word meaning originally "of noble descent," but soon restricted to members of a royal family, and in the *Anglo-Saxon Chronicle* used almost exclusively for members of the royal house of Wessex It was occasionally used after the Norman Conquest to designate members of the royal family In the 10th century, the *wergild* of an aetheling was equal to that of an archbishop and one-half of that of a king

AETHELNOTH (d 1038), archbishop of Canterbury, known also as EGELNODUS or EDNODUS, was a son of the ealdorman Aethelmaer, and a member of the royal family of Wessex. He became a monk at Glastonbury, then dean of the monastery of Christ Church, Canterbury, and chaplain to King Canute, and on Nov. 13, 1020, he was consecrated archbishop of Canterbury. He appears to have exercised considerable influence over Canute, largely by whose aid he restored his cathedral at Canterbury. Aethelnoth, who was called the "Good," died on Oct. 29, 1038

AETHELRED, king of Mercia, succeeded his brother Wulfhere in A D 675. In 676 he ravaged Kent, destroying the monasteries and churches and taking Rochester Aethelred married Osthryth, the sister of Egfrith, king of Northumbria, but a quarrel arose between the two kings, presumably over the possession of the province of Lindsey, which Egfrith had won back at the close of the reign of Wulfhere. In a battle on the banks of the Trent in 679, the king of Mercia was victorious and regained the province. Aelfwine, the brother of Egfrith, was slain, but at the intervention of Theodore, archbishop of Canterbury, Aethelred agreed to pay a wergild for the Northumbrian prince and so prevented further hostilities. Osthryth was murdered in 697 and Aethelred abdicated in 704, choosing Coenred as his successor. He then became abbot of Bardney, and, according to Eddius, recommended Wilfrid to Coenred on his return from Rome. Aethelred died at Bardney in 716. *See* WILFRID.

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AETHELRED I., king of Wessex and Kent (866–871), was the fourth son of Aethelwulf of Wessex, and should, by his father's will, have succeeded to Wessex on the death of his eldest brother Aethelbald. He seems, however, to have stood aside in favour of his brother Aethelbert, king of Kent, to whose joint kingdoms he succeeded in 866. Aethelred's reign was one long struggle against the Danes. In the year of his succession a large Danish force landed in East Anglia, and in the year 868 Aethelred and his brother Alfred went to help Burgred, or Burhred, of Mercia, against this host, but the Mercians soon made peace with their foes. In 871 the Danes encamped at Reading, where they defeated Aethelred and his brother, but later in the year the English won a great victory at "Aescesdun." A fortnight later they were defeated at Basing, but partially retrieved their fortune by a victory at "Maeretun" (perhaps Marden, in Wiltshire), though the Danes held the field. In the Easter of this year Aethelred died, perhaps of wounds received in the wars against the Danes, and was buried at Wimborne.

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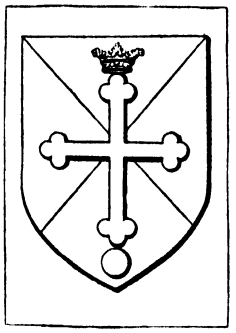
AETHELRED II. or **ETHELRED** (*c.* 968–1016), king of the English (surnamed THE UNREADY; *i.e.*, without *rede* or counsel), son of King Edgar by his second wife, Aelfthryth, was born in 968 or 969 and succeeded to the throne on the murder of his step-brother Edward (the Martyr) in 979. In the year after his accession the Danish invasions recommenced, though as yet their object was plunder only, not conquest. For an account of the repeated invasions, which gathered strength as time went on, *see* ENGLISH HISTORY. Aethelred's policy of buying off the raiders failed, and the massacre of Danes in England carried out by his orders on St. Brice's Day (Dec. 2, 1001) only made matters worse. Next year Sweyn returned, his hostility fanned by the desire for revenge. For two years he ravaged and slew; in 1003 Exeter was destroyed; Norwich and Thetford were sacked in 1004. No effectual resistance was offered, despite efforts here and there; disorganization of the country was complete. In 1005 the Danes were absent in Denmark, but they came back next year, and emboldened by the utter lack of resistance, they ranged far inland. In 1007 Aethelred bought them off for a larger sum than ever (£36,000), and for two years the land enjoyed peace. In 1009, however, in accordance with a resolution made by the witan in the preceding year, Aethelred collected such a fleet "as never before had been in England in any king's day"; but owing to a miserable court quarrel the effort came to nothing. The king then summoned a general levy of the nation, with no better result. Just as he was about to attack, the traitor Edric prevented him from doing so, and the opportunity was lost. In 1010 the Danes returned, to find the kingdom more utterly disorganized than ever. "There was not a chief man in the kingdom who could gather a force, but each fled as he best might; nor even at last would any there resist another." Incapable of offering resistance, the king again offered money, this time no less than £48,000. While it was being collected, the Danes sacked Canterbury and slew the archbishop Alphege. The tribute was paid soon afterwards; and about the same time the Danish leader Thurkill entered the English service.

From 1013 an important change is discernible in the character of the Danish attacks, which now became definitely political in their aim. In this year Sweyn sailed up the Trent and received the submission of northern England, and then, marching south, attacked London. Failing to take it, he hastened west and at Bath received the submission of Wessex. Then he returned northwards, and after that "all the nation considered him as full king." London soon acknowledged him, and Aethelred, after taking refuge for a while with Thurkill's fleet, escaped to Normandy. Sweyn died in Feb. 1014, and Aethelred was recalled by the witan. At once he hastened north against Canute, Sweyn's son, but Canute sailed away, only to return next year, when the traitor Edric joined him and Wessex submitted. Canute and Edric harried Mercia, and were preparing to reduce London, when Aethelred died there on April 23, 1016. Weak, self-indulgent, improvident, he had pursued a policy of opportunism to a fatal conclusion.

Aethelred's wife was Emma, or Aelfgifu, daughter of Richard I. the Fearless, duke of the Normans, whom he married in 1002. After the king's death Emma became the wife of Canute the Great, and after his death in 1035 she struggled hard to secure England for her son, Hardicanute. In 1037, however, when Harold Harefoot became sole king, she was banished; she went to Flanders, returning to England with Hardicanute in 1040. In 1043 Edward the Confessor seized the greater part of Emma's great wealth, and the queen lived in retirement at Winchester until her death on March 6, 1052. By Aethelred Emma had two sons, Edward the Confessor and the aetheling Aelfred (d. 1036), and by Canute she was the mother of Hardicanute. Her marriage with Aethelred was an important step in the history of the relations between England and Normandy, and J. R. Green says "it suddenly opened for its rulers a distinct policy, a distinct course of action, which led to the Norman conquest of England. From the moment of Emma's marriage Normandy became a chief factor in English politics."

BIBLIOGRAPHY.—*The Anglo-Saxon Chronicle* (ed. C. Plummer, Oxford, 1892–99); Florence of Worcester (ed. B. Thorpe, London, 1848–49); *Encomium Emmae* (ed. G. H. Pertz in the *Scriptores Rerum Germanicarum*, Band xix., Hanover, 1866) for the latter part of the reign. *See* also J. M. Kemble, *Codex Diplomaticus aevi Saxonici* (London, 1839–48); and B. Thorpe, *Ancient Laws* (London, 1840).

AETHELSTAN (*c.* 894–940), Saxon king, was the son (probably illegitimate) of Edward the Elder. He had been the favourite of his grandfather Alfred, and was brought up in the household of his aunt Aethelflaed, the "Lady of the Mercians." On the death of his father in 924, Aethelstan succeeded him, and was crowned at Kingston shortly after.



AFTER G. M. COLLEN'S BRIT. SAXONICA

SHIELD OF AETHELSTAN
The cross boutonné, on a field of red and blue, is surmounted by a crest coronet of gold. The circle at the base is gold

One of Aethelstan's first public acts was to hold a conference at Tamworth with Sihtric, the Scandinavian king of Northumbria, and as a result Sihtric received Aethelstan's sister in marriage. In the next year Sihtric died and Aethelstan took over the Northumbrian kingdom. He now received, at Dacre, in Cumberland, the submission of all the kings of the island; viz., Howel Dda, king of West Wales, Owen, king of Cumbria, Constantine, king of the Scots, and Ealdred of Bamburgh, and henceforth he called himself "rex totius Britanniae." About this time (the exact chronology is uncertain) Aethelstan expelled Sihtric's brother Guthfrith, destroyed the Danish fortress at York, received the submission of the Welsh at Hereford, fixing their boundary along the line of the Wye, and drove the Cornishmen west of the Tamar, fortifying Exeter as an English city. In 934 he invaded Scotland by land and sea, perhaps owing to an alliance between Constantine and Anlaf Sihtricsson. The army advanced as far north as Dunottar, in Kincardineshire, while the navy sailed to Caithness. Simeon of Durham speaks of a submission of Scotland as a result; if it ever took place it was a mere form, for three years later we find a great confederacy formed in Scotland against Aethelstan. This confederacy of 937 was joined by Constantine, king of Scotland, the Welsh of Strathclyde, and the Norwegian chieftains, Anlaf Sihtricsson and Anlaf Godfredsson, who, though they came from Ireland, had powerful English connections. A great battle was fought at Brunanburh (perhaps Brunswark or Birrenswark hill in south-east Dumfriesshire), in which Aethelstan and his brother Edmund were completely victorious. England had been freed from its greatest danger since the days of the struggle of Alfred against Guthrum.

Aethelstan was the first Saxon king who could claim in any real sense to be lord paramount of Britain. In his charters he is continually called "rex totius Britanniae," and he adopts for the first time the Greek title *basileus*. This was not merely an idle flourish, for some of his charters are signed by Welsh and Scottish kings as *subreguli*. Further, Aethelstan was the first king to bring England into close touch with continental Europe. By the marriage of his half-sisters he was brought into connection with the chief royal and princely houses of France and Germany. His sister Eadgifu married Charles the Simple, Eadhild became the wife of Hugh the Great, duke of France, Eadgyth was married to the emperor Otto the Great, and her sister, Aelfgifu, to a petty German prince. Embassies passed between Aethelstan and Harold Fairhair, first king of Norway, with the result that Harold's son Haakon was brought up in England, and is known in Scandinavian history as Haakon Adalsteinsfóstri.

Aethelstan died at Gloucester in 940, and was buried at Malmesbury, an abbey which he had munificently endowed during his lifetime. Apparently he was never married, and he certainly had no issue. A considerable body of law has come down to us in Aethelstan's name. The chief collections are those issued at Grately, in Hampshire, at Exeter, at Thunresfeld, and

the *Iudicia civitatis Lundonie*. In the last-named one personal touch is found when the king tells the archbishop how grievous it is to put to death persons of 12 winters for stealing. The king secured the raising of the age limit to 15.

BIBLIOGRAPHY.—Primary: *The Saxon Chronicle, sub ann.;* William of Malmesbury, *Gesta Regum*, i. 141–157, Rolls Series, containing valuable original information (*v.* Stubbs' Introduction, II. lx., lxvii.); Birch, *Cartul. Saxon.* vol. ii. Nos 641-747; A. S. Laws (ed Liebermann), i. 146–183; Aethelweard, Florence of Worcester. Secondary: *Saxon Chronicle* (ed. Plummer) vol. ii. p. 132–142, D. N. B., *s.v.*

(A M.)

AETHELWEARD or **ETHELWARD,** Anglo-Saxon historian, was the great-grandson of Aethelred, the brother of Alfred, and ealdorman or earl of the western provinces (*i e*, probably of the whole of Wessex) He was the author of a Latin chronicle extending to the year 975. Up to the year 892 he is largely dependent on the *Saxon Chronicle,* with a few details of his own; later he is largely independent of it. He was the friend and patron of Aelfric, the grammarian.

BIBLIOGRAPHY.—Primary: *The Saxon Chronicle,* 994 E; Birch, *Cartularium Saxonicum;* A. S. Laws (ed. Liebermann), pp. 220–24; *Fabii Ethelwerdi Chron.,* Mon. Hist. Brit., pp. 449–54. Secondary. Plummer, *Saxon Chronicle,* vol. ii. p. ci.; Napier and Stevenson, *Crawford Charters,* pp. 118–20; D.N.B., *s.v.*

AETHELWULF, king of the West Saxons, succeeded his father, Egbert, in A.D 839. Aethelwulf's reign was chiefly occupied with struggles against the Danes After the king's defeat 843–44, the Somerset and Dorset levies won a victory at the mouth of the Parret (*c.* 850). In 851 Ceorl, with the men of Devon, defeated the Danes at Wigganburg, and Aethelstan of Kent was victorious at Sandwich; despite this the Danes wintered in England that year for the first time. In 851 also Aethelwulf and Aethelbald won their great victory at Aclea, probably the modern Ockley In 853 Aethelwulf subdued the North Welsh, in answer to the appeal of Burgred of Mercia, and gave him his daughter Aethelswith in marriage The year 855 is the date of the Donation of Aethelwulf and of his journey to Rome with Alfred On his way home he married Judith, daughter of Charles the Bold According to Asser he was compelled to give up Wessex to his son Aethelbald on his return, and content himself with the eastern under-kingdom. He died in 858

See Asser, *Life of Alfred* (W. H. Stevenson, 1904), 1–16; *Saxon Chronicle, s a.* 823, 836, 840, 851, 853, 855.

AETHER: *see* ETHER (PHYSICS).

AETHICUS (=ETHICUS) **ISTER,** "the philosopher of Istria," the supposed but unknown author of a description of the world written in Greek. An abridgment, under the title of *Cosmographia Ethici,* written in barbarous Latin, and wrongly described as the work of St. Jerome, probably belongs to the 7th century.

The name Aethicus is also attached to a geographical treatise probably dating from the 6th century, a reproduction of the cosmography of Julius Honorius.

BIBLIOGRAPHY.—D'Avezac (1852); Pertz (1853); Wuttke (1854); Riese's *Geographi Latini Minores* (1878); *see* also Bunbury, *History of Ancient Geography.*

AETIOLOGY or **ETIOLOGY,** strictly, science or philosophy of causation, but generally used to denote the part of any special science (and especially of that of medicine and disease) which investigates the causes and origin of its phenomena. An *aetiological myth* is one which is regarded as having been invented *ex post facto* to explain some fact, name, or coincidence, the true account or origin of which has been forgotten Such myths were often based on grotesque philological analogies, according to which an existing connection between two personalities (cities, etc) was traced back to a common mythical origin. For a good example of the evolution of such myths *see* the argument under AEGINA, *History.*

AETION or **EETION,** a Greek painter, mentioned by Cicero, Pliny, and Lucian. His most noted work, described in detail by Lucian (*Herodotus or Eetion,* 5), was a picture representing the marriage of Alexander and Roxana. Through a misunderstanding of the words of Lucian, Aetion has been supposed to belong to the age of Antonines; but there can be little doubt that he was a contemporary of Alexander and of Apelles (Brunn, *Geschichte der griechischen Künstler,* ii. p. 243). Pliny gives his date as 350 B.C.

AETIUS (ah-ĕt'ĭ-oos) (fl. 350), surnamed "the Atheist," founder of an extreme sect of Arians, was a native of Coele-Syria. He studied successively under the Arians, Paulinus, bishop of Antioch, Athanasius, bishop of Anazarbus, and the presbyter Antonius of Tarsus. At the first synod of Sirmium he won a dialectic victory over the homoiousian bishops, Basilius and Eustathius, who sought in consequence to stir up against him the enmity of Caesar Gallus. In 356 he went to Alexandria with Eunomius (*q.v.*) in order to advocate Arianism, but he was banished by Constantius. Julian recalled him from exile, bestowed upon him an estate in Lesbos, and retained him for a time at his court in Constantinople. At the accession of Valens (364) he retired to his estate at Lesbos, but soon returned to Constantinople, where he died in 367. The Anomoean sect of the Arians, of whom he was leader, are sometimes called after him *Aetians.* His work *De Fide* has been preserved in connection with a refutation written by Epiphanius (*Haer.,* lxxvi. 10).

See A. Harnack, *History of Dogma,* vol. iv. *passim.*

AETIUS (died 454), a Roman general of the closing period of the Western empire, born at Dorostolus in Moesia, late in the 4th century. He was the son of Gaudentius, who, although possibly of barbarian family, rose in the service of the Western empire to be master of the horse and later, count of Africa. Aetius passed some years as hostage, first with Alaric and the Goths, and later in the camp of Rhuas, king of the Huns, acquiring in this way the knowledge which enabled him afterwards to defeat them. In 424 he led into Italy an army of 60,000 barbarians, mostly Huns, which he employed first to support the *primicerius* Ioannes, who had proclaimed himself emperor, and, on the defeat of the latter, to enforce his claim to the supreme command of the army in Gaul upon Placidia, the empress-mother and regent for Valentinian III. His calumnies against his rival, Count Boniface, which were at first believed by the emperor, led Boniface to revolt and call the Vandals to Africa. Upon the discovery of the truth, Boniface, although defeated in Africa, was received into favour by Valentinian; but Aetius came down against Boniface from his Gallic wars, and in the battle which followed wounded Boniface fatally with his own javelin From 433 to 450 Aetius was the dominating personality in the Western empire. In Gaul he won his military reputation, upholding for nearly 20 years, by combined policy and daring, the falling fortunes of the empire. His greatest victory was that of Châlons-sur-Marne (Sept. 20, 451), in which he led the Gallic forces against Attila and the Huns. This was the last triumph of the empire. Three years later (454) Aetius presented himself at court to claim the emperor's daughter in marriage for his son Gaudentius; but Valentinian, suspecting him of designs upon the crown, slew him with his own hand.

"That he was the one prop and stay of the Western empire during his life is the unanimous verdict of his contemporaries; but whether he was a really great general or statesman we cannot tell He was beaten by Boniface; and it was not he, but the Goths and their king, who really triumphed in the Mauriac plain; yet he recovered Gaul in a series of campaigns, and he kept the Visigoths in check. . . . If he was less Roman than his predecessor Constantius, he was far more Roman than his successor Ricimer; and if he had occasionally used the arms of the Huns for his own ends, he had also used them to maintain the empire. One merit he had which must count for much—the merit of recognizing and encouraging men of ability. Majorian and Marcellinus, two of the finest figures in the history of the fallen empire, were men of his training." (Ernest Barker in *Cambridge Mediaeval Hist.,* vol. i., I., 418–419.)

See T. Hodgkin, *Italy and her Invaders,* vols. i. and ii. (1880).

AETIUS, a Greek physician, born at Amida in Mesopotamia, flourished at the beginning of the 6th century A.D. He was court physician at Byzantium. He wrote a large medical work in 16 books, founded on Oribasius and compiled from various sources, especially Galen (Galenos). Eight books of the Greek original were printed in Venice in 1534, and a complete Latin translation by Cornarius at Basel, 1542.

See Weigel, *Aetianarum exercitationum specimen* (1791); Danelius, *Beitrag zur Augenheilkunde des Aetius* (1889); Zernos, *Aetii sermo sextidecimus et ultimus*, editio princeps (1901).

AETNA, a Latin hexameter poem of 644 lines ascribed by the mss. to Virgil. This ascription is now universally rejected, but it is obvious that the author was an imitator of Virgil who was familiar with the Aeneid as well as the Bucolics and Georgics, and therefore lived at least as late as the time of Augustus. As there is no mention of the famous eruption of Vesuvius which destroyed Pompeii and Herculaneum it is safe to presume that the work was composed before A.D. 79. The poem has been attributed by various authorities to Claudian, Cornelius Severus and Manilius, but modern opinion assigns it to Lucilius Junior, the friend of Seneca, whose interest in, and knowledge of scientific matters is alluded to in the philosopher's correspondence. He is known to have been a governor of Sicily and also to have written poems *Aetna* discusses the possible scientific explanation of the volcano's action.

Text edited (1920) by Robinson Ellis in J. P. Postgate's *Corpus Poetarum Latinorum.*

AETOLIA, a district of northern Greece, bounded on the south by the Corinthian Gulf, on the west by the river Achelous, on the north and east by the western spurs of Parnassus and Oeta The land naturally falls into two divisions The basins of the lower Achelous (mod. *Aspropotamo*) and Euenus (*Phidharis*) form a series of alluvial valleys intersected by detached ridges which mostly run parallel to the coast This district of "Old Aetolia" lacks a suitable sea-board, but the inland, and especially the plain of central Aetolia lying to the north of Lakes Hyria and Trichonis and Mount Aracynthus, forms a rich agricultural country. The northern and eastern regions are broken by an extensive complex of chains and peaks, whose rugged limestone flanks are clad at most with stunted shrubs and barely leave room for a few precarious mule-tracks These heights often rise in the frontier-ranges of Tymphrestus, Oxia and Corax to more than 7,000 ft; the snow-capped pinnacle of Kiona attains to 8,240 ft. A few defiles pass through this barrier to the other side of the north Greek watershed

In early legend Old Aetolia, with its cities of Pleuron and Calydon, figures prominently During the great migrations (*see* DORIANS) the population was largely displaced, and the old inhabitants long remained in a backward condition. In the 5th century some tribes were still living in open villages under petty kings, addicted to plunder and piracy, and hardly recognized as Hellenes at all. Yet their military strength was not to be despised: in 426 their archers and slingers easily repelled an Athenian invasion under Demosthenes In the 4th century the Aetolians began to take a greater part in Greek politics, and, in return for helping Epameinondas (367) and Philip of Macedon (338), recovered control of their sea-board, to which they annexed the Acarnanian coast and the Oeniadae. Aetolia's prosperity dates from the period of Macedonian supremacy. It may be ascribed partly to the wealth and influence acquired by Aetolian mercenaries in Hellenistic courts, but chiefly to the formation of a national Aetolian league, the first effective institution of this kind in Greece. Created originally to meet the peril of an invasion by the Macedonian regents Antipater and Craterus, who had undertaken a punitive expedition against Aetolia after the Lamian War (322), and by Cassander (314–311), the confederacy grew rapidly during the subsequent period of Macedonian weakness. Since 290 it had extended its power over all the uplands of central Greece, where its command over Heracleia (280) provided it with an important defensive position against northern invaders, its control of Delphi and the Amphictyonic council with a useful political instrument. The valour of the Aetolians was conspicuously displayed in 279, when they broke the strength of the Celtic irruption by slaughtering great hordes of marauders. The commemorative festival of the Soteria, which the league established at Delphi, obtained recognition from many leading Greek states. After annexing Boeotia (by 245) the Aetolians controlled all central Greece. Endeavouring next to expand into Peloponnesus, they allied themselves with Antigonus Gonatas of Macedonia against the Achaean league (*q.v.*), and besides becoming protectors of Elis and Messenia won several Arcadian cities. Their naval power extended to Cephalonia, to the Aegaean islands and even to the Hellespont. The league at its zenith had thus a truly imperial status.

Later in the century its power began to be sapped by Macedonia To check King Demetrius (239–229) the Aetolians joined arms with the Achaeans. In 224 they held Heracleia Trachis against Antigonus Doson, but lost control of Boeotia and Phocis Since 228 their Arcadian possessions had been abandoned to Sparta. At the same time a new enemy arose in the Illyrian pirate fleets, which outdid them in unscrupulousness and violence The raids of two Aetolian chiefs in Achaean territory (220) led to a coalition between Achaea and Philip V of Macedon, who assailed the invaders with great energy, driving them out of Peloponnesus and marching into Aetolia itself, where he surprised and sacked the federal capital Thermon. After buying peace by the cession of Acarnania (217) the league concluded a compact with Rome In the great war of their Roman allies against Philip the federal troops took a prominent part, their cavalry being largely responsible for the victory of Cynoscephalae (197). The Romans in return restored central Greece to the league, but by withholding its former Thessalian possessions excited its deep resentment. The Aetolians now invited Antiochus III of Syria to European Greece, and so precipitated a conflict with Rome But in the war they threw away their chances. In 192 they wasted themselves in an unsuccessful attempt to secure Sparta. In 191 they supported Antiochus badly, and by their slackness in the defence of Thermopylae made his position in Greece untenable. Having thus isolated themselves the Aetolians stood at bay behind their walls against the Romans, who refused all compromises, and, after the general surrender in 189, restricted the league to Aetolia proper and assumed control over its foreign relations. By the time of Sulla, the functions of the Aetolian league had become purely nominal. The federal constitution closely resembled that of the Achaean league (*q.v.*), for which it doubtless served as a model. The general assembly, convoked every autumn at Thermon to elect officials, and at other places in special emergencies, shaped the league's general policy; it was nominally open to all freemen, though no doubt the Aetolian chieftains really controlled it. The council of deputies from the confederate cities undertook the routine of administration and jurisdiction. The *strategus* (general), aided by 30 *apocleti* (ministers), had complete control in the field and presided over the assembly, though with restricted advisory powers. The Aetolians also used the Amphictyonic synod for passing solemn enactments The league's relation to outlying dependencies is obscure; many of these were probably mere protectorates or "allied states" and secured no representation. The federal executive was certainly much more efficient than that of the Achaeans, and its councils suffered less from disunion; but its generals and admirals, official or otherwise, enjoyed undue licence; hence the league deservedly gained an evil name for the numerous acts of lawlessness or violence which its troops committed. But as a champion of republican Greece against foreign enemies no other power of the age rendered equal services. In the 15th century Aetolia passed under the rule of Scanderbeg and the Venetians, but was finally conquered for the Turks by Mohammed II. In the War of Independence it was the scene of severe fighting, including the sieges of Missolonghi.

(M C.)

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AFARS (DANAKIL), a tribe of African "Arabs" of Hamitic stock. They occupy the arid coast-lands between Abyssinia and the sea. They claim to be Arabs, but are more akin to the Galla and Somali. The tribe is roughly divisible into a pastoral and a

coast-dwelling group. Their religion is chiefly fetich and tree-worship; many, nominally, profess Mohammedanism. They are distinguished by narrow straight noses, thin lips and small pointed chins. They wear, generally, nothing but a waist-cloth. They are divided into many sub-tribes, each having an hereditary sultan.

See Fr. Scazamucci and E H. Giglioli, *Notizie sui Danakil* (1884); P. Paulitschke, *Ethnographie Nordost-Afrikas* (2 vols., Berlin, 1893–1896), and *Die geographische Erforschung der Adâl-Lander und Harâr in Ost-Afrika* (Leipzig, 1884).

AFER, DOMITIUS, a Roman orator and advocate, was born at Nemausus (Nîmes). He became an informer and gained the favour of Tiberius by accusing Claudia Pulcra, a cousin of Agrippina, of treason. He was consul under Caligula (39) and superintendent of the water supply under Nero. He died in A.D. 60. His pupil, Quintilian, who calls him the greatest orator he had ever known, quotes some of his witty sayings (*dicta*), collections of which were published, and mentions two books by him *On Witnesses.*

See Quintilian, *Instit.* vi. 3. 42, viii. 5. 16, x. 1 118, etc.; Tac *Ann.* iv. 52, 68, xiv. 19; Dio Cassius lix. 19, lx. 33, Pliny, *Epp.* ii. 14, viii. 18.

AFFECTION, literally, a state resulting generally from an external influence. The term was at one time employed to denote the states even of material bodies, but is now confined to certain *mental* states only, in fact, to certain *feelings.* It is popularly used of a sentiment between persons amounting to more than good will or friendship. By ethical writers the word has been used generally of distinct states of feeling, both lasting and spasmodic; some contrast it with "passion," as being free from the distinctively sensual element. More specifically the word has been restricted to emotional states which are in relation to persons. In the former sense, it is the Gr. πάθος, and as such it appears in Descartes and most of the early British ethical writers. On various grounds, however—*e.g.,* that it does not involve anxiety or excitement, that it is comparatively inert and compatible with the entire absence of the sensuous element—it is generally and usefully distinguished from passion. In this narrower sense the word has played a great part in ethical systems, which have spoken of the social or parental "affections" as in some sense a part of moral obligation. For a consideration of these and similar problems, which depend ultimately on the degree in which the affections are regarded as voluntary, *see* H. Sidgwick, *Methods of Ethics,* pp. 345–349.

In psychology the terms "affection" and "affective" are used for the characteristic quality of experiences that are neither cognitive nor conational. As all intellectual phenomena have by some psychologists been reduced to sensation, so all feeling has been regarded as reducible to simple mental affection, the element of which all emotional manifestations are ultimately composed. The nature of this element is a problem which has been provisionally, but not conclusively, solved by many psychologists; the method is necessarily experimental, and all experiments on feeling are peculiarly difficult. The solutions proposed are two. In the first, all affective phenomena are primarily divisible into those which are pleasurable and those which are the reverse. The main objections to this are that it does not explain the infinite variety of phenomena, and that it disregards the distinction which most philosophers admit between higher and lower pleasures. The second solution is that every sensation has its specific affective quality, though by reason of the poverty of language many of these have no name. W. Wundt, *Outlines of Psychology* (trans. C. H. Judd, Leipzig, 1897), maintains that we may group under three main affective directions, each with its negative, all the infinite varieties in question; these are (a) pleasure, or rather pleasantness, and the reverse, (b) tension and relaxation, (c) excitement and depression.

Two methods of experiment have been tried. The first, introduced by A. Mosso, the Italian psychologist, consists in recording the physical phenomena which are observed to accompany modifications of the affective consciousness. Thus it is found that the action of the heart is accelerated by pleasant, and retarded by unpleasant, stimuli; again, changes of weight are found to accompany modifications of affection—and so on.

The second is Fechner's method; it consists in recording the changes in feeling-tone produced in a subject by bringing him in contact with a series of conditions, objects or stimuli graduated according to a scientific plan and presented singly, in pairs or in groups. The result is a comparative table of likes and dislikes. (*See* FEELING.)

AFFETTUOSO (Ital.), a musical direction signifying that the composition or particular passage so marked is to be played with much expression and feeling. *Espressivo* and *con espressione* are other terms having much the same significance.

AFFIDAVIT, a written statement sworn or affirmed to before some person who has authority to administer an oath or affirmation Evidence is chiefly taken by means of affidavits in the chancery division of the High Court of Justice in England on a petition, summons or motion. Interlocutory proceedings before trial are conducted by affidavits, *e.g.,* for discovery of documents, hence called *affidavit of documents.* Affidavits are sometimes necessary as proof that certain legal formalities have been duly and legally performed. On special application to the court a deponent may be cross-examined on the statements contained in his affidavit. In Scotland the testimony of witnesses by affidavit is almost unknown, except in proceedings in the Sheriff Court of Chancery, and petitions for the sequestration of bankruptcy, where affidavits are enjoined by statute. In the rules of the Supreme Court (R.S.C. Ord. XXXVIII.) certain formal requirements are laid down for all affidavits and affirmations in causes or matters depending in the High Court. An affidavit must consist of title, body or statement and jurat. It must be written or printed on foolscap, bookwise, in the first person; give correctly the names of the parties to the action; and the description and true place of abode of the deponent. An affidavit is confined, except on interlocutory motions, to such facts as the witness is able of his own knowledge to prove. The signature of the deponent must be written opposite to the jurat, which must contain the place, date and time of swearing, and this signed by the officer or magistrate before whom the affidavit is sworn An affidavit sworn on a Sunday is not invalid Quakers, Moravians and Separatists were first privileged to make a solemn declaration or affirmation, and by the Common Law Procedure Act, 1852, and other statutes all persons prevented by religious belief from taking an oath were allowed to affirm; and, finally, by the Oaths Act, 1888, every person who objects to be sworn is allowed to affirm in all places and for all purposes where an oath is required by law. By an act of 1835 justices are permitted to take affidavits in any matter by declaration, and a person making a false affidavit in this way is liable to punishment. The same act prohibited justices of peace from administering oaths in any matter in which they had not jurisdiction as judges, except when an oath was specially authorized by statute, as in the bankruptcy law, and excepting criminal inquiries, parliamentary proceedings and instances where oaths are required to give validity to documents abroad. Scottish justices can act in England and *vice versa.* The Oaths Act, 1888, and the Commissioner of Oaths Act, 1889, consolidated all previous enactments relating to oaths and gave the lord chancellor power to appoint commissioners for oaths to take affidavits for all purposes (*see* OATH).

In the United States affidavit has the same meaning as in England and its general uses are the same, but it is not substituted for oral evidence in court to anything like the extent to which that is done in the English courts of chancery. The statutes of each State designate the persons before whom affidavits may be made outside the State, and special commissioners are appointed for that purpose by each State. Affidavits made abroad must be made before such commissioners or persons so designated, who are usually diplomatic and consular officials, justices, notaries public or mayors.

AFFILIATION, in law, the procedure by which the paternity of a bastard child is determined, and the obligation of contributing to its support enforced. In England a number of statutes on the subject have been passed, the chief being the Bastardy Act of 1845, the Bastardy Laws Amendment Acts of 1872 and 1873, the

Affiliation Orders Act, 1914, the Affiliation Orders Act, 1918, and the Bastardy Act, 1923. The mother of a bastard may summon the putative father to petty sessions within 12 months of the birth (or at any later time if he is proved to have contributed to the child's support or ceased to reside in England within 12 months after the birth), and the justices, after hearing evidence on both sides, may, if the mother's evidence be corroborated in some material particular, adjudge the man to be the putative father of the child, and order him to pay a sum not exceeding 20 shillings a week for its maintenance, together with a sum for expenses incidental to the birth, or the funeral expenses, if it has died before the date of order, and the costs of the proceedings. An order ceases to be valid after the child reaches the age of 13, except as regards arrears, but the justices may in the order direct the payments to be continued until the child is 16 years of age. An appeal to quarter sessions is open to both the mother and the defendant, and a further appeal on questions of law to the King's Bench. Should the child afterwards become chargeable to the parish, the sum due by the father may be received by the relieving officer. When a bastard child whose mother has not obtained an order, becomes chargeable to the parish, the guardians may proceed against the putative father for a contribution, and such an order may be varied and continued in favour of the mother or person having custody of the child. Any woman who is single, a widow, or a married woman living apart from her husband, may make an application for a summons. The Bastardy Act, 1872, makes due provision for the enforcement of an order of affiliation, and commitment is governed by the Summary Jurisdiction Act, 1879, and the Criminal Justice Act, 1914. In the case of soldiers an affiliation order cannot be enforced in the usual way, but by the Army Act 1881, as amended in 1883, 1891, 1904 and 1915, if an order has been made against a soldier of the regular forces, a portion of the soldier's pay may be retained There is similar legislation with regard to sailors in the Royal Navy, by the Naval Discipline Act, 1915.

It having been found in practice that affiliation orders became ineffective owing to the unwillingness or inability of the mother to make continual appearances before the justices, under the Affiliation Orders Act, 1914, collecting officers may be appointed

In the United States the father is primarily responsible for the support of a bastard child The mother is responsible in the event of the father's death

In the British colonies there is some procedure (usually termed filiation) akin to that described above, by means of which a mother can obtain a contribution to the support of her illegitimate child from the putative father. On the continent of Europe, however, the legislation of the various countries differs rather widely. (*See* ADOPTION; also BASTARD, POOR LAWS)

BIBLIOGRAPHY.—Saunders, *Law and Practice of Orders of Affiliation* (1915); G. Lushington, *Law of Affiliation and Bastardy* (1923); J. B Little, *Poor Law Statutes* (1901–02).

AFFINE GEOMETRY. An affine geometry, as distinguished from a projective geometry, involves a definition of parallelism. Thus, when from the definitions and theorems of the ordinary euclidean geometry of the plane all those involving euclidean measurement of length and angle are eliminated, the residue is an affine geometry. In this case the line at infinity is unique, in that any two lines meeting in a point of the former are parallel. In the projective geometry of the plane there is no such preferred line; when any line is designated as preferred in this sense, we have a corresponding affine geometry. For example, in affine geometry there is a distinction between an ellipse, a parabola and a hyperbola, but not in projective geometry; moreover, only when the geometry is metrical is there a distinction between circles and ellipses.

The euclidean affine geometry is given analytic form by means of coordinates x and y referred to two intersecting lines of the plane in the usual manner. In this case the equations

$$\begin{aligned} x_1 &= a_{11}x + a_{12}y + a_1, \\ y_1 &= a_{21}x + a_{22}y + a_2, \end{aligned} \tag{1}$$

where the a's are arbitrary constants subject to the condition $a_{11}a_{22} - a_{12}a_{21} \neq 0$, define the most general transformation of points of the plane among themselves which transforms parallel lines into parallel lines. Such a transformation is called *affine*. The transformations (1) form a group, and we may say, following Klein, that the body of definitions and theorems expressing properties of quantities invariant under this group is an affine geometry. If $x', y'; x'', y''; x''', y'''$ are the coordinates of three non-collinear points, the quantity

$$\begin{vmatrix} x' & y' & 1 \\ x'' & y'' & 1 \\ x''' & y''' & 1 \end{vmatrix} \tag{2}$$

is invariant under transformations (1) for which $a_{11}a_{22} - a_{12}a_{21} = 1$. These transformations are called *equiaffine*. There is a considerable body of theorems concerning properties of plane curves which remain invariant under equiaffine transformations. In particular, there is a metric theory based upon a certain invariant of the type (2) associated with a curve.

The foregoing concepts are readily generalized to spaces of higher order. Thus there is for spaces of three dimensions a theory of curves and surfaces analogous in many respects to the theory for euclidean space of three dimensions. The developments of these ideas have been made by many geometers, notably Klein, Mobius, Sylvester and lately by Blaschke and Pick.

Any n independent variables x_i, where i takes the values 1 to n, may be thought of as the coordinates of a general n-dimensional space, or variety, in the sense that each set of values of the x's defines a point. In a space thus defined there is not a basis for the comparison of directions at different points. Such a basis is provided when a definition of parallelism is added. In Riemannian geometry we say, following Levi-Cività, that at points of a curve, defined by $x_i = f_i(t)$, $(i = 1, \cdots, n)$, a set of functions ξ^i of t satisfying the system of equations

$$\begin{aligned} &\xi^i\left(\frac{d\xi^j}{dt} + \sum_{k,l}^{1,n} \Gamma^j_{kl}\,\xi^k \frac{dx_l}{dt}\right) \\ &-\xi^j\left(\frac{d\xi^i}{dt} + \sum_{k,l}^{1,n} \Gamma^i_{kl}\,\xi^k \frac{dx_l}{dt}\right) = 0 \quad (i, j = 1, \cdots, n) \end{aligned} \tag{3}$$

are the components of a family of vectors parallel with respect to the curve; in this case Γ^i_{jk} are functions of the x's determined by the metric of the space (*see* RIEMANNIAN GEOMETRY) As thus defined, parallelism is relative to a curve, and not absolute, as in euclidean space. If the Γ's in (3) are taken as n^3 arbitrary functions of the x's, equations (3) may be taken as the definition of parallelism for a general V_n, thus generalizing Levi-Cività's concept of parallelism for spaces with a Riemannian metric. In this case we say that the space is *affinely connected*, following Weyl; the Γ's are called the coefficients of the affine connection.

When $\Gamma^i_{jk} = \Gamma^i_{kj}$, the connection is called *symmetric*, otherwise *asymmetric*. When, and only when, the connection is symmetric, there exist preferred coordinate systems, with a given point as origin, with respect to which corresponding components of a vector at the given point and of a parallel one at a nearby point are the same. When the connection is asymmetric, there are other connections giving an equivalent definition of parallelism; the definition is unique for symmetric connections.

The fundamental curves of an affinely connected space are those whose tangents are parallel with respect to the curves; *i.e.*, they are the straight lines of the space. They are the integral curves of the differential equations obtained when $\xi^i = dx_i/dt$ in (3). Some writers call them the *paths* of the space, others *geodesics*, since they are the generalizations of the geodesics of Riemannian spaces. There are many affine connections with the same paths, so that the theorems dealing with the paths and not with a particular affine connection constitute a projective geometry. A theory of affinely connected spaces, in many respects analogous to Riemannian geometry, has been developed recently, notably by Cartan, Eddington, Einstein, Schouten, Joseph M. Thomas, Tracy Y. Thomas, Veblen and Weyl.

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sungen uber Differential Geometrie, vol. ii. (1923); J. A. Schouten, *Der Ricci-Kalkul* (1924), L. P. Eisenhart, "Non-Riemannian Geometry," *American Mathematical Society* (1927), O. Veblen, "Invariants of Quadratic Differential Forms," *Cambridge Tracts in Mathematics* (1927). (L. P. E.)

AFFINITY, in law, as distinguished from consanguinity (*q.v.*), the term applied to the relation which each party to a marriage, the husband and wife, bears to the kindred of the other. Affinity is usually described as of three kinds: (1) *direct*, that relationship which subsists between the husband and his wife's relations by blood or between the wife and the husband's relations by blood. The marriage having made them one person, the blood relations of each are held as related by affinity in the same degree to the one spouse as by consanguinity to the other But the relation is only with the married parties themselves, and does not bring those in affinity with them in affinity with each other; so a wife's sister has no affinity to her husband's brother. This is (2) *secondary* affinity. (3) *Collateral* affinity is the relationship subsisting between the husband and the relations of his wife's relations (*See* CONSANGUINITY; MARRIAGE)

AFFINITY, CHEMICAL, the property or relation in virtue of which substances are capable of entering into chemical combination with each other. (*See* CHEMISTRY; CHEMICAL ACTION; VALENCY.)

AFFIRMATION, the declaration that something is true; in logic, a positive judgment, the union of the subject and predicate of a proposition; particularly, in law, the solemn declaration allowed to those who conscientiously object to taking an oath (*see* OATH).

AFFORESTATION: *see* FORESTRY.

AFFRAY is the misdemeanour of breaking the peace in public to the terror of the king's subjects Fighting in public is an affray, but no actual violence is necessary, and the offence is committed even where a man arms himself with weapons so as to cause terror to the public. Abusive and threatening words alone will not amount to an affray. In 1903 at the Carnarvon assizes before Mr. Justice Wills a conviction was obtained in *Rex* v *Meade* where the accused went about armed and discharged a loaded revolver in a public street. He was also indicted under a statute of 1328 (2 Edw. III. *c.* 3) (*See* also RIOT)

In the United States the English common law as to affray applies, subject to certain modifications by the statutes of particular States (Bishop, *Amer. Crim. Law*, 9th ed., 1923, vol i § 535). The Indian penal code (§159) adopts the English definition of affray, with the substitution of "actual disturbance of the peace" for "causing terror to the lieges"

AFFRE, DENIS AUGUSTE (1793–1848), archbishop of Paris, was born at Saint-Rome-de-Tarn, on Sept. 27 1793 He became archbishop of Paris in 1840 His episcopate is chiefly remembered for its tragic close. During the riots of June 23–26, 1848, the archbishop mounted a barricade in the Faubourg St Antoine bearing a green branch as a sign of his desire for peace, and was hit by a stray bullet. He was the author of an *Essai sur les hiéroglyphes égyptiens* (1834) criticizing Champollion's system

See Ricard, *Les grands évêques de l'église de France au XIXe siècle* (Lille, 1893), L. Alazard, *Denis-Auguste Affre, archévêque de Paris* (Paris, 1905).

AFFREIGHTMENT. Payment for the carriage of goods by water, more especially by sea, is called freight, and a bargain made between the carrier and the person whose goods are to be so carried is called a contract of affreightment. The law does not require that a contract of this kind shall be made in writing, but usually it is expressed in that form. The terms on which goods are carried by sea are, except in coasting trade, ordinarily expressed in a charter-party or a bill of lading or both. The former may be shortly described as a contract between a shipowner and a merchant for the hire or use of a ship, and the latter as a receipt for goods, stating the terms on which they are delivered to and received by a ship. A charter-party usually relates to the full cargo of a ship, and a bill of lading may do the same, but it is more often given with reference to a particular parcel of goods.

Terms Implied by Law.—The parties to a contract of affreightment are assumed by law (unless the contract expressly negatives or qualifies the assumption) to have dealt with each other on the footing of certain obligations included among the terms of contract In the unusual case of no terms being expressly agreed, the implied terms alone would regulate the relations of the parties In the common case of terms being expressly agreed, the implied terms are included, subject to any modification of them specifically and explicitly made by the express terms. It should be mentioned in passing that, where the goods are carried under bills of lading, certain terms are by statute (as explained below) included in the contract which the parties are not free to exclude even if they wish.

Subject then to any modification made by the contract, a person who for payment carries goods by sea is under an implied obligation to exercise due care and diligence Except possibly in a case where the sea carrier is not a common carrier (*i.e.*, where he does not profess himself ready to carry goods for everybody) he has a further degree of responsibility, in that he is liable for every accident, unless caused by act of God, or of the king's enemies, or by inherent defect of the goods themselves, or by their having been sacrificed for the general safety. He also impliedly undertakes absolutely that the ship is seaworthy at the beginning of the voyage, and that he will proceed on the voyage with reasonable dispatch, and without unnecessary deviation Seaworthy has a special meaning as explained later The carrier may in some circumstances be entitled to claim statutory limitation of the amount of his liability.

On the part of the shipper an undertaking is implied not to ship dangerous goods without notice, and he or the person entitled to take delivery of the goods is impliedly under obligation (1) to be prepared, without notice from the carrier, to take delivery within a reasonable time after the arrival of the ship at the place of delivery, and (2) to pay freight and general average contribution (if any) before he can claim delivery of the goods In some circumstances where performance of the contract becomes impossible the parties may be released from performance under terms deemed to be implied in the contract

Parties to the Contract.—As already mentioned, the terms of contract are ordinarily expressed in a charter-party (shortly, a charter) or a bill of lading, or both. A bill of lading may be more fully described as "a receipt for goods shipped on board a ship, signed by the person who contracts to carry them, or his agent, and stating the terms on which the goods were delivered to and received by the ship It is not the contract, for that has been made before the bill of lading was signed and delivered, but it is excellent evidence of the terms of the contract" (Scrutton) Usually the printed form of the particular carrier is filled up in writing and signed by the captain, broker or other agent of the carrier, and the terms of the contract made or deemed to have been made before the bill of lading was given are thus reduced to documentary form Though in form a receipt, a bill of lading is also a transferable document of title representing the goods to which it relates.

Where the contract is between a shipper and a carrier who is himself the shipowner the bill of lading binds the shipowner In the case of a chartered ship—*i.e.*, a ship hired by a charterer—the bill of lading may, according to the circumstances, bind the shipowner or the charterer. Charters are varied in form. Under some, where the shipowner parts with the whole possession and control of the ship (so that the charter amounts to a demise, a form rare in modern practice) the contract would be between the shipper and the charterer. Under other charters the charterer may merely undertake that a full cargo shall be shipped and guarantee payment of a certain freight. There the contract would be between shipper and shipowner. Where, in intermediate cases, the shipper is a person other than the charterer, the bill of lading may, according to the terms of the charter, bind the shipowner or the charterer.

Charter-parties.—Charters (apart from the unusual form amounting to a demise of the ship) are entered into for a voyage (or series of voyages) or for a period of time. A voyage charter

commonly provides that the ship, as described, shall proceed to a named place, and there load a cargo, and shall then proceed to a named place of discharge, where the cargo is to be delivered Freight is to be paid in a lump sum, or at a rate named on the cargo carried, or calculated in some other way. The number of days within which the charterers are to load and discharge (called lay days) is specified, and also a rate for demurrage should the ship be longer detained, with provisions to apply in the event of stoppages occurring "Days" in a charter is understood to mean calendar days of 24 hours commencing at midnight. Sundays and holidays are included unless expressly excepted. "Working days" means all days on which work is ordinarily done at the port, excluding Sundays and holidays. Provisions as to time are frequently expressed in hours instead of days. Further clauses deal with issue of bills of lading, exceptions from liability, discharge of cargo, payment of freight, general average, ceasing of charterer's liability, brokerage, etc

By a time charter the ship is hired to the charterers for a specified time, commencing on a certain date, when the ship is to be placed at the disposal of the charterers, at some specified place, or place to be named, to be employed in lawful trades between certain limits The clauses deal with various matters in connection with the employment of the ship, such as payments for stores, provisions, wages, insurance, fuel, port and other charges, the appointment and giving of directions to the master of the ship, stevedoring, exceptions from shipowner's liability, arbitration, etc. A number of common forms of charter are in use containing clauses adjusted to the requirements and conditions of particular trades

In determining the effect to be given to a charter it may be necessary to take into consideration along with its express terms other terms which, as already explained, are implied by law. Thus if a charter contains no express provision as to seaworthiness there is underlying the contract, and implied and involved in it, a warranty by the shipowner that the ship is seaworthy The special meaning attached to this word is that the ship shall have that degree of fitness which an ordinarily careful and prudent owner would require his ship to have at the commencement of her voyage, having regard to all the probable circumstances of it. Not only must the ship be tight, staunch and strong, but also fit for the carriage of the particular kind of cargo to be carried This implied absolute warranty of seaworthiness is fulfilled if the ship is seaworthy when she leaves her moorings, and does not include any undertaking that the ship shall continue seaworthy; but where the voyage is in stages the ship must be fit for each stage when entered upon

There may also have to be taken into consideration, in construing a charter, trade usages or customs with reference to which the parties are presumed to have made their contract The express terms often refer to custom (which in a charter means a settled and established practice of the port) and they may be explained by evidence of usage or custom short of alleging anything inconsistent with them. For example, stipulations as to loading or discharging cargo in a port may be thus construed Evidence of custom may be given to explain the meaning of working day at the port.

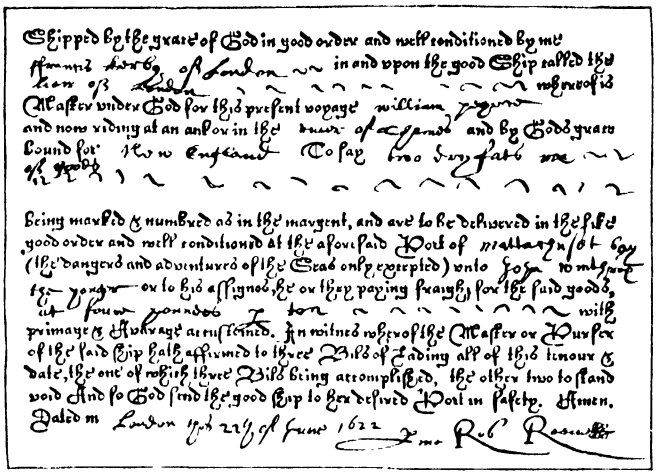
When a ship has reached the place where (under a voyage charter) she is to be ready to load, and is ready to load, and the charterers have been notified of this, the ship is an arrived ship and the lay days (for loading) begin to run.

Subject to any express or implied qualification, a charterer undertakes absolutely to furnish a cargo. When he fails to furnish a full cargo the damages which the shipowner is entitled to recover for this breach of contract are called dead freight It is the duty of the master of the ship on behalf of the owner to receive and properly stow on board the cargo to be carried, which ordinarily is to be delivered to him alongside, but this duty may be subject to modification by custom or contract.

Should a ship be detained beyond the lay days the charterer will become liable to pay for the detention. If the basis for payment has been agreed by the charter the payment is known as demurrage. If it has not been agreed or if the charter refers to a fixed number of demurrage days which has been exceeded, then the payment, or part of it, will be damages for detention, the rate of which may have to be ascertained and may be different from the demurrage rate.

A common provision in a charter is the cesser clause, which is to the effect that the charterer's liability shall cease on the shipment of the cargo to the extent to which the charter gives the shipowner a lien. Under common law the shipowner's lien on the cargo is in respect only of freight and general average contributions. The cesser clause ordinarily confirms this, and, in addition, gives a lien for demurrage, and sometimes also for dead freight.

Bills of Lading.—Though either a charter or a bill of lading or both together may express the terms of a contract, the trans-



BY COURTESY OF MASSACHUSETTS HISTORICAL SOCIETY

FACSIMILE OF A BILL OF LADING DATED JUNE, 1622, COVERING A SHIPMENT FROM LONDON, ENGLAND, TO PLYMOUTH, MASSACHUSETTS

actions in which no bill of lading is issued are few, because the bill of lading, in addition to its primary purpose of expressing terms of contract, serves in commerce as a transferable document of title representing the goods to which it relates. Where the charterer is also the shipper, the bill of lading, as between shipowner and charterer, is regarded as no more than a receipt which does not alter the contract contained in the charter It is merely a receipt until used by the charterer as a transferable document of title, *i e* , until negotiated Where the shipper is a person other than the charterer, the bill of lading is the evidence of the contract and does not, except by plain words, incorporate or impose on the shipper the obligations of the charter. Where the shipper (whether he is the charterer or not) has indorsed the bill of lading to a holder for value, the bill of lading is the only evidence of the contract

Apart from statutory limitations on freedom of contract presently to be referred to, a common form of bill of lading (as set out in Carver, *Carriage of Goods by Sea*), was as follows:—

"Shipped, in good order and condition, by , in and upon the good ship called the , whereof is master for this present voyage, now riding at anchor in the port of , and bound for (*description of goods*) marked and numbered as in the margin, and are to be delivered in the like good order and condition at aforesaid (the act of God, the king's enemies, fire, and all and every other dangers and accidents of the seas, rivers, and navigation of whatever nature and kind soever excepted), unto , or to his assigns, he or they paying freight for the said goods at the rate of , with primage and average accustomed. In witness whereof, the master or agent of the said ship hath affirmed to bills of lading, all of this tenor and date, the one of which bills being accomplished the others to stand void

"Dated in the day of . . . . . .

"(Signed) . . ."

Many "negligence clauses" (exceptions from liability formerly inserted to protect sea carriers) have disappeared from bills of lading as a result of legislation. In the United States the Harter Act was passed in 1893. It requires the exercise of due diligence properly to equip the ship and make it seaworthy, and, subject to this being done, gives exemption from navigation risks as distinguished from carrier's risks which the act compulsorily imposes on the carrier by prohibiting the insertion in any bill of lading or shipping document of any clause whereby obligations carefully to handle and stow the cargo and to care for and deliver the same may be lessened, weakened or avoided. Similar legislation was afterwards passed by some of the British dominions

More recent legislation has attempted to define by its express terms the liabilities as well as the immunities of the carrier. The Carriage of Goods by Sea Act, 1924, was formulated in this way. Scheduled to it is a series of rules which are in effect standard clauses to be deemed part of the terms of bills of lading. This act is applicable to these documents when issued in Great Britain or Northern Ireland. Similar legislation has been passed in Australia, India and certain British colonies.

The Carriage of Goods by Sea Act requires that (subject to limited exceptions) the bill of lading shall expressly incorporate as part of its terms the provisions of the rules scheduled to the act. These impose on the carrier an irreducible minimum of responsibility for the safe carriage of the goods.

Though the Act thus defines the carrier's liabilities, it does not (except in the case of the implied absolute undertaking to provide a seaworthy ship) expressly exclude the implied obligations referred to above. Though an alternative basis of liability is expressly laid down, the question apparently might arise whether those obligations (other than that of seaworthiness) still exist underlying the contract and implied and involved in it. In any event the compulsory minimum of responsibility is a protection to third persons (such as endorsees or bankers) who, though not parties to the contract, may be affected by its terms, as well as to shippers. In practice, the extent of the carrier's liabilities will be reduced if the courts maintain their attitude of interpreting widely the exceptions from responsibility contained in article IV., rule 2.

Under the form of bill of lading set out above the goods are to be delivered to a named person "or to his assigns." A document in this form is by English law a negotiable instrument, in the sense that it is transferable by indorsement and delivery. A bill of lading may be indorsed by the person named in it (the shipper or the consignee) either in blank, by a simple signature on the back, or specially by indorsing and signing a direction to deliver to some other person or order The indorsee may then transfer by indorsing in blank or specially. If indorsed in blank, or made out to a name left blank, or to bearer, a bill may be dealt with by mere delivery.

The indorsement and delivery of a bill of lading transfers such property as it was the intention of the parties to the indorsement to transfer, and, by the Bills of Lading Act, 1855, also transfers to the indorsee, to whom the property in the goods passes, the rights and liabilities of the shipper under the bill of lading. A pledgee is however not an indorsee to whom the property passes, and does not incur liabilities unless he takes delivery of the goods.

Performance of the Contract.—Reference has already been made to the implied undertakings by the carrier that he will proceed on the voyage with reasonable dispatch and without unnecessary deviation, and to the doubt whether these obligations still underlie the contract where a bill of lading has been issued subject to the statutory rules

To complete the voyage the sea carrier should, if necessary, repair the ship, or tranship the cargo in order that it may be forwarded to its destination.

If necessary for the common safety a shipmaster may jettison cargo properly stowed. Any such extraordinary sacrifice or expenditure intentionally and reasonably made or incurred for the common safety, for the purpose of preserving from peril the property involved in a common maritime adventure, is a general average act. Damages, losses and expenses which are the direct consequence of a general average act are borne by ship, freight and cargo as contributing interests. The contributions are adjusted by a general average statement. If, as is commonly the case, the charter or bill of lading incorporates by reference the York-Antwerp Rules, 1924, the adjustment is made as provided by those rules. (*See* further as to this under AVERAGE.)

Should the contract prove impossible of performance owing to circumstances which were unforeseen, and to which no provision in the contract is applicable (in particular where circumstances arise from the occurrence of war or in some other way, involving such delay as to frustrate the commercial purpose of the adventure) the contract may be held by the court to have come to an end by virtue of a provision implied in it. Cases of this kind are, of course, quite different from those where the contract, when made, cannot be performed without breaking the law. It is then void from the beginning for illegality.

Under the contract the ship is bound to proceed (unless prevented by an excepted peril) to the agreed place of discharge. On the ship's arrival there the charterer or consignee is bound to take delivery Unless, under express provision, or by custom, notice of arrival is to be given, none is required. In the case of goods imported from abroad into Great Britain, if the owner of the goods fails to make entry of them at the Customs, or to take delivery, the goods may, under and subject to compliance with the provisions of the Merchant Shipping Act, 1894, sections 492-501, be landed and warehoused. Delivery should not be made except to a person producing a bill of lading making the goods deliverable to that person By custom bills of lading are made out in sets, usually of three copies, but the carrier is justified in delivering to the first person producing a bill of lading making the goods deliverable to him, if without notice or knowledge of anything making it wrong to do so.

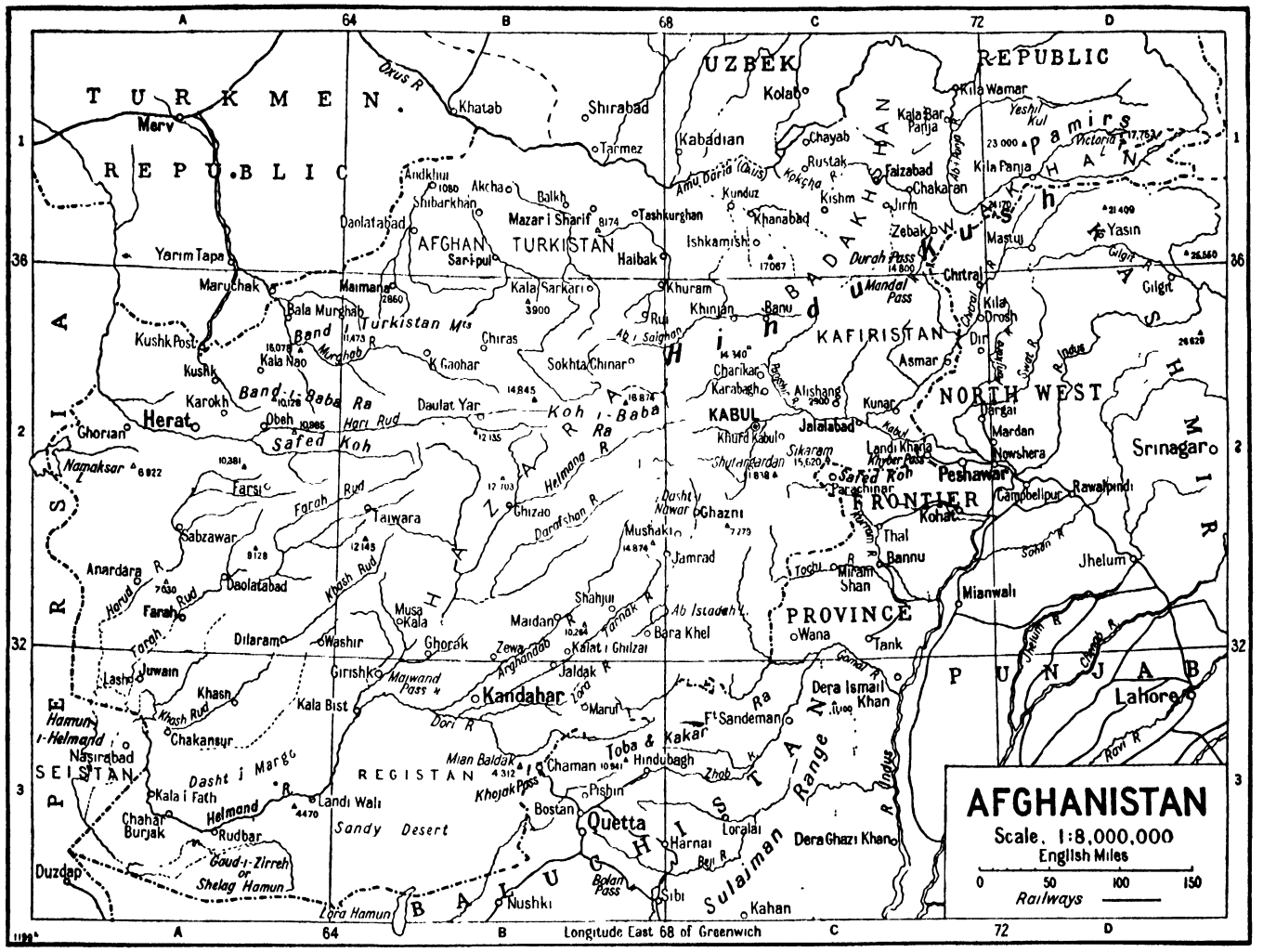
If goods are carried to the place where the voyage is to end, and, though damaged, are in a merchantable condition and ready for delivery, freight is payable. For delivery short of destination no freight is due unless the parties have taken steps justifying the conclusion that they intended to make a fresh contract whereby the owner of the goods has agreed to accept the goods at an intermediate port. English law in this respect differs from some continental laws under which proportional distance freight is payable. For short delivery at destination pro rata freight is payable. The carrier is entitled to a lien for freight payable on delivery. This is a possessory lien entitling him to withhold delivery until payment. It extends also to a general average contribution and to expenses incurred in the protection and preservation of the goods If expressly so provided by the contract, the lien may extend to other matters, *e.g.*, demurrage, damages for detention and dead freight.

See T. G. Carver, *Carriage of Goods by Sea* (1925); T. E. Scrutton, *Charter-parties and Bills of Lading* (1925). (S. D. C.)

AFFRETANDO (Ital.), a musical term having just the same significance as *accelerando, i.e.*, a quickening of the *tempo* or speed, but with a suggestion of hurry and agitation in addition.

AFGHANISTAN, a country of Asia. Estimated area is 245,000–270,000sq.m. (including Badakshan and Kafiristan). Pop. about 8,000,000. It is bounded on the north by Russian Turkistan, on the west by Persia, and on the east and south by Kashmir and the north-west frontier of India and Baluchistan. Surveys from 1872 to 1905 delimited the frontier which was accepted by Afghanistan in a treaty of 1921.

Boundaries.—From the town of Zulfikar on the Hari Rud river the boundary between Afghanistan and Russia is roughly parallel to the Paropamisus, and about 35m. N. of it, till it strikes the Kushk river in Jamshidi territory at a point once known as Chahil Dukteran, but now the Russian post Kushkinski, terminus of a branch railway from Merv. Kushkinski is about 20m. below the old Jamshidi settlement of Kushk, the capital of Badghis. From Kushkinski the boundary runs north-east, crossing the Murghab river near Maruchak (an Afghan fortress), and passing through the hills of the Chul, and the undulating deserts of the Aleli Turkmans, to the Oxus, leaving the valleys of Charshamba and of Andkhui (to which it runs approximately parallel) within Afghan


AFGHANISTAN
Scale, 1:8,000,000
English Miles
0 50 100 150
Railways
Longitude East 68 of Greenwich
TURKMEN. REPUBLIC
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AFGHAN TURKISTAN
KAFIRISTAN
NORTH WEST FRONTIER PROVINCE
PUNJAB
KASHMIR
BALUCHISTAN
SEISTAN
REGISTAN
Merv
Herat
Kandahar
Quetta
KABUL
Peshawar
Srinagar
Lahore
Hindu Kush
Sulaiman Range
Dasht i Margo
Sandy Desert
Koh i Baba Ra
Safed Koh
Turkistan Mts
Khyber Pass
Mandal Pass
Durah Pass
Khojak Pass
Bolan Pass
Helmand R.
Oxus R.
Indus R.
Jhelum R.
Chenab R.
Ravi R.
Kurram R.
Gomal R.
Zhob R.
Tochi R.
Kabul R.
Panjshir R.
Ghorian
Farah
Girishk
Lashkar Gah
Chakansur
Nasirabad
Kala i Fath
Chahar Burjak
Rudbar
Duzdap
Shelag Hamun
Hamun i Helmand
Lora Hamun
Chaman
Pishin
Bostan
Nushki
Sibi
Kahan
Loralai
Harnai
Dera Ghazi Khan
Dera Ismail Khan
Tank
Bannu
Kohat
Campbellpur
Rawalpindi
Jhelum
Mianwali
Srinagar
Gilgit
Chitral
Yarkand R.
Yeshil Kul
Victoria L.
Pamirs
Sarikol
Kila Panja
Kila Wamar
Kala Panja
Faizabad
Chakaran
Jirm
Zebak
Mastuj
Yasin
Kila Drosh
Dir
Asmar
Kunar
Jalalabad
Landi Khana
Mardan
Nowshera
Sikaram
Safed Koh
Paropamisus
Band i Baba Ra
Band i Turkistan
Band i Saighon
Band i Amir
Band i Murghab
Hari Rud
Farah Rud
Khash Rud
Harut Rud
Helmand R.
Arghandab R.
Tarnak R.
Dori R.
Lora R.
Zhob R.
Kokcha R.
Kishm R.
Khanabad
Kunduz
Ishkamish
Taloqan
Khwaja Salar
Andkhui
Akcha
Balkh
Shibarkhan
Daolatabad
Mazar i Sharif
Tashkurghan
Shirabad
Kolab
Chayab
Rustak
Tarmez
Khatab
Orus R.
Aq Saighon
Kokcha R.
Amu Darya (Oxus)
Yarim Tapa
Maruchak
Kushk Post
Kushk
Kala Nao
Karokh
Obeh
Ghoriam
Naqaksor
Farsi
Sabzawar
Anardara R.
Daolatabad
Farah
Taiwara
Ghorak
Dilaram
Washir
Juwain
Khash
Kala Bist
Maiwand
Kandahar
Maruf
Toba & Kakar
Ft Sandeman
Chaman
Hindubagh
Khojak Pass
Bostan
Quetta
Harnai
Loralai
Dera Ghazi Khan
Dera Ismail Khan
Tank
Bannu
Kohat
Campbellpur
Rawalpindi
Jhelum
Mianwali
Lahore
Srinagar
Gilgit
Chitral
Yasin
Mastuj
Zebak
Jirm
Chakaran
Faizabad
Kila Panja
Kila Wamar
Kala Panja
Yeshil Kul
Victoria L.
Pamirs
Sarikol

Kadanai to a point beyond the Sind-Peshin terminal station of New Chaman, west of the Khojak range, and then drops south to Shorawak and Nushki. From Nushki it crosses the Helmand desert, touching the crest of a well-defined watershed for a great part of the way and, leaving Chagai to Baluchistan, it strikes nearly west to the Persian frontier, and joins it on the Koh-i-Malik Siah mountain, south of Seistan.

Indefinite Limits.—Two important points upon this part of the Afghan boundary are notable. It leaves some of the most fanatical of the Durani Afghan people on the Baluch side of the frontier in the Toba district, north of the Quetta-Chaman line of railway; and it passes 50m. S. of the Helmand river, enclosing within Afghanistan the only approach to Seistan from India which is available during the seasons of Helmand overflow. Beyond these lagoons to Hashtadan it is still indefinite. The eastern limits of Hashtadan had been previously fixed as far north as the Hari Rud river at Toman Agha. From this point to Zulfikar the Hari Rud is itself the boundary. The Hindu Kush spreads fan-wise from a stem of great height (24,000ft) in the north-east The rays of the fan diminish in height to the north and south of a more or less central one called Koh-i-Baba, west of Kabul (greatest height 16,870ft) and the Safed Koh of western Afghanistan farther west. On the north-north-west are the deep defiles of the southern feeders of the Oxus, while the Murghab drains the north-western hills and loses itself in the wastes of Turkistan. The Hari Rud runs parallel to and north of the Koh-i-Baba and Safed Koh of the west, giving a site to Herat as it leaves the hills, and turns north to lose itself like the Murghab. The southward rays of the fan have rivers between them which reach through the desert of Registan to the lake-swamp of Seistan; the chief of these is the Helmand At the emergence of one of the feeders of the Helmand from the hills, above the desert, stands Kandahar, a focus for numerous valleys, and also related to the Bolan pass On the east the tremendous drop from Afghanistan to the Indus lowland has promoted the cutting of deep valleys, notably that of the Khyber pass on a feeder of the Kabul river, which has eaten back among the hill lines right to the Hindu Kush. The northern flank of the fan-mountains, on the west, is the Band-i-Turkistan, a sombre line overlooking the immense Chul, a loess area stretching away northwards to the Oxus.

The complexity of the Kabul river feeders is an important factor of the existence of the historic city of Kabul. From the city one may follow lines between the ridges southwards to Ghazni and to Kandahar, or the line of the Hari-Rud westwards to Herat, or one may go north over either the Hindu Kush (via the Unai pass) or Koh-i-Baba (via the pass of Irak) and so down the tremendous defiles of the Balkh river or one may skirt round the north-east of the Koh-i-Baba at a lower level via Charikar and the Shibar pass. By taking the last route one avoids getting more than 10,000 ft. above sea-level and this route is not often snowbound for long. It is the historic way. In the 19th century somewhat more direct ways from the Oxus to Kabul have been developed farther east. From Kabul into India one route much used in historic times left the Kabul river above Jalalabad and went north-east across the Kunar, thence into Bajaur and so via Malakand or some route near it into the Indian plains. The famous Khyber pass is entered beyond the fort of Jamrud, 11m. W. of Peshawar: it follows the Khyber stream up to Landi Kotal, debouching on to the Kabul river at Dakka whence the route goes along to Jalalabad, beyond which are alternative ways to Kabul. The Khyber pass is the part of the route between the entry to the mountains west of Jamrud and the emergence above at Landi Kotal and it lies within the North-West Frontier Province of India.

The Bara route farther south leads up into the heart of the Tirah country. The Kurram river route with the Peiwar (8,600ft.) and Shutargardan (10,800ft.) passes across the southern extensions of the Safed Koh (note the resemblance to the name of the range in western Afghanistan) is the next route southwards. The Tochi river route leads to Ghazni whence, in the days of its power, many raids were made upon the Indian plains. The Gomal river route has considerable commercial importance as it involves no very difficult pass though it is forced to leave the river because of very narrow precipitous defiles. From Kandahar a route skirts the ends of the hill lines to the frontier at Chaman whence it goes through the Kojak pass down to Kila Abdullah; it has considerable trade.

In spite of much work spread over many years some of the physical features of Afghanistan are still undetermined, the rugged nature of the country being a severe handicap to research.

Climate.—In the north the climate is extreme. In winter, waves of intense cold occur with temperatures ranging from −12° F. to 15° F., while in summer the shade temperature in the Oxus region may reach 110° or 120°F. For seven months of the year (May–November) the temperature-range exceeds 30°F. daily, this range being greater than that of the days in the cold season. In Kabul snow lies for two or three months and people stay indoors near the stoves. At Ghazni also snow lasts long and tradition tells of disastrous snowstorms Everywhere, however, summer heat is great, but this is especially the case all around Kandahar; this country in summer suffers from dust storms and snow rarely lies on the plains in winter. Herat has a strong north-west wind and relatively mild temperature throughout the summer and in winter the snow rarely lies long; but above Herat fierce winter cold prevails and the upper part of the Hari Rud river freezes, rapids and all

The south-west monsoon brings rain only to the valleys that lead down from Afghanistan to the Indus plains, the Kabul valley as far as Laghman, the eastern ends of the Safed Koh, of the east and the Kurram valley. It therefore does not bring rain to Afghanistan which gets much of its precipitation as winter snow and a small but very important contribution of rain in spring. Snow and spring rain come largely from the north-west and in winter the snow-winds are intensely cold. The atmosphere is dry and the brilliant sunshine of a large part of the year, with very bright clear nights also, is a feature.

Vegetation.—On the main ranges at 6,000 to 10,000 ft. grow large forest trees, among which conifers are most prominent, such as *Cedrus deodara, Abies excelsa, Pinus longifolia, P. pinaster, P. pinea* (the edible pine) and the larch. Yew, hazel, juniper, walnut, wild peach and almond are also found. Growing under the shade of these are several varieties of rose, honeysuckle, currant, gooseberry, hawthorn, rhododendron and luxuriant herbage, the Ranunculaceae being abundant and rich in genera. The lemon and wild vine are commonest on the northern mountains. The walnut and oak (evergreen, holly-leaved and kermes) descend to the secondary heights, where they become mixed with alder, ash, khinjak, *Arbor-vitae,* juniper, *Indigoferae* and dwarf laburnum, with species of *Astragalus,* etc. Lower again and down to 3,000ft. grow wild olive, species of rock-rose, wild privet, acacias and mimosas, barberry and *Zizyphus;* and, in places, *Chamaerops humilis* (which is applied to a variety of useful purposes), *Bignonia* or trumpet flower, sissu, *Salvadora persica,* verbena, acanthus, varieties of *Gesnerae.* The lowest terminal ridges, especially towards the west, are naked in aspect. Their scanty vegetation is almost wholly herbal; shrubs are only occasional; trees almost non-existent. Labiate composite and umbelliferous plants are most common. Ferns and mosses are almost confined to the higher ranges. On the dreary Kandahar table-lands grow many vigorous plants, such as papilionaceous *Leguminosae,* and the camel-thorn (*Hedysarum Alhagi*), *Astragalus* in several varieties, spiny rest-harrow (*Ononis spinosa*), the fibrous roots of which often serve as a tooth-brush; plants of the sub-family *Mimosae,* such as the sensitive mimosa; a plant of the rue family, called by the natives *lipâd;* the common wormwood; also certain orchids, and several species of *Salsola.* Rue and wormwood give domestic medicines—the former for rheumatism and neuralgia; the latter for fever, debility and dyspepsia, as well as for a vermifuge. The *lipâd,* of heavy nauseous odour, is believed to keep off evil spirits. On some sides and hollows of ravines are found rose-bay (*Nerium Oleander*), called in Persian *khar-zarah,* or ass-bane, wild laburnum and various *Indigoferae.*

The chief cultivated trees are mulberry, willow, poplar, ash, and occasionally the plane.

Of commercial value is the gum-resin of *Narthex asafetida* of the high and dry plains of western Afghanistan, especially between

Kandahar and Herat. The Kakar clan collects this gum-resin; and the depot is Kandahar, whence it finds its way to India, for use as a condiment. It is not used in Afghanistan, but the Seistan people eat the green stalks preserved in brine. In the highlands of Kabul edible wild rhubarb is an important local luxury. The bleached rhubarb, which has a very delicate flavour, is obtained by covering the young leaves as they sprout with loose stones or an empty jar. Leaf-stalks are gathered and carried down for sale. Bleached and unbleached rhubarb are both largely consumed, both raw and cooked. Walnut and edible pine-nut are both wild growths, which are exported. The *sanjît* (*Elaeagnus orientalis*), common on the banks of watercourses, furnishes an edible fruit The dried tuber of a mountain orchis affords the nutritious mucilage called *salep;* a good deal of this goes to India. *Pistacia khinjak* affords a mastic. The fruit, mixed with its resin, is used for food by the Achakzais in southern Afghanistan. The true pistachio is found only on the northern frontier; the nuts are imported from Badakhshan and Kunduz. Mushrooms and other fungi are largely used as food, especially by town Hindus as a substitute for meat. Manna, of at least two kinds, is sold in the bazaars One, called *turanjbîn,* appears to exude, in small round tears, from the camel-thorn, and also from the dwarf tamarisk; the other, *sir-kasht,* in large grains and irregular masses or cakes with bits of twig imbedded, is obtained from a tree which the natives call *siah chob* (black wood), thought by Bellew to be a *Fraxinus* or *Ornus.*

Agriculture.—In most parts of the country there are two harvests, as generally in India. One of these, called by the Afghans *bahârak,* or the spring crop, is sown in the end of autumn and reaped in summer. It consists of wheat, barley and a variety of lentils. The other, called *pâizah* or *tirmâi,* the autumnal, is sown in the end of spring and reaped in autumn. It consists of rice, varieties of millet and sorghum, of maize, *Phaseolus mungo,* tobacco, beet, turnips, etc. The loftier regions have but one harvest. Wheat is the staple food; rice is not largely distributed. In the eastern mountains *bâjra* (*Holcus spicatus*) is the chief grain Most English and Indian garden-stuffs are cultivated, turnips in some places very largely, as cattle food. The growing of melons, watermelons and other cucurbitaceous plants is very important near towns Sugar-cane is grown only in the rich plains; and though cotton is grown in the warmer tracts, most of the cotton cloth is imported.

Madder is part of the spring crop near Ghazni and Kandahar and in the west and supplies the Indian demand. It is said to be very profitable, though it takes three years to mature. Saffron is grown and exported. The castor-oil plant furnishes most of the oil of the country. Tobacco is very general; that of Kandahar is exported to India and Bokhara. Two crops of leaves are taken

Lucerne and a trefoil called *shaftal* form important fodder crops in the west, and, when irrigated, are said to afford ten or 12 cuttings in the season. The *komal* (*Prangos pabularia*) is abundant in the hill country of Ghazni, and is said to extend through the Hazara country to Herat. It is stored for winter fodder. Others are derived from the *Holcus sorghum,* and from two kinds of panick. It is common to cut down the green wheat and barley before the ear forms, for fodder, and the repetition of this, with barley at least, is said not to injure the grain crop. Bellew gives the following statement of the manner in which the soil is sometimes worked in the Kandahar district:—Barley is sown in November; in March and April it is twice cut for fodder; in June the grain is reaped, the ground is ploughed and manured and sown with tobacco, which yields two cuttings. The ground is then prepared for carrots and turnips, which are gathered in November or December.

European fruits are of many varieties and excellent quality. Fresh or preserved, they form a principal food of a large class of the people, and the dry fruit is largely exported. In the valleys of Kabul mulberries are dried, and packed in skins for winter use. This mulberry cake is often reduced to flour, forming in some valleys the staple food. Vines are sometimes trained on trellises, but most frequently over ridges of earth 8 or 10ft. high; the produce round Kandahar must be enormous.

Open canals are usual in the Kabul valley, and in eastern Afghanistan generally; but in the west much use is made of the *karez,* a subterranean aqueduct uniting waters of several springs and conducting their combined volume to the surface at a lower level.

Wild mammals include the tiger in the north, the common leopard and other cats, wolves, jackals, foxes and hyenas among the dog tribe, goats, wild sheep, gazelles, deer, Himalayan varieties of markhor and ibex, wild hogs, wild asses (*Equus onager*). Afghanistan seems to furnish a retreat for the breeding season for many Indian and perhaps some African birds, while in winter its bird life is akin to that of lands farther north

Of domestic animals, the one-humped camel is cared for and is a stronger breed than the taller one used in India. The two-humped camel is used in the north. The yabu, an indigenous horse, is strong and heavy-shouldered and about 14 hands high; it cannot do fast work nor stand great heat. The breed was improved by Abdur Rahman and those bred in the north are exported to India. Humped cows are kept for milk in the south and south-west, pressed and dried curd being largely eaten, it is said to be a Mongol introduction. Fat-tailed indigenous sheep are either white or russet; the white fleeces are exported to Persia and to Europe via Bombay Mutton salted and dried in the sun is one of the chief foods of the nomad people who also use beef and camel's flesh in the same way. Goats and dogs (pointers and greyhounds) are also noteworthy.

Minerals.—A little gold is taken from the streams in Laghman and the adjoining districts. Famous silver mines were formerly worked near the head of the Panjshir valley in Hindu Kush. Kabul gets iron from the Permuli (or Farmuli) district, between the Upper Kurram and Gomal. Iron ore is most abundant near the passes leading to Bamian, and in other parts of Hindu Kush. Copper ore from various parts of Afghanistan has been seen, but it is nowhere worked Lead is found in Upper Bangash (Kurram district), and in the Shinwari country, also among the branches of the Safed Koh of eastern Afghanistan and in the Kakar country. There are reported to be rich lead mines near Herat scarcely worked. Lead, with antimony, is found near the Arghandab, 32m. N.W. of Ghazni, and in the Ghorband valley, north of Kabul. Most of the lead used, however, comes from the Hazara country, where the ore is described as being gathered on the surface. A large and elaborate ancient mine exists at Feringal, in the Ghorband valley. Antimony is obtained at Shah-Maksud, about 30m. N. of Kandahar. Sulphur is said to be found at Herat, dug from the soil in small fragments, but the chief supply comes from the Hazara country and from Pirkisri, on the confines of Seistan, where there would seem to be a crater, or fumarole. Sal-ammoniac is brought from the same place. Gypsum is found in large quantities in the plain of Kandahar, being dug out in fragile coralline masses from near the surface. Coal (perhaps lignite) is found at least in the Ghorband valley and near the Khurd Kabul pass. Nitre abounds in the soil over all the south-west of Afghanistan, and often affects the water of the karez or subterranean canals. Rubies, turquoises and first-quality lapis lazuli come from Badakshan. This last material, especially, is smuggled to the north.

People.—The term Afghan really applies to one section only of the people, but this is the dominant section known as the Durani. The Ghilzai (almost as powerful as the Durani) claim to be of Turkish origin; the Hazaras, the Chahar-Aimak, Tajiks, Uzbegs, Kafirs and others are more or less subject races. Popularly any inhabitant of Afghanistan is known as Afghan on the Indian frontier without distinction of origin or language; but the language division between the Parsiwan (or Persian-speaking Afghan) and the Pathan of the Indian frontier is a very distinct one. The predominance of the Afghan in Afghanistan dates from the mid-18th century, when Ahmad Shah carved out Afghanistan from the previous conquests of Nadir Shah and called it the Durani empire.

The Durani Afghans claim to be Ben-i-Israel, and insist on their descent from tribes carried away captive from Palestine to Media by Nebuchadrezzar. Yet they also claim to be Pukhtun (or Pathan) in common with all other Pushtu-speaking tribes, whom they

do not admit to be Afghan. The bond of affinity between the various peoples who compose the Pathan community is simply the bond of a common language. All of them recognize a common code or unwritten law called Pukhtunwali, which appears to be similar in general character to the old Hebraic law, though modified by Mohammedan ordinances, and strangely similar in some points to Rajput custom. Besides their division into clans and tribes, the whole Afghan people may be divided into dwellers in tents and dwellers in houses; and this division is apparently not coincident with tribal divisions, for of several of the great clans at least a part is nomad and a part settled. Such is the case with the Durani and with the Ghilzai.

Dominant Stock.—Afghans have fine figures, aquiline profiles, fair complexions, and a small group yielded an average cephalic index of 74·8, a value nearer to that found among Rajputs in India than to that among the Pukhtun (Pathan) groups (av. ceph ind. 80–83) of the Indian frontier or to that among some of the subject peoples. Among the latter, the Hazaras are tall, very broad-headed (average cephalic index 85·0), and akin in feature to peoples of parts of Turkistan and Mongolia; they are said to have been planted in Afghanistan by Jenghiz Khan and they inhabit especially the mountains west of Kabul The Tajiks are as broad-headed as the Hazaras but belong to the pale rosy-skinned rather than to the yellow-skinned stock; they seem to be an old established, settled, agricultural people.

Tribal law, with the custom of hospitality, and the vendetta in many forms are rules of life, and even the settled Afghan is very much a soldier. They are able to endure great privation and are sober and stern, and may often become cruel. They have long been free of law and have looked upon taxation as interference to be resisted by force, but now the "modernization" of Afghanistan is said to be proceeding apace.

The cultivators, including owners, tenants, labourers and slaves, are skilled irrigators, utilizing every fragment of profitable land; some of the Ghilzai are specially skilled in building underground water-channels (*karez*). The settled folk live chiefly in village communities and leave handicraft and commerce largely to subject races save that some Ghilzai are wandering traders (*powindaks*). Afghanistan is a stronghold of Islam, of the Sunni sect for the most part, though the Hazaras and others are Shiah The Kafirs, as the name implies, are non-Mohammedans, living in Kafiristan (E.N.E.); other tribes of the Indian border are recent converts to Islam. Some of the Durani Afghans of Kandahar and Zamindawar districts are very fanatical "Ghazis," that is, men who have vowed their lives to the extinction of other creeds

Language and Administration.—The official language of Afghanistan is Persian, which is also the vernacular of the people west of the Helmand; Pushtu is more widely spoken, especially towards the east, but is unknown in the west; Turki is spoken in the north. There is a respectable amount of Afghan literature The oldest work in Pushtu is a history of the conquest of Swat by Shaikh Mali, a chief of the Yusafzais, and leader in the conquest (A.D. 1413-24). In 1494 Kaju Khan became chief of the same clan; during his rule Buner and Panjkora were completely conquered, and he wrote a history of the events In the reign of Akbar, Bayazid Ansari, called Piri-i-Roshan, "the saint of Light," the founder of an heretical sect, wrote in Pushtu, as did his chief antagonist, a famous Afghan saint called Akhund Darweza. The literature is richest in poetry Abdur Rahman (17th century) is the best known poet. Another very popular poet is Khushal Khan, the warlike chief of the Khattaks in the time of Aurangzeb. Many other members of his family were poets also. Ahmad Shah, the founder of the monarchy, likewise wrote poetry. Ballads are numerous Much of the literature is in Persian. The village Mullah or priest teaches the boys reading and writing and religion through the Koran; the Afghan noble has long known Persian and there is an old-established traditional lore in religion and medicine. But of late a good deal has been done to modernize education, by teaching agriculture, by developing free secondary schools including one under French and one under German supervision, by opening two colleges in Kabul, one for army officers and one for administrators, as well as other colleges elsewhere. Afghan students in recent years have been sent to France and Germany. The Government was an absolute monarchy until 1922 when a legislative and a State assembly were organized with a cabinet under the presidency of the king. Amanullah Khan (born 1892, succeeded to the throne 1919), who took the title of king in 1926 in place of that of Amir. Ministers are appointed for foreign affairs, internal affairs, education, commerce, justice, revenue and war. There are five major provinces: Kabul, Kandahar, Herat, Mazar-i-Sharif, and Kataghan-Badakhshan, and four minor provinces Jalalabad, Khost, Farah and Maimena. Each province is under a governor. The law is that of Islam with courts in each seat of Government and appeals to higher courts and ultimately to a supreme one at Kabul The army is a short service conscript one, but tribal groups also count for a great deal; there are armament factories at Kabul, and, by a treaty of 1921, the Afghans may import munitions through India. Herat in the west and Dehdadi near Balkh in the north are strongly fortified A new currency was established in 1926, and revenue is mainly from customs A subsidy was formerly paid by the Indian Government to the Amir but that ceased, by agreement, in 1919 There is no regular budget but the public revenue is still under £1,000,000. There are neither banks nor railways, nor is Afghanistan as yet in the International Postal Union, but some waterfalls, notably that of Djebel-us-Seradj, are utilized as sources of hydro-electric power Railways reach the Afghan frontier at various points from the British side and also from the Russian side The Khyber railway goes up to Landi Kotal.

Communications and Industries.—As well as railways, telegraphic communication exists between Kabul and Peshawar; telephones exist in some of the towns, and Kabul has a wireless installation

Great Britain, France, Germany, Italy, Persia, Russia and Turkey have legations at Kabul. Kabul (pop 100,000) is the historic centre and the limits of its authority have varied greatly from time to time, some mountain regions being practically independent Herat (pop 121,000) is largely Persian in character and has often been in rebellion Kandahar (pop 60,000) in the south and Mazar-i-Sherif (pop 46,200) in the north are other important centres.

Silks, felts, carpets, articles made from camels' and goats' hair, sheepskin coats, soap, clothing, boots, etc , are produced at Kabul, chiefly for the army, in factories that are partly instructional Herat and Kandahar have long been famed for their silks, felts and carpets, though these are not comparable to true Persian ones Herat and Kandahar gather fine wool from the nomad shepherds Commerce across the frontiers has been limited by high duties India sends to Afghanistan cotton goods, dye-stuffs, hardware, etc , while Afghanistan sends into India timber, dried fruits, provisions, drugs (especially asafoetida), madder, spices, wool, silk, hides, cattle, tobacco Merchandise is still carried chiefly on camel or pony back, but timber is floated down the streams where that is possible. Cattle go in greater number into Soviet territories and food stuffs are also exported in that direction, while imports from Russian lands into northern Afghanistan include wool and cotton Trade with Persia is of little account

The basin of the Kabul river especially abounds in remains of the period when Buddhism flourished. Bamian is famous for its wall-cut figures and at Haibak (on the route between Tashkurghan and Kabul) there are some most interesting Buddhist remains In the Koh-Daman, north of Kabul, are the sites of several ancient cities, the greatest of which, called Beghram, has furnished coins in scores of thousands, and has been supposed to represent Alexander's Nicaea. Nearer Kabul, and especially on the hills some miles south of the city, are numerous topes In the valley of Jalalabad are many remains of the same character.

In the valley of the Tarnak are the ruins of a great city (Ulan Robat) supposed to be the ancient Arachosia. About Girishk, on the Helmand, are extensive mounds and other traces of buildings; and the remains of several great cities exist in the plain of Seistan, as Pulki, Peshawaran and Lakh, relics of ancient Drangiana. An ancient stone vessel preserved in a mosque at Kandahar is almost certainly the same that was treasured at Peshawar in the 5th

century as the begging pot of Sakya-Muni. In architectural relics of a later date than the Graeco-Buddhist period Afghanistan is remarkably deficient. Of the old city of Ghazni, the vast capital of Mahmud and his race, no substantial relics survive, except the tomb of Mahmud and two remarkable brick minarets. A vast and fruitful harvest of coins has been gathered in Afghanistan and the adjoining regions. The concession for archaeological exploration in Afghanistan has been given to France. Regarding the proprietorship of finds, it may be noted that the adoption of regulations such as are in force in Egypt is being considered.

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Present-day Army.—The present military system dates from the days of Abdur Rahman who in 1896 introduced semi-compulsory service which provided that one man in every eight between the ages of 16 and 70 should take his turn in undergoing military training In 1917 an organization was introduced to provide corps (Urdu) of all arms with a personnel of about 24,000 combatants, divisions of all arms with about 12,000 and mixed brigades with about 4,000, all with mounted troops in the proportion to infantry of one to six, with a six- or four-gun battery attached to each infantry "battalion" Recruitment is practically for life, but nominally discharge can be obtained after 3 years if a substitute is forthcoming The king is head of the army, with a commander in chief as executive commander, and subordinates for the army formations. The headquarters of the military districts are Kabul, Jalalabad, Kost, Ghazni, Mukur, Kandahar, Farak, Herat, Maimana, Mazar-i-sharif and Faizabad. The distribution of troops is irregular. Kabul has the most. Practically all Afghans being armed with modern rifles, estimates of fighting strength are misleading. Taking the population at 6,000,000, an estimate of about 1,200,000 of fighting age would be somewhere near the mark. The size of mobile formations would depend upon success in collecting transport. Some motor transport is kept at Kabul. There are military academies at Kabul and Herat, military schools for cadets at Kabul, Ostalif and Jalalabad, but the majority of officers seem to be drawn from other sources. Kabul and other places have defences. Herat and Dehdali near Balkh are credited with being the chief fastnesses in Northern Afghanistan, the latter covering the roads leading from the Oxus into Afghan Turkistan. According to travellers' reports, attention is being directed to the development of air forces. Visits to Kabul of Russian aircraft and negotiations for their purchase have been reported, the Russians desiring to provide the pilots.

BIBLIOGRAPHY.—Afghanistan is one of the few countries for which information about armaments is not to be found in the League of Nations *Armaments' Year Books*. Foreign travellers were not encouraged by the present King's predecessors. The preceding notes are from the best accessible reports, culled from many sources. Among the most recent is an English translation by B. K Featherstone of *Through the heart of Afghanistan* by Emil Trinkler (Faber and Gwyer, 1928). (G. G. A.)

HISTORY

The geographical term Afghanistan ("land of the Afghans") is an anachronism as applied to the country before 1747, when it first became a separate and independent state, and though it is now the official name of the kingdom it is not in common use among the Afghans.

The Afghan chroniclers call their people *Ben-i Israil*, or "Children of Israel," and claim for them descent from King Saul, whom they call *Tālūt*, through a son named Jeremiah, who is said to have had a son named Afghana; but this legend assumes so many conflicting and improbable forms that it may be safely regarded as a late invention. According to one account Afghana was settled by Sulaiman (Solomon) in the Sulaiman Mountains, and according to another, evidently connected with the account of the captivity of the Ten Tribes, his descendants were removed from Palestine by Nebuchadrezzar and found their way to the mountainous country about Herat. Another legend related that in pre-Islamic times Bilo (father of the Biluchis), Uzbak (father of the Uzbaks) and Afghana were considered as brethren. The historian Firishta cites a legend which makes the Afghans Copts, of the race of Pharaoh; and the Afghans explain their conversion to Islam by a story to the effect that nine years after Mohammed's announcement of his mission a holy man named Kais, sent to Medina to make inquiry of him, became a zealous Muslim and on his return converted his countrymen, adding that all true Afghans are descended from Kais and his three sons, but ignoring the other descendants of Afghana. Omitting the legend which attributes to the Afghans a Coptic descent we find the grandson of King Saul made contemporary with Mohammed Uzbak Khan, who flourished in the 14th century, as well as with King Solomon; and Kais, whose name suggests Kish, Saul's father, made contemporary with the prophet Mohammed.

Despite these and other discrepancies some intelligent British officers, well acquainted with the Afghans, have accepted the story of their Hebrew descent. Their belief has been based on certain Afghan customs and on the fancied resemblance of a well-known type of Afghan physiognomy to the physical characteristics of the Jews; but the Afghans, as Muslims, have many customs similar to those of the Hebrews, and they share their physical resemblance to the Jews with other races in no way connected with them.

Early Period.—Until 500 B.C. Afghanistan formed part of the Achaemenian empire, and comprised the ancient provinces of *Aria*, or Hari Rud; *Bactria*, or Balkh; *Drangiana*, or Seistan and the Helmand Valley, *Arachosia*, or Kandahar, and *Paropamisus*, the region of the Hindu Kush and Kabul The population in the north was Iranian, and in the south contained a large Indian element; but the most interesting people mentioned in the Greek records are the *Paktyes* in Arachosia, which Herodotus calls *Paktyike*, for in their name we may trace that of the *Pakhtun* or Pushtun, by which the Afghans still describe themselves. The story of Alexander's campaign in the eastern provinces of the Persian empire need not be repeated here, but the cities of Herat (Alexandria Arion) and Kandahar (Alexandria Arachosion) were either founded or restored by him.

He was succeeded in the eastern provinces of his empire by Seleucus Nicator, the founder of the Seleucid dynasty, but the Indian provinces and the Kabul valley fell to Chandragupta (*Sandracottus*), the founder of the Maurya dynasty.

Greek Dynasty.—As the power of the Seleucids waned an independent Greek dynasty was established, about 246 B.C., in Bactria, and about 50 years later annexed a great part of north-western India, but Afghanistan passed from its possession into that of the Parthians (who occupied its western provinces), and the Sakas, a Scythian tribe, who conquered the eastern provinces about 130 B.C. and gave their name to Seistan (*Sakastan* or *Sakastene*). Within 200 years the Yue-chi (*q v.*), another central Asian tribe, expelled the Parthians and founded the Kushan dynasty, which ruled Afghanistan, and, at the height of its power, northern India, as far as Benares on the east and Malwa on the south. This dynasty adopted the Buddhist religion, and Kanishka, the greatest king of the line, convened the great council which settled the canon of northern Buddhism, and is mentioned as a champion of Buddhism by Hiuen Tsang, the Chinese pilgrim; al-Biruni, the Mohammedan traveller, philosopher, and geographer; and in the Mongol versions of the Buddhist story.

The empire of Kanishka did not long survive his death, but kings of his race, known as the Turki Shahs, were found by Hiuen Tsang reigning in the Kabul valley in the 7th century, and were not overthrown until the end of the 9th century, when a Hindu dynasty known as the Hindu Shahi ousted them.

The Caliph Empire.—The title of Arab conquest and Islamic propaganda in the 7th century reached western Afghanistan, which was included in the empire of the Caliphs, but did not touch the kingdom of Kabul, which remained independent under the Turki Shahi and Hindu Shahi kings. As the power of the Caliphs declined their provincial governors founded dynasties owning a

nominal allegiance to them but virtually independent. One of the earliest of these was the Arab dynasty of the Tahirids, who included Herat and Balkh in their kingdom of Khurasan, in which they were succeeded by a native Persian dynasty, the Saffarids, who were overcome in the 9th century by the Samanids of Balkh and Bukhara, another Persian house. Alptigin, a Turkish slave of this house, established himself in Ghazni, where he was succeeded, after a short interval, by another Turkish slave, Sabuktigin, who threw off the yoke of the Samanids and annexed to his dominions not only the Hindu kingdom of Kabul, but the territory lying between it and the Indus. Assistance given by him to the Samanids was rewarded with the government of Khurasan, to which he appointed his elder son Mahmud, and Afghanistan became the nucleus of a great empire. Sabuktigin died in 997, and his son Mahmud, after deposing a younger brother, ascended the throne in 998. The tale of his predatory raids into India need not be repeated here. He added to his empire Baluchistan, and, later in his reign, the Indian kingdom of the Punjab, the province of Multan, and the greater part of western Persia, and divided with Ilak Khan, the founder of a Turkish dynasty in Transoxiana, the dominions of the house of Saman, which came to an end during his reign.

The hitherto obscure town of Ghazni now became a great and splendid city, for Mahmud was no mere ravager and despoiler. It is in Mahmud's reign that we first hear of the small state of Ghor, in the southern ranges of the Safid Kuh, which Mahmud reduced to vassalage, and the rulers of which, eventually, extinguished his dynasty. He himself paved the way for the destruction of his empire by admitting into Khurasan the Seljuk Turks, who afterwards stripped his descendants of their possessions in the north and west and founded a great empire on the ruins of that of Ghazni.

Mahmud died in 1030 and his descendants continued to reign over a gradually diminishing empire, with Ghazni as their capital, until 1153, when Alauddin Husain, chief of Ghor, to avenge the death of his brother, Saifuddin, who had been treacherously put to death by the sultan of Ghazni, captured and burnt the city, driving Mahmud's descendant, Khusrav Shah, into the Punjab. The destruction of the great city of Ghazni earned for its author the cognomen of *Jahansuz*, "the World-Burner."

Ghor Dynasty.—In 1186 the World-Burner's nephew, Muizzuddin Mohammed, commonly known as Mohammed Ghori, treacherously enticed Khusrav Malik, the last of the Ghaznavids, from Lahore, and imprisoned him for the short remainder of his life. Having secured the Punjab, Mohammed invaded India, and founded there a Muslim empire which endured, in name at least, until 1858.

This dynasty of Ghor is commonly believed to have been of Afghan origin, but the belief rests on a very slender foundation of evidence Legend also assigns it descent from Zahak; and though this is no better attested than their Afghan genealogy, it seems to be probable that they were Tajiks of Persian race. The Afghans themselves are Indo-Iranian by race, and their antiquity as a separate people is uncertain. Firishta's statement that the inhabitants of the Sulaiman mountains were known as Afghans in the 1st century of the *Hijra* (the 7th century of the Christian era) carries no weight, but the name occurs in al-'Utbi's *History of Sultan Mahmud*, written about A.D. 1030, coupled with that of the Khalaj or Khaljis, who were apparently a Turkish tribe domiciled in western Afghanistan, but always antagonistic to the true Afghans. Both names occur in the history of India during the 13th and 14th centuries, and the Indian historians are not careful to distinguish between the two peoples. Hence it is, probably, that some Europeans have carelessly classed all the five dynasties which preceded the Timurids on the throne of Dihli as "Pathans," or Afghans, though in fact two of them were Turkish, one was Khalji, and one was of Arab descent.

The Muslim empire in India was founded by a manumitted slave of Mohammed Ghori, and shortly after Mohammed's death his great empire fell to pieces and was divided between provincial governors and members of his own family holding small principalities in Afghanistan. These petty princes were subdued by the shahs of Khvarazm, or Khiva, of whose great but ephemeral empire Afghanistan for a time formed part.

Mongol Rule.—In the 13th century Afghanistan, like Persia, suffered the dreadful calamity of invasion by the heathen Mongols of Jenghiz Khan, who settled to the north of the Hindu Kush; but the rest of the country, owing to its inhospitable nature, suffered less than more fertile and populated lands. It was here, however, that the gallant Jalaluddin, last of the shahs of Khvarazm, made his most strenuous efforts to avenge on these savages the annexation and devastation of his kingdom.

The greater part of Afghanistan remained under Mongol rule until the rise of Timur Lang (Tamerlane), who established himself in northern Afghanistan in the latter part of the 14th century, wresting Herat from the Kurts, a family which claimed descent from the princes of Ghor (*see* MONGOLS).

The Moghul Empire.—In 1504, Babur, fifth in descent from Timur, having been expelled from his ancestral dominions in Transoxiana, occupied Kabul and made it the capital of a kingdom which he established in Afghanistan; and in 1522 he captured Kandahar from the Afghans, a Moghul family which had long held it, but he did not remain long content with his Afghan kingdom. In 1526 he invaded India, defeated Ibrahim Lodi, the Afghan Sultan of Delhi, on the field of Panipat, and founded the state which is usually known to Europeans as the Moghul empire, though Babur was no Moghul, and would have resented the designation. Kabul and Kandahar remained for the time merely provinces of Babur's Indian empire, and Herat fell into the hands of the Safavi shahs of Persia.

Babur's son, Humayun, was expelled from India by the Afghan, Sher Khan, and was compelled to seek an asylum with Shah Tahmasp of Persia, who helped him to recover Kandahar, held by his rebellious brother. From Kandahar Humayun proceeded to Kabul, from which city he ousted another brother, and after spending seven years in re-establishing his authority in Afghanistan was able, in 1554, to recover his Indian empire, but died shortly afterwards, as the result of an accident, leaving the task of extending and consolidating the dominions of his house in India to his young son Akbar (*q.v.*), the real founder of the "Moghul" empire of India.

Afghanistan was then divided, Kabul remained a province of India, and Herat a province of Persia; Balkh fell to the Uzbaks of Transoxiana, and Kandahar, after remaining for a time in the possession of the Timurids, was taken by the Persians. Akbar's grandson, Shah Jahan, made a disastrous attempt to recover Balkh and twice endeavoured to recover Kandahar, but without success.

In 1708 the Ghilzais of Kandahar, who perhaps represented the Khalaj, provoked by the oppressive rule of the Persian governor, Shahnavaz Khan, a Georgian prince of the Bagratid house, rose under Mir Vais and expelled the Persians. Mir Vais defeated the Persian armies sent against him and established his independence, but died in 1715. His son Mahmud, carrying out a project of his father's, invaded Persia, besieged Isfahan, and in Oct. 1722, compelled Shah Husain, the feeble Safavid, to surrender his crown to him, but the rule of the Ghilzais in Persia was brief—Mahmud died mad and his successor, Ashraf, was defeated by Nadir Kuli, the Afshar, who shortly afterwards ascended the throne. In 1737–38 Nadir Shah, one of Persia's greatest monarchs, recovered Kandahar and conquered the Indian province of Kabul, but conciliated the Afghans and enlisted many in his army—among them Ahmad Khan, a young chieftain of the Sadozai family of the Abdali tribe. Ahmad Khan rose to high rank in the Persian army, and after the assassination of Nadir Shah in 1747 was chosen by the Afghan chiefs at Kandahar as their leader and assumed the royal title. Among his titles was that of *Durr-i-Dauran*, "the Pearl of the Age," from which his tribe received the name of Durrani.

The land of the Afghans had been successively a congeries of petty states, the centre of great empires ruled by foreigners, and a dismembered country, furnishing provinces to three monarchies. It now became, for the first time, a distinct political entity, ruled by an independent native sovereign.

Ahmad Shah Abdali extended his kingdom westward nearly to the Caspian and eastward over the Punjab and Kashmir, which he wrested from the feeble successors of Babur on the throne of Delhi. He claimed and commanded the allegiance of Sind, which had been ceded by Mohammed Shah of Delhi to Nadir Shah. His northern boundary was the Oxus, and Baluchistan and Khurasan were tributary states of his kingdom. At the third battle of Panipat, fought on Jan. 6, 1761, he inflicted on the confederate Maratha chiefs, who were then at the zenith of their power and were the real masters of the great empire founded by Babur and Akbar, a crushing defeat, and with inferior numbers nearly annihilated their great army.

Foreign Influences.—Ahmad Shah died in 1773 and was succeeded by his son Timur, who transferred his residence from Kandahar to Kabul. In his reign Sind was lost, Balkh and other districts in Afghan Turkistan became virtually independent, and the seeds of revolt were sown in Khurasan and Kashmir He died in 1793, leaving 23 sons, of whom the fifth, Zaman Mirza, by the help of Payinda Khan, head of the Barakzai family of the Durranis ascended the throne. His reign was short and troubled and was marked by one act destined to have momentous consequences—the grant of Lahore, in 1799, to the Sikh adventurer, Ranjit Singh. In the same year Mahmud, another son of Timur, ousted Zaman Shah and ascended the throne, but in 1803 was deposed by conspirators who placed his brother, Shuja-ul-Mulk, on the throne. In 1809 the East India Company's government in India, alarmed by the intrigues of Napoleon in Persia, sent Mr Mountstuart Elphinstone as envoy to Shah Shuja at Peshawar, but Napoleon's ambitious eastern schemes came to nought and the British mission at Peshawar was unable to effect anything, for Shah Shuja's rule was unpopular, and while his army was engaged in quelling a rebellion in Kashmir his deposed brother, Mahmud, rose in rebellion, defeated him and put him to flight, and ascended the throne for the second time In 1815 Shah Shuja took refuge in India and remained a pensioner of the Indian Government until, at a later date, a use was found for him Mahmud ruled until 1818 but the real ruler of the kingdom was Fath Khan the Kingmaker, the eldest son of Payinda Khan Barakzai. It was he who recovered Herat, which had been seized by the Persians, and in the insolence of his power he ventured to offer a gross outrage to the Sadozai family. Mahmud, already chafing under Fath Khan's yoke, avenged the insult by causing him to be blinded, and Mohammed Azim and Dost Mohammed, the minister's brother and half-brother, rose in arms against Mahmud, who retorted by causing Fath Khan to be put to death with torture. The Barakzais prevailed and in 1818 drove Mahmud from Kabul and dethroned him A period of anarchy then ensued. Mohammed Azim ruled Kabul, but his brothers and other Afghan chiefs, the provincial governors, withheld their allegiance from him and the kingdom fell to pieces Herat, always a Persian rather than an Afghan town, was alienated; Afghan Turkistan and Badakhshan regained their independence, and Ranjit Singh, who had already conquered Kashmir, Multan, Dera Ghazi Khan and Attock, was threatening Peshawar, which he secured by defeating the Afghan army at Naushahra in 1823 In the same year Mohammed Azim died, and the remaining Barakzai brothers plunged into a fratricidal war. Three years later Dost Mohammed established himself in Kabul, Ghazni and Jalalabad, and, having secured this fragment of the Afghan kingdom, assumed the title of Amir, after having, in 1835, defeated an attempt by Shah Shuja to regain his throne.

Russia had succeeded France as the bugbear of British administrators in the East, and the fear of Russian intrigue, as well as the prospect of active hostilities between the Amir Dost Mohammed and Ranjit Singh, induced the Company's government to despatch an envoy, Sir Alexander Burnes, to the court of the Amir. His mission was ostensibly commercial, but he was instructed to oppose the attempt of the shah of Persia to recover Herat. He was well received, but the Amir was disappointed by his refusal to pledge his Government to aid him against Ranjit Singh, and consequently held himself in no way bound to refuse to receive Captain Vikovitch, a Russian officer who then arrived in Kabul. The Governor-General, Lord Auckland, peremptorily demanded his dismissal and the renunciation of all claims to the Punjab and Kashmir, which Ranjit Singh had recovered from the Afghans, and rashly decided to make Dost Mohammed's natural refusal of these demands a *casus belli*, and to attempt to restore the fugitive Shah Shuja, who had already been tried and found wanting Ranjit Singh, whose material interests were involved, bound himself to co-operate with the British, but when all was ripe for the invasion declined even to permit British troops to cross his territories, though a Sikh force, with Sir Claud Wade and a small British detachment, advanced through the Khyber Pass

The "Army of the Indus," numbering 21,000, assembled in Upper Sind in 1838 and advanced through the Bolan under the command of Sir John Keane. It met with hardly any resistance and in April, 1839, occupied Kandahar, where Shah Shuja was crowned in his grandfather's mosque. On July 21 Ghazni was taken by storm and Dost Mohammed, deserted by his troops, fled northwards. On Aug. 7 Shah Shuja, escorted by the British army, entered Kabul. It was believed that the war was over, and Sir John Keane, who received a peerage for his services, returned to India with the greater part of the army, leaving Sir William Macnaghten as envoy and Sir Alexander Burnes as his colleague, with 8,000 British and Company's troops and the contingent which had been raised for the service of Shah Shuja for their protection. The trouble was in fact only beginning, for the best of rulers is not acceptable to a free people when imposed upon them by foreign arms, and Shah Shuja had already rendered himself odious to the Afghans. He now, acting on the advice of the British Resident, attempted to raise a regular army to take the place of the tribal militia under its hereditary leaders; but the opposition of the chiefs, who apprehended the diminution of their own power and influence and the extinction of their country's independence, ensured the failure of this design. Shah Shuja was obliged to rely more and more upon British assistance, and his rule grew daily more unpopular A danger was removed by the surrender of Dost Mohammed, who was sent to India, but it was impossible to save Shah Shuja, and in Nov 1841, discontent at Kabul culminated in a revolt in which Burnes and other officers were massacred Akbar Khan, the son of Dost Mohammed, placed himself at the head of the national party, and at a conference with the British authorities stabbed Sir William Macnaghten with his own hand The British agreed to evacuate the country, and, in accordance with a convention with the Afghans, the garrison, then reduced to 690 British and 3,810 Indian troops, with the enormous number of 12,000 followers, marched out of Kabul on Jan 6, 1842 The Afghans made no pretence of observing the terms of the convention, and the retreat of the demoralized army in the depth of a severe winter was a scene of confusion and massacre On Jan. 13 the survivors of the force mustered at Gandamak only 20 muskets, and Dr Brydon, the sole survivor of the Army of Kabul, except those whom the Afghans had captured, reached Jalalabad alone. The garrison of Ghazni had been obliged to surrender, but Kandahar was held by General Nott and Jalalabad by General Sale: In April, 1842, Shah Shuja was assassinated

Preparations were made in India to avenge these disasters and to recover the prisoners In April, 1842, General Pollock forced the Khyber Pass and relieved Jalalabad, and in September re-occupied Kabul, where he was joined by General Nott from Kandahar, who had recaptured and dismantled Ghazni. The prisoners were recovered from Bamiyan, where the Afghans had lodged them, and the army evacuated Afghanistan in Dec. 1842, after destroying the citadel and the central bazaar of Kabul. Dost Mohammed was permitted to return to his country and assumed the government, with the title of Amir

In 1848, during the second Sikh War, Dost Mohammed was induced to go to the aid of the Sikhs The adventure was unfortunate for him, for at the battle of Gujarat, in Feb 1849, his cavalry was ignominiously routed and pursued as far as the hills, and the Peshawar territories were annexed to British India

and thus lost to Afghanistan. Balkh was recovered in 1850 and Kandahar in 1855, in which year also a treaty of peace was concluded between him and the British Government at Peshawar. In 1856 the Persians captured Herat but were obliged to surrender it to an independent ruler after the British expedition to Persia. In 1857 the Amir met, at Peshawar, Sir John Lawrence, who promised him arms and a subsidy to aid him in defending his country against Persia, and a British mission under Major Lumsden was received at Kandahar. During the Indian Mutiny the Amir declined to listen to those who instigated him to aid the rebels, and remained faithful to his alliance.

In 1863 Dost Mohammed captured Herat after a long siege, and, dying almost immediately afterwards, was succeeded by his son Sher Ali Khan, the early years of whose reign were disturbed by contests with his brothers. Early in 1873 the British Government succeeded in obtaining from the Russian Government a declaration that Afghanistan was beyond the field of Russian influence, and the recognition of the Oxus as the northern frontier of the State. Later, the Amir's failure to secure a British guarantee for his sovereignty and family succession, and his refusal to admit British agencies into Afghanistan led to estrangement between him and the British Government, and when, in July, 1878, he ostentatiously received a Russian mission at Kabul and shortly afterwards refused to permit a British mission to cross the frontier, his attitude was regarded as definitely hostile. After some warnings the Government of India delivered an ultimatum, his disregard of which led to the decision to invade Afghanistan. In Nov. 1878, the British forces inflicted severe defeats on the Afghan troops and occupied the Khyber pass and the Kurram valley, and early in 1879 occupied Kandahar, Kelat-i-Ghilzai, and Girishk. The Amir, with the Russian mission, had fled from Kabul, and he died, a fugitive, in March, 1879 His second son, Yakub Khan, who was recognized by the people of Kabul as Amir, voluntarily visited the British camp at Gandamak in May, 1879, and there concluded a treaty, by the terms of which he ceded the Kurram valley, Pishin, and Sibi, and the control of the Khyber and Michni passes and of the tribes in their neighbourhood He also agreed to receive a British resident at Kabul and to subordinate the foreign affairs of Afghanistan to British influence. Major Sir Louis Cavagnari was well received by him as Resident, but the Amir was either unable or unwilling to control the fanatical element in Kabul, and in Sept. 1879, the Residency was attacked by a mob of townspeople and soldiers, and the Resident and his escort were murdered after a gallant defence.

Abdur Rahman Khan.—The Kandahar force then concentrated at Kandahar, and a force under General (afterwards Field-Marshal Earl) Roberts advanced through the Kurram valley, defeated an Afghan force at Charasia, and occupied Kabul in 1879. Yakub Khan, having entered the British camp, abdicated, and was sent to India, where he lived for the rest of his life. The British force under Roberts remained at Kabul, and in July, 1880, the British Government recognized a new Amir, Abdur Rahman Khan, a grandson of Dost Mohammed and nephew of Sher Ali.

Sardar Sher Ali Khan, a Barakzai of Kandahar, had already been recognized as independent ruler of that province, but in July, 1880, Ayub Khan, a younger brother of Yakub Khan, advanced from Herat, inflicted a crushing defeat on a brigade of British troops at Maiwand and invested Kandahar. On Aug. 8 General Roberts left Kabul with a relieving force, which reached Kandahar on the 31st, and on Sept. 1 defeated the besiegers and captured their camp, artillery, and baggage. Ayub Khan fled with a few followers, and, peace having been restored in southern Afghanistan, the British forces evacuated the country in 1881. Sher Ali was unable to maintain his authority in Kandahar and retired to India, where he ended his days as a pensioner. Ayub Khan again took the field, defeated Abdur Rahman's troops, and occupied Kandahar, but in Sept. 1881, Abdur Rahman utterly defeated him and drove him to seek refuge in Persia. In 1888 he went to India, and lived there as a pensioner of the British Government until his death.

Abdur Rahman had been recognized as Amir of Kabul only, but within a year of ascending the throne had made himself master of Kandahar and Herat also, and he succeeded in quelling tribal disturbances and in establishing his rule on a firm basis. No attempt was made to fetter his independence except with regard to his foreign relations, which he agreed to conduct subject to the control of the Government of India, from whom he received an annual subsidy to be devoted to the payment of his troops and the defence of his north-western frontier, and considerable supplies of war material, together with facilities for importing arms through India at his own cost.

In 1884 it was agreed that a joint commission of British and Russian officers should demarcate the northern boundary of Afghanistan, but the Russian commissioners did not immediately arrive on the scene, and in March, 1885, while the Amir was conferring with Lord Dufferin, the Viceroy of India, at Rawal Pindi, Russian troops attacked and drove from Panjdeh, a small town on the frontier, an Afghan force. In 1888 the Amir's authority was seriously menaced by the revolt of his cousin, Ishak Khan, who held a quasi-independent position as governor of Afghan Turkistan and caused himself to be proclaimed Amir, but the rebellion was crushed. Ishak was expelled and settled at Bukhara as a pensioner of the Russian Government, and Abdur Rahman's authority was established in the northern province. In 1895 he completely subjugated Kafiristan, a wild mountainous tract to the north-east of Kabul, the inhabitants of which had hitherto successfully resisted all attempts to destroy their independence.

In 1901 Abdur Rahman died, after a reign of 21 years, in the course of which he gave Afghanistan a government such as it had never known before. This he effected, first, by substituting for a feudal militia under tribal chiefs a standing army, well trained, well armed, and regularly paid, owning allegiance to none but himself. By means of this force he was able to establish an efficient central administration, retaining all power in his own hands, and to improve the public revenues not only by increasing the burden of taxation, but by ensuring the collection of all assessed taxes. He was harsh and ruthless, but he relieved his subjects from the petty tyranny of local chieftains and he suppressed highway robbery and violent crime. It is probable that he fully appreciated the advantages which his country might gain from projects of a commercial or strategical nature, such as railways, telegraphs, and mines; but it was his settled conviction that these advantages would be purchased at too high a price by the necessary employment of large numbers of foreigners, whose activities in the country might have amounted to peaceful penetration and menaced Afghan independence.

Habibullah.—Two days after the death of Abdur Rahman his eldest son was recognized as his successor. Habibullah introduced the reduction of taxation, the establishment of a council of state for tribal affairs, and the association of tribal chiefs with provincial governors for the adjudication of tribal cases. He also inaugurated military reforms. He loyally observed the condition regarding the control of the foreign affairs of Afghanistan on which the Government of India had recognized his father as Amir, but on all questions relating to the development of his country's trade and more intimate relations with the Government of India he proved to be as wary and suspicious as his father had been. He consented, indeed, to receive a special mission under Sir Louis Dane, foreign secretary to the Government of India which reached Kabul in Dec. 1904, but the mission failed to obtain any concessions, and the result of its work was merely the confirmation and ratification of existing agreements and the concession to him in the treaty of the title of "Majesty." After the failure of this mission an endeavour was made to remove his prejudices and to enlarge his mind by arranging for him a visit to India, in the course of which he could meet the leading administrators of the country. His acceptance of the invitation was viewed with disfavour by the more bigoted and ignorant of his subjects, but the manner of his reception by Lord Minto in Jan. 1907, and the good will displayed towards him, undoubtedly did much to improve the relations between the two Governments.

By the Anglo-Russian convention signed on Aug. 13, 1907, Great Britain disclaimed any intention of altering the political status of Afghanistan, and Russia declared Afghanistan to be beyond her sphere of influence.

Habibullah, though as suspicious as his father, was more susceptible to modern influences, and among the many mixed blessings of civilization which he introduced into an unappreciative country were motor-cars, telephones, newspapers, a hydro-electric scheme, and the Habibia college, a high school in Kabul, the staff of which was chiefly composed of teachers from India. Many of these were regarded by the ignorant clerics of Afghanistan as inventions of the devil and the seed of infidelity, and it was partly from a sense of the antagonism which their introduction had aroused and partly with a view to conciliating the hereditary enemies of his house that Habibullah treated with great and unusual leniency the Ghilzais and Mangals of Khost, the district lying immediately to the west of the Kurram valley, who in 1912 had been goaded into rebellion by the rapacity of the local governor.

The World War.—On the outbreak of the World War in 1914 the Amir declared his intention of abiding by his agreement with the British Government and maintaining the neutrality of his country, but the entry of Turkey, the chief Islamic power, whose ruler was regarded by many Muslims as their Caliph, encouraged the anti-British party in Afghanistan and induced the Amir to receive a German mission, which contrived to reach his western frontier by way of Persia and entered the country as fugitives, having left in the hands of the Russians their confidential papers and that which was most likely to make them welcome in Afghanistan, their gold. They were admitted to Kabul, but their manners and bearing were not calculated to conciliate their hosts. They were regarded as state prisoners rather than as guests, and, in 1916, becoming apprehensive, on misleading information, of the Amir's intentions towards them, they retired hastily from Afghanistan, and some of them, falling into the hands of the Russians, were treated as prisoners of war Habibullah preserved his neutrality until the end of the war, and would doubtless have received substantial recognition of his loyalty, in most difficult circumstances, to his obligations, had he not been assassinated on Feb. 20, 1919. His brother Nasrullah Khan, caused himself to be proclaimed Amir, but after a reign of six days was ousted by his nephew, Amanullah, who was recognized by the nobles and people as king. He was unfortunately not strong enough to resist the popular demand for war with Great Britain, regarded as Turkey's chief enemy, and on May 2, 1919, Afghan troops crossed the Indian frontier Immediate steps were taken to expel them, and British and Indian troops, after encountering some resistance, occupied Dakka, beyond the Khyber; but before the concentration of the British troops was complete Amanullah, brought to his senses by the appearance of the first aeroplane over Kabul, made overtures for peace. Negotiations ended in a Treaty of Peace signed at Rawal Pindi on Aug. 8, 1919, by the terms of which the annual subsidy which the Amir had received since 1879 was discontinued, and Afghanistan was released from the control of her relations with foreign states A conference at Mussoorie in 1920 prepared the way for the Treaty of Nov. 22, 1921, by which the two Governments agreed to respect one another's independence in domestic and foreign affairs; to recognize existing frontiers, subject to a slight readjustment near the Khyber, and to receive legations at London and Kabul, and consular officers at Delhi, Calcutta, Karachi and Bombay, and Kandahar and Jalalabad respectively. The Afghan Government retains the privilege of importing through India, free of duty, arms and munitions of war; and all restrictions on the export of goods from Afghanistan to British territory have been removed. A trade convention has since been concluded, and one to deal with posts and telegraphs is contemplated.

Russo-Afghan Treaty.—Afghanistan has proved that she may be trusted to control her relations with other states with credit to herself, for she has dealt successfully with three difficult and delicate situations. The first arose from a clause in the Russo-Afghan Treaty of Feb. 28, 1921, permitting the establishment of Russian consulates at Ghazni and Kandahar—places so remote from the sphere of Russia's legitimate interests that it was obvious that the consulates could serve no purpose but that of facilitating hostile intrigue on the Indian frontier The British commissioner declined to discuss the terms of a treaty unless Afghanistan annulled a concession so prejudicial to British interests, and she satisfied his demand without dangerously offending Russia. The second arose in 1924, out of the murder of two British officers by two Afghan subjects within a mile of the Afghan frontier, and this outrage was closely followed by the flight into Afghanistan of some ruffians who had murdered an English lady and abducted her daughter The third, which nearly led to a rupture with Italy, arose from the shooting of an Afghan policeman by an Italian named Piparno in the employ of the Afghan Government. The procedure at the trial was prejudicial to the accused and violated the principles of at least one school of Muslim jurisprudence by ignoring the prior settlement of the case, with the cognizance of the State, by the payment of blood-money to relatives. In these circumstances the execution of Piparno aroused a dangerous feeling in Italy, but Amanullah's success in handling this and the other two cases cited proved that he had inherited a large share of his grandfather's strength of character and political sagacity.

In opening up his country to Western civilization Amanullah has departed from the traditional policy of his dynasty, and he is in many respects so far more enlightened than the generality of his subjects as to be in some danger of alienating them, as in the case of his scheme for female education, which led the clerics to foment the dangerous rebellion which broke out in Khost early in 1924, and was not suppressed until the following spring

Amanullah seems to be making some progress in overcoming the ignorant prejudices of his subjects The establishment of Afghan Legations in Moscow, Berlin, Paris, Rome, Tehran, Angora and London, and the reception of foreign legations in Kabul will familiarize them with the life of the outside world. In addition to a wireless station at Kabul, which is in regular communication with Peshawar and Tashkent, Kabul and neighbouring towns are linked with the Indian telegraph system and it is probable that Kabul will soon be linked, through Kandahar and Herat, with the Russian system. Since 1910 the introduction of motor-cars has had its natural result in the improvement of the roads. Those in the neighbourhood of the capital have already been completed, and the projected roads from Kabul to the Khyber, and from Kabul to Kandahar, and thence to Chaman will influence profoundly the economic and political development of the country. The extension, in 1925, of the Khyber railway from Jamrud to the head of the pass has stimulated trade by this route The Hindu Kush, with its steep ascents and difficult passes, for the present effectively blocks communication by mechanical transport between Kabul and the north

The extensive employment of Europeans on technical, educational, and other work can hardly be said to be popular, but its necessity, for the present at least, is gradually coming to be recognized The wisdom of entrusting the development of the air force and some other essential services exclusively to Russians may well be doubted, but there is no need to despair of Amanullah's ability to rid himself of Soviet agents should he find himself embarrassed by their intrigues

Late in 1927 Amanullah left Afghanistan for an extensive tour which included part of India, Egypt, Italy, and England, as well as other European countries. That it should be possible for him to absent himself from his kingdom for so many months without apprehension is evidence of his belief in the loyalty of his ministers and the stability of his throne A trade convention signed at Kabul on June 5, 1923, provided for three transit routes across British India for the forwarding of goods to and from Indian ports.

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AFGHAN LANGUAGE: *see* PUSHTU.

AFGHAN TURKISTAN, province of Afghanistan, bounded east by Badakshan, north by the Oxus river, north-west and west by Russia and the Hari Rud river, and on the south by the Hindu Kush, the Koh-i-Baba and the northern watershed of the Hari Rud basin. It is 500m. long, north-east to south-west, and averages 114m. in width between the Russian frontier and the Hindu Kush The area is about 57,000sq m —two-ninths of Afghanistan The population is about 750,000, mainly cultivators in towns and villages, the chief being Mazar-i-Sharif (46,200), the modern supplanter of Balkh. The lowland has much loess and the riverine lands of the Oxus are highly cultivated, but to the west the Turkoman area is waste, and to the south are rough mountains. The people are Persian and Uzbeg with Turkoman, Hazara (Mongol) and Hindu elements. Ancient Balkh or Bactriana belonged to the Achaemenian empire. About 250 B.C. Diodotus (Theodotus), governor under the Seleucidae, made himself independent and founded the Graeco-Bactrian dynasties which succumbed to Parthian and nomad movements about 126 B.C. The succeeding Buddhist era has left us huge sculptures at Bamian and the rock-cut topes of Haibak Jenghiz Khan laid waste the land, later it belonged for a century to the Delhi empire, then became Uzbeg, and in the 18th century came under Ahmad Khan and his son Timur (Durani Afghans). Next the Khanates fell apart during strife between Timur's sons, and the Uzbeg khans came under the rule of Bokhara. Under Dost Mohammed (1850–1859) the Afghans occupied the province, and boundary disputes were settled (1873) by the Anglo-Russian agreement awarding Andkhui, Shibarghan, Saripul and Maimana to Afghanistan. The Russo-Afghan commission delimited the boundary in 1885.

AFIUN QARAHISAR, the popular name of Kara-hissar Sahib, the chief town of a vilayet in Asiatic Turkey, nearly 200m. east of Smyrna, and 50m. south-south-east of Kutaiah. Population (1927), 102,487. Called Nicopolis by Leo III. after his victory over the Arabs in 740, its name was changed by the Seljuk Turks to Kara-hissar. It stands partly on level ground, partly on a declivity, and above it rises a precipitous trachytic rock (400ft.) on the summit of which are the ruins of a Byzantine castle. The town is an important centre of trade. Opium in large quantities is produced in its vicinity and forms the staple article of its commerce; and there are, besides, manufactures of black felts, carpets, arms and saddlery. Afiun contains several mosques (one of them a very handsome building). The town is connected by railway with Smyrna, Konia, Angora and Constantinople.

See V. Cuinet, *Turquie d'Asie* (Paris, 1894), vol. iv.

A FORTIORI (Lat. "from a stronger [reason]"), a term used of an argument in which the conclusion is supported by a ground that is stronger than another that has already been accepted, or is commonly accepted, as sufficient justification for asserting the predicate of the conclusion of that kind of subject. For example, if in a right-angled triangle the side opposite the right angle must be greater than either of the other sides (because the right angle is greater than either of the other angles), "how much more so" (*a fortiori*) must this be the case in an obtuse-angled triangle (which is even greater than a right angle).

AFRANIUS, LUCIUS, Roman general, lived in the times of the Sertorian (79–72 B.C.), third Mithridatic (74–61 B.C.) and Civil Wars. In 60 B.C., chiefly by Pompey's support, he was raised to the consulship. In the following year, while governor of Cisalpine Gaul, he obtained a triumph, and on the allotment of Spain to Pompey (55 B.C.), Afranius and M. Petreius were sent to govern it as legates. On the rupture between Caesar and Pompey they were compelled, after a short campaign in which they were at first successful, to surrender to Caesar at Ilerda (49 B.C.), and were dismissed on promising not to serve again in the war. Afranius, however, joined Pompey at Dyrrhachium, and at the battle of Pharsalus (48 B.C.) had charge of Pompey's camp. Despairing of pardon from Caesar, he went to Africa, and was present at the disastrous battle of Thapsus (46 B.C.). He was afterwards taken prisoner and handed over to Caesar, whose veterans put him to death.

See Hirtius, *Bell. Afric.*, 95; Plutarch, *Pompey;* Dio Cassius xxxvii, xli.–xliii., Caesar, *B.C.* i. 37–87; Appian, *B C.* ii., CAESAR and POMPEY.

AFRANIUS, LUCIUS, Roman comic poet, flourished about 94 B.C. He dealt chiefly with everyday subjects from Roman middle-class life, and tells us that he borrowed freely from Menander and others.

See Horace *Epp* ii. 1 57; Cicero, *Brutus*, 45. *de Fin.* i. 3; Quintilian x. 1. 100; fragments, about 400 lines, in Ribbeck *Scaenicae Romanorum Poesis Fragmenta*, ii. (1898).

AFRICA, the name of a continent which is the largest of three great southward projections of the main land-mass of the earth's surface, joined to Asia by the isthmus of Suez, 80m. wide. From its northern extremity, Ras ben Sakka, a little west of Cap Blanc in 37° 21′ N. to the southern, at Cape Agulhas, 34° 51′ 15″ S, it is about 5,000m. long while west to east it is about 4,600m. from Cap Verde, 17° 33′ 22″ W, to Ras Hafun, 51° 27′ 52″ E. Length of coastline is 16,100m. for a mainland area of 11,262,000 square miles.

GEOGRAPHY

Africa is largely a plateau, broken and elevated in the south and lower towards the north, with fold mountains adhering to the northern flank, and it thus contrasts very strikingly with Euro-Asia in which fold mountains of successive series in diverse stages of denudation occupy a large proportion of the surface. The mean elevation of Africa is about 2,000ft., that of Asia 3,117ft. Asia has much quite low as well as very high land. Africa, as a plateau, has little at either extreme and in particular the land over 10,000-ft. in Africa is merely small groups of peaks.

The high southern part of the plateau reaching north almost to lat. 10° S. has sharp slopes around its edges on the west, south and east, with a narrow coastal plain below, broadening in the north-west and especially the north-east in Angola and Portuguese east Africa respectively. Towards the south this plateau has a high rim, over 6,000ft. above sea near Windhoek in the west and in Basutoland on the south-east. The southern edge is stepped, with the Nieuwveld range above the Great Karroo, the Little Karroo as the step next below and the coastal plain next below that Within the high rim are considerable areas of centrally placed lower land, the South Kalahari in the south, the depression draining into Lake Ngami (now practically dry) and the Barotseland depression, but all keep above the 1,500ft. contour and each is a local-depression in a table-land most of which is at more than 3,000ft. above the sea. Generally speaking the plateau-edge dips down, with a small coastal ledge, into fairly deep water, but towards the Cape of Good Hope there is a fair area of shallow water off-shore.

The steepness of the edge of the plateau is important as a determinant of the character of the rivers, long sections of which flow in deep slots cut back into the plateau from its edge. The Orange river is fed from the rains that fall on the Drakenberg range and flows west through lands of drought; the Limpopo and Zambezi, the two largest on the east flow out to the broad sandy alluvial flats of Portuguese East Africa and the slot-like character

of a large part of the Zambezi-channel is generally known from the occurrence of the famous Victoria Falls. In the south-west the Zambezi system interlaces with that of the Taukhe or Tioghe and receives surplus water from it at times. The rest of the Taukhe water loses itself in the swamps and saltpans of the former Lake Ngami basin. The lower parts of the three great rivers have contributed to the lowering of considerable areas of the plateau below the 3,000ft. level. The Zambezi river, about 2,000m. long, drains an area of half a million square miles, the Orange river, about 1,300m. long and with a drainage area of about 170,000sq.m. but more than that amount must be added if we define the basin orographically and so include in it larger waterless tracts. Towards the north this southern plateau tends to run rather higher and there is a continuous belt of highland across the continent from the coastal plain on the west to Lake Nyasa on the east, in which region the typical form of the southern plateau is interfered with by important rifts to be considered next. Allowing for complexities the southern plateau of Africa is thus essentially an elevated surface with still higher edges for the most part and with, also, considerable depressions, usually desertic in character, near the median north to south axis of the plateau. North of this southern plateau, on the west, is the basin depression, largely floored by younger rocks and now occupied by the Congo and its numerous feeders. The basin is almost enclosed by land over 1,500ft. in height, for the main river escapes through a deep cut between the hills out to sea; there is general agreement that the basin is a depression in the original plateau surface that has been an inland sea. To the east of the basin are series of physical features that together constitute one of the major physical problems of the earth's surface. They are collectively designated the Rift valley system and have been the subject of much discussion, for which reference may be made especially to the files of the Geographical Journal (London, especially 1916–21) and to Krenkel *Geologie Afrikas* (1925). In this region in later tertiary and early Pleistocene times great movements occurred and earthquakes are still a feature. Often a block has sunk between parallel fractures and thence has come the name of Rift valley. A western rift may be traced from Lake Nyasa via Tanganyika and Lake Albert to Gondokoro. Many of the fractures run either north-west to south-east (the so-called "Erythraean" direction) or, in the north, north-east to south-west (the "Somali" direction). A middle rift line goes north-north-east from Nyasa via Lake Naivasha to Lake Rudolf, with branchings and changes *en route;* though its general direction is north to south, its component fractures are generally north-west to south-east and north-east to south-west, with some north to south ones in the north. The easterly rift line is less important and goes on the whole north-eastwards from about the middle of Lake Nyasa. In the floors of the rifts lie the long narrow lakes, Nyasa 1,645ft. above sea-level but with a maximum depth of 2,580ft. so part of its floor is over 900ft. below sea-level, Tanganyika, also very deep and normally 2,624ft. above sea-level but this level is so variable that the outflow from Tanganyika is quite intermittent, and Rudolf at only 1,180ft. Some other lakes are small; that of Naivasha is over 6,100ft.



BY COURTESY OF THE PRESBYTERIAN BOARD OF FORFIGN MISSIONS

NATIVES OF WEST AFRICA ENGAGED IN MAKING SPOONS IN THEIR TRADITIONAL MANNER

Many portions of these lakes have sharp walls and are obviously filling depressed zones. The western rift is the youngest and sharpest; the most important movements may have been as late as the Pleistocene period. The rifts all show volcanic activity which is most marked along the eastern sides of the middle one, where occur the great peaks of Kenya (17,007ft.) and Kilimanjaro, on which Kibo peak (19,321ft.) has long been held to be the culmination of Africa but Nilsson (1927) claims to have found points on Kilimanjaro 13ft. and 17ft. higher, respectively, than the highest previously known. Ruwenzori, on the eastern side of the western rift is 16,794ft. high and has a block structure apparently with faulted sides; interestingly enough it is in about the same latitude as the other great peaks mentioned and they are all on a belt of land, higher than most of the flanking territory, that stretches from the volcanic Cameroons (*v. inf.*) to the east coast. This cross-line scheme is noticeable in great basins (Niger, Chad and Bahr-el-Ghazal) to the north-west and is evidently of some importance in the story of the deformations that Africa has undergone.

It seems clear that at Lake Albert there was faulting on a large scale both before and after the country was arched up into a wrinkled dome while, farther east, the middle rift may be connected with faulting near the median axis of a long arch. Faulting of domed and arched structures, supplemented by vulcanicity on a large scale, both occurring so recently as to leave features extremely sharp, are thus the characteristics of the country. Between the arched areas of Lake Albert and the middle rift in a downfold lies Lake Victoria of area approximately 26,000sq.m. and more or less rectangular but fractures determine only a small part of its outline and its shores are not high-cliffed. Unlike the rift lakes, it is less than 50 fathoms deep. It is at 3,720ft. above sea-level.

It is well known that the zone of fractures extends northwards marking the east and west edges of the Abyssinian highland, the series of cliff lines bordering the Gulf of Aden and the Red Sea, and the rift lines along the Gulf of Aqaba to the Dead Sea and the Jordan valley. All through this zone one finds systems of parallel fractures and a considerable number are north-west to south-east, others are north-east to south-west, others apparently north to south.

The relations of land and water, both inland waters and the ocean, have naturally varied a lot with the great changes of land levels, but apparently since present levels were reached, and therefore probably well on in the Pleistocene period, lakes of immense size existed in the rift valleys of East Africa. Shore lines 600ft. above present water-levels have been traced over long distances and there is not much doubt that during the major glacial phases of the Pleistocene ice age in Europe the mountains of East Africa were glaciated much farther down than at present.

The northern extension of the rift system to Lake Rudolf and beyond it north-westwards to the lowlands of the White Nile divides east Africa from Abyssinia and Somaliland. The latter is a plateau sloping south but broken sharply on the north, where a steep slope marks the coast of the Gulf of Aden, and less sharply on the south-east to the Indian Ocean. Towards the south-west it declines fairly gradually into the coastal plain of East Africa, rather wide in the Juba basin. Socotra is essentially a broken off projection of Somaliland. Abyssinia on the other hand is a remarkable mountain land bounded east and west by great fractures of remarkable sharpness giving steep cliffs down to the Red Sea and to the White Nile lowland. The rift system of the Red Sea and that of the Gulf of Aden both enter into relationship with an Abyssinian rift which runs from the sea to Lake Rudolf and divides Abyssinia from Somaliland. Abyssinia differs entirely from any folded mountain range; it is a high and deeply dissected block full of evidences of volcanic activity and provided with powerful rivers, feeders of the White Nile (Sobat, etc.) the Blue Nile and the Atbara, indicating its high (largely summer monsoonal) rainfall. It lies for the most part more than 5,000ft. above sea-level and reaches up to nearly 15,100ft. at Ras Dashan in the north. Lake Tana (Tsana) in the highlands is actually 5,690ft. above sea-level.

The Nile may be said, in a way to begin as the Kagera, the chief feeder of Lake Victoria. It leaves that lake on the north and after passing through the lake swamp of Kioga it goes to the north-eastern end of Lake Albert. Issuing again from the northern end of that lake, it emerges in due course from the rift system into a great flat area less than 1,500ft. above sea-level and framed by higher land save in the north-east and giving so little fall on the river that it becomes obstructed by floating vegetation. It is noteworthy that this upper Nile basin, the Lake Chad basin and the main Niger basin, all more or less enclosed, are nearly in the same latitude, with the still more enclosed basin of the Congo to the south. Basins of this kind are thus a marked feature of the geography of the old block of Africa. After the Nile (Bahr-el-Jebel) has received the Sobat from the east it flows north through increasingly barren country into a slot cut in the great desert. The transition from the fertile slot up the, often steep, slope to the desert plateau is a very sharp one and the river has no tributaries in its desert section. It thence follows that, though the Nile is 4,037m long from the Kagera source to the sea, its basin-area is only 1,107,227sq.m., whereas the Congo, rather under 3,000m. long but very rich in tributaries, has a basin area of about 1,425,000 square miles.

North of the Congo basin one may go from the Gulf of Guinea across to the extreme east without touching a point less than 1,500ft. above sea. This rise or swell of the land surface has, on its north-west border, the high line (north-east to south-west) of the Cameroons, apparently an old mountain structure rejuvenated by volcanic outpourings. On this line stands the great peak of the Cameroons (13,370ft.) at the corner of the Gulf of Guinea, and it is continued into the sea giving the island of Fernando Po (Spanish) and those of S. Thomé and Principe (Portuguese). On Fernando Po, Clarence Peak is over 9,000ft high.

North of the Gulf of Guinea the land soon rises above the 600ft. level and towards the west there is a fairly marked slope up from the sea to over 1,500ft. above its level, the slope faces south-west and above it towards the north is a patch above 3,000-ft. in height while one small area near the northeast border of Liberia reaches nearly 10,000ft. This region, with a heavy, monsoonal, summer rainfall is the birthplace of the feeders of the Niger. Thence that river flows north-east demonstrating the general slope of the land down to the Sudan and Sahara, then east and south-east and south to reach the gulf in the lowland between the eastern end of the West African coastal edge and the highland of the Cameroons. Its length is about 2,600m. and basin-area about 800,000 square miles.

Between the main Niger basin and that of the Bahr-el-Ghazal and White Nile lies a basin of internal drainage with the shallow, shrinking Lake Chad in its southern half and a depressed area with some swamps in the north-east. Lake Chad is about 850ft. above sea-level, and receives drainage from the south-east and west. The other depressed area is, in parts, less than 600ft. above sea but the drainage to it is of very small account. North of the Niger and Chad basins is the immense arid belt of the Sahara. It reaches the Atlantic along a low practically waterless coast 1,000m. long from the mouth of the Senegal to the streams of the Atlas. The western part of the Sahara is generally low and has no heights reaching 1,500ft. but in the northern centre is the Ahaggar plateau, connected with the eastern end of which are north-west to south-east lines of higher land one going north-west to the Gulf of Qabes and one south-east crowned by the Tibesti highlands. Eastward, heights diminish again but there is practically a continuous cliff edge along the Nile slot on both sides and the continuation of the desert plateau on the east stands for the most part more than 1,500ft. above sea with a considerable area over the 3,000ft. line.

The desert has large sandy areas especially in the west with regions of stony desert (*hammada*) in the northern centre and a good deal of stony desert to the east. A number of oases break the monotony of the desert, some being north of Lake Chad; some of the land around the Tibesti highland (reaching 8,000ft.) also gets more moisture and has a population aggregated in certain centres. Wadis from the Ahaggar plateau and elsewhere in the desert are interesting evidences of a former greater rainfall and from a study of animal remains as well as of finds of human implements it seems that the Sahara was more or less a grassland during some phases at any rate of the early ages of man. The probability is that periods of greater rainfall in the Sudan more or less coincided with periods of Pleistocene glaciation in Europe. The desert area is estimated at 3,500,000 square miles. The Nile slot cuts the desert without modifying it appreciably, and opens out north to the famous delta west of which the coast is not high save in the Barca or Cyrenaica plateau which reaches 1,500ft. not far from the sea.

The Atlas range, the north-western part of the continent, is orographically a part of the mountain arcs that frame the basins of the western Mediterranean. It reaches a height of 14,000ft. at Bu Uriul and Ari Aiaschi and runs, generally, east-north-east to west-south-west. The eastern half has the Tell Atlas on the north and the Sahara Atlas on the south side with the plateau of the Shotts, several lakes without outlets, between them. The western region has the Mid Atlas continuing the first and the Great Atlas continuing the second; the Anti Atlas is parallel to and south of the Great Atlas. To the north of the Mid Atlas the separate coastal mountain range of Er Rif curves north-west to the Strait of Gibraltar beyond which the curved high line is continued in the Sierra Nevada of southern Spain.

South of the eastern ends of these highlands is a more or less east to west line of low land containing the Shott el Jerid (about 52ft. above sea-level) and the Shott Melrir (nearly 100ft. below sea-level) both without outlet. Africa is remarkable for the extent of land, 3,750,000m. in basins of inland drainage.

Africa is singularly poor in islands. Madagascar 229,820sq.m., is one of the large islands of the world (smaller than New Guinea and Borneo); it is separated from Africa by the rather deep Mozambique Channel and in structure it resembles Africa. Biologically it has links both with Africa and with the East Indian archipelago. Socotra, east-north-east of Cape Guardafui, a continuation of the Somaliland plateau is the only other African island of any size. The Canary and Cape Verde archipelagoes of the north-west and the Comoro archipelago of the east are volcanic (but pebbles of continental, or plutonic, material have been sent to Europe from Anjovan, one of the lesser Comoro Islands); the Seychelles are a continental remnant. There are coral islets between the Comoros and the Seychelles. Mauritius, Reunion and Rodriguez, the two last entirely, the first mainly volcanic, lie in the Indian Ocean east of Madagascar; Ascension, St. Helena and Tristan da Cunha in the south Atlantic far to the west. (X.)

CLIMATE

Extending from latitude 37° N to 35° S, the greater part of Africa lies within the tropics, and except on mountains and plateaux the average annual temperature is high, ranging from 62° at Cape Town to 86° at Massaua on the Red Sea. On the other hand there are great extremes of rainfall; in the Egyptian desert appreciable falls occur only once in a number of years, while the western slopes of the Cameroon mountains are among the wettest parts of the world, Debundscha at the foot of Cameroon Peak having an average of 369in. a year. Africa may be conveniently divided into five climatic divisions, of which four run roughly parallel with the lines of latitude, while the fifth occupies a large part of the eastern coastal districts. On either side of the equator is a belt of heavy rainfall which is distributed fairly uniformly throughout the year, but with a tendency for April and October to be the wettest months, those following the annual passage of the sun across the equator. This belt roughly coincides with the Congo valley and Gabon. Northwards the first rainy season is retarded into May and June, while the second rainy season is advanced into September and August, giving a long dry season, a principal wet season, a short dry season and a secondary wet season which is not much inferior in intensity to the first. In latitude 8° or 9° N. these two rainy seasons coalesce into one wet season lasting from May or June until September, while the rest of the year is dry; at the same time the total rainfall decreases. North of 15° N. the rainfall is small and irregular and

we pass into the belt of desert which includes the Sahara and Sudan. This extends to the Mediterranean in the north-east, but in the north-west there is a coastal strip in Algeria and Morocco which has a long dry summer but an appreciable winter rainfall and forms part of the Mediterranean climatic province.

In South Africa there is a similar succession, the April rainfall maximum of the equatorial belt advancing into March and February, while the October maximum is retarded into November and December, until the two coalesce into the summer rainfall region of the southern hemisphere, which includes Angola and southern Rhodesia. South of this is the Kalahari desert, the counterpart of the Sahara, while in the extreme south-west is a small area round Cape Town with a dry summer but appreciable rainfall in winter (April to September). This zonal division does not apply to eastern Africa south of the equator, which has summer monsoon rains and a winter dry season over its whole extent.



BY COURTESY OF THE AMERICAN BOARD OF FOREIGN MISSIONS

A RAIN-MAKER, AN IMPORTANT MEMBER OF WEST AFRICAN COMMUNITIES, WITH THE REQUISITES OF HIS MAGIC

The Equatorial Rainfall Belt.—This region includes the greater part of the Congo basin above Leopoldville, Gabon, Cameroon and the coast of Nigeria as far as the mouth of the Niger. Its characteristics are uniformly high temperature and humidity, a large amount of cloud and a rainfall generally exceeding 60in a year and rarely falling below 2in in any month. The temperature is rarely extreme, and probably many parts of the region have never reached the Greenwich maximum of 100°, but on the other hand the temperature rarely falls below 60° on the low ground The annual average may be taken as 80°, rising to 87° during the day and falling to 73° at night The hottest months generally fall in the early part of the year, while July and August tend to be coolest, but the annual range is rarely as much as 10°. The relative humidity averages 80%, and this continual moist heat is very enervating to Europeans. The greater part of the region is densely forested.

Savanna Belts.—North and south of the equatorial rain forest is a zone of moderate rainfall, the whole of which falls in a short summer rainy season, while the remainder of the year is dry. These belts may be regarded as extending as far as the isohyet of 20 inches. The northern belt includes Senegal, Bathurst, Sierra Leone, the Gold Coast, Dahomey, the greater part of Nigeria, the Sudan and Abyssinia. The rainfall varies greatly, rising to as much as 154in. a year at Sierra Leone, but even there the months of December to March are almost rainless The drier parts are occupied by open grass-land but the wetter areas are forested. The rainy season from May or June to September inclusive, in spite of being summer in the astronomical sense, is the coolest part of the year, the temperature being kept down by the great cloudiness and heavy rainfall. This season is unpleasant because of the high humidity, the small daily range of temperature and the frequent thunderstorms and tornadoes, especially at the beginning and end of the season. The prevailing wind is south-westerly at the surface, but is very light; at a height of a few thousand feet the wind becomes north-easterly, and the thunderstorms advance from the north-east. From late October until the end of February is the most pleasant season, with hot days but cool nights, dry air and clear skies; the prevailing wind is north-easterly except on the coast, where sea-breezes occur during the day. Over the interior the wind is often laden with penetrating fine dust (Harmattan wind). In March, April and the beginning of May, the temperature is very high, maxima sometimes exceeding 100° even on the coast, and reaching 110° in the interior. The humidity of the air is still low but is rising steadily, and the wind is light and variable. The rainfall of the Abyssinian plateau is of great importance as the source of the annual Nile floods, and so of the fertility of Egypt. The annual rainfall of Addis Ababa averages 50in., but more than three-fifths of this amount falls in July, August and September, while October to January inclusive are almost rainless. In spite of the position of Abyssinia near the eastern margin of Africa, it is believed that most of the moisture which falls as rain is derived from the Atlantic ocean, and is carried across the whole width of the continent by the south-west winds, and that only a comparatively small part of the rainfall is derived from the Indian Ocean. The southern savanna belt includes Angola and Rhodesia; the climate is generally similar to that of the northern belt, but the summer rainy season occurs from December to February. The rainfall nowhere exceeds 60in. and owing to the generally high elevation the climate is comparatively pleasant and healthy The amount of cloud is comparatively small, and the lowest temperatures occur in winter and not, as in the north, in the rainy season

Deserts.—The greater part of Africa north of 16° N. is occupied by an arid climate which gives rise to the deserts of the Sahara and Egypt. The rainfall is less than 10in. a year, and over a large part of the area is probably less than an inch, being confined to a few drops once or twice a year and isolated heavy falls at intervals of many years; under these conditions the term "average" has no meaning. The temperature is very high in summer, the average in July exceeding 90° over a large part of the interior; it remains very hot from April to September inclusive, but the winter months are relatively cool. The daily range of temperature is very great, exceeding 30° at many places; for example at El Obeid in the Anglo-Egyptian Sudan in January the mean daily maximum is 86° and the mean daily minimum 52°, and frosts are occasionally experienced. Very high maxima are recorded in summer, exceeding 110° on the coast and 120° in the interior, while at Azizia, in Tripoli, a shade temperature of 136° has been recorded, the highest known on the earth's surface The air over the interior is dry, less than 40% average humidity for the year, and figures of 2 or 3% have been recorded. On the coast special conditions prevail, which will be referred to later The amount of cloud is very small, generally less than one-fifth of the sky covered, while in parts of the Egyptian desert no cloud is seen for months together The winds are generally light and irregular over the Sahara, but dust storms, sand pillars and other local violent winds occur In the Nile valley the prevailing wind is southerly from November to February and northerly from April to September and reaches considerable strength in the midsummer months, greatly moderating the temperature; occasional very hot, dry, dust-laden southerly winds are known as the Khamsin; these are very unpleasant, especially when accompanied by sand storms. Similar winds from the desert occur also under local names in Tripoli, Tunis and Algeria; they frequently cross the Mediterranean to southern Italy as the scirocco. A severe form is the dreaded simoom or samun, a hot blast of air (125° or more), often accompanied by heavy clouds of dust or sand Land and sea breezes are well developed on the coast of Tripoli, Tunis and Algeria, but not of Egypt The corresponding desert of southern Africa, the Kalahari, is of much less extent, being limited to the western half of the continent, and the heat and dryness are not so excessive as in the Sahara.

The climate of the coast of the Red Sea and Gulf of Aden is peculiar. The rainfall is exceedingly scanty, the sky almost cloudless, and the temperature very high, but this is associated with an abnormally high humidity, the moisture being derived from the warm waters of the Red Sea, which reach 90°. The highest known temperature of the wet-bulb thermometer, 100°, has occurred at Kamaran island and Berbera; this moist heat is very unpleasant Where the Sahara and Kalahari meet the Atlantic, different conditions occur; here the presence of cold currents makes the surface of the sea very cold, while the land a few miles inland is very hot; these regions have a very small rainfall, clear skies but frequent fogs over the sea, and a moderate temperature which changes very little throughout the year. The rainfall of the South African west coast from 17 to 28° S. is less than an inch a year

Mediterranean Climate.—Morocco, northern Algeria and northern Tunis have pleasantly mild, rather rainy winters and

long, hot, dry, almost cloudless summers. The annual rainfall averages about 30in., but is very variable. The mean temperature is between 50° and 60° in January and about 80° in July and August; the daily range is about 15°. A similar climate is found over a small area near Cape Town, which has a temperature ranging from 55° in July to 70° in January and February, and a rainfall of 25in. falling mainly from May to September inclusive.

Eastern Africa.—Kenya Colony, Tanganyika, Uganda, Nyasaland and Portuguese East Africa have an equable climate with a temperature between 75° and 80° near sea-level and a rainfall of 30 to 60 inches. There is generally a fairly well-marked rainy season; near the equator this occurs in April and May with a minor rainy season in November and December, but further south there is only one rainy season, falling in summer. Thus at Zanzibar the rainiest months are April, May and November, in that order, and at Nairobi, April, November and May, but at Lourenço Marques in 26° S, January and February The dry season or seasons are not so extreme as in West Africa; months entirely without rain are rare and the relative humidity remains fairly high throughout the year The prevailing winds are easterly Thunderstorms are very frequent during the rainy season, recurring with great regularity almost every afternoon. The low-lying coastal areas are enervating and in places unhealthy, but large parts of the interior, including the whole of Uganda, form plateaux with an elevation of several thousand feet, and as the average temperature decreases upwards at a rate of about 3° per 1,000ft, these uplands are much cooler and more bracing than the coastal regions, while their distance from the sea makes them somewhat drier except on slopes directly exposed to the rain-bearing easterly winds. These plateaux are rather more suitable for European habitation than the coastal areas. Natal and the eastern parts of the Cape Province have warm, rainy summers, with a temperature of 70° to 75°, and moderately cool winters, relatively dry but very seldom rainless The annual rainfall is between 30 and 40in; the average July temperature is 63° at Durban and 59° at East London, but over the high ground of the interior frosts are sometimes experienced in winter This is one of the finest and healthiest climates in Africa. (C E P B)

FAUNA

Africa, together with the Deccan and West Australia as well as Brazil, forms part of the old continental mass of Gondwanaland, whatever view one may take of the process of separation of each from the others Gondwanaland seems to have persisted through much of the Mesozoic era, during which these southern lands were separated from the northern ones by the broad sea of Tethys, along which later uprose the great fold mountain ranges that stretch from the Pyrenees to the Malay. The southern lands thus show resemblances in their forms of life that are due to these old links. Another factor of the history of life within them is the stability of their conditions as contrasted with the wide variations that have occurred in the orography and climate of the northern lands. Those wide variations have been reflected in evolutionary changes among living things and thus the northern lands have become in a large measure the homes where new forms are born, while the southern ones are largely refugees of early strays from the north, or places where certain types immigrating since connections were made have had a great career The Sahara desert-barrier is largely a modern (post-glacial) hindrance to immigration of animals, the Rift system a partial but serious hindrance also relatively recently established.

The isolation of Africa is far less than that of Australia, and, whereas Australia retains the two lowly egg-laying mammals (*Ornithorhynchus* and *Echidna*) and is the great home of the marsupials, and of no other truly native mammals save bats, an indication of its long separation, Africa retains neither the egg-laying mammals nor the marsupials. The lowliest order of truly placental mammals, the so called Edentata, absent from Australia, occurs in South America, Africa and south-east Asia. Its great home is South America, but the aardvark (Cape ant-eater) is peculiar to Africa and *Manis* (the scaly ant-eater) has species both in Africa and in south-east Asia. It is an interesting fact that the order, though an ancient one is absent from Madagascar. The primates offer a contrasted distribution. Among them the lemurs are ancient forms of known fossil from the northern lands but now surviving in Africa, Madagascar and south-east Asia; Africa has many more forms than south-east Asia and Madagascar many more still. From the lemurs have descended monkeys and apes; the platyrrhine monkeys are American, the catarrhine, African and Asiatic, including, among anthropoid apes, the orang-utan and the gibbon of south-east Asia and the gorilla and chimpanzee of intertropical Africa. It is generally thought that the survival of lemurs in Madagascar is a result of its separation from Africa before the great carnivores had spread thither. The absence of elephants, rhinoceros and anthropoid apes from Madagascar is noteworthy. The most important African carnivore is the lion, also found in parts of Arabia, Persia and western India and formerly more generally distributed in south-west Asia and north-east Africa until man restricted its range. The leopard (panther) and hyena are the other large carnivores. Madagascar has very primitive carnivores only, one of which was formerly said to be closely related to a West Indian form though the resemblances seem better interpreted by the fact that both are ancient types The African elephant is a species distinct from the Indian one, the distribution of the genus was of course far wider until postglacial times The hoofed animals of Africa are of some interest Of even-toed forms Africa alone preserves the hippopotamus which ranged widely in northern lands until a late phase of the ice age; remains of a small hippopotamus species have been found in Madagascar which also possesses a river hog (*Potamochaeros*) It is thought that they may have swum across from Africa before the separation between continent and island became very marked The giraffe and okapi are another family of hoofed animals found in East Africa only. The rhinoceros has east African and south-east Asiatic species. The single humped camel is now a feature of the steppes and deserts of north Africa but only as a domesticated animal introduced from Arabia Deer are absent from Africa save for a few forms in French Africa, north of the Sahara, just as bears and wolves do not occur south of the desert. On the other hand the immense warm African grasslands are overrun by many antelopes, and the zebra and formerly the quagga Africa thus, along with a number of old fashioned forms has several relatively new fashioned ones, but the absence of true cattle, pigs, goats, sheep and camels until man brought them is a striking fact Of the genus *Bos*, nevertheless, South Africa possesses a representative in the Cape buffalo (*Bos caffer*). Africa has many birds peculiar to it but we need only notice the ostrich family of birds that run over grassland and desert border; extinct running birds of great size (*Aepyornis*) lived in Madagascar apparently not very long ago. Some African reptiles (*e g. Amphisbaena*) appear closely related to South American forms, others to those of northern lands, the abundance of crocodiles is a feature and so are the chameleons, which especially abound in Madagascar. The python and puffadder are notable among African snakes. Monitor lizards, abundant in Africa and elsewhere, have not reached Madagascar The Amphibians of Madagascar include several species also found in south-east Asia and this may be a result of an ancient land connection, and analogous arguments could be given concerning the land snails. Africa has the disastrous fate of being the one home of the tse-tse fly. (X.)

FLORA

The character of the vegetation of Africa is largely determined by the distribution of heat and moisture coupled with the great range in altitude. Phytogeographically the continent may be primarily divided into three sections: (1) a northern extratropical region, bordering the southern shores of the Mediterranean and gradually fading into the northern Sahara desert with a very scanty flora; (2) a tropical African region, bounded approximately on the north by the Tropic of Cancer; and (3) a South African region, reaching as far north as the Limpopo, Lake Ngami and southern Angola. According to Thonner (*Fl. Pl. of Africa*, 1913), there are in Africa about 3,712 genera and over 40,000 species of flowering plants, a number constantly being added to.

The Northern Area.—The northern area contains a considerable proportion of genera and species common to the south of Europe, besides a large number of endemics in and south of the Atlas mountains and in Morocco In the Atlas mountains the Atlantic cedar (*Cedrus atlantica*) is a characteristic tree, and is very closely related to species in Asia Minor and the western Himalayas, some authorities having considered them all to be forms of one variable species. The flora of Morocco is related to that of the Canary islands, whilst the somewhat meagre indigenous vegetation of Egypt is largely the same as that of Palestine and Persia.

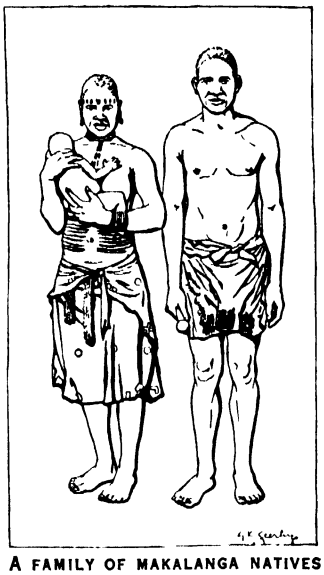
The tropical African flora may be roughly divided into four regions: (1) a northern desert or semi-desert region; (2) a savannah region; (3) a high mountain region, and (4) the tropical rain forest. The first type is characterized by a very scanty rainfall, and its flora consists largely of plants which are short-lived, such as annuals, or those specially adapted to resist long periods of drought These include the date-palm (*Phoenix dactylifera*) which grows where other vegetation is practically non-existent. The transition from the semi-desert to that of the savannah is usually gradual with an increase in annual rainfall and pronounced wet and dry seasons In the savannah the low, thorny bushes of the desert are replaced by scattered trees and shrubs, giving the country a park-like appearance, with an undergrowth of grasses and herbaceous flowering plants, including numerous annuals and species with underground root-stocks This vegetation is typical of the elevated plateau-region which occupies a large portion of the continent. Characteristic trees are the baobab (*Adansonia digitata*), the shea butter tree (*Butyrospermum Parkii*), *Anogeissus Schimperi, Afzelia africana, Entada sudanica, Parkia filicoidea,* the fan-palm (*Borassus flabellifer*), etc.

In general it may be stated that the desert type is steadily encroaching on the savannah, which in turn is gradually penetrating the northern limits of the forest region, a condition resulting from a combination of desiccating winds during the prolonged dry period and of human agency (shifting cultivation and burning of the grass). In the drier parts of the savannah, for example in the eastern Sudan, large areas are covered by species of thorny acacia, including *A. arabica,* producing gum-arabic In somewhat less arid but similar country farther south, in Rhodesia, south-east Belgian Congo and parts of Angola, another leguminous genus, *Bracnystegia,* is very plentiful, and forms almost pure low forest, whilst in the drier semi-desert areas of south Angola and Damaraland a unique example of the vegetable kingdom, *Welwitschia mirabilis,* is found In the savannah and neighbouring forest regions there are numerous plants with edible fruits and not a few poisonous plants such as species of Dichapetalum (*Chailletiaceae*), the arrow-poison (*Akokanthera*), *Lasiosiphon Kraussianus, Strophanthus,* etc.

The high mountains capping the savannah region, such as the Cameroon mountains, Mt. Elgon, Mt. Kenya, Mt Ruwenzori, Mt. Kilimanjaro, etc , carry a flora of great interest. On one or other of these mountains it is possible to traverse almost as varied a succession of types of vegetation as might be encountered in a journey from the equator to the vicinity of either of the poles. Many of the genera found on their slopes are represented elsewhere only in the temperate regions of the northern or southern hemispheres. Some of the better known examples are berberis, cornus and anemone, whilst outliers from the Cape region occur, such as *Protea.* The weird forests of tree-groundsels (*Senecio*) and the giant species of lobelia are characteristic features of the East African mountains.

The evergreen forest occupies mainly the low-lying country with a high rainfall distributed throughout the year, and extends in an ever-widening belt from the colony of Sierra Leone to the Cameroons, whence it spreads out over a great part of the Belgian Congo and the Gabun as far as the Victoria Nyanza. This forest sometimes penetrates for a considerable distance into the savannah regions along the banks of rivers. It is particularly rich in endemic species of trees, shrubs and woody climbers, some of which are of great commercial value The most important timber trees are the African mahoganies (*Khaya, Pseudocedrela, Entandrophragma,* etc.) and numerous trees of the families Caesalpiniaceae, Combretaceae, Simarubaceae and Euphorbiaceae. Amongst ornamental shrubs the numerous species of Mussaenda (Rubiaceae), with enlarged, brightly coloured calyx-lobes, and the brilliant-flowered combretums, are conspicuous The silk-cotton or kapok tree (*Ceiba pentandra*), with its enormous buttressed trunk, often attains gigantic proportions, whilst in West Africa especially the valuable oil-palm (*Elaeis guineensis*) is abundant. As many of the peculiar genera found in this primaeval forest, especially in the Cameroons and Gabun regions, are also found in the Guianas and Brazil on the opposite side of the Atlantic, it seems probable that it is but the remains of a once much more extensive and continuous tract of forest. Apart from Madagascar, the connection between the East African forests and those of tropical Asia is not nearly so marked

South African Flora.—The South African flora, broadly speaking, consists of two main types: the typical Cape or south-western region occupies a narrow strip within the southern coast line In some respects it resembles certain features of the Australian flora, the peculiar families Proteaceae and Restionaceae and certain groups of Leguminosae being common to the two areas and rare in other parts of the world. The vegetation of this coastal area is of a marked xerophilous character and bears a superficial resemblance to that of certain parts of the Mediterranean It is of the so-called bushwood type, and here and there are tracts of grassland Intermingled with the shrubs are numerous annuals, herbaceous perennials, succulents, etc Farther inland, between the ranges of mountains, much of the surface is occupied by the "rhenosterbosch," *Elytropappus rhinocerotis* (Compositae). True forests occur only towards the eastern part of the region, in the districts of Knysna and Humansdorp, and the trees composing them nearly all belong to tropical genera In the north-west a few trees of a conifer, *Callitris juniperoides,* are found, being the sole remains of a once extensive forest The silver-tree, *Leucadendron argenteum,* is now confined to the Cape peninsula, which harbours as many as a hundred species of Erica Other striking plants in the same district are the brilliant scarlet *Disa uniflora* and the blue *D graminifolia,* two beautiful ground orchids There are also numerous species of the geranium family and many beautiful oxalis, large numbers of which are in cultivation



A FAMILY OF MAKALANGA NATIVES
The Makalangas are a branch of the Bantu race of southern Africa—an agricultural people and more civilized than the tribes of the interior

Of the remainder of the South African regions perhaps the most interesting and remarkable is the Karroo, which occupies a broad belt in the hinterland of the south-western coast region. It is mainly a vast shallow basin which in former times was the bed of a large lake Its altitude, according to Bolus, ranges from 1,800–2,500ft , the mountains on the northern margin reaching 8,000ft. altitude The vegetation is of an intensely xerophytic type, being composed mainly of succulents of weird and diverse form, thorn-bushes and numerous plants with bulbous and tuberous root-stocks. Trees are almost entirely absent The predominant families in this region are Compositae, Leguminosae and Ficoidaceae, the last-mentioned being almost entirely represented by about 70 species of the genus *Mesembryanthemum* and its segregates In this area the exotic *Opuntia* from Central America has become a pest

The upper and Kalahari regions distinguished by Bolus may for convenience be treated as one Whilst the families mentioned above are still highly represented, the grass family, Gramineae, takes a very high place, much of the country being grassland (high veld). Here also there is a considerable influx of families and

genera characteristic of the tropical regions to the north. Amongst the Compositae the everlastings (Helichrysum) are conspicuous.

The south-eastern coast region is bounded on the south-west by the Van Stadens mountains and extends northwards east of the Drakenberg as far as the tropic into which it gradually merges. It is essentially a southerly extension of the tropical flora of East Africa, and contains a large number of such tropical families as Asclepiadaceae, Acanthaceae, Rubiaceae, etc. True rain-forest occurs in Natal. The plants so characteristic of the south-western coast region diminish rapidly northward. Some of the most striking plants in the area are a large tree-euphorbia (*E. grandidens*) and several species of Eucephalartos (Cycadaceae) and numerous species of aloe. Although nearly opposite the island of Madagascar, there is scarcely anything in common between the two floras.

As in the case of the tropical flora, it seems clear, judging by the history of the vegetation, that the climate of South Africa is gradually becoming drier. (J. Hu.)

GEOLOGY

Africa has a simpler geological structure than any other continent, although it has many unique features and formations. It consists essentially of a plateau of which the rocks have not been bent into steep folds by compression since primaeval times, except for a strip in Cape Colony, which was part of an ancient southern continent, and for the Atlas Mountains, which are geologically and biologically European. The continent between these remote chains of fold mountains has undergone no close folding, and most of it has remained above sea level since the time of the oldest known fossils. The margins have been repeatedly reached by the sea, which has submerged the coastal plains and occasionally extended inland up the valleys. The plateau has been fractured and cleft by earth movements which occasioned widespread volcanic eruptions; but the plateau surface has remained a land area on which plants and animals have evolved continuously, subject to the stimulus of changing climate, but never interrupted by submergence. Africa is part of an ancient continent which included most of South America, India and Australia. This southern continent, Gondwanaland, was separated from the contemporary northern land of Eurasia, except for an occasional isthmus, by a sea, the Tethys, which extended from central America through the Mediterranean and across southern Asia to the Eastern Archipelago. The range of this southern continent is best established in Carboniferous times; by the Jurassic its disruption had begun by subsidences which formed the Atlantic and Indian oceans, introduced great changes in its biological relations, and repeatedly caused widespread volcanic eruptions.

The foundation of the continent consists of a vast slab of rocks belonging to the Primaeval or Pampalaeozoic era. They are exposed over about one-third of the continent. They outcrop from Cape Town to southern Egypt, and from the Gold Coast on the west to Somaliland, the eastern horn of Africa. Most progress in the classification of these rocks has been made in South Africa, where they have great mineral wealth. They are divided into three main divisions. The lowest, the Swaziland system, consists of gneisses and coarse schists; in addition to the typical areas in South Africa, it forms most of Africa, including Nubia, the highlands along the eastern and Atlantic coasts, and the Sudan from Abyssinia to Nigeria and the Gold Coast This division corresponds to the old gneiss of other lands, such as the Laurentian of Canada and the Lewisian of Britain.

The second division consists of sedimentary rocks, including quartzites, limestones, dolomites and slaty schists, with vast sheets of volcanic rocks. They are classified in South Africa as the Witwatersrand, Ventersdorp and Transvaal systems. Some of the rocks are so little altered that they have been expected to yield fossils; but none has been found and the *Orthoceras*, said to prove the Ordovician age of the Otavi dolomite, was based on cylindrical concretions. Some of these beds were regarded as Lower Palaeozoic; but they are probably earlier owing to the absence of fossils, and their resemblance to the pre-Cambrian rocks of other continents. The representatives of this division include important copper, lead and zinc mining fields in northern Rhodesia and the Congo basin, the goldfield of Kilo in the eastern Belgian Congo, the goldfields of the Gold Coast Colony and the less important gold occurrences that have been discovered in Tanganyika Territory and Kenya Colony.

The third division includes sandstones that are so little altered that they have been persistently regarded as the inland continuation of the Devonian red sandstones of the coast at Cape Town. The chief member is the Waterberg sandstone of the northern Transvaal, which is probably represented in Uganda by part of the Karagwe series (most of which is referable to the second division), and in Angola by the Oendolongo series. These sandstones are probably the equivalent of the Torridonian of Britain and the Keweenawan of the United States and Canada.

The Palaeozoic era began with apparently the whole of Africa as part of a continent, for the only Cambrian beds known in it are in Morocco near Tetuan, though the sea came close to the eastern coast in Sinai. No certain Ordovician rocks are known, though they have been doubtfully recorded from the Atlas mountains. Many beds in Africa have been called Ordovician and Silurian on inadequate evidence, but some Silurian beds with graptolites occur in the central Sahara.

The Devonian is the oldest African system with widespread fossiliferous beds. It includes the Bokkeveld beds in Cape Colony, and has a wide extent in the Sahara, Libya and the western Sudan, and it reaches the Atlantic on the Gold Coast; marine representatives occur of the lower, middle and upper divisions. Marine Carboniferous rocks occur to the north of the Devonian beds in Cape Colony and limestones with crinoids and *Productus* show that a contemporary sea covered part of Egypt. The Lower and Middle Carboniferous are widely developed in the northern and north-western Sahara, and in south-western Tripoli; and there are small outcrops by the Gulf of Suez. The Carboniferous land deposits are extensive. The lowest part of the Karroo system of southern Africa is Upper Carboniferous and includes the glacial Dwyka Conglomerate and rich coal seams. Coal is also found in southern Rhodesia, Tanganyika Territory and Lake Nyasa. The glacial deposits of this period extend northward into the Congo basin and southern Madagascar. The later divisions of the Karroo system range from the Permian to the Lower Lias and are represented in equatorial Africa; they have yielded many remarkable fossil reptiles. The Permian beds (Lower Beaufort) are represented by shales of freshwater origin with *Palaeanodonta* on the Sabaki in Kenya Colony, and the Trias (Upper Beaufort) by the Tanga beds and part of the Buruma sandstone, of which the fossil *Dadoxylon* forest may be the equivalent of that of the Molteno beds of South Africa. In the Congo there are large areas of sandstones, the Lualaba and Lubilache series, which, judging from their sparse fossils, are Permian and Trias.

There is no established marine Trias in Africa, except for a small development in southern Tunis and along the Atlas of beds like those in Andalusia; though the sea lay a little north in the Mediterranean, most of the Triassic beds of Algeria and Tunis are of the continental type, like those of England and Germany. The breaking up of Gondwanaland had nevertheless probably begun in the Trias, and in the next period, the Jurassic, marine beds were deposited along parts of the east African coast. An arm of the sea then ran up the Mozambique channel between Madagascar and the mainland. The eastern part of Madagascar consists of the primaeval gneisses and schists, on which rest some Karroo beds; the western slope consists of marine Jurassic, Cretaceous and Kainozoic beds, with some volcanic rocks. The Jurassic beds of Madagascar and Tanganyika Territory range from the Lias to the end of the system; further north, in Kenya Colony and Somaliland, the horizons established represent from the Bathonian to the Tithonian. In Tanganyika Territory the Upper Jurassic beds (Corallian to Tithonian) in Tenduguru are famous for their fossil reptiles, of which *Gigantosaurus* is the largest known animal.

The advance of the sea during the Jurassic received in East Africa a check in the Cretaceous; for though a Neocomian gulf ran northward from Uitenhage in Cape Colony past Madagascar, the lowest Cretaceous series is barely represented in Kenya and

its occurrence in Abyssinia is probably due to a gulf from the Mediterranean. The widespread Cretaceous rock of eastern Africa is the Nubian sandstone (possibly partly Upper Jurassic), a land deposit which extends from Egypt to Abyssinia and Somaliland. In Egypt an arm of the Mediterranean sea deposited Cretaceous beds, which represent all the series from the Lower Cenomanian to the Danian.

A Cretaceous strait in the Upper Albian and Senonian extended from the Mediterranean across the Sahara, past Lake Chad and along the Benue valley as far south as Angola. The Cretaceous in Africa is best represented in Tunis, Algeria and Morocco. At the beginning of the period the sea covered a narrow strip of land from the coast to just south of Tunis and Oran; but by the Middle and Upper Cretaceous compact limestones were deposited over much of northern Algeria, and the Cenomanian lagoons lay along the front of the Sahara.

In the same region the Cretaceous sea was succeeded directly by that of the Lower Eocene, wherein were deposited the phosphatic limestones that are the most valuable mineral deposit of northern Africa. A still wider submergence in the Middle Eocene formed the Nummulitic limestone, which ranges across northern Africa from Cairo through Cyrenaica and along the Atlas Mountains to Morocco; and a gulf southward extended on to some of the lower parts of the Sahara. A strait from this gulf continued to the Niger valley and covered the district of Sokoto, and reached the Gulf of Guinea in southern Nigeria and the Cameroons. The Oligocene saw a general retreat of the sea from northern Africa, but beds with small Nummulites were deposited in bays. The freshwater lakes of the Oligocene have yielded at Fayum the fossils which revealed to C. W. Andrews the story of the origin of the elephants from the primitive *Moeritherium*.

The Miocene sea along the Atlas was restricted to a strait from Oran to central Tunis, which was one of the passages that connected the Atlantic and the western Mediterranean. A renewed uplift at the end of the Miocene of the channel reduced these straits, though that south of the Riff in Morocco was apparently still occupied by the sea. In other parts of Africa the marine Cainozoic deposits are scanty. The sea occasionally reached the tropical coasts. A full series of Eocene limestones occur in Somaliland, with also the Upper Oligocene. Eocene and Miocene deposits occur both on the coasts of Kenya Colony and in Tanganyika Territory at Lindi; Miocene limestone occurs in the island of Pemba. The marine Pliocene of the Mediterranean is represented in Algeria and Egypt, while marine Pliocene deposits allied to those of the Persian Gulf also occur, notably in Zanzibar island and at Mombasa.

Africa, therefore, has a long stable development, which was occasionally interrupted by volcanic outbreaks connected with the fractures made by the foundering of the adjacent ocean basins. The eastern half of Africa appears to have been slowly upraised during the Mesozoic into a broad, flat arch contemporary with the formation of a great sea-filled trough along the East African coast The wider subsidence that formed the Indian Ocean led to the giving way of the eastern side of the arch, and the infall of its roof formed the Great Rift valley, which extends from Mozambique throughout eastern Africa and along the Red Sea to the Jordan valley. The fractures connected with its formation were accompanied by great volcanic eruptions, and the Kapitan phonolites of Kenya Colony are probably contemporary with the Deccan traps of north-western India. The earth movements connected with the formation of the Great Rift valley lasted from the Oligocene to the Pleistocene, and they were accompanied by repeated volcanic eruptions. They built up the two highest of African mountains—Kilima Njaro, which still has a crater upon its summit, and Kenya, which is the denuded neck of an old volcano. Subsidences around volcanic centres formed great cauldrons, such as Ngorongoro in Tanganyika and Menengai in Kenya Colony. Volcanoes along the fractures connected with the formation of the Atlantic produced the shonkinite vent at Chieuca in Angola, the volcano of the Cameroons, which is still active, while eruptions along a fracture parallel to the coast formed the islands of the Guinea Gulf, Fernando Po, San Thomé, Principé and Annobon. The deepest subsidences along the Rift valley in Africa formed the lake basins of Tanganyika, Nyassa, the Albert Nyanza and Lake Rudolf.

The economic geology of Africa is connected mainly with its rich mineral fields, especially of gold and diamonds in South Africa, southern Rhodesia and the Gold Coast; of gold at Kilo; of diamonds, copper, zinc and lead in Northen Rhodesia and Katanga. Tin and platinum are found in the Transvaal, and chromium in southern Rhodesia. The most important phosphate deposits are along the Atlas Mountains. The only productive African oil-field is on the coast of the Gulf of Suez; oil-shale is known in South Africa, Nigeria and elsewhere; rich coal-fields are worked in the Transvaal, Natal and Southern Rhodesia; and coal also occurs in Tanganyika Territory, Nyassaland and Nigeria. Iron ores are widespread, as are also deposits of bauxite and manganese, which are most extensively worked on the Gold Coast. The chief African mica mines are in Tanganyika Territory.

TABLE OF FORMATIONS

		CAINOZOIC
	Pleistocene.	Raised coral reefs. Alluvial river and lake plains. Moraines on Kilima Njaro, Kenya, and Ruwenzori Elephant beds in Zululand. Lavas and tuffs of recent volcanoes. Gravels, desert sands, etc., with Neolithic and Palaeolithic implements.
	Pliocene.	Marine beds in Tunis and Algeria. Sands with *Clypeaster* in Egypt. Limestones of Zanzibar, Pemba and Mombasa. Naivashan lavas in Kenya. Bone beds at Homa, Omo Valley, etc. Lavas in Atlantic islands, Aden, etc.
	Miocene.	Marine limestones in Algeria and Tunis. Limestones of Pemba and Tanganyika coast *Dinotherium* beds of Victoria Nyanza. Limestones of Egypt with oil-field of Gulf of Suez.
	Oligocene.	In former bays along Mediterranean coastlands. Dubar limestone of Somaliland. Limestones N. of Mombasa and at Lindi. Lake beds of Fayum. Early faulting of Great Rift valley.
	Eocene.	Nummulitic limestone of N Africa coastlands; in Sokoto, northern Nigeria; Somaliland; Coasts of Kenya Colony. Tanganyika Territory. Sheringoma in S. Mozambique. *Aturia* beds of S.W. Africa. Widespread volcanic eruptions in Kenya.
		MESOZOIC
	Cretaceous.	Neocomian to Up. Cretaceous along eastern coast of S. Africa Neocomian-Cenomanian in Mozambique; Urgovian-Senonian in Tanganyika Territory. Cenomanian-Danian Egypt. Lower to Up. Cretaceous along the Atlas mts. Albian in Angola. Turonian, Benue valley. Kapitian Phonolites of Kenya Colony. Nubian sandstone in Nubia, Abyssinia, and Somaliland.
	Jurassic.	Upper—Meragalleh limestone in Somaliland and Kimmeridgian-Purbeckian, with giant reptiles and marine beds, in Tanganyika Territory. Ammonite beds near Mombasa. Middle.—Kenya and Tanganyika Territory. Lower.—Bathonian and Bajocian limestones in Tanganyika Territory, Kenya (Kambe limestone), Somaliland, and Madagascar.
Karroo System.		Lias. Tanganyika Territory and Jubaland. Rhaetic. Drakenberg lavas. Upper Tanga beds with plants. Coal series in Natal.
	Trias.	Marine. Terrestrial Trias in S S. Tunisia and Atlas Cave sandstone and Molteno beds. Mazeras sandstone with *Dadoxylon* forest in Kenya coastlands. Upper Beaufort. Kenya coastlands. Burghersdorp beds of S. Africa. Lubilache sandstones of Congo basin.
		PALAEOZOIC
	Permian.	Lower Beaufort in S. Africa. Tanga beds. Sabaki shales with *Palaeanodonta*. Tanga beds. Upper Lualaba sandstones of Congo.
	Carboniferous.	Upper Uralian. Ecca beds with coal-fields of Transvaal and glacial Dwyka conglomerate in S. Africa. Wankie coal in S. Rhodesia. Coals in Tanganyika Territory and Congo. Glacial beds in Congo and Madagascar. Middle.—Absent. Lower.—Witteberg series of Cape Colony. Crinoid and *Productus* limestone in Egypt.
	Devonian.	Bokkeveld series of Cape Colony. Marine beds of Sahara, Libya, and Sudan. Table Mountain sandstone.

Silurian.	Central Sahara.
Ordovician.	Absent.
Cambrian.	N.W. Morocco and Gulf of Akaba.

PAMPALAEOZOIC (PRIMAEVAL)

Upper Division.	Waterberg sandstone of S. Africa. Oendolongo beds, Angola.
Middle Division.	Transvaal, Ventersdorp, and Witwatersrand systems in Transvaal and S.W. Africa with representatives in Rhodesia, southern Congo. Lepi series of Angola. Kandelurgu and Karagwe quartzites of Tanganyika and Uganda. Banket series of Gold Coast.
Lower Division.	Swaziland system with gneiss Schists of the main foundation of the African continental plateau.

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ANTHROPOLOGY AND ETHNOLOGY

North Africa and Egypt.—Apart from Egypt and the Nile Valley the divisions of Africa north of the Sudan are in the main political and from the anthropological standpoint almost entirely artificial. Not only are the Egypto-Tripolitan and the Morocco-Algerian frontiers entirely conventional, but even the Libyo-Tunisian frontier lacks the ethnic significance it might possess if instead of leaving the Mediterranean in the neighbourhood of Cape Roux it ran almost due south from the Gulf of Gabes. The political divisions of the western portion of North Africa—Africa Minor—thus stand in sharp contrast to its natural unity, so well-defined between the desert and the Mediterranean that the early Arab geographers named it Geziret el Magreb, "the Western Island." It is also necessary to realize that the predominantly Arab complexion of North Africa and the general substitution of Hamitic languages by Arabic began little more than 1000 years ago, while to appreciate the vast area of country over which the spread of Arab influence has obliterated or modified the earlier Berber tongues reference should be made to some such linguistic map as that given by Meinhof in *Die moderne Sprachforschung in Afrika* (Berlin 1910).

The Berbers and Their Position in North Africa.—While Sergi (*Antropologia della Stirpe Camitica*, Turin, 1897) regards the Berbers as the northern branch of the Hamitic stock (the Eastern Hamites being typically represented by proto-Egyptians, Beja and Galla), Keane (*Man, Past and Present*, Cambridge, 1920) quotes T. A. Joyce to the effect that it is impossible to prove the connection between Eastern and Northern Hamites, and that the latter should be regarded as the African representatives of the Mediterranean race The question is largely a matter of terminology, since we cannot doubt the close relationship of the groups commonly termed Mediterranean, proto-Egyptian, and Beja.

The term Moor, which is often applied to the townsmen of Morocco, is here purposely avoided, and with Collignon and Deniker ("Les Maures du Senegal," *L'Anthropologie*, 1896) is restricted ethnically to a group of peoples lying between the Senegal River and Morocco and extending east to the Tuareg country.

Egypt.—For Egypt alone in North Africa it is possible to construct a connected anthropological record, which, in spite of gaps, reaches back to the very dawn of history. Some thirty years ago Flinders Petrie and J. E. Quibell discovered at Naqada and Ballas in Upper Egypt a series of cemeteries belonging to a people with a mode of life and habit of burial utterly different from those of the dynastic civilization previously known in Egypt. Their discovery was followed up and extended by de Morgan, who recognized that Petrie's "new race" preceded even Mena, traditionally the first ruler of a united Egypt, whose tomb he found and excavated. Unfortunately de Morgan applied the term "neolithic" to this newly discovered people, a complete misnomer —though still used in French works—since detailed archaeological examination indicates that copper occurs in the earliest graves in

these cemeteries. These early inhabitants of the Nile Valley are now known as the predynastic or proto-Egyptians, terms which respectively emphasize their position in time and their ethnic relation to the other inhabitants of the Nile Valley.

The Pre-dynastic Egyptians.—The proto-Egyptians have been best described by Elliot Smith, who writes of them (*The People of Egypt,* Address to Cairo Scientific Society, 1909) as a people slightly below the average size of mankind, with muscular development so feeble that it may be difficult to determine to which sex an isolated skull belongs. In physical character they exhibit a remarkable degree of homogeneity. Their hair was dark, and either straight or wavy, never woolly In the men apart from a chin-tuft beard there was the scantiest development of facial hair. These proto-Egyptians had long narrow heads with a narrow forehead and prominent occiput, so that the skull when viewed from above presents a characteristic form which has been termed "coffin-shaped" The face was a moderately long and narrow ellipse, and the chin was almost always pointed. More precisely, they were longheaded, with a cranial index of 73 (Naqada) and a mean height estimated at a little under 65 inches for men and about 60 inches for women, and though there can be no direct evidence as to skin and eye colour there is no doubt that they had dark eyes and skins of a yellowish brown or pale copper colour.

The Dynastic Egyptians.—All this applies only to the population of Upper Egypt; knowledge is lacking of the inhabitants of the delta at this early period, as of the whole of Lower Egypt until the time of the pyramid builders. Among the skeletons of this date from the neighbourhood of the pyramids Elliot Smith found a considerable number in which the skeleton was more robust, with a bigger and especially a broader skull without the angularity and the projecting occiput of the proto-Egyptian type; there are modifications in forehead, orbits and nose, with particularly obvious differences in the jaw, in fact the type of man buried round the pyramids belonged to that well characterized group known as the dynastic Egyptian, which in antiquity is represented by the Saqqara "Scribes" and the Sheikh el Belled, and is essentially that of the peasant Egyptians, the *fellahin* of the present day. For a detailed account of skeletal material, and especially of crania, throughout the dynastic period *see* A. Thomson and D. Randall-Maciver *The Ancient Races of the Thebaid* (Oxford 1905). Elliot Smith (*The Ancient Egyptians,* 1923, chapter 7), arrays evidence that long before the New Empire, Egypt was permeated from end to end by this foreign element, which in his opinion carries the physical traits of the Armenoid race There is however one difficulty in accepting this view, which does not arise from any examination of the skeletal remains but results from the large number of portrait statues which the Egyptians have left to us, namely, that although so many of these statues exhibit the broader face and heavier jaw brought in by the alien race, not one of them exhibits any approach to the typical Armenoid, so-called "Jewish," nose. If therefore the foreign element is to be termed Armenoid it can only be called by this name so long as it is realized that this does not imply the presence of one of the most characteristic features of that race as known at the present day. The difficulty is not lightened by the fact that less than 1000 years later at Beni Hassan there are excellent representations of the Aamu, a people of the eastern desert with typical Armenoid noses.

Contemporary Representations of Beja.—The proto-Egyptian type persists to the present day among the southern Beja (*q.v.*), tribes of the Anglo-Egyptian Sudan. It also occurs, though probably in less typical form, among the Ababda of the Eastern (Egyptian) Desert and the riverain settlements in the neighbourhood of the first cataract. We have direct evidence dating from about 2000 B C. of the existence of the pure proto-Egyptian type among a people wearing their hair in the same fuzzy mop as the Beja of the present day on the eastern border of Egypt. Among the wall paintings of the 12th Dynasty in the tombs at Meir (A. M. Blackman, *The Rock Tombs of Meir,* vol. ii., Pl. xxx., London, 1915), is one that undoubtedly represents a Beja. The long thin figure and limbs, with broad chest, narrow flanks and retracted abdomen, are no doubt conventional and exaggerated representations of the characters of the lean pastoral desert men as they appeared to the agricultural Egyptians, but there can be no criticism of the splendid naturalism of the lined face, the thin pointed nose and the mop of hair projecting over the forehead and standing out stiffly over the whole head to the nape of the neck. The beard is the usual chin tuft of the Beja tribes, and comparison with modern Beni Amer clinches the identity of the two peoples, living in the same desert area but separated by 4,000 years. Confirmatory evidence of the proto-Egyptian characters of the inhabitants of the eastern desert and of their civilization is offered by the discovery by G. W Murray of a burial of late pre-dynastic date, with characteristic grave goods, near Ras Samadi on the Red Sea Coast, in lat. 24° 59′ N. (*Man* 1923, *81*). The skull accorded well with those of the pre-dynastic Egyptians.

The desert must indeed be regarded as a reservoir not only of early archaic physical types no longer preserved in the richer Nile lands but also of ancient ideas and appliances, *e g*, the camel stick of the Ma'aza of the Eastern Desert is no other than the *Uas* sceptre of ancient Egypt applied to a new use

The Arab Element.—The Arab conquest, which politically altered the whole history of Egypt, had no appreciable influence on the physique of its inhabitants. While in part this may be due to a certain physical resemblance between Arabian and Egyptian the numerical inferiority of the conquerors must be held to be the determining cause. The nature of the invasion may be best illustrated by considering the history of the Juhaina (Sudanese, Guhayna, *q v*). The tribesmen took a prominent part in breaking the power of the Christian kingdom of Nubia; yet in spite of their importance in the past, at the present day few groups that may fairly be called Arabs exist except in association with the desert Such are the fisher folk of Lake Menzaleh, who trace their origin to Sinai; the Harabi of the Fayum, extending into the Tripolitan desert, still pastoral nomads; the Aulad Ali of the Behera district of the Delta, no longer nomads; and the practically sedentary Howeitat of Matarieh; all dolichocephals or low brachycephals In the Eastern Desert the only important Arab tribe is the Ma'azâ, about whom very little is known, described by Chantre (*Recherches Anthropologiques en Egypte,* Lyon, 1904), as short dolichocephals.

Besides these more or less well-defined groups there is in upper Egypt a small number of people, generally mobile in their habits, living along the edge of the cultivation. These folk generally keep goats and often own a few palm trees, and formerly may have been of more importance as charcoal burners. Somewhat in the position of gypsies in England fifty years ago, they are generally unpopular with the *fellahin,* on whom they levy a certain amount of blackmail. Such groups as the Bili, near Baliana, and the Aleiqat, of whom there are a considerable number near Qus, do not come into this category

In Sinai, with a total population of some 10,000, the chief tribes are the Howeitat, the Tiyaha and Terabin, in the North; in the South the Tawara (*i e*, the people of Tor), who include the Aleiqat, the Sawalha and Muzeina.

The Modern Egyptian.—Passing to the *fellahin,* the modern Egyptian, the most important of the numerous studies that have been made are those of C S Myers ("Contributions to Egyptian Anthropology," in vols. xxxv, xxxvi, and xxxviii. of the *Journal of the Royal Anthropological Institute*) and of J. R. Craig ("Anthropometry of Modern Egyptians," *Biometrika,* vol. viii, 1911). Omitting the province of Aswan and the town dwellers, these papers, which must be regarded as complementary, indicate that the Egyptian peasant has a stature of approximately 65½in, showing no sharp division between Upper and Lower Egypt; he is longheaded, with a cephalic index of about 75, the cephalic index—again omitting Aswan—being about a unit higher in Lower than in Upper Egypt. There is no evidence that the natives of various provinces differ in variability, nor is it possible to resolve distribution curves, whether of measurements or indices, into components corresponding to hypothetical underlying ethnic types, though it seems that passing from Lower to Upper Egypt

eye and skin colour darken and the proportion of unusually broad noses increases as does the frequency of spiral and crisp hair, all evidences of increased though still well diluted negro blood in the population.

The position of the Copts (the Christian population of the present day, and therefore with insignificant exceptions the descendants of the Egyptians who refused to relinquish their faith at the Conquest or during the succeeding centuries) is particularly interesting. The observations available refer to Coptic peasants, not town dwellers, and so far as these go the remark commonly made by Europeans that they can distinguish at sight between Muslim and Copt is not borne out. No significant deviation from the general Muslim population is found as regards head measurements or facial characteristics, though the nose is slightly less broad and the lip slightly thinner, with eye and skin colour a trifle lighter. Thus, diagnosis at sight between Copt and Muslim, if really practicable, cannot rest on easily defined physical characteristics but must be attributed to such other factors as gait, dress, etc.



BY COURTESY OF NORTHERN BAPTIST CONVENTION

A NATIVE OF BELGIAN CONGO
Of powerful physique and expert huntsmen, a few of the tribes in the Belgian Congo persist in cannibalism

The measurements and photographs of natives of Kharga Oasis published by Hrdlicka (*The Natives of Kharga Oasis, Egypt,* Washington, 1912) show that its inhabitants are Egyptians, differing in no essentials from the inhabitants of the Nile Valley. The inhabitants of Siwa speak a Berber dialect, akin to Tuareg, with many Arabic loan words, some so profoundly modified that their origin is not immediately apparent. Jaghbub (Jarabub), in Italian territory, is believed to have been uninhabited before its occupation by the Senussi, whose capital it now is.

Disposition of the Fellahin.—Difficult as it is to sum up the temperament or disposition of a people it is probably true to say that the *fellahin* are in the main good natured, cheerful and excitable, genuinely religious but not generally fanatical, though certain centres such as Tanta have a bad reputation in this respect. They are liable to occasional bursts of ferocity (such as distinguished the rioting of 1919), and inter-village enmities, leading to fights with iron-shod staves, were formerly fierce and persistent. Nothing approaching an adequate account of the beliefs and customs of the *fellahin* has yet been written, for Lane's *Modern Egyptians,* first published in 1836 before western influence had contaminated Egyptian habits and modes of thought, though giving an invaluable account of Cairene life and manners cannot be held to apply except in somewhat general terms to the habits and beliefs of the peasants, which even preliminary inquiry will show to vary not only from those of the towns but as between Upper and Lower Egypt. Meanwhile the work of Miss Winifred Blackman (*The Fellahin of Upper Egypt,* 1927) avowedly only a preliminary account, contains much useful information.

Tattoo, etc.—Tattooing is the most obvious, common and widespread method of bodily enhancement and mutilation. Lane mentions the simpler designs—dots, lines and circles—common in women and refers to the "extremely displeasing" habit of the women of Upper Egypt of discolouring their lips with tattoo. C. S. Myers ("Contributions to Egyptian Anthropology, Tattuing," *J.R.A.I.,* vol. xxxiii., 1903) found that of about 400 male subjects nearly 100 were tattooed, the designs falling into two main classes, namely simple, generally geometrical, designs, and pictorial representations, *e.g,* the façade of a mosque or the Persian lion with sword. Local examples of the type prevailing throughout North Africa form the first class while the latter are derived from eastern sources. Circumcision is universal; clitoridectomy, though far less recognized by Europeans, is customary in cities, at least among the poorer class, and may be equally common among the Fellahin. Both long antedate Islam, circumcision being represented in a tomb of the pyramid age at Saqqara, while clitoridectomy or a similar operation is alluded to by Strabo —*Circumcidunt etiam mares et foeminas excidunt.*

Survivals from Ancient Egypt.—One of the most interesting features of present day Egypt is the persistence in popular belief of ideas traceable to ancient Egypt, especially intricate ceremonies connected with mourning, the survival of the belief in *ka* or double, the persistence of a ceremony in which a sacred boat takes a prominent part, and the superstitions connected with particular days in the calendar. The boat ceremonies are particularly important, since these exist widely in Asia outside the Near East (*e.g,* in Ceylon) and it seems probable that their distribution has been to a considerable extent brought about from Egypt by the spread of Islam. Nearly 20 years ago the writer observed a full-sized river boat suspended in a tree outside Luxor; enquiries showed that once a year this was placed in a cart, filled with children and dragged round the fields. Actually there are three boat processions every year in Luxor, the most important being observed in honour of Abu'l Heggag, the patron saint of Luxor. The substitution of Amon and his sacred barque by Abu'l Heggag and his Nile boat is suggested by the popular belief at Karnak that on certain nights the golden boat of Amon may still be seen to emerge from the waters of the sacred lake, steered, as of old, by the Pharoah.

The calendar customs are a striking example of how beliefs attached to a particular day may last for over 3,000 years, persisting through a complete change in the mode of reckoning time, as well as the introduction of new beliefs. The Sallier papyrus, which dates from the time of Rameses II. or possibly his successor, gives an account of the lucky and unlucky days in the year, and describes in some detail the quality of the good and bad luck, with instructions for behaviour on each of these days. It may first be noted that the five epagomenal days of the old Egyptian year were unlucky. In modern Egypt the epagomenal days are still observed to the extent that neither sowing nor planting should be undertaken, mares and cattle should not be covered lest their offspring be misshapen, and it is even believed that children begotten during these days will show some abnormality. A still more interesting example perhaps is that afforded by a day near the end of the old Egyptian month of Choiak; the Sallier Papyrus marks the 26th of this month as most unlucky, and of this day it is written, "Do not eat fish. Those residing in the midst of Tattu turn themselves into the fish An." The mythological allusion cannot be explained, but the modern popular calendar, such as is hawked about the Bazaars, notes that on the 11th of Moharram (corresponding to the 26th day of the Coptic month Kyhak) "the eating of pigeons is liked, that of fish disliked."

The Beja Tribes of Egypt.—Of the Beja tribes of the eastern desert the Ababda (*q.v.*) fall wholly within Egyptian territory; the Bisharin extend some 80 miles south of the boundary and occupy a strip of territory stretching along the right bank of the Atbara. While the physical characters of both tribes have been studied by E. Chantre (*Recherches Anthropologiques en Egypte,* Lyons, 1904) and the mode of life of the Bisharin described by Linant de Bellefonds (L'Etbaye, 1858), two recent papers by G. W. Murray ("The Ababda," *J.R.A.I.,* vol. liii., 1923, and "The Northern Beja," vol. lvii., 1927) constitute by far the most valuable account of these people. The Ababda inhabit the eastern desert from the Sudan frontier to north of the Kena-Kuseir road, and there are isolated colonies along the edge of the cultivation from Assiut to Korosko. In the time of Bruce their southern range was limited by the 'Atawna (Arabs) who have now vanished from the desert. Earlier yet Makrisi records the Beli (Bili) a tribe of which scattered groups still exist along the edge of the cultivation—as being in possession of parts of the desert now belonging to the Ababda. The desert Ababda intermarry with the Bisharin, and those settled in the Nile Valley with the Fellahin, but they do not appear to intermarry with any Arab tribes still carrying the desert tradition. Like other Beja tribes the Ababda wear the *dirwa,* the shock head-dress of hair

besmeared with mutton fat, though this custom is gradually dying out. Unlike their Beja neighbours to the south the Ababda speak Arabic, but coloured by Bedauye (*To-Bedawi*) words, while transposition of consonants—a Hamitic rather than a Semitic feature—often occurs.

In physique the Ababda resemble the Beni Amer, and therefore the predynastic Egyptians, *i.e.*, they are longheaded with a cephalic index of 73·6 and a stature of 1·63 metres. The Bisharin on the other hand present two types, those of the Red Sea coast with a cephalic index of 74·7, and those living inland with a cephalic index of 78·4, the latter substantially identical with the index given by Chantre, presumably derived from individuals living in or near the Nile Valley. (Murray, *op.cit.*)

Tripoli.—Westwards beyond the Egyptian frontier knowledge of the physical anthropology of Tripoli is but slight. At the extreme west of Italian territory, *i.e.*, in the area surrounding Tripoli city, the systematic observations of Bertholon and Chantre show that the population is predominantly long-headed and of rather low stature (below 1·65¾m) but there is an island of high brachycephaly in the immediate area of Bu Ajilat, though these brachycephals exhibit no marked departure from the general low stature of the area. Throughout the rest of Tripoli but few observations have been made, certainly not enough to permit of any connected anthropological history or description of the country. The observations of the late Oric Bates at Mersa Matruh, not far east of the Egyptian frontier ("Archaic Burials at Marsa Matrûh" *Ancient Egypt*, 1915, Part IV., p. 158) suggest that at a period possibly as remote as that of the pyramid builders the population of the coastal plain was not unlike that of the proto-Egyptians, and presumably a people of some such type long continued to form the basis of the population of the coastal plain. Evidence such as that afforded by the ram of Bu Hamama (in Algiers) crowned with the sun-disk and uraei, as well as the presence of the sun-disk on Carthaginian coins, indicates the very considerable cultural influence exercised by Egypt along the north African littoral in late dynastic times, but so far there is no direct evidence of Egyptian influence on the physical anthropology of the country. Nor is there any knowledge in this sense of the effect of the Roman occupation. Herodotus, however, describes the Libyans east of Lake Tritonis, *i.e.*, the inhabitants of Tripoli, as nomadic and thus differing from the settled agricultural peoples of what is now predominantly Algeria, although it is clear that many of these people were in fact no more than semi-nomadic; the Nasamones for instance with their main settlements on the Syrtic shore, left their herds in summer and went up to Aujila for the date harvest, just as some "nomad" Arab tribes of the present day sow their crop in the oases in the autumn, leading a more or less wandering life until the spring.

Apart from the littoral belt the greater portion of Tripoli is desert or poor steppe, for the most part with an annual rainfall varying from three to less than ten inches, such a country can never have been densely populated or have offered any great temptation to highly civilized folk. The position is different with regard to nomads or semi-nomads; here is a sparsely inhabited area which could scarcely fail to attract the Arab tribes that poured into north Africa after the conquest of Egypt under the Khalif Omar, and again in the eleventh century when, in 1048, the Wazir of the Fatimid Khalif Mustansir launched a number of the nomad tribes of Upper Egypt, including the Beni Halal, against his master's orthodox vassals of the northern African States. Each man was given a camel and a gold piece on condition that he would settle in Maghreb, with the result that within two years Cyrenaica had been pillaged and Kairwan captured. But the western movement of the Hilali invasion did not stop here, for while the majority of the Beni Hilal settled in Tripoli and Tunis, and the Athbej passed into what is now Algeria, as far as the Aures mountains and the river Zab, the Makil pressed westwards as far as the high plateau of Morocco-Algeria. Beneath this flood the Berber tongue largely disappeared, and except among the Beni M'zab, the Abadite schism was almost wiped out.

At the present day the population of the coastal plain may for practical purposes be regarded as Arab, and since with the exception of the towns and the oases of the far south the coastal plain—never more than 20 miles in width and generally less than this—constitutes almost the whole of the available territory suitable for agriculture, the Arab tribes of this area form the predominant factor in the population of the country. Of these tribes the Awlad Ali may be taken as the type. Extending from the outskirts of Alexandria to the neighbourhood of Tobruk they grow a considerable amount of barley, and (at any rate before the Great War) possessed horses, sheep and camels, the latter constituting their main wealth. Predominantly sedentary, and horsemen rather than camel-men, they yet live in tents. Their tribal organization is into sections and divisions as among the Arabs of the Sudan, whom (*e.g.*, the Kababish) they closely resemble physically to judge from the measurements given by Chantre. But not all the folk who have been described as Tripolitan Arabs are long-headed; an examination by Mochi ("Presentazione di cranii d'indigeni di Tripoli" *Archiv. per l'Antrop. e la Etnol.*, Florence XL, 1912, p. 381) of the skulls from Tripoli in the National Museum at Florence indicates that they contain at least one hyperbrachycephalic group. Remarkable as is this fact, its significance becomes clear in the light of a series of skulls described by Giuffrida Ruggeri ("I Crani Egiziani antichi e Arabo-Egiziani dall' Universita di Napoli," *Atti dell Societa Romana de Antropologia*, XV., 1910, pp. 112 *et seq*) from an ancient Arab cemetery at Abassieh near Cairo, with an average cranial index (13) of 85·3. The significance of these skulls and their relation to definite areas of round-headedness in Tripoli has been studied by Seligman ("The Physical Character of the Arabs," *J.R.A.I.*, vol xlvii., 1907), who points out that their characters indicate that the Abassieh skulls belonged to natives of Southern Arabia, that brachycephaly prevails both in southern Arabia and in the Levant, and that both these areas have contributed to the population of North Africa.

Barbary (Tunis, Algeria, Morocco).—Tunis, Algeria and Morocco, are but artificial political divisions of one natural area, which from the anthropological as well as the geographical aspect might still be called by its old name of Barbary. Its inhabitants, the Berbers, are commonly regarded as aborigines, and apart from immigrant stocks this seems to be true as far back as the end of the palaeolithic period. The physical anthropology of the natives of Eastern Tripoli, Tunisia and Algeria, has been exhaustively studied by Bertholon and Chantre (*Recherches anthropologiques dans la Berberie Orientale Tripolitaine, Tunisie, Algerie*. Lyon, 1912). The following facts give a rough idea of the progressive weakening of Arab influence, passing from East to West, and the physical characteristics of the three main groups generally recognized.

In Tunis, with a total Islamic population of something under two millions, there are about half a million Berberized Arabs and less than 100,000 Berbers, forming for the most part two isolated masses, the Matmata in the far south in the neighbourhood of Jebel Nefusa, and a group mainly of the Ababdite (Kharijite) heresy in the island of Jerba. Passing westwards to Algeria there are pure Berber groups in the Kabyle hills and in the Aures mountains. Apart from these two areas the remainder of the province of Constantine may be regarded as inhabited by Arabized Berbers except for a few Arab coastal areas. Numerically some 75% of the inhabitants of the province may be regarded as Berber or Berber-speaking, the remainder Arabs or partially Berberized Arabs. In the department of Algiers Arabs mixed with Arabized Berbers preponderate, while in Oran the Arab element is frankly dominant. In Morocco on the contrary the Berbers are not only in great numerical majority but socially form by far the most important groups. Here it is calculated that not more than five per cent of the population are Arabs, with perhaps another five of Berberized Arabs, the remainder of the population being fairly equally divided into pure Berbers and Berbers with a tinge of Arab influence Nothing would be gained by attempting to enumerate the "Berber" and "Arab" tribes of Morocco. Westermarck (*The Moorish Conception of Holiness*, Helsingfors, 1916) divides the Berbers into five groups.—(1) the Ruâfa—the Berbers of the Rif—whose country extends along the

Mediterranean coast from the neighbourhood of Tetuan to the Algerian frontier; (2) the Berāber, who inhabit the mountain regions of Central Morocco and the eastern portion of the Great Atlas; (3) the Shleuh, inhabiting the western part of this range, and to the south of it in the province of Sūs a territory with an eastern frontier running from Demnat in a south-easterly direction and a northern frontier uniting Demnat with Mogador on the Atlantic coast, following more or less closely the foot of the mountains; (4) the Draa, who inhabit the valley of the Wad Draa in the extreme south of Morocco; (5) various tribes living in the neighbourhood of Ujda, in the north-east of the country. The so-called "Arabs" are the Jebala, the mountain-dwelling tribes of Northern Morocco, with their centre in the area between the Rif and Fez and extending westwards of the latter.

Physical Characteristics of the Berbers.—Morocco, is from the standpoint of physical anthropology for the most part unexplored Three physical types of Berber are, however, generally recognized: (1) tall men, with a stature of about 1·70m., dolichocephalic, with strongly marked supraorbital ridges, the face long, tending to oval, the cheek bones by no means prominent, nose long and narrow, chin square and rather scant beard. This type appears to form perhaps half the population of Tunisia and is widespread in Algeria (2) The second type is short, with a stature of about 1·63m, longheaded, with a prominent occiput so that the head when viewed from above is distinctly pentagonal; the face is short and broad, the cheek bones well developed, the nose tends to be broad, the chin prominent and often well bearded, the lips full. This type is to be found in the mountains of central Tunisia, in the neighbourhood of Gabes and of Algiers, in the south of Algeria, as well as all over Morocco. It seems to be generally accepted that the skulls found in the megalithic monuments of this part of Africa belong to one or other of these types. (3) The third group is of moderate stature, 1·64m. to 1·65m., and brachycephalic. The face is broad and short, the forehead round (*bombé*), nose short and broad. This type is specially present in the Island of Jerba and in the oasis of M'zab; it is also found in the hills to the south of the Gulf of Gabes, western Tripoli, and on the Algerian littoral, as well as among the Kabyles and the inhabitants of the Aures hill. Many of the M'zab have a skin so pale that they burn wheaten colour rather than brown in the sun.

While the number of the blonde Berbers certainly varies locally and their proportion has no doubt often been exaggerated (at least in Algeria), a competent anthropologist, the late Anthony Wilkin, specially studying the problem, has recorded that of the observed population of El Arbaa fully 20% were "fair men" (*Among the Berbers of Algeria*, 1900, p. 77). Good observers always lay stress on the essentially white quality of the skin of the pure Berber tribes The origin of this blonde element has been much discussed; it is no doubt foreign—presumably Nordic, with perhaps Alpine admixture—and it existed in Libya as long ago as the New Empire, as is shown by contemporary paintings in Egyptian tombs.

Cultural Characteristics of the Berbers.—On the psychical side some of the main Berber characteristics can perhaps be best appreciated by contrasting them with those of the Arab; moreover such a comparison is particularly useful since apart from the Nile Valley it in some sense embodies an epitome of the history for some 1,200 years of the whole of North Africa.

The Berber is essentially an agriculturist, with a passionate love of the soil upon which he has been born, though a keen trader, often willing to take service abroad but always anxious to return to his village in his old age or when he has amassed a competence. He is a stern fighter, often a determined brigand and in religious matters a born sceptic, while his strong democratic tendencies are indicated by his social organization in which leadership is usually a matter of election, though raiding and war may give real authority to individual strong men which may to a limited extent pass to their descendants. In contrast, the Arab is typically a nomad pastoralist, whose attitude to agriculture is mirrored in the proverb that shame enters with the plough, a poor worker, whose real courage is less likely to be shown when raiding than on a point of honour or as an expression of his religious faith. Moreover, Arab society is essentially aristocratic; the Arab is, and always has been, ruled by hereditary leaders, and his struggles when he does revolt are spasmodic, and directed against the individual rather than the system. With this aristocratic and religious bias there exists a strong contempt not only for the stranger but for Muslims of other sects, and here again he stands in strong contrast to the Berber. These contrasts are of course not absolute; there are nomad Berbers, and many sedentary Arabs; some Berbers become really good Mohammedans, though generally there is much truth in the epigram that the Berber is not a Mohammedan but only thinks he is Moreover, in the West, *i e*, in Algiers and Morocco, there is always the difficulty of knowing whether a given people not obviously Berber or Arab should be regarded as Arabized Berbers or Berberized Arabs. Here social organization and history rather than language seem to be the best guides

Political and Social Organization of the Berbers.—In spite of the religious and cultural influence of Islam the social organization of the Berbers differs in every essential from that of the Arabs. The following outline (*see* MacIver and Wilkins, *Libyan Notes*, London, 1901), in principle valid throughout Barbary, applies specifically to the Kabyle Hills. The Berbers are typically hillmen, living in isolated villages, formerly often well fortified or with a central citadel, and, while possessing flocks and herds which in particular instances may regulate their mode of life, are essentially skilled agriculturists, who have long practised irrigation and are quick to take advantage of every scrap of cultivable ground in the difficult and often sterile hills among which they live.

The unit of government is the village, each possessing complete autonomy. A number of villages form the tribe, the connection being administrative and not regulated by kinship. A union of several such tribes may be termed a Confederation, the bond is looser than in the lower federative grade and the confederation never interferes in the affairs of its tribes unless directly appealed to or when vitally necessary. In time of war a head is appointed for each of the tribes and for the confederation The tribe has deliberative and administrative duties, such as the determination of questions of peace and war, the making of roads, and manages tribal property such as mosques, tombs of saints, and educational establishments; it is concerned with the levying of taxes necessary for these purposes, and may act as arbiter between villages A general assembly of the tribe is almost unknown, its affairs being managed by a deputation of the chief men from each of the villages composing it.

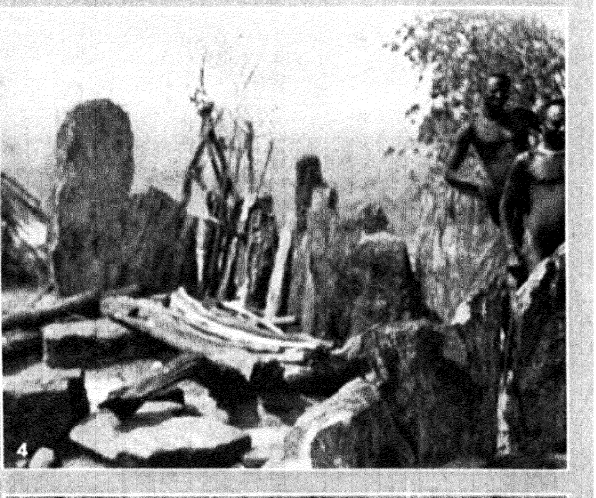
Every village is brought into contact with its neighbours by means of its *sof*, of which there are always two, the term signifying a group whose members covenant to render mutual aid to one another in cases of necessity. In each village the two *sof* are in some sense opposed, and each *sof* will be allied with similar fraternities in neighbouring villages, the ramifications of the *sof* organization extending through entire districts Within the village the members of each *sof* are united by the closest bonds, the obligations ranking above all personal interests and even ties of kinship. Nevertheless, though loyal to his *sof* while he is a member of it, the Kabyle thinks little of transferring his allegiance from one *sof* to another if he thinks he will gain thereby, and outside the village the members of a *sof* though willing to assist their fellows with provisions and even with money would expect to be paid for any active armed assistance they might give The funds of the *sof* are raised by subscription from members and are administered by the heads of the organization, usually men of powerful families and of private wealth, who may disburse considerable sums on secret services without rendering account to the members.

Within the village affairs are controlled by the *jemâa*, the general assembly of the citizens, of which every adult man is a member though in practice only the old men and heads of families exercise the right to speak. Nothing which concerns the welfare of the village escapes the control of the *jemâa*—it exercises judicial authority, makes laws, levies taxes and administers the public property. Decisions are not taken by a majority of votes

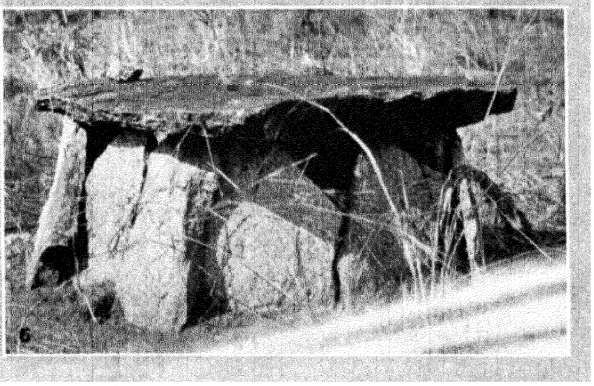










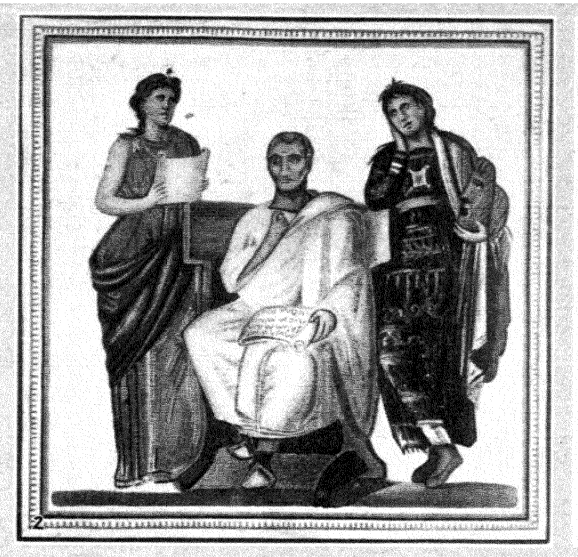


(1, 2) FROM KAMMERER, "ESSAI SUR L'HISTOIRE ANTIQUE D'ABYSSINIE," BY COURTESY OF PAUL GENTHNER LIBRAIRIE ORIENTALISTE, (4) BY COURTESY OF CHARLES PARTRIDGE, (5) FROM TONGUE, "FROM BUSHMAN PAINTINGS" (CLARENDON PRESS), (6) BY COURTESY OF E. E. EVANS-PRITCHARD

CARVED AFRICAN MONUMENTS AND CAVE WALLS

1. **Phallic monoliths, Sidamo**, southern Abyssinia
2. Swords and other low relief stone carvings found in southern Abyssinia
3. Carved monoliths, Cross river, southern Nigeria
4. Megalithic circle of Lotuko tribes, Mongalla Province, Anglo-Egyptian Sudan
5. Bushman painting in a cave at Zuurfontein, Cape Colony, showing a man, oxen, rhebucks, elands and a vulture in colors, which are as bright as when first made
6. **Dolmen, 2-3 ft.** high, over modern burial, Moro tribe, Anglo-Egyptian Sudan







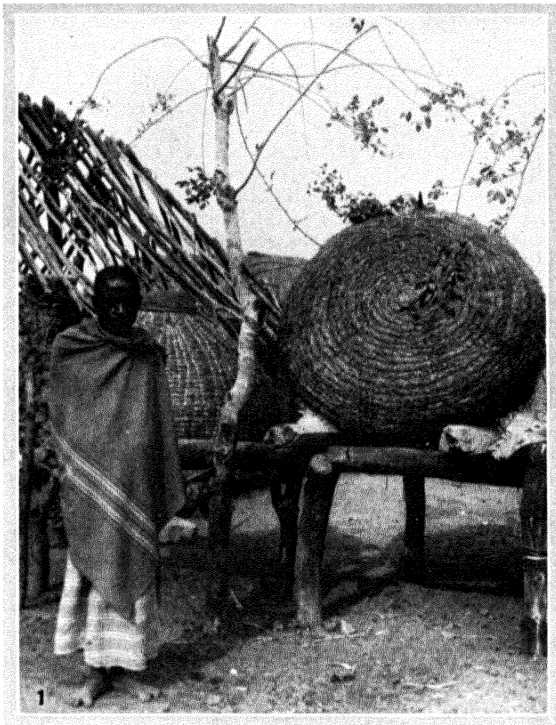




PHOTOGRAPHS: (1, 4, 5) LEVY AND NEURDEIN, (2) FROM "MONUMENTS ET MÉMOIRES DE LA FONDATION EUGÈNE PIOT" (LIBRAIRIE ERNEST LEROUX), (3) BY COURTESY OF TRUSTEES OF THE BRITISH MUSEUM

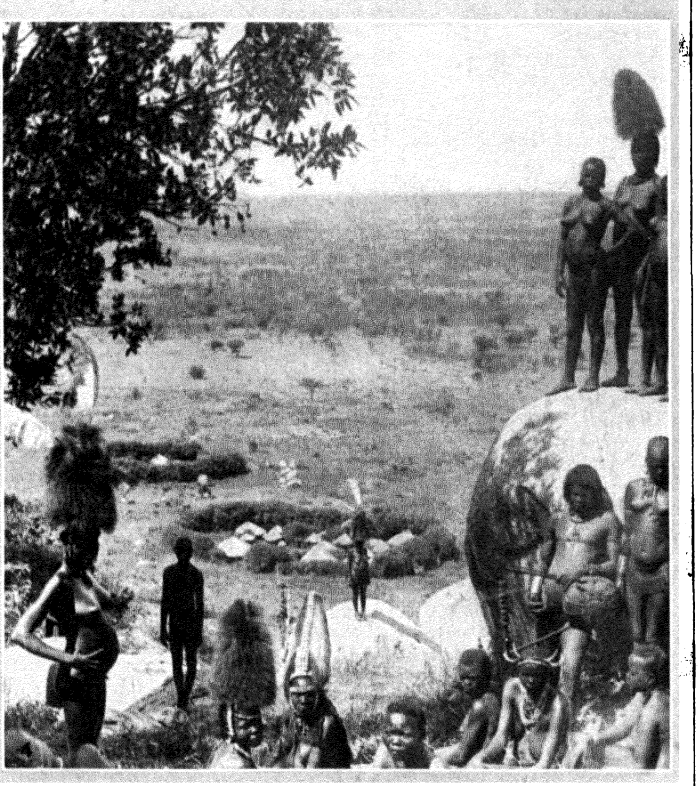
ARCHAEOLOGICAL DISCOVERIES IN NORTH AFRICA

1. The ruins of the capitol at Sbeitla (Sufetula), an ancient Roman city of Tunisia, founded at the beginning of the first century A.D.
2. A mosaic portrait of Virgil, found in Tunis, and dating probably from the first century A.D.
3. Bronze head of a young man of the great Berber tribe of North Africa, with the typically fine features of the early Hamites, to which race he belongs
4. Street of Decumanus Maximus, in Timgad (Thamugas), Algeria, a ruined Roman city, in a remarkable state of preservation. It was founded in the second century, passed from history in the seventh and lay unnoticed in the middle of the Sahara until the eighteenth century
5. A Byzantine wall in Tebessa (Theveste), Algeria, dating from the sixth century A.D., with the Roman triumphal arch of Caracalla built into it







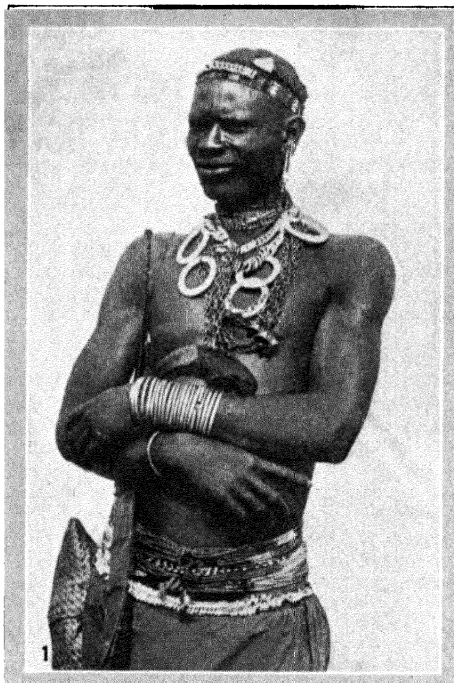


PHOTOGRAPHS (1, 2) VISUAL EDUCATION SERVICE, CHICAGO, (3) UNDERWOOD PRESS SERVICE

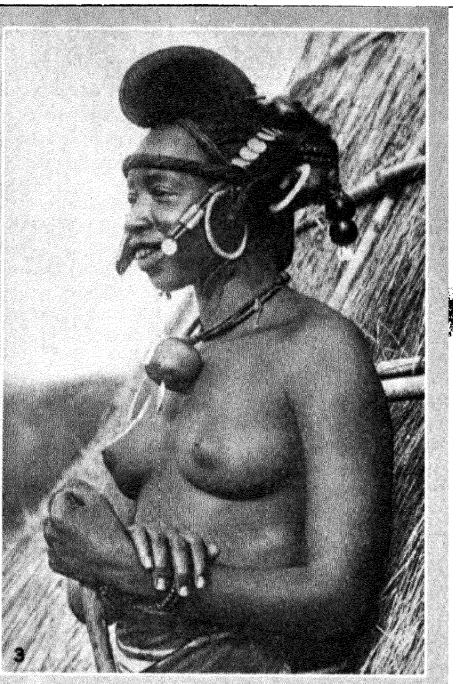
HUTS AND VILLAGES IN CENTRAL AND EASTERN AFRICA

1. Corn-storage-house construction and costume of a negro, Angola, West coast Africa
2. Village granaries and homes of natives, Angola, West coast Africa
3. Masai women building homes of grass and reeds with their husbands looking on
4. Kraals at foot of a hill overlooking a stretch of grassland in Central Africa

AFRICA

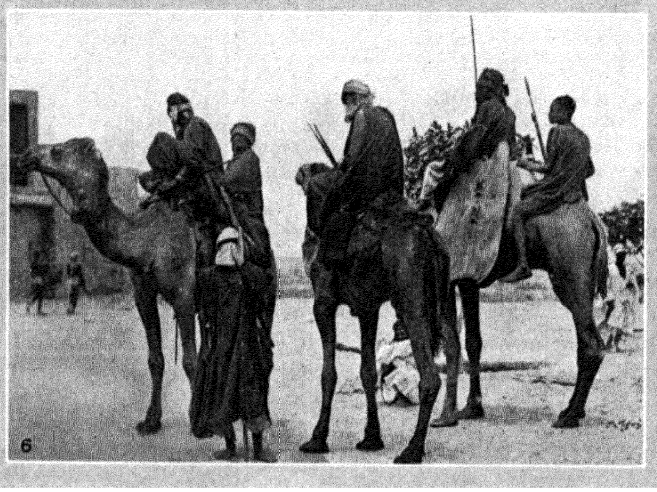


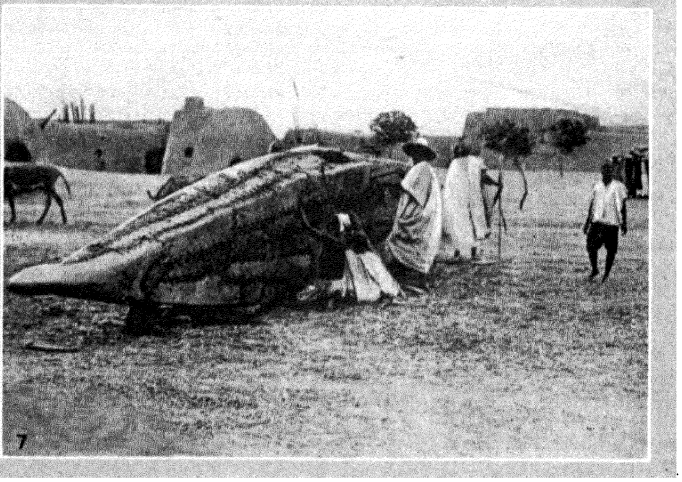












BY COURTESY OF M. FORTIER

NATIVES OF WEST AFRICA

1. An inhabitant of Diola, in Senegal, with ornaments and jewellery
2. Natives of Mankena, in Senegal
3. Ful woman from French West Africa, with headdress and earrings
4. A Moorish camp on the desert
5. Native fishing canoes on a river in West Africa
6. Tuareg warriors from the neighbourhood of Timbuktu
7. Native method of canoe-manufacture in West Africa. Pieces of wood are sewn together

but unanimity is required, and if the assembly fails to arrive at an agreement the discussion may be adjourned, or reference made to an arbiter chosen from among its members or from another village. The executive head of the Assembly is the Amin, sometimes called *amekkeran* (chief) or *amrân* (old man), usually a member of one of the leading families, a man of wealth and able to rely absolutely on the support of his *sof*. He is put forward by the influential persons of the village, the appointment being ratified by the Assembly. His duties include public finance, but except in small matters he has no independence or initiative and cannot act without the consent of the *jemâa*, over whose meetings he presides. He has assistants who are in some sense "police," supervising the various quarters of the village and giving information of all that passes.

Although emphasis must be laid on the agriculture and even the horticulture of the Berbers—the Shawia of the Aures Mountains and the Kabyles being regarded as typical—the Berbers are also pastoralists, and in the higher mountains the seasonal change of pasture-land (*cf.* French *transhumance*), plays an important part in their social life. Thus in the Middle Atlas, a tract of plateaux and peaks some 7,000 feet high merging in the west into the Tadla plain and in the south into the High Atlas, there is a heavy winter snowfall as low as 3,000 feet, which determines a transhumance of the winter type (as in Europe in the Carpathians and Balkans), the flocks being driven down to the lowlands. The familiar summer type of transhumance of the Mediterranean valleys also occurs in the Middle Atlas, the animals leaving the dried sun-parched valleys for mountains; indeed in the Middle Atlas some tribes—as the Beni Mgild—practise both forms, and such tribes when the winter movement leads them far into foreign territory do in fact approach a nomadic life. The so-called nomadism of the Berbers in Morocco should not, therefore, be classed with the wanderings of such true nomads as, *e g.*, the Berber-speaking Tuareg.

Arts and Crafts.—The Berbers are good craftsmen The best Kabyle silver work is probably as good as any made by Africans, many of their tribes make excellent carpets, and in studying their decorative art it is possible to make the generalization that apart from Arab influence their limiting lines are straight, not circular or even arcs of circles. This is particularly obvious in their architecture, even when advanced, as in the minarets of their finest mosques, *e g*, in Marrakesh, Rabat (and even in Seville) the mosque towers are square in section, or sometimes hexagonal, contrasting notably with the rounded minarets of Egypt and the Near East generally. So too the designs woven into their carpets by the more typically Berber peoples of Morocco is geometrical, often rectangular, and always made up of straight lines. Nevertheless, Arabic influence has brought in the arc and the cupola, the latter as common in the *Qubba* (saints' tombs) of the countryside as in Egypt.

The hand made pottery of the Berbers of Algeria, and especially of the Kabyles has excited much interest; it was even suggested that it betokened a direct and somewhat close relationship between the ancient inhabitants of Algeria and the proto-Egyptians (MacIver and Wilkins, *op. cit.*, give good coloured plates of Kabyle pottery; *see* also papers by MacIver and by J. L. Myres in *J.R.A.I*, vol. xxxii., 1902). It is now generally held that the red-faced pot fabrics of Kabylia descend directly from the widespread red-ware of the Neolithic period, so that their resemblance to certain types of pottery of pre-dynastic Egypt is secondary. As regards the characteristic geometric designs, usually black on white or yellow, of the area, these too descend from the endemic geometrical art of north Africa, though affected by Mediterranean influences, especially Aegean. Further, since the Punic settlers of the early Iron Age used the wheel, the survival of hand-made fabrics in the mountains is of interest as defining the rather limited quality of outside influences to which the mountaineers have been subjected.

Medicine and Surgery.—By far the greater part of medicine proper is little more than magic, but there is evidence that, in spite of the recognized danger of the necessarily large doses, henbane (*Hyoscyamus albus*) may be used before operations for its sedative and alleged paralytic and anaesthetic qualities, while in surgery trepanning is successfully performed for fractured skulls. The *dura mater* is never incised—indeed every attempt is made to avoid touching it—and the danger of the brain bulging through the wound (hernia cerebri) is appreciated and special means taken to prevent it. As might be expected, dead bone is freely removed when necessary, but the repair of limbs does not stop here; bone grafting is practised, grafts taken from a dog being most approved, and the cases recorded seem to indicate that the operation may be successful. Other operations include the removal of pterygium from the eye, and, it is said, occasionally lithotomy.

Berber Folklore.—The folk beliefs and customs of the Berbers are particularly well known as the subject of the classical works of Doutté (*Magie & Religion dans l'Afrique du Nord*, Alger, 1908) and, especially, Westermarck (*Marriage Ceremonies in Morocco*, 1914, *Ritual & Belief in Morocco*, 2 vols., 1926). Among outstanding examples of the successful study of the magic and superstitions (in the sense of unorthodox beliefs) of a barbaric people, may be mentioned the ceremonial use during the *ashura* ceremony (*i e.*, the festival held on the tenth day of Moharram, the first month of the Muslim year) of two figures, male and female, called by the names *Yaghussa* and *Yauka*, who according to local popular belief were idols of olden days These can be none other than the pre-Islamic gods *Yaghūth* and *Ya'ūq* mentioned in the Koran (*sura* lxxi, v. 23). The extreme rarity of the persistence of the names of pre-Islamic deities makes this of particular interest, and suggests the early date at which Arab influence began to be felt.

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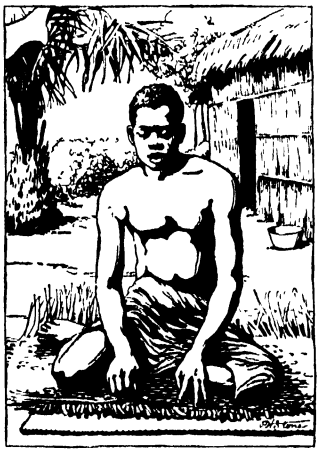
Sudan.—The Anglo-Egyptian Sudan, including Darfur, incorporated in 1916, has an area of over a million square miles, measuring roughly 1,300 miles from north to south (lat. 22° N. to lat 4° N.) and at its greatest breadth over 1,000 miles from east to west (long. 21° 30′ E and long. 30° E.). It is divided into fifteen Provinces and one Military District, the latter the Sobat-Pibor between the Nile and the Abyssinian frontier Although a number of these Provinces are well characterized units from the historical or geographical standpoint, they are not generally delimited on lines of ethnic significance, and no attempt to hold to them will be made in the following account.



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MAT WEAVING, A COMMON INDUSTRY AMONG THE TRIBES OF SOUTHERN AND CENTRAL AFRICA

The population of the Anglo-Egyptian Sudan may most conveniently be considered under two headings, Northern or Mohammedan, and Southern or Pagan The former embraces the peoples of the dry regions of the north, Islamic in religion and culture, predominantly Arab in language, and at least in part Arab in origin. The Pagans include the great mass of the negro or negroid tribes of the south, though nowhere are the two zones clearly defined by any single degree of latitude.

Even the northern area has no ethnic unity: in the east the Red Sea and Kassala provinces are in the main Hamitic, and many of the riverain Arabs of the White and Blue Niles carry at least as much negro as Arab blood, both superimposed upon older Hamitic stocks which were predominant in the land before the

introduction of Islam. In the south, although the negro has given his name to the Sudan (*Bilad el-Sudan*, the Land of the Blacks of mediaeval Arab authors) and has excited the greatest interest from mediaeval times onwards, yet adequate knowledge is lacking of the habits, customs and religion of any one tribe.

The tribes of the Northern area belong to two great families, (*a*) Hamite, and (*b*) Arab. The Hamites proper include the group of tribes known historically as the Beja (*q v.*) inhabiting the Red Sea Province and outside the Anglo-Egyptian Sudan extending into Eritrea. Less purely Hamitic, but none the less to be classed as Hamites, are the inhabitants of Nubia, commonly called Berberines or Barabra (*q.v.*), for, in spite of much negro blood and a language which is commonly regarded as negro, history indicates that fundamentally they are of Hamitic origin, while their civilization is not and seems never to have been negro in character. (*See* ARABS, BARABRA, BEJA.)

The true negro undoubtedly represents one of the most primitive of the African stocks. His main physical characteristics are tall stature, a "black" skin, woolly hair and moderate dolichocephaly, a flat broad nose and thick and often everted lips, prominent cheekbones and a varying degree of prognathism. With these qualities there go certain cultural characteristics. Such true negroes are found in the far western Sudan and the Guinea Coast, but hardly in the valleys of the Nile or of its affluents where as far as many of its most characteristic groups are concerned there is evidence of old Hamitic mixture. It is indeed scarcely possible to go further than this at the present time. In a classification proposed by Westermann, based on linguistic criteria, the term Nilotic is used in a sense so wide that it seems to signify no more than related to the Nile valley, but within it three groups are constituted, "High," "Middle" and "Low" Nilotic, which in part at least may be natural

1. The High Nilotic group, comprising Mittu, Madi, Abukaya, Abaka, Luba, Wira, Lendu and Moru.

2. The Middle Nilotic group, comprising Shilluk, Anuak, Beir, Jur, Belanda and many of the peoples of Eastern Uganda, the Acholi, Lango (*q v.*), Aturu and Jaluo.

3 The Low Nilotic group, comprising Dinka and Nuer.

This classification, though of wider geographical scope, embraces the whole of the Anglo-Egyptian Sudan, but the Bari with their numerous constituent "sub-tribes" are not mentioned, nor are the Lotuko-speaking tribes. Westermann places the former in his Nilotic-Hamitic group, *i.e.* with the Masai, Turkana, etc. to which the Lotuko-speaking tribes may also be assigned. For descriptive purposes, the following scheme is proposed.

A Tall "black" dolichocephals, comprising Dinka, Shilluk, Nuer, Anuak, with perhaps some others as yet unclassified. These are the typical Nilotes of most writers, and in this article the term will be confined to this group The mesaticephalic Acholi no doubt arose within this group, which probably also gave origin to the Belanda and the (Shilluk-speaking) Jur.

B. Tall "black" mesaticephals (probably sometimes brachycephals) comprising some Nuba and probably a number of the little-known tribes of Dar-Fung, including the Barun.

C. Medium statured "black" dolichocephals, comprising the Bari (but probably not the majority of the Bari-speaking tribes of the west bank), the Lotuko-speaking tribes and perhaps some of Westermann's High Nilotic group.

D. Short mesaticephals, with skin showing a coppery tinge—the Azande—or with blacker skins as the Bongo, Mittu and probably a number of the tribes now constituting the Azande nation. Knowledge of this group is very limited.

This classification by no means includes all the tribes of the Sudan. Many of the peoples of the Bahr-el-Ghazal Province are quite unknown ethnologically, *e.g.* the Moro, the Kaliko, the Bukuru (Babuckur) and the Liggi, and even the relations of such important Bari-speaking tribes of the west bank as the Mandari, Kuku, Kakuak, Nyangbwara and Fajelu, are far from clear. Nor is there any substantial knowledge of the Madi, who in the south cross the political boundary into Uganda. In the east, on the borders of Uganda and Abyssinia, are groups of unknown tribes, some of which may constitute ethnic units, *e.g.* Didinga, Longarim, Murle, with perhaps further north and nearer the Nile the Beir (Ajiba), all said by J. H. Driberg (unpublished information) to speak dialects of one language. The position of the Dongotono is obscure, while Driberg considers the Lorwama to be a section of Lotuko-speaking Lango. (C. G. S.)

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EAST AFRICA

The geographical area which is included under this designation extends roughly from the north frontier of Kenya Colony as far south as the Zambezi, and includes Kenya Colony, the Uganda Protectorate, Tanganyika Territory, Nyasaland and Portuguese East Africa.

We cannot say for certain who were the original inhabitants of this vast territory, for as yet our archaeological data are too scanty, but a number of tribes preserve in their mythology and legends recollections of what may have been a bygone autochthonous race. Thus the Akikuyu tell of cannibal dwarfs known as Maitoachiana, and both the Nandi and Masai have traditions of fantastically shaped ogres with cannibalistic instincts. Probably the nomads, who still exist under a variety of names wherever the natural conditions permit, represent the earliest inhabitants of whom we can have any knowledge. In this area they occupy a subordinate, almost a servile position, live by trapping and hunting, or by collecting roots and berries, are often shy, elusive creatures of the forest, rarely seen, and at other times are engaged in what their neighbours consider the menial task of blacksmiths, and always dreaded for their knowledge of poisons and witchcraft. Excluding these nomads, the races of East Africa fall into the following groups: (1) Bantu; (2) Nilotic; (3) Nilo-Hamitic. The Bantu are subdivided into Lacustrians and eastern Bantu The classification is really linguistic, but happens to be sufficiently valid in this case as a cultural criterion. Thus by Bantu are meant all those peoples of Africa who use the root *ntu* or some similar word to express human being. *Ba-* is the plural personal prefix of which *mu-* or *omu-* is the singular. Thus we speak of *Muganda*, a Ganda person and *Baganda*, Ganda people. As the prefix is really redundant we shall refer to the Bantu tribes without the prefix and speak of Ganda, Nyoro, Swahili and so on.

The history of East Africa is the history of the Hamites, for the various groups are differentiated by the degree and nature of their Hamitization The Bantu-speaking peoples are an early mixture of negroes and Hamites, and a series of later waves from the north-east, culminating in the great upheaval of the 16th century, of which the Galla expansion under Mohammed Granye and his invasion of Abyssinia in 1537 was a symptom, profoundly affected East African cultural relations. The Lacustrians were further Hamitized and a Hamitic autocracy imposed itself on many of the conquered Bantu peoples to the north and west of Lake Victoria. The Nilotics or inhabitants of the Nile valley, a parallel fusion of negroes and Hamites, with possibly a Semitic element added as well, were dispossessed of their tribal territories in what is now the south-eastern Sudan and were dispersed by invaders from the east. The bulk of them moved northwards and became the modern Shilluk, Dinka and allied tribes, but a few followed natural lines southwards, and to-day are known as the Acholi, Lango, Alur, Jopaluo and Jaluo. The invaders themselves were what are often known as "Half-Hamites," a rather meaningless term to which Nilo-Hamitic is preferable, as they are in fact increasingly Hamitized Nilotics. Southern Abyssinia and regions round Lake Rudolf have during the last 400 years witnessed a perpetual ebb and flow of immigrant peoples, more and more Hamitized, who were deflected by the Nile valley and moved southwards to populate the highlands of Kenya Colony and Tanganyika, until gradually the whole area from these highlands to the Horn of Africa was filled up with mainly pastoral peoples of Hamitic ancestry. This centrifugal movement southwards was

only checked by the intervention of western Powers in whose absence the process would undoubtedly have continued despite temporary checks such as the defeat of the Masai at the hands of the Bantu Hehe. This wedge of Nilo-Hamitics thrust southwards into Bantu areas appropriated the highlands to their pastoral requirements and separated the eastern Bantu from the Lacustrians. The eastern Bantu were agriculturalists and content with the lower highlands and the coastal regions, but under the stress of isolation came very much under the influence of their Hamitic neighbours, and though linguistically they remain Bantu they have assimilated many of the characteristic features of Hamitic culture.

The coastal belt and the adjacent islands, including Zanzibar and Pemba, are inhabited by the Swahili, whose language is morphologically Bantu and who are therefore generally classed as such. Culturally, however, they are not homogeneous and have few Bantu affinities. Since Abdul Malik bin Muriani brought his Syrian builders in A.D. 659 to found his African kingdom, a succession of colonizing waves from Persia and from the Oman established a Mohammedan empire over the whole coastal region from the Lamu archipelago to the Zambezi. These immigrants brought their own culture, interbred with and assimilated the local Bantu at each of their administrative and trading centres Thus was gradually formed the Swahili language, largely Arabic in origin, though structurally Bantu; and this was the genesis of what are now known as the Swahili people, or more properly the Swahili-speaking peoples, a heterogeneous conglomerate of localized dialects and customs, based on the original Bantu tribes who both assimilated the alien Mohammedan culture and incorporated in it no inconsiderable portion of their own. There were early Chinese voyages to the east coast of Africa, relics of which in pottery and coins, have survived on the coast from Lamu southwards. The Mongoloid eye found sporadically throughout this area, may also be a survival of Chinese infiltration, though other explanations are possible.

The Lacustrian and eastern Bantu meet in Tanganyika Territory and gradually the typical Bantu characteristics reassert themselves, though now we find a social organization with a more pronounced military bias than we encounter farther north. Typical of such tribal polities are the Hehe of Tanganyika Territory and the Yao of Nyasaland, whose organization, though much the same as that of their neighbours the Anyanja, is more closely knit and adapted to the exigencies of war. This may in part be due to the influence of the Angoni, an offshoot of the Zulu who fought their way north and penetrated as far as the southern shores of Lake Victoria. They were finally conquered by the Nyamwezi, a tribe also Zuluized and organized for military purposes, and were permitted to settle in their present homes. The Simba appeared on the lower Zambezi in 1540 and triumphing over the Portuguese and their African allies pushed north-east and succeeded in capturing Mombasa, before they were finally defeated and apparently annihilated near Malindi. The whole of this southern area has for centuries been the battle-ground of warring tribes, marching and counter-marching in almost inextricable confusion, achieving an evanescent eminence and as rapidly fading to comparative insignificance. Consequently there are fewer individual characteristics, the distinctions are less clearly cut, and their affinities are southern and western rather than northern. They belong to the southern Bantu more than to the Lacustrians despite the common characteristics which are part of the Bantu inheritance as a whole. The Thonga of Portuguese East Africa, for instance, very definitely merge into the southern complex and in Nyasaland the Anyanja extend into Rhodesia and come into contact with distinct Zambezi affinities.

In an area so complex and so full of cultural conflict it would be difficult to summarize the salient characteristics both briefly and adequately. Overlapping between the different groups is inevitable owing to the diffusion of cultural elements from one to the other and emphasizes the impossibility of a rigid classification. A fair picture, however, may be obtained of tribal cultures (social organization, mode of life and religious beliefs) by a concise examination of representative tribes in each group, with allowance for individual variation from the norm. The nomads require separate mention, and the Ganda and Ankole represent the Lacustrians. The Nyika group represent the eastern Bantu. The Hehe and Angoni represent the fusion of the Lacustrians and the eastern Bantu with their southern influences. Lango represent the Nilotics and Masai the Nilo-Hamitics

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(J. H. D.)

WEST AFRICA

West Africa was inhabited in prehistoric times, ancient stone implements being found in Senegal, the Sudan, French Guinea, the Ivory Coast, Gold Coast and Nigeria, and sites are frequently found in the Sahara in regions now barren, but which no doubt anciently enjoyed different climatic conditions. North Africa was probably peopled by men of Mediterranean race, then by Eastern Hamitic people (dark-skinned, fine features, soft hair), the modern Berber resulting from their admixture Later came the Jews and Arabs. The Pygmies or Negrilloes, were pushed back by negroes from Central Africa, and were established in the area lying between the Sahara and the Gulf of Guinea and between the Atlantic and Lake Chad Negrilloes and negroes at first interbred among themselves, then mixed with Berbers and peoples of Hamitic and Semitic stock, thus giving rise to higher grade peoples such as the Bornuan, Kanuri, Hausa, Mandingo, Yoruba and Ashanti

Principal Ethnic Groups.—The following provisory classification rests on physical, cultural and institutional data:

I. White race:	Berbers, Fulani	
II. Black race.	*a*) Senegalese-Guinea family	
	b) Nigerian Senegalese	,,
	c) Volta	,,
	d) Guinea	,,
	e) Lower Nigerian	,,
	f) Hausa	,,

Social Organization: General.—The social unit is the family in the strict sense, and more often the extended family, a group occupying the same enclosure whose members are divided into classes consisting of parallel generations having equal rights, with labour and ownership in common. Several related family groups form a village quarter. The distinct and organized clan is rare; more easily distinguished is the identity of the tribe and sub-tribe. Matriarchy is rare. Marriage is seldom exogamous, nearly always patrilocal; the children are attributed to the father, and descent is usually traced in the paternal line. Family authority devolves upon the father or the patriarch assisted by elders. Common ownership of family goods, with individual ownership of personal property, is almost universal. Women are usually at liberty to dispose of their own property. Succession to the family possessions, of which women form part, is vested sometimes in the brother and sometimes in the son of the deceased. On the Ivory Coast, in the Upper Volta and Nigeria, a husband allows his wife to cohabit with another man, the children belonging to him. Marriage between brothers-in-law and sisters-in-law is frequent. Personal possessions are heritable in the same way as family goods, but frequently men succeed to a man's goods and women to a woman's.

Government.—Many bush peoples (Liberia, Ivory Coast, Southern Nigeria) and peoples of the French Sudanese region (Gourounsi, Bobo, Lobi, Bariba) live in small independent groups Elsewhere kingdoms have been constituted, very often theocratic in character and ruled over by a priest-king or by a king and a priest reigning together (Nigeria, Dahomey, French Sudan, Upper Volta) and uniting the civil and magico-religious power Ministers and councillors assist the sovereign. The Queen-Mother (Gold Coast, Nigeria) possesses authority. The heir to the throne is often chosen, by an electoral group, from certain families according to local hereditary laws.

Religion.—Islam spread, in particular, over Mauritania, Senegal, the Guineas, the Niger valley, the Hausa country, Bornu and Nigeria, elsewhere, there is general belief in a supreme deity, in a sky and an earth god, and in inferior gods. Respect is paid to ancestors. Gods and ancestors share in the life of the social group. Various methods of divination are in vogue to ascertain their will. Infraction of certain sacred inhibitions (murder, the shedding of blood) are displeasing to the gods and are regarded as sins and require compensation and expiation. Family and clan cults are found, more rarely tribal cults. Sacrifices, frequently of a seasonal character (altars, trees, stones, hills, streams), insure fertility and fecundity, there being a close association between magic and religion. The head of the family is the domestic priest, and the descendant of the first occupant of the country is the priest of the earth. Sacerdotal colleges, male and female, are frequent (Dahomey, Ashanti, Yoruba). Traces of totemism are found in French Sudan, Ashanti, Dahomey, Nigeria. Numerous tribal, clan, family, individual, occasional and professional tabus, probably of totemic origin, are recorded.

Belief in witchcraft is general, the sorcerers being supposed to be able to change themselves into animals, injuries to the animal inflicted during the metamorphosis appearing on the sorcerer's body. There are special laws and punishments for sorcery.

Initiation of members of the social group is by successive degrees in secret ceremonies to adolescents, adults and men of full experience. They seclude the grades in the forest or in sacred groves. The neophyte is considered to have died and to have been reborn with a new personality, and receives instruction (moral, religious, technical, aesthetic) His position in the group depends on initiation. There are similar but less complicated ceremonies for women

In Nigeria the king was frequently slain after he had reigned for a certain period, or when he grew old (Yoruba, Jukun, Hausa), the same custom appears to have existed in the French Sudan (Mandingo, Dogon)

Cannibalism and head-hunting have almost disappeared, but existed on the Ivory Coast, in Liberia, Dahomey and Nigeria In former times human sacrifices were followed almost everywhere by a feast at which the victim was eaten. (H. Lab)

SOUTH AFRICA

The natives of Africa south of the Kunene, Okavango and Zambezi rivers fall into three main divisions, known respectively as Bushmen, Hottentots and Bantu. These divisions represent a series of successive waves of southerly migration by which the peopling of the country has been effected. The Bushmen, a race of short yellowish-brown nomad hunters, are the earliest human inhabitants of South Africa of whom there is any reliable historical record. Recent archaeological research, however, has established clearly that they were not the first to occupy the country, but are an invading people who superseded its original inhabitants (*see* South Africa, *Archaeology*). From the evidence afforded by their cultural remains it seems likely that at a very early time they occupied the hunting grounds of tropical East Africa and gradually passed southwards until, when the written history of the country begins, they were roaming all over the territory south of the Zambezi river.

By this time they were already being encroached upon by the Hottentots, who resemble them greatly in racial characters and in language, but are a pastoral people with a more complex material culture and social organization. The Hottentots seem to have sprung out of a mixture of the old Bushman population of East Africa with an early migration of Hamites from whom they obtained their cattle and certain elements of their language. They migrated south later than the Bushmen, and after crossing the upper waters of the Zambezi passed on to the west coast and down to the south coast, where they were found by the first Europeans to touch at the Cape.

The Bantu peoples are the latest of the native inhabitants to have entered South Africa. They all speak languages belonging to the characteristic Bantu language family of Africa (*see* African Languages), but in racial characters they vary considerably, though certain negro characteristics predominate. They seem to have originated as a distinct variety somewhere in the neighbourhood of the Great Lakes and to have migrated South at various times between about the 12th and 15th centuries, each of their main groups (*see* below, *Principal Groups*) representing a different series of tribal movements.

The impacts upon one another of all these different peoples, and the later advance inland from the Cape of the European settlers, resulted in a complicated series of wars, migrations and extermination, in which the Bushmen and the Hottentots were almost completely broken up, while the original distribution and condition of the Bantu were profoundly disturbed (*see* South Africa, *History*).



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A HAUSA HEADMAN

More Arab than negro, the Hausa peoples are intelligent, well developed physically and good traders

Principal Groups.—At the present time the Bushmen are confined to the Central and Northern Kalahari and neighbouring regions. They are there found chiefly in the southern half of each speaking its own language (*see* Bushman Languages), but as a result of intermixture with the neighbouring Bantu peoples they have to a great extent lost their purity of race. The Hottentots were formerly divided into four main sections—the Nama, Korana, Gonaqua and old Cape Hottentots—but of these the only relatively compact group to-day are the Nama, who are found chiefly in the southern half of South-west Africa The others have either died out or completely lost their racial entity. The Bantu peoples, on the other hand, are still vigorous and powerful, and are increasing in numbers. They are divided into numerous small tribes which on the basis of cultural and linguistic differences, may be classified into the following groups:—

(*a*) Eastern, or Zulu-Xosa, which occupies the coastal region East of the Drakenberg mountains and South of the Sabi river. This group includes the so-called "Kafirs" of the Transkei (*i e*, the AmaXosa, AmaMpondo, AmaMpondomisi, and AmaTembu), the "Fingoes" of the Cape Province, who are the fugitive remnants of tribes broken up in Natal during the great inter-tribal wars at the beginning of last century, the Zulu peoples of Natal and Zululand, with their offshoot the Matabele (AmaNdebele) of Southern Rhodesia, the AmaSwazi of Swaziland, and the BaThonga (AmaTonga) and kindred tribes of Portuguese East Africa.

(*b*) Central, or Sotho-Chwana. This group occupies the greater portion of the interior plain North of the Orange river, and includes among many others the BaTauana about the Botletle river and Lake Ngami, the BaMangwato of North Bechuanaland, the degraded BaKalahari of the Kalahari desert, the BaKuena, BaNgwaketse, BaRolong and BaTlaping of Central Bechuanaland, the BaHurutse, BaPedi, BaKgatlha and kindred tribes of West and Central Transvaal, the BaVenda of the North East Transvaal and the celebrated Basuto of Basutoland.

(*c*) The so-called "Mashona" peoples of South Rhodesia, including the BaNyai or BaRoswi and the AbeNanswa immediately South of the Zambezi river, the MaKaranga (MaKalanga), WaManyika and BaZezuru of Mashonaland and the VaNdau of Portuguese East Africa.

(*d*) South-western, comprising the OvaHerero and the OvaMbo peoples of South West Africa. They are each divided into various tribes which between them occupy the northern half of the region between the Western fringe of the Kalahari desert and the Atlantic ocean.

Another distinct, though less important, division of the natives of South Africa is constituted by the Bergdama (Haukhoin), who inhabit the coastal region of South West Africa. Their racial history is still far from clear. Physically they are a true negro people, yet they are isolated far from others of their kind; they

live an extremely primitive life, and speak the language of the Naman, to whom they have long been in subjection.

Social Organization.—Both the Bergdama and the Bushmen have very simple forms of social structure. Among the Bergdama the social units are small, independent local groups, each consisting of a patriarchal family, together with any relatives who may put themselves under the protection of its head, and sometimes including a certain number of dependent families who do not feel capable of founding a settlement of their own. The Bushmen are divided into small hunting bands, each of which owns a definite hunting territory over which it wanders and out of which it may not venture except with the permission of the neighbouring group Within this territory members of the band are free to go where they like. The organization of the band is of the loosest kind. There is no chief, but skilled hunters and the older, more experienced, men in general have a great influence in directing social affairs. The only other structure of any importance is the family, consisting of a man and his wife, or wives, with their dependent children. Marriage within the band appears to be forbidden. A wife generally joins her husband's people, although in some of the northern tribes the young couple remain with the wife's parents until after the birth of the first child.

Of the Hottentots the only section whose social organization has been studied are the Nama, comprising several tribes, each of which has its own territory, name and chief. The tribe, however, is not a centralized body, but is made up of a rather loose aggregation of clans with the chieftainship hereditary in one of them. The authority of the chief is slight The heads of the other clans act as his council, and he cannot do much without their co-operation. Each clan consists of a number of families claiming descent from some remote ancestor in the male line after whom they are named, and marriage within the clan is strictly forbidden. Polygamy was formerly practised, but monogamy is now the rule

Among the Bantu peoples considerable variation exists in details of social organization, but certain general features prevail. Each tribe occupies its own territory under its own chief His authority is generally considerable, but his actual power is somewhat modified by a council consisting of some of his relatives and the more influential heads of families. The family or household group is always of great social importance It is normally polygamous, and generally forms a distinct local unit, except among the central tribes, where there is a tendency for different household groups to collect together in villages Even here, however, each household is distinctly marked off from the rest. Within the household each wife has her own hut; and with her children constitutes an economic unit with well defined legal rights. Marriage is patrilocal, and is legalized by the payment of a bride-price (*lobola*), generally in the form of cattle. There exists also an organization of the people into clans, which, except in the eastern group, are associated with totemism. Clan exogamy is customary, but does not obtain among the Sotho-Chwana tribes Membership of the clan is determined by descent through the father, except among the OvaMbo, who are matrilineal people, while the OvaHerero have a double system of clans, one set with patrilineal descent, the other with matrilineal (*see* later, *General Features of Note*).

Mode of Life.—Levels of culture differ considerably. All the Bushmen in their original condition are hunters and collectors They practise neither agriculture nor pastoralism, but derive their subsistence entirely from the game they hunt and from the wild vegetable foods which the women collect Their chief hunting weapons are the bow and small arrows with detachable poisoned points, but they also make use of throwing-sticks, pitfalls, traps and snares of all kinds, while the women have pointed digging-sticks, which are sometimes weighted with perforated stones. They are a nomadic people, confined in the dry season to places well supplied with water-holes, but, when the rainy season comes, wandering about freely within the limits of their hunting territory. Their encampments are temporary, and their dwellings crude shelters of rush or reed. The Bergdama on the whole lead a similar mode of life, although many of them also keep goats.

The Hottentots are chiefly a pastoral people, with herds of long-horned cattle and flocks of fat-tailed sheep. Sour milk forms a staple element of their diet; and in contrast to all the Bantu except the OvaHerero, it is not the Hottentot men, but the women, who do the milking Hunting also plays an important part in their economic life, their methods of hunting and their weapons being practically identical with those of the Bushmen. To some extent they are also nomadic, as fresh pastures for their herds are necessary from time to time. Their encampments, however, are less impermanent than those of the Bushmen They live in beehive huts, covered with reed mats, and their settlements are arranged in circular form, leaving in the centre an open space in which the cattle are collected at night. Their material culture is on the whole superior to that of the Bushmen; in particular they smelt iron for the manufacture of their implements and weapons, while the Bushmen barter with the neighbouring Bantu peoples for whatever iron they require.

With the exception of the OvaHerero who are a purely pastoral people, all the Bantu tribes practise both hoe-culture and pastoralism. The eastern tribes are more predominantly pastoral, the others more agricultural, but all have this combined means of subsistence Each household group has its own cattle and goats, as well as its own fields The cattle are the concern of the men (except among the OvaHerero, where the women do the milking), the fields that of the women. The food supply is derived mainly from sour milk and from crops of millet and maize, supplemented in minor forms by pumpkins, peas, beans, etc , while for meat they rely chiefly upon the game hunted by the men. Cattle are never slaughtered for food except on ceremonial occasions The life of the people is more or less sedentary The eastern and south-western tribes live in beehive huts of thatch, the central and Mashona tribes in circular huts with conical roofs. The settlement is always arranged on the circular principle already noted among the Hottentots All the industries are essentially domestic, practically everything required by the household being made within it. The one exception is in the case of iron implements and weapons, for which there are special workers, who barter their products for cattle and grain.

Religion, Special Features.—In religious beliefs there are certain fundamental features which appear to be common to both the Bushmen and the Hottentots, but there is also considerable variation in several important details. All Bushmen pray to the moon and other celestial bodies, and have an extensive series of myths and legends relating to them They believe also in certain mythical beings, known variously to different tribes as Cagn (the mantis), Huwu, Tora, Gauna, etc., who appear to be personifications of natural forces, especially those producing the rain, and are frequently invoked These mythical beings are credited with creative powers, and are met with in various myths of origin. From references in their myths and folk-tales it appears that the Bushmen have further a well developed system of ritual relating to animals and other sources of food, but it is not known in any detail what that ritual is or was. There seem also to be certain beliefs and practices connected with the spirits of the dead, but concerning these the information available is vague.

The religious cult of the Hottentots seems in general to consist mainly in the worship of mythical heroes derived partly from animistic beliefs and partly from the personification of the natural forces producing rain In their general attributes these beings, chief of whom are Tsui-goab, Heitsi-Eibib and Gaunab, strongly resemble those of the Bushmen. The worship of the moon also seems to have been prevalent among the Hottentots at one time, judging from the records of prayers made to it for food and rain. There is further an extensive ritual relating to the cattle, which, as the chief source of food, are of paramount importance to the well-being of the community; while water, another extremely important factor in the economic life of the Hottentots, also plays a part in numerous ceremonial performances and taboos. One of the chief functions of the medicine-men, as among the Bushmen, is always the making of rain.

Among the Bantu, the religious cult is very largely a strongly developed form of ancestor worship. This is primarily a domestic cult, each family through its eldest male representative worshipping its ancestors in the male line. On important tribal occasions

the chief also prays to his ancestors on behalf of the tribe as a whole. The ancestors are regarded as guiding the destiny of their living descendants, and are propitiated by means of sacrifices offered on ceremonial festivals such as birth and marriage and on other special occasions. All the Bantu have also some conception, often rather vague, of a power in the universe which is not connected with the ancestors. This power is often associated with the sky, but shows itself most impressively in the phenomena of the weather, and hence rain, lightning and thunder are considered its manifestations. It is also sometimes looked upon as the creator of all things and the moulder of destiny. It is met with under various names (such as Tilo among the BaThonga, Unkulunkulu and Inkosi among the Zulu, Modimo in the central tribes and Nzame among the OvaMbo), and the beliefs and customs relating to it differ considerably from tribe to tribe. There is further an extensive ritual relating to agricultural life and to the cattle (the OvaHerero have a sacred herd of cattle), while traces of a totemic cult are found in all the tribes except the eastern. Magic and witchcraft play an extremely important part in the lives of the people, and in connection with this shamanism has developed to a high degree, so that there are many different kinds of medicine men with special functions, such as rain-making, divining, "doctoring" the crops, purifying the army, healing disease, etc.

General Features of Note.—In physical appearance there are many features which readily distinguish the Bushmen from all other inhabitants of South Africa, save the Hottentots. They are typically short in stature, but not dwarfish. Their limbs are slight and finely shaped, the hands and feet being especially small; but there is a curious curvature of the spine which gives a great prominence to the buttocks, where also a great accumulation of fat (steatopygia) sometimes occurs in the women. The skin is yellowish-brown in colour, and wrinkles very easily. The hair is woolly and sparse, commonly very short, and is scattered on the head in little tufts, or "peppercorn" fashion. The head is small and markedly low in the crown, the face broad, with prominent cheek bones, bulging forehead and convex upper lip, the nose extremely flat, the eyes narrow and often slightly oblique; frequently there is no lobe to the ear. In the more northern and eastern tribes there is a distinct tendency towards greater stature, darker colour and better muscular development, while the head and face are longer and higher. These divergent characters are the result of intermixture with the neighbouring Bantu peoples.

The culture of the Bushmen is noted for the highly artistic paintings and engravings which they executed on the walls of caves and rock-shelters. The subjects portrayed are chiefly animals, human beings, hunting, battle and dancing scenes, and the representations are remarkable for their fidelity to nature. The practice of the art seems to have died out, but it proves a most important link in the chain of evidence connecting the Bushmen with the Palaeolithic cultures of Europe. (*See* SOUTH AFRICA, *Archaeology*.)

Of the social customs of the Bushmen, especially those connected with birth and marriage, little is known. Initiation ceremonies at puberty are common to all Bushmen. On reaching her first menstrual period a girl is secluded in her hut and has to observe various food taboos. In the northern tribes a special religious dance, known as the "eland bull" dance, is added in her honour. Initiation ceremonies for boys seem to be restricted to the northern tribes. The special tribal marks are cut by the medicine men between the eyebrows of the boys, who are then kept in a secluded spot for about a month. During this time they are instructed in the lore of the tribe, and religious dances are held in which animal masquerades predominate. The Tati Bushmen practise circumcision as part of the initiation ceremony, but they are the only Bushmen of whom this is known, and have probably adopted the custom from the Bechuana among whom they live. At death the corpse is usually buried lying on one side with the knees drawn up against the breast. The group then removes to another site.

The Hottentots resemble the Bushmen closely in appearance, and it is only in certain characters that there are any noticeable differences. They are taller than the Bushmen, and have distinctly longer and narrower heads. Their skull is also higher and the face more prognathous. They have, however, the same prominent cheek bones, small chin, flat nose and peculiar eyes as the Bushmen, while their ears are often also lobeless. Their hair and their skin colour are the same as in the Bushmen, and steatopygia is often more marked.

An important feature in their culture is the great prominence of the communal meal in their ceremonies. It is a means of curing a sick person by aggregating him to the group of those who have had the disease and recovered; of introducing young men and women to the life of full members of the tribe; of bestowing on a young mother the solidarity of the group of mothers with strong and healthy children; of welcoming a widow, or widower, into the group of the widowed, and so giving them a new place in the society as a whole. The part water has come to have in their ceremonial life because of its extreme value in their economic life is also noteworthy. In addition to there being a great annual rain-making ceremony, water plays an essential part in many religious ceremonies, is endowed with a special protective power in some cases, and is considered extremely dangerous in others. Rain, as the source of water, is also held sacred, and the natural forces producing it are even personified and worshipped.

The Bergdama are of considerable interest, as they appear to be the most primitive negro people known, apart from the Congo pygmies. They are of medium height, strong, even coarse, build, with long rather thick skulls, prognathous faces, broad noses, very dark, even black skin, and all the features typical of the true West African negro. What their original language was is not known, for they have been so long enslaved by the Hottentots that they have completely adopted the Hottentot language. Yet in ceremonial their lives appear to have been but little influenced by the Hottentots, and among them there is found what appears to be a very important feature of many Bantu cultures, the sacred fire round which the whole life of the society centres. Each little group has a sacred fire which must never be allowed to go out, but which must be guarded day and night by the chief wife of the patriarch. Day by day, when the members of the group go out to seek for food, the head of the group and the old men sit guarding the fire, and as long as that is aglow and respected by all, the hunters and collectors will find food for the day. All game must be laid by the sacred fire, and certain portions of it must be eaten ceremonially by the elders of the group. Each kind of berry and root, as it ripens, must be brought to the sacred fire before it can be eaten. All good, all evil hangs upon the guarding of the fire from all impurities, which come from breaches in the regulations as laid down in the traditions of the tribe.

Racially the Bantu peoples present a great variety of types. They are fundamentally negro peoples, mixed with Hamitic, negrillo and other types. The skin is usually less dark, stature lower, head less elongated, forehead flatter, prognathism less marked, nose generally more prominent and narrower than in the true negro. The Hamitic strain often shows itself clearly among the Zulu and allied tribes in a relatively narrow nose. The hair is uniformly of the ordinary negro type, the skin all shades from yellowish-brown to the black of the AmaSwazi, usually a reddish ground tint, dark chocolate colour being the prevalent hue. The Eastern tribes are on the whole taller and more dolichocephalic than the Central, while the South-western tribes are more typically negro than the rest.

The political organization of these peoples is well developed, and they have an elaborate system of laws regulating their social life. Among the OvaMbo blood revenge is still practised, but among the Central and Eastern tribes the tribal authority is supreme. All members of the tribe are regarded as belonging to the chief; an injury to them is, therefore, an injury to him, and compensation for death or injury must be paid to him. The Ama-Zulu and AmaXosa are renowned as fighting tribes, none of the rest being specially war-like; and among the former a strict disciplinary system was established by the great chief Chaka, who abolished the throwing spear, which is the typical weapon of this area, and introduced the short stabbing spear. By this reform he forced upon his warriors the necessity of coming to close quarters,

and from that time the Zulu became a dominant people and were able to found and develop a great military kingdom in South East Africa.

The initiation ceremonies at puberty of the Eastern and Central tribes are of some importance. The boys are initiated in groups, which are kept secluded in a special "lodge" for about three months, during which they are taught their tribal history, the moral and religious code of the society and its social etiquette. The ceremony itself consists in circumcision, performed by a special medicine man. These initiation "schools" are held every year in some tribes, in others at intervals of from four to five years. In each case the group of initiates is usually given a special name by which it is known throughout life. These groups play an important part in the tribal organization, and form the nucleus of the military system. The Zulu do not have initiation schools, nor do they practise circumcision, but the system of initiation groups has persisted in the formation at regular intervals of military regiments comprising boys of about the same age. Girls are also initiated in groups at the time of puberty, and are not considered marriageable till they have passed through the ceremony.

The Central tribes have remains of a tribal totemism. Each independent section of the people, which may at one time have represented a clan, has a *siboko* or laudatory name, taken from some animal or some natural phenomenon. In former times there was a definite ritual connected with the species of animal so used Nowadays, however, the main division of the people is into patrilineal clans, and the possession of a common *siboko* is no bar to marriage. In the Eastern tribes all traces of totemism, if it was ever present, have disappeared. They are all divided into clans each with its own *isibongo* (laudatory name) which is generally the name of the ancestor from whom the clan is thought to have sprung Marriage between people with the same *isibongo* is not permitted. Very often, however, a clan will split up, a younger branch taking some more immediate ancestor as its *isibongo,* while the older branch preserves the more ancient *isibongo,* and intermarriage between the two branches is then permissible.

The OvaHerero clan system is a combination of the patrilineal and matrilineal systems The people are divided in the first place into clans with matrilineal descent, called *eanda,* and then into clans with patrilineal descent, called *oruzo.* Every person belongs to the *eanda* of his mother, and the *oruzo* of his father. Both the *eanda* and the *oruzo* are totemic and exogamous. Each of these clan divisions has a different function. The *eanda* is associated with economic relationships, so that inheritance is in the female line. The religious life, on the other hand, is almost entirely connected with the *oruzo,* and is a developed form of ancestor worship, so that a man prays always to the ancestors of his father. Here again, the sacred fire is very prominent At the chief's village the ancestors of the chief are worshipped, and represent the ancestors of the whole tribe. In addition the sacred fire is found in the kraal of each head of a family, lighted, in the first instance, from that of the chief. None of these fires must ever be allowed to go out. To this fire the women bring the milk each night and morning to have it blessed by the kraal head and the ancestors.

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ARCHAEOLOGY AND ANTIQUITIES

The boundary between Negro Africa and "White" Africa, *i.e.,* Egypt and the northern and north-western portions of the continent, must be both conventional and provisional. The explorations of Reisner at Kerma in Nubia (between the third and fourth cataracts) and of Garstang at Meroe, have carried Egyptian influence so far south in the Nile valley that these sites, although inhabited by peoples of mixed culture, must from the archaeological standpoint be referred rather to Egypt than to the Sudan.

No such line of division exists in the west between the North African cultures and those of negro-land; indeed Gautier ("Études d'ethnographie saharienne," *L'Anthropologie,* 1907) has shown that there is good reason to suppose that the latter has advanced perhaps as much as 1,000km. at the expense of the former, during the last 2,000 or 3,000 years. Moreover, Meroe itself does not accurately represent the southern limits of the mixed civilization to which it has given its name; some 12m. south of Khartum on the right bank of the Blue Nile are the remains of Soba, a Meroitic site, later the capital of the Christian kingdom of 'Alwa (the Alut of the hieroglyphs), while Meroitic remains have been recently discovered 20om. south of Khartum.

Yet Meroe, which lies in the neighbourhood of the 17th parallel of north latitude, may well stand as the main southern bastion of Egyptian influence, and the area with which this article will deal is that part of Africa lying south of 16° north, which will be divided into three provinces, eastern, western and southern.

The Nile-Congo watershed, a natural feature of geographical and ethnic importance, constitutes part of the dividing line between the eastern and western areas, which continues northwards along the broad ridge of relatively high land that roughly divides the territories of the Anglo-Egyptian Sudan from those administered by France. Thus the boundary line somewhat closely follows the western confines of Darfur, while south of the Nile-Congo watershed it coincides with the boundary between the Belgian Congo and British territories to the east, both eastern and western provinces being limited to the south by a line roughly following the 10th parallel of south latitude

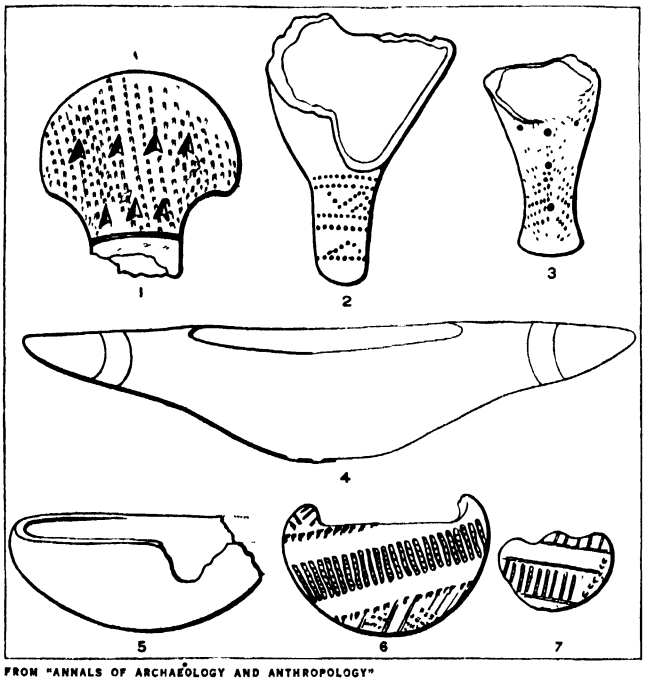
THE EASTERN PROVINCE

Palaeolithic Artifacts.—Here discoveries have so far been imited to the Sudan, Uganda, Somaliland and Kenya Colony, while surprisingly little is yet known of the early pre-history of even these territories Except possibly in the extreme north, within a few miles of Halfa, no implement of River-drift type is known to have been found in the Sudan. This fact may be due to incomplete exploration, but is of some significance considering the abundance of specimens which have been found on the surface in Egypt and Libya, in Somaliland (where H W Seton-Karr has collected countless specimens of River-drift and Mousterian types), South Africa, and recently, in deposits, by Wayland in Uganda, though the majority of the implements he discovered are perhaps to be associated with the Le Moustier *facies* rather than that of the River-drift Be this as it may, Wayland has collected Chellean hand-axes in gravels, considered of Pleistocene date, capping quartzite hill-tops some 300ft. above the present level of the lake, and also implements of a well-developed Mousterian type, including "points, side-scrapers, flake knives, tortoise cores and tortoise points," as well as two typical side-scrapers in a cave under some five feet of cave earth. (A. A. Smith and E. J. Wayland, *Some Primitive Stone Implements from Uganda;* Uganda Protectorate, Geological Survey Dept., 1923.)

No typical Mousterian specimens have yet been found in the Sudan, but certain specimens collected from two sites, namely, Jebel Katul in north-west Kordofan, and Jebel Gule in Dar Fung, are considered by the Abbé Breuil to belong to the Mousterian period So far as is known no implements attributable to the latter part of the Palaeolithic age have been found anywhere in the Eastern Province, certain pygmy implements which will be mentioned later being regarded as Neolithic. (C. G. Seligman, "A Neolithic Site in the Anglo-Egyptian Sudan," *J.R.A.I.,* vol. 40, 1910.)

Neolithic Age.—Evidence concerning the Neolithic age is furnished by a number of finds made on widely scattered sites in the Sudan, Uganda and Kenya Colony, and there are hints that in parts of Negro Africa, which nowhere had a Copper or Bronze age, stone implements may have persisted to within the last few centuries and the use of iron be quite recent. The distribution of the most typical of Neolithic implements, the ground stone axe, makes it necessary to refer to the conditions prevailing north of latitude 16 degrees Unknown in pre-dynastic Egypt polished axe heads are common in Nubia, where a number have been found in pre-dynastic and early dynastic tombs. Many examples have come from Meroe, and specimens probably occur on every site of Neolithic date in the Sudan; they have been found, *e g*, at Jebel Geili, 90m. east of Khartum, at Jebel Gule, and at Faragab in northern Kordofan; moreover, the grooves in the rock faces on which they were ground exist both at Jebel Gule and Jebel Geili, while stone axes of a peculiar type have been found in western Darfur by D. Newbold. These facts all support the idea put forward (*Rep. Brit Assn.*, Pres. Address, Section H, 1915) that the ground stone axes of the Nile valley are of negro origin, a view consistent with their occurrence in the Congo, and, in relatively enormous numbers, in the Gold Coast. Perforated discs or rings, and hollow conical and spherical stones, all ground in the usual Neolithic style, have been found at Meroe, on Jebel Haraza (Kordofan) and at Jebel Geili, where stone discs and axe heads can be definitely associated together and with Meroitic potsherds.

Besides the types already alluded to, Jebel Gule yielded a large number of pygmy implements of quartz, carnelian and hornstone (similar to those found in South Africa and attributed to Bushmen), and there is reason to believe that this industry also existed at Faragab, where these "points" were used to bore the innumerable disc heads of ostrich egg-shell which cover the ground. The British Museum has a number of beautifully worked *dos abattu*



FROM "ANNALS OF ARCHAEOLOGY AND ANTHROPOLOGY"

POTTERY FROM THE MOUNDS AT FARAGAB, WHICH INDICATE POSSIBLE LINES OF RECONSTRUCTION OF THE EARLY HISTORY OF THE SUDAN

Figures 1, 2 and 3 are fragments of vessels; figure 4 is a reconstructed vessel of a type hitherto unknown in Africa; figure 5 is a bowl; figures 6 and 7, objects of unknown use

specimens of obsidian from the neighbourhood of Njoro in Kenya Colony; typical lunates, of jasper and of carnelian respectively, have been found in Uganda (Wayland), while to pass northwards of latitude 16°, G. A. Reisner (*Sudan Notes and Records*, vol. 2, No. 4, 1919) has found in tombs dating to the Egyptian 25th dynasty in Upper Nubia, perfect lunates of carnelian, in such numbers that there can be no question of their inclusion in the tombs being accidental.

This may close the account of stone implements which may be assigned to the Stone age cultures, so long as it is realized that the Neolithic certainly comes down to a period vastly more recent than the Neolithic of even northern Europe, and that in the Sudan, at least, it is overlapped by the Meroitic civilization, numerous outliers of which have been found, including those of Jebel Geili, another in the neighbourhood of the Makwar dam on the Blue Nile, notable for its Greco-Roman bronze vessels, and at Abu Sofian in western Kordofan. Although there is no evidence to show that they are Meroitic it will be convenient here to refer to the discoveries made by H. S. Wellcome at Jebel Moya near the Blue Nile and by Seligman in the mounds near Faragab, a village of sedentary Arabs some 20m. east of Bara in northern Kordofan. Though made about 1910 only the most meagre descriptions of the Jebel Moya discoveries have been published, although they are of prime importance to the history of the Sudan. Besides stone implements, were found beads and amulets, a number of scarabs and small plaques bearing Ethiopian and Egyptian cartouches, ranging from about 700 B C. or perhaps going back to an even earlier date (*Brit. Assn. Reports*, 1912), while a paper by Prof. D. E. Derry (*Proc. 17th Internat. Congress of Medicine*, Sec 1, Pt. 2, 1913), giving anatomical details of skeletons from graves at this site indicates that the inhabitants were tall negroes resembling in height and cephalic index some of the present day negroes of the hills of southern Kordofan (C. G. Seligman, *J R.A I.* vol. 40, 1910. Plate xxxv., figs. 8 and 9). At Faragab the mounds extend over acres and their surface and the areas between them are literally covered with disc beads of ostrich egg, fragments of bone débris and other foreign objects, including fragments of imported rocks. Two types of potsherds are of special interest, one consisting of a fabric bearing the impression of the string mat on which it was made (such mats are still used in the hills of northern Kordofan), and in this resembling the coarser wares found by Garstang in the graves of Meroe, the other oblong-oval in shape and rather shallow, often decorated with geometrical designs and produced at each end into a solid mass (handle?), its general appearance recalling that of many Melanesian wooden food bowls. This type seems to be hitherto unknown anywhere in Africa. The beads are of ivory, dolomite and scolectite; the single dolomite bead is definitely not of a type hitherto regarded as negro, while a single carnelian bead, if Egyptian, as no doubt it is, is regarded by Sir Flinders Petrie as certainly not later than 18th dynasty. (C. G. Seligman, "Prehistoric Site in Northern Kordofan," *Annals of Archaeology and Anthropology*, vol. 7, 1915) The presence of many pieces of worked ivory is noteworthy. Of Meroitic monuments of any size, apart from those found at Soba, *e g*, the "lamb" now in the Palace gardens at Khartum, the rock drawings discovered by Crowfoot at Jebel Geili, representing a king wearing the uraeus crown worshipping a rayed solar divinity, which may be taken to be of late Meroitic date, is of special interest.

Rock Drawings.—The rock drawings of the Sudan are in Kordofan and Darfur Generally they are outlined in red or blackish pigment, but examples roughly graved on masses of granite also occur in the Jebel Haraza *massif* Drawings with pigmented outlines are found on Jebel Haraza and Jebel el 'Afarit, and seem to form two groups. (H. A. MacMichael, "Rock Pictures in North Kordofan," *Journ. Roy. Anthrop.-Inst.* vol. xxxix., 1909, pp. 562–68) To the first belong rough but spirited sketches of men on horseback, camels and giraffes. The workmanship of the second group is rougher and much less vigorous; it includes representations of camels, men on horseback and men marching or dancing, carrying the small round Hamitic shield. This, together with their general resemblance to the "Libyo-Berber" rock pictures of the southern Sahara, indicates a comparatively recent date. Moreover, the work is faint and indeterminate, and there is no trace of graving; in other words the Neolithic tradition has not persisted. Probably the drawings are more recent than the stone discs and hollow conical and spherical stones found on Jebel Haraza, already mentioned.

It is as yet too early to estimate the significance of the objects found by D. Newbold (*Sudan Notes and Records*, vol. 7, 1924) on his recent journey from Bara in Kordofan to the international

boundary (long. 24° E.) between the Sudan and French Equatorial Africa Evidence of former occupation of the country, now desert or the poorest steppe, was abundant, including cairns, pottery (some Meroitic), a small brick pyramid at Abu Sofian (16° N., 28° E.), and five ground axes of glauconite of hitherto unknown type from the Wadi Hawa Drawings roughly incised on boulders, *e g.*, at Sobat el Hammad, showed tailed and phallic men, elephants, giraffes, ostriches, oryx, cattle and several other animals which could not be identified. At Umm Tersawen there were also a number of human figures, some tailed, some armed with bows. "At Abu Sofian two groups of pictures, obviously of the same date and 'school,' were within a day's march of one another Here the drawings were incised on rough boulders, and were very numerous Camels are shown literally in hundreds; giraffes and ostriches still appear; but the cattle dwindle in numbers, while the elephant is not represented, and the bowmen give place to men armed with spears and carrying shields" The latter armament appears to bring these drawings into the Libyo-Berber class

Megalithic Monuments.—Megalithic stone monuments occur in the Sudan, some of the present day, others certainly recent, a few apparently of some antiquity, though as to these our knowledge is of the slightest In the northern Sudan the Beja tribes surround the graves of their dead with a circle of upright stones, round some of the older graves individual stones were occasionally taller than a man, and it is probably the persistence of such stones after their smaller neighbours have disappeared that has given rise to monoliths such as that some two metres high (to which the Prophet, according to the accepted tradition, tied his horse) overlooking the Khor Arab near the Sinkat-Erkowit road in the Red Sea Province.

Another monolith of much the same dimensions has been described and figured by J. W Crowfoot from Assarema Derheib, inland from 'Aqiq (*Geog Jour*, May 1911), and in this instance there seems nothing to suggest its origin in a Beja grave Farther south megalithic monuments have been reported from the Madi, while stone circles are made by the Lotuko-speaking tribes wherever stone is abundant, as squatting places for the men, though in no case could evidence be obtained of stones large enough being carried even a few miles Again, although megalithic structures occur among the Lotuko and the Bari-speaking tribes of Mongalla Province, it is certain that some are recent erections over graves, *e g.*, the examples discovered by E E Evans-Pritchard among the Moro of the eastern Bahr el Ghazal Although megalithic neither in structure nor form there is a type of stone monument some 80ft long and about 5ft high occurring in some number in the neighbourhood of Erkowit. These (*Jour Egypt Archaeology*, vol. 2, 1915) are constructed without any cement or mortar; the face consists of a limiting wall of more or less flat slabs of local rock, while the spaces between the containing walls are filled in. Each monument may be considered as of three main elements, viz: (1) an oblong rectangular portion, (2) two oval masses, to each of which is attached an expansion shaped somewhat like a fish's tail and (3) the curved walls uniting the other elements. Their orientation seems to have been toward the rising sun, while each oval element is interrupted at a constant point in its circumference by the interposition of from two to four upright slabs. There is no chamber or space behind these stones, but from their constant presence and the uniformity of their position it is obvious that they must have had a perfectly definite significance to the builders, indeed they recall the false doors of Egyptian monuments J. W. Crowfoot found human bones under the filling of the rectangular portion but no objects with them. They may provisionally be regarded as mediaeval, but as antedating the spread of Mohammedan influence which was becoming dominant towards the middle of the 15th century.

Abyssinia.—Although the monuments dating from the 4th century A.D. discovered at Aksum by Theodore Bent (*The Sacred City of the Ethiopians*, 1896) are still the most important, interest will for some time tend to centre round the many new discoveries of "prehistoric" date, including some presumably of no great age, made by the Rev Father Azais.

Littman, the leader of the German expedition to Aksum, holds that the carved and decorated monuments generally termed "obelisks" are in fact stelae (of huge dimensions it is true, *e.g*, from 15 to 33 metres) and therefore each to be regarded as part of a tomb, a point of view rendered the more probable by the presence at their base of stone slabs, often carved, which have every appearance of being altars. All this seems to imply a cult of the dead, but, apart from this, inscriptions dating from the 1st and 4th centuries record the names of the gods of the Semitic conquerors of northern Abyssinia. A Greek inscription of Adulis, no longer in existence but copied in the 6th century by Cosmos Indicopleustes, states that the king of Aksum of the 1st century, who caused this record to be cut, worshipped Zeus, Ares and Poseidon A later document of King Aizanas (about A D. 350) is in Greek, Sabaean and old Ethiopic. An analysis by Littman of this inscription, together with one dating from about a century later, indicates that worship was rendered to Heaven, Sea and Earth, together with Mahren "who begat the King," the latter being identified with Ares Other monuments include rude monoliths, some ornamented with bands, and a most spirited rock-carving of a lioness in low relief.

The recent work of Father Azais shows that Abyssinia is remarkably rich in stone monuments, of types hitherto unsuspected. The following is derived from the well illustrated, but summary, account of the rev father's investigations given by A Kammerer (*Essai sur l'Histoire antique d'Abyssinie*, Paris, 1926). Most of the discoveries were made in an area stretching southwards from Addis Ababa beyond Lake Zwai to the neighbourhood of Lake Margherita. Large tumuli, some surrounded by a circle of megaliths, and a number of dolmens in excellent preservation, were found about 100m south-east of Harrar, *i e*, on the edge of the Ogaden Somali country These dolmens are said to be of the same general type as is found in western Europe One which was systematically explored yielded, besides human remains, potsherds, a silver ring and a heavy metal bead

Menhirs are particularly abundant in Sidamo Province, where they are generally of dressed stone, phallic in form, and may attain a height of 20 feet A number of menhirs with anthropoid designs in low relief were found near Silte, the capital town of Guragwe. Further south, not far from Lake Margherita, statue menhirs carved in the round occur These may show geometric designs which suggest tattoo or cicatrices, while to the west and north-west of Lake Zwai, hundreds of short stout uprights of dressed stone, "stunted menhirs," have been discovered, each bearing in relief representations varying in number from one to 13 of a short broad-bladed sword which vaguely suggests the short Roman sword In this district, too, were found several stele bearing Arabic inscriptions in the Nasri script.

Recent Discoveries in Kenya and Tanganyika.—Important (and at the time of writing unpublished) discoveries have been made in East Africa In 1913 a human skeleton was found by Dr. Hans Reck at Oldaway, in northern Tanganyika, on the borders of the Seringeti plain This lay some three metres deep, in undisturbed deposits of the last Pluvial period, associated with a fauna of which more than 50% represents extinct species, including *E. antiquus Recku, Hipparion sp*, and an extinct sheep (*Pelorovis oldawayensis*) The skull from this skeleton is said to resemble that from Elmenteita, found by L S. B Leakey, whose important discoveries in Kenya in the neighbourhood of Lake Nakuru may provisionally be summarized as follows —

A partial excavation of a flat-topped kopje at Eburu yielded crouched burials of a people with long slender limb bones and long narrow skulls, probably Negro-Hamitic There was an iron toe-ring on one of the skeletons. At Nakuru a series of forcibly contracted burials was found along the side of a cliff; the skulls which are not negro—it is too early to discuss whether they are in any degree negroid—are long and massive with a long face and well developed and narrow nose. The muscular impressions are well marked, the longbones long and relatively slender. With these skeletons were found obsidian microliths, including lunates, small *dos abattu* blades, stone bowls and mortars, grinding-stones, pottery, simple bone tools and two beads of foreign origin which may possibly date about 2,000 B.C. At Elmenteita, near the Makalia

river, there were found bones, including skulls, probably representing burials disturbed by flood, and some of these bones are definitely fossil. Here the skulls are of more than one type, (1) strongly built, dolichocephalic, and, apart from the lower jaw, somewhat resembling the Combe Capelle skull, (2) smaller, brachycephalic, represented only by women. The associated industry consists of fair-sized flakes, lunates and end-scrapers of obsidian, ostrich-shell beads and pearl shell pendants, as well as at least three types of pottery. Besides the effects of flood this site was disturbed some ten years ago, so that the original stratification may have become confused and the associated objects be of different ages.

THE WESTERN PROVINCE

Palaeolithic Remains.—It is only recently that stone implements of River-drift type, and therefore to be regarded provisionally as of Palaeolithic age, have been discovered in West Africa. In the British Museum there is a series of massive implements of Chellean type, consisting of quartz porphyry, which on the surface have weathered to the softness of chalk. These come from the alluvial deposits of the Bauchi plateau, as do a smaller number of implements of Mousterian type of the same mineral, and one very steep end-scraper of a more homogenous stone showing no surface weathering. (These implements are described by H. J. Braunholtz in *Occasional Paper* No. 4 of the Geological Survey of Nigeria.) There is also in the national collection a number of short stumpy implements of Drift type of a reddish quartzite, for the most part with unworked butt, found on the golf links of Accra (Gold Coast). Similar specimens have been found in the local gravels, the actual specimens in the museum having apparently been washed up from the beach.

Neolithic Age.—Polished axe-heads of ordinary Neolithic type are by no means uncommon in West Africa and the Congo valley. They are found in Northern Nigeria, especially in the Bauchi Plateau gravels, where it is said that they overlap to some extent the Drift types. They are, however, of a different stone, for the most part of dolerite. In the Gold Coast Colony they are found in large numbers, as are perforated quartz discs, while a few bossed spheres about 2in. in diameter, of anomalous appearance and unknown use, have been recovered. A collection of Neolithic implements from Calabar include stone axes, unusual in that they possess a definite tang for hafting.

Under the title "Tumbakultur" Oswald Menghin (*Anthropos.* 20, 1925) has described a culture characterized by series of implements, widespread in the Lower Congo area, which he tends to approximate, though with difficulty, to the Campignian of Europe. Be this as it may, Menghin finds a long series of artifacts passing insensibly from implements of coup-de-poing type, Campignian *pics*, flattened ovates of almost laurel-leaf type, to notched and roughly cruciform spear or arrowheads, some, though larger and coarser, irresistibly recalling the "freak" forms from Breonio in Italy. Apart from these, many ground stone axes have been found in the Congo area.

Megalithic Monuments.—Megalithic monuments are distributed widely in West Africa in the form of stone circles and standing stones. In Gambia both classes of monuments have been carefully described by the late Henry Parker in a paper published after his death (*Jour. Roy. Anth. Inst.*, vol. 53, 1923):—

"The circles themselves are generally found in groups or clusters comprising from two to nine, but single circles are met with. With one possible exception there are no uncompleted circles, except those formed by concentric outer pillars standing round an inner circle. . . . The groups of circles are arranged in single straight lines; in nearly parallel lines consisting of two, three or four circles; or in pairs; but never in triangles or pentagons. Many stones are prostrate and . . . almost invariably these fallen pillars . . . are at least partly buried by the soil. . . . Some have their upper face almost level with the ground, and as a rule the others are half or three-quarters covered by the earth. . . . Superficially considered this is the only indication of the age of these structures, and . . . it would be of great value if we knew the rate of elevation of the soil. Without such knowledge it is only possible to draw the conclusion from this evidence that both the circles and the menhirs must have been erected many centuries ago.

"In addition to the concentric outer pillars, there are several instances where the outer pillars are arranged on the eastern side of the circle in a straight line, or even in two parallel lines, in a north and south direction. Such lines are invariably to the east of the circle. . . ."

The circles are considered sacred to the Earth Spirit, and ceremonies are performed in them to propitiate the latter, as also for the protection of the crops. It does not, however, appear that Parker excavated in them, and their date and purpose must be left for further exploration, though in the light of information received on the spot the contents of the circle (human remains, spearheads, copper armlets) dug by J. L. Todd and G. B. Wolbach (*Man*, No. 96, 1911) suggest that in recent times these monuments were the sites of sacrifice for success in warfare.

In some of the northern villages of the Cross River Division of Nigeria, *i.e.*, in the villages of the Akayu, Indem and Atam districts (on the left bank of the Aweyong river) there are stone circles, the stones often more or less conical and carved to represent the human body from the waist upwards. These have been described and figured by C. Partridge (*Cross River Natives*, 1905, pp. 268–599); the navel is specially prominent, and cicatrices seem to be reproduced. At Agba village the circle surrounds an old tree, and the grove of the great chief who erected the circle. The tree is sacred, and of the stones it was said by the ancestors "these stones are your forefathers, your very great chiefs; every year you must sacrifice to them" (p. 271).



BY COURTESY OF THE PRESBYTERIAN BOARD OF FOREIGN MISSIONS

WOMEN SERVE AS CARRIERS IN AFRICA, COVERING 35 MILES A DAY

Beads.—In the past, claims of high antiquity have been made on behalf of the so-called "aggry" beads that have been found in West Africa. Yet as stated by Sir Hercules Read, with the single exception of the necklace to be discussed immediately none of these beads shows features not to be found in mediaeval or later beads from the factories of Venice. The necklace, presented to the British Museum by L. P. Davies, was obtained from the grave of "a renowned chief" at Mansu, a town on the route from Elmina to Kumasi. It is described in detail in *Man* (1905, 1).

For present purposes interest centres in some 20 beads of crystalline glass, irregular-faceted, and especially one bead of crystalline glass moulded like a mulberry. Sir Hercules Read writes of these as being in a state of iridescent decay, the surfaces being in many cases deeply pitted and presenting exactly the same appearance as beads of the same kind from the Mediterranean area. He points out that the crystalline glass in this necklace is identical in appearance with those from the tombs at Kameiros in Rhodes, dating from the 6th century, and goes on to suggest, but "without insisting too strongly on this point," that here are "glass beads of classical style found for the first time in West Africa, and presenting features that in point of date may justifiably be associated with the name and time of the Carthaginian Hanno, a name often invoked when objects of indeterminate age are found on the African coast."

Though probably not of any great age, reference must be made to the soap-stone carvings of human heads or figures (occasionally animal figures) found in the ground, sometimes apparently in pits, in certain districts of Sierra Leone, where they are used as agricultural charms. These figures are for the most part roughly carved, the work being well within the scope of present-day Africans, and Joyce (*Man*, No. 57, 1905, and No. 40, 1909), points out that there is really no reason to see in them—as has been proposed—evidence of foreign, *i.e.*, Egyptian or Carthaginian influence. The objects described by Frobenius from Old Ife (*The*

Voice of Africa, 1913, vol. i, chap. 14; "The Archaeological Finds"; and *Das Unbekannte Africa,* Munich, 1923), the ancient capital of the Yoruba, are also probably of no great age; there do not seem to be any which the 16th century Benin civilization might not have produced.

Possibly of about the same date are a number of bronze and silver objects, now on deposit in the British Museum, from a sandy mound (no doubt a grave) at Tumuni in the Sokoto Province of Northern Nigeria. Sir Hercules Read holds that they exhibit features and analogies which are unusual in negro African metal work, pointing to artistic or commercial relationship with the culture of the Mediterranean area, doubtless at a period remote from the date of the manufacture of the relics themselves.

The most important pieces are a bucket with incurved sides and lugs, and a barrel-shaped armlet (?) for wear on the bicepital region. The lines and casting of both, and the geometrical patterns tooled on their surfaces, are good and careful work. While the find as a tomb-group may date to A D. 1480, as suggested by H. R. Palmer, yet, as stated by Read, they are of unusual interest from the analogies they present with the early Mediterranean cultures, and we may have here a distant echo of the early art of the Bronze age. At the same time there is no reason to think that the actual objects are anything but local productions, though they may differ from those of more recent date.

THE SOUTHERN PROVINCE

Palaeolithic Implements.—Artifacts of rude Chellean type, often larger than the corresponding implements of western Europe, are found over the greater portion of South Africa, nor does there seem to be any reason why these should not be regarded as true palaeoliths perhaps of an age comparable to those of Europe. One of the most satisfactory finds of this order is constituted by a considerable number of implements of chalcedony, quartzite, etc, exactly similar to types characteristic of the River-drift Period of western Europe and Great Britain, associated with and evidently forming part of ancient terrace gravels deposited as drifts by the Zambezi (in the neighbourhood of Victoria Falls) at a remote period. The position of these terrace gravels and surface drifts in regard to the Batoka Gorge indicates their real antiquity, since they must have been deposited by the river when the latter was covering the old valley floor more than 400ft above its present level. Here Henry Balfour excavated several implements from undisturbed gravel deposits at depths varying from 6in to 2ft., some greatly water-worn and heavily patinated.

Recently A. J. H. Goodwin ("South African Archaeology," *Man,* 1927, 14, and "Capsian Affinities of S. A. later Stone age Culture," *South African Journal of Science,* vol. xxii., 1925) has summarized South African history on the following lines.—

The terms Palaeolithic and Neolithic are dropped, the two main periods being termed the Earlier Stone age and the Later Stone age, Péringuey's name for the main *coup-de-poing* culture of the Earlier Stone age, the Stellenbosch industry, being retained A second culture, the Victoria West industry, centres round Victoria West in the south-central Karroo, running north into the Free State and west to Nakob on the S.-W. African border; the *coup-de-poing* occurs, but the main implement appears to be a core similar to the European Acheulean tortoise-core, but some 8in. or so in length. It is not clear whether core or flake was the desired element, but secondarily worked flakes of this industry have not been found. The last culture of the Earlier Stone age is that of Fauresmith in the Orange Free State, with a flake worked to resemble a *coup-de-poing* as the characteristic tool.

There is no evidence of the Earlier Stone age developing into the Later Stone age, indeed they probably overlapped. The earliest industry of the Later Stone age is that of Still bay (near Mossel bay) covering most of the eastern part of the Union and extending into the Free State and to Okahandja in South-West Africa. This culture somewhat resembles the Solutrean of Europe, with lanceolate implements (usually small) as well as tanged forms, sometimes with serrated edges.

The Still bay culture was followed by two probably contemporaneous industries which extend into modern times, termed from sites in the Orange Free State the Smithfield and Wilton cultures respectively. The Smithfield culture includes end-scrapers, thumbnail and horse-shoe scrapers, trimmed points (of Chatelperron type), handpicks, bored stones, ostrich eggshell beads, ground stone rings, pottery and human remains. The human remains are of the "Bushman" type, and in a general way this culture is similar to the Capsian or the Aurignacian of Europe. The Wilton industry is very similar; the chief implements are pygmy lunates, thumbnail, and end-scrapers, as well as geometrical forms; the pottery is similar to that of Smithfield; bone arrowheads and link-shafts occur; burials are flexed, with skeletons of the same general type as the Smithfield specimens. Slate "palettes" are also found, and the culture is definitely associated with the cave paintings. Goodwin considers this culture as identical with the last phases of the Capsian of Spain and North Africa, a point of view confirmed by I. Schapera ("Some Stylistic Affinities of Bushman Art," *South African Journal of Science,* vol. xxii. Nov. 1925, pp. 504–15), who, as the result of a careful comparison of European Palaeolithic and Bushman art concludes that the Capsian art of Spain shows most affinity with that of the Bushmen.

Information supplied by Goodwin indicates the existence of a true Mousterian—the Glen Grey industry—with high-backed as well as the more usual flat points similar to those found in North Africa and Europe, while in the Later Stone age the recent discovery at Howieson's Poort of a number of true graving points (*burin*) is important, both in itself and as further suggesting contact with the north.

Pottery.—It is not clear that examples of pottery of any considerable age exist. Those figured by Péringuey (*Annals of the South African Museum,* vol. viii, 1911), provisionally assigned to Bushmen, Strandloopers and Hottentots, are of the rudest type, predominantly ovoid with conical bottoms, sometimes ornamented, the kneading and baking being very poor.

The Bushmen.—No apology seems necessary for considering the "archaeology" of the Bushmen with that of the kindred Strandloopers (no longer to be regarded as a distinct race, the name describing a mode of life and not implying a constant physical difference), for even though the former are not utterly extinct, the few survivors no longer pursue their characteristic arts of painting and graving on rock. It is generally admitted that the Bushmen stock came into South Africa from the north, and Stow was of the opinion that there were two great divisions, each with its characteristic mode of life and art, viz.: (1) cave-dwellers (painters), and (2) kopje-dwellers (sculptors), the latter producing their works by "pecking" the rock face on which they worked. This view does not seem to be generally accepted, perhaps it only emphasizes differences in technique due preponderantly to environment.

The paintings of the Bushmen, naturalistic monochrome and polychrome studies of high artistic merit, for the most part record the animals which they hunted and upon which they subsisted. But paintings of the carnivora are not absent, and cattle raids, dances and magico-religious (?) scenes are also portrayed. Belonging no doubt to the latter class are the fairly numerous examples of animal-headed human figures—representations of masked dances—not to be confused with the wearing of animal skins as a hunting ruse to admit approach to the game, as in the famous picture in the Hershel district of Cape Colony of a Bushman wearing an ostrich skin while stalking a flock of these birds.

The character of Bushman paintings has been well summed up by Henry Balfour:—

They are "remarkable not only for the realism exhibited by so many, but also for a freedom from the limitation to delineation in profile which characterizes for the most part the drawings of primitive peoples, especially where animals are concerned. Attitudes of a kind difficult to render were ventured upon without hesitation, and appreciation even of the rudiments of perspective is occasionally to be noted, though only in a crude and uncertain form. The practice of endeavouring to represent more than could be seen at one time . . . is far less noticeable in Bushmen art than might have been expected from the rudimentary general culture of these peoples, and one does not see instances of *both* eyes

being indicated upon a profile face, or a mouth in profile on a full face. . . . The colours were usually laid on uniformly over the surface which they individually covered, but a shading off is sometimes exhibited." (*Bushmen Paintings*, 1909, p. 9.)

Dr. K. M. Barnard points out that examples similar in execution to those described by L. Péringuey (*Trans. S Afr. Philos. Soc.*, 16, 1906, and 18, 1909) have been discovered at various places in South-west Africa, the farthest north being in the Grootfontein district. In addition to the usual animals there are representations of the human foot, and the spoor of various bucks, while from the position in which these latter occur the explanation that they are "sign-posts" to water cannot be maintained

Major F. J. Bagshawe (see *Man*, 1923, 92) has discovered in Tanganyika Territory rock-paintings of Bushmen type of so high an artistic quality that their origin can only be referred to this race, an extension northwards which goes well with the distribution of the Bushmen *kwe* (digging-stick weight), of which specimens, known in Tanganyika, have been discovered in Uganda (Wayland) and even among the Bari of the Southern Sudan (Seligman). The Tanganyika rock-paintings include an eland, cow, ostriches, giraffe and antelope.

Strandloopers.—The Strandloopers are a people of whom, apart from their skeletal characters, we know little, though concerning these there is a fair volume of reliable if not always consistent data. Their cultural attainments may be judged, *e g.*, from the remains found in the caves and rock-shelters of T'zitzikama cliffs, about 100m. to the west of Port Elizabeth. One of these shelters explored by F. W Fitzsimons (described by Sir Arthur Keith, *The Antiquity of Man*, I., 1925), contained deposits some 30ft. deep. The lower 5ft. and the upper 6ft. were sterile; below this latter layer was a stratum some 7 in thickness in which numerous Strandlooper burials were encountered amidst remains of fireplaces, broken pottery, implements and ornaments in stone and bone. Then came the third stratum, over 6ft. in thickness While removing this stratum and working at a depth of 15ft. below the original floor of the shelter, Fitzsimons found graves containing remains which differed from those he had met with in the stratum above. Unfortunately the bones in the lower stratum were imperfectly preserved The graves had been partly protected by slabs of stone some of which had been rudely engraved with human figures. There were lumps of red ochre, necklaces of shell and bone and tools of stone and bone. In a still deeper stratum, also about 6ft. in thickness, there were traces of burials and hearths, the human remains being fragmentary, but considered to belong to individuals of the Boskop type.

Mediaeval Remains in Rhodesia.—The conclusions of D Randall-MacIver (*Mediaeval Rhodesia*, 1906) that the Zimbabwe and similar ruins in Rhodesia are negro in origin and modern in date, though not generally accepted in South Africa, have not been disproved. For though there is no inherent improbability in the early Semitic origin of these ruins, it seems unnecessary to seek a foreign colonization where the facts in no way contradict a local origin. No authentic inscriptions have been found, and no objects discovered in the Great Zimbabwe, around which the controversy has chiefly centred, need be more than a few centuries old, while those that are not foreign imports (porcelain, etc.) are of African type. Moreover, a re-examination of the evidence, including unpublished material in the library at Lisbon, has led Father Schebesta (*Mitt. der Anthrop. Ges in Wien*, 1922–23) to the conclusion that not only is the Zimbabwe a product of the indigenous kingdom of Monomotapa described by the Portuguese, but that its builders culturally resembled the Baganda, and probably certain other of the more advanced peoples of Central Africa

For bibliography, *see* the references in the text. (C. G. S)

NORTH AFRICA

The archaeological documents of north Africa reflect the cultural conditions recorded in its ancient history, the imposition of successive alien civilizations by dominant Mediterranean Powers upon a receptive but resistant native population. The ancient invaders were (under their political names) Phoenicians, Greeks, Romans, Vandals and Byzantines; the Arab invasions, which began in the 7th century A.D., belong to modern history.

Native Cultures.—The native Libyan and Berber (*q.v.*) elements, whether aboriginal or not, have persisted without visible change from the prehistoric period to the present day. Their most ancient handiwork is represented by stone implements and simple pottery found in cave-dwellings, figures of men and animals engraved on rocks, some fortress-walls and many sepulchral monuments of megalithic type, square and circular dolmens, cairns and cromlechs. This material is related on the one side to the most primitive remains of Spain and south France, on the other side to those of Egypt and Crete; but while neolithic culture in the Egyptian and European areas was superseded in the prehistoric age, the African stone implements seem to have remained in use in certain districts until very recent times. It is seldom possible to date these monuments even approximately. The Berber language was inscribed on stone, often in conjunction with Punic and Latin texts, in a local alphabet which is still current among the Tuaregs (*q v*) of the Sahara. Beside this backward element there was in historical times an urban population more or less civilized by contact with Greeks and Semites; but it does not appear to have developed a distinctive art. Its surviving monuments are mostly sepulchral: most notable are two pyramidal structures near Tipaza (anc. *Tipasa*) and Batna in Algeria The former, called the Tomb of the Christian Woman (*Kbor er Roumia*), is evidently a royal tomb and perhaps that of Juba II, the philhellene king of Mauretania in the time of Augustus The other, called the Medracen (*Madghasen*), is older, and may be the tomb of Massinissa, the Numidian ally of Rome in their last war with Carthage. Both are low cones of stepped masonry set on cylindrical bases which have cornices borne by engaged columns; their diameters measure about 200 feet The form may have been derived from the native cairns, but it closely resembles the monumental tumuli of Italy and Asia. The architectural orders are Greek, with some archaisms and other peculiarities that indicate Punic influence

Phoenician.—The Phoenician settlement, of which Carthage was ultimately the chief city, is assigned to the 12th century B.C., but its earliest known remains are not older than the 7th. At the time of its fall in 146 B C Carthage controlled nearly the whole of what is now Tunisia, and was in touch with the native kingdom of Numidia on the west, and through the Phoenician territory of Tripolitania with the Greek colonies of Cyrenaica on the east

Nothing is left of the Punic city of Carthage and very little of its Roman successor, the colony which was founded as the capital of Africa after the destruction of the original Carthage But its site is indicated by a zone of cemeteries, which lay outside the walls. It is a large semicircular area bounded on its short side by the sea; its central point, the modern St Louis' Hill, was certainly the Punic citadel, the *Byrsa*, and the port was south of this, near the place where two lagoons now lie These agree perhaps fortuitously with ancient descriptions of the commercial and war harbours, the latter having the Admiralty Island in its midst; but the coast has greatly changed even in the last century, and ancient lines of sea-walls and quays have been identified on the outer coast. The curse that Rome invoked upon the Punic site has operated on its own foundation. After the Arab sack, the city was abandoned by the conquerors, and became a quarry for Mediterranean masons of all later ages. The cathedral of Pisa is said to have been built with stones of Carthage. A few of the larger structures can be traced. On the Byrsa is a temple of Aesculapius; in the western plain, an amphitheatre; on either side of the northern hill, a theatre and an Odeum; in the eastern plain, the baths, better preserved in the Arab name of the locality (*Dermesh*) than in its soil. The waterworks have fared better: there are great vaulted reservoirs at Dermesh and La Malga, fed by an aqueduct from a copious source at Zaghouan, 100 miles away.

The Punic graves that have been found are not older than 700 B C. They are mostly double chambers approached by shafts; burials were often made in stone coffins with lids carved

as recumbent human figures. There are numerous grotesque clay masks which were placed in the graves to keep evil spirits away. Personal trinkets and jewellery are the other furniture.

In a sanctuary of Baal at Dougga (*Thugga*) birds' bones were buried in jars. This temple, which was dedicated to Saturn under Roman rule, was enclosed in a square colonnade. A temple of Tanit-Caelestis at the same city stands in a semicircular court. A mausoleum built there in the 4th century B.C. and recently reconstructed was designed in Graeco-Phoenician style, and bore a bilingual inscription in Libyan and Punic. The art of Carthage was rapidly hellenized, probably by contact with Greek colonies in Sicily rather than with those of Africa.

Greek.—The largest Greek city in Africa was Cyrene, one of the greatest cities of the Greek world. Yet its famous and conspicuous site was almost inaccessible until the 20th century. In 1861 two young officers of the British forces at Malta, R. Murdoch Smith and E. A. Porcher, found and identified the temple of Apollo, sent to England a large series of sculptures, now in the British Museum, and excavated at other points outside and inside the city, but could not stay long enough to explore its topography more definitely. An expedition equipped by the Archaeological Institute of America made a good beginning in 1910, but met with organized hostility among the natives, and before its second season had begun the country was seized by Italy. All archaeological work in Cyrenaica and Tripolitania has since been directed by the Italian Government. The results at Cyrene show that the Roman city occupied the two hills that are the landmarks of the site. The western hill was the Greek acropolis and contained the agora; on the eastern hill is a Doric temple and a stadium; the residential quarters lay in the dividing valley and on the south-west slope of the eastern hill. At the north end of the valley, outside the city wall, the sanctuary of Apollo stands on a partly artificial platform below the fountain, Kyra The low and narrow channel of this famous spring can be followed for a quarter of a mile inside the mountain; ancient inscriptions are scratched and moulded on the clay that covers its walls, and the mouth of the channel is an open chamber cut in the face of the cliff. Rows of chamber-tombs with elaborate architectural fronts are cut or built in the slopes of the plateau. It seems that the city when fully excavated will be another example of the conventional Roman splendour which is the characteristic element in north African antiquities; but the sanctuary is a new feature, preserving its original plan, and important remains of the Greek structures have been found beneath the Roman ornament. The sanctuary is a walled precinct like that of Delphi. It contains the temples of Apollo and Artemis, each with a great altar in front, and smaller shrines of lesser deities. A curious adjunct of the Artemisium is an underground Nymphaeum, apparently for purificatory rites. The Apollo temple has treasure-cists sunk in its floor. In Roman times two bath-establishments were intruded on the terrace, from one of which some 20 marble statues were recovered, including a headless Aphrodite now in the museum of the Terme at Rome. The rest of the material from Cyrene is at Bengazi. On the west side of the precinct is a Greek theatre The Sacred Way leads from the sanctuary past the fountain to the agora, a colonnaded area of the usual Roman type containing the provincial *capitolium* and other official buildings. Among the Greek survivals here are the *heroön* and a small circular structure which was the tomb of the first Battos, founder of the city and of the dynasty which ruled it. The round tomb is apparently the base on which stood a column depicted on some Cyrenaïc coins. Curious sepulchral monuments found in the rock-tombs are sculptured busts with heads in which the face was indicated by painting, or with tapering columnar necks instead of heads. Greek art is rare: a few archaic votive statutes have been found and further excavation will doubtless produce others. The archaic strata should also help to determine the origin of the so-called Laconian or Cyrenaïc pottery. (*See* POTTERY, *Greek*) A small bronze head of a bearded man (5th century B.C.) has been found by the Italians, and a marble head of Athena (said to be 4th century) was excavated by the American expedition, but the finest work of art from Africa is a Hellenistic bronze head of a young Berber, which was found by Smith and Porcher in the temple of Apollo. It is also an anthropological document of great value. There are other Hellenistic pieces among the numerous marble statues from Cyrene, but the sculpture here as in other north African cities is generally of Roman date The other cities of Cyrenaica have produced Greek terra-cotta statuettes and painted vases, mostly from tombs; among the vases are several oil-jars which were prizes in the Panathenaic games. The Punic colonies must have contained examples of Greek art, and the Mauretanian capital of Juba II. at Cherchel (*Caesarea*) was decorated with imported statuary, some fragments of which survive Some good examples of Hellenistic sculpture have come from the sea They were found in a sunken ship which was located in 1907 off Mahedia near the Lesser Syrtes, and are now in the museum of the Bardo at Tunis. The most important is a bronze herm signed by Boëthos of Chalchedon. There are many decorative bronzes belonging to furniture, and parts of large marble vases and candelabra in Neo-Attic style. The ship's hold was divided into three compartments, and the deck was laden with marble columns. The date of the wreck is placed in the 2nd century B.C. Two large bronze statuettes, a standing boy and a seated girl, came from the harbour of Bône (*Hippo Regius*) in 1912, and a bronze horseman, said to be of the 5th century B.C., was excavated at Ksar Farun (*Volubilis*) in Morocco

Roman.—Most of the Roman cities are comparatively late foundations The civilization of Africa was never finished, and its imperial history is a record of continual progress southwards and westwards from the original province to the Sahara and the ocean. Even the older Greek and Carthaginian cities, such as Cyrene and Thugga, and the native capitals of Cirta and Caesarea, were converted to the metropolitan Roman model in the mature imperial age. But the ordinary African township was a mushroom growth, built to an emperor's order and peopled with colonists from the army and the countryside. As the citizens were Romanized by the gift of the Latin name, so the dignity of their city was asserted in its public buildings. Theatres and baths were erected and adorned by the munificence of wealthy Africans, to whom and to Roman landowners and their agents belonged the luxurious villas that are scattered through the country districts. But the urban population in general was meanly housed The best example of a new city is Timgad (*Thamugadi*) in south-east Algeria (*Numidia*), north of Mt Aures It was founded by Trajan as a colony in A.D. 100, and built by military architects and labour from the Legion III Augusta, whose discharged soldiers were the colonists. The site is laid out on the lines of a military camp, a square cut up into small blocks (*insulae*) by intersecting streets drawn parallel to the enclosing ramparts A monumental gateway (the so-called triumphal arch of Trajan) stands in the middle of the west side. At the central crossing of the two main streets (*cardo* and *decumanus*) is the *forum*, occupying the space of eight *insulae*, and next to the forum is a theatre Other public buildings now inside the ramparts are a market-place, a library and baths. The city rapidly outgrew its walls; the later *capitolium*, more baths, a larger market, another triumphal arch, pagan temples and Christian churches were built outside, and as the town grew its formal character was lost. The camp in which the legion itself was permanently quartered is *Lambaesis*, 20m. W. of Timgad. It was established in the first half of the 2nd century, and consists of a fortified square intersected by the two main roads and containing military offices, barracks and baths. A great part of the site is covered by a modern prison To the south lies the town that attached itself to the legion, entered through monumental arches and equipped with the usual apparatus of capitol and lesser temples, theatres, amphitheatre and baths Lembaesis is a unique example of a permanent camp. *Cardo* and *decumanus* are paved with stone and bordered with colonnades, and south of their intersection stands nearly to its full height the four-arched entrance to the *praetorium*, leading to a court with porticoes behind which are the headquarters' offices, legionary shrines and armouries.

Other municipal foundations were built on the same model as Timgad, but not always with the formal plan that can only be

achieved on an empty site. The best preserved structures are probably those of Lebda (*Leptis Magna*) in Tripolitania. This was the native city of the emperor Severus, and was magnificently adorned by him. It has been covered by wind-borne sand, which overthrew whole walls with its weight and at the same time buried and protected their ruins. But many walls and columns are still standing with cornices and entablatures intact. At the other end of the Roman dominion, in Morocco, lies Ksar Farun (*Volubilis*) near Meknes, a solitary outpost of classical culture in a barbarous land. A triumphal arch and the remains of a basilica were visible before its excavation. The site was largely cleared by prisoners of war in 1915. Other well-preserved or excavated cities are, in Algeria, Jemila (*Cuicul*), Khamissa (*Thubursicum Numidorum*), and Tipaza (*Tipasa*); in Tunisia, Bou Grara (*Ghighi*), Dougga (*Thugga*), Henchir Kasbat (*Thuburbo Maius*), Medeina (*Althiburus*), and Sbeïtla (*Sufetula*); and Sabratha in Tripolitania. In all of these the usual public places are represented, the *forum* with its *curia, basilica,* and *rostra,* flanked by temples and porticoes which sheltered honorific statues. Khamissa has its table of standard measures still in place; Timgad, Lembaesis, Jemila and Henchir Kasbat have markets appropriately fitted for various commodities. In the military foundations these lie just outside the gates, but Timgad has also smaller and perhaps later markets within the ramparts. There is also a library at Timgad, unique in Africa. Baths and triumphal arches (gateways) abound on these and many other sites, and each city has its theatre; those of Cherchel and Dougga are particularly well preserved. The finest amphitheatre is at El Jem (*Thysdrus*). The official sacred building of a provincial town was the *capitolium,* and was usually placed near the *forum,* but at Timgad it lies outside the walls. The regular tripartite plan is seen in this example. At Dougga the front columns with their pediment are still standing, and at Sbeïtla the capitol consists of three separate shrines. A temple at Tebessa (*Theveste*) is nearly intact, and has an elaborately carved parapet but no pediment. A notable temple is that of Aesculapius at Lembaesis, which has a thermal establishment attached and is approached through an avenue of subsidiary chapels. Many miles of aqueducts are standing between the cities and the springs from which they drew their water. The supply of Carthage came from Zaghouan, where there is an elaborate *Nymphaeum.* Similar water-sanctuaries exist at Hammam Derraji (*Bulla Regia*), Khamissa and elsewhere; the aqueduct at Sbeïtla is carried over the ravine on a massive bridge. Houses of Graeco-Roman design like those of Pompeii have been excavated on many sites: most famous is the House of Sertius at Timgad, but this does not belong to the original city. Bulla Regia has some underground houses, and there are catacombs at Sousse (*Hadrumetum*).

Large quantities of Roman sculpture have been found in these excavations, and are housed in the local museums, among them many imperial portraits and other pieces of historical value. Inscriptions also are abundant. But the peculiar artistic riches of north Africa are mosaic pavements, which have for their subjects, besides decorative patterns, seascapes and landscapes, historical and mythological scenes, and incidents of agricultural life, fishing, hunting and games. Among them are portraits of Xenophon from Sbeïtla and Virgil from Sousse. A large and varied series comes from a villa near Zliten in Tripolitania.

Vandal and Byzantine.—Mosaic decoration is a prominent feature in the remains of Early Christian churches (basilicas): there are particularly fine examples in the baptisteries of Jemila, Sbeïtla and Timgad. At the last place the church is attached to a monastery, as also at Tebessa. Some of the churches are Late Roman, others are Byzantine foundations. During the short interval of Vandal occupation (A.D. 439–533) there seems to have been no architectural activity, but some fortification and a good deal of military demolition date from this epoch. Examples of the latter are supplied by the theatres of Carthage, which were filled in with the ruins of their superstructures. The great fortress walls that dominate many sites are Byzantine. They were erected to hold the civilized country against native tribes, the same aggressors that the Roman conquerors had to face; and it is significant that the two most imposing Byzantine strongholds, at Haïdra and Tebessa, are on the sites of the first permanent camps that the Roman legion fortified on Mt. Aures (*Ammaedara* and *Theveste*). Haïdra is the type of a military fort, Tebessa of a fortified city. The fortress-walls were made of ancient materials, and often incorporate whole buildings of preceding ages. Triumphal arches at Tebessa are worked into the circuit of the ramparts; one at Haidra was built up to make a tower; the capitols of Dougga and Sbeïtla were turned into forts. The ruin of classical buildings involved in these defensive works was immense, and it has been justly said that the real vandals of north Africa were the Byzantines. Arab conquests, though fatal to town-dwellers, did no great damage to the structures. Indeed their subsequent desertion and neglect have been the means of preserving so many Roman cities to an extent unequalled in any other land. (E. J. F.)

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HISTORY

The ancient history of Africa is shrouded in mystery and the earliest records of that continent and its people are far from trustworthy. *See* AFRICA, ROMAN; EGYPT.

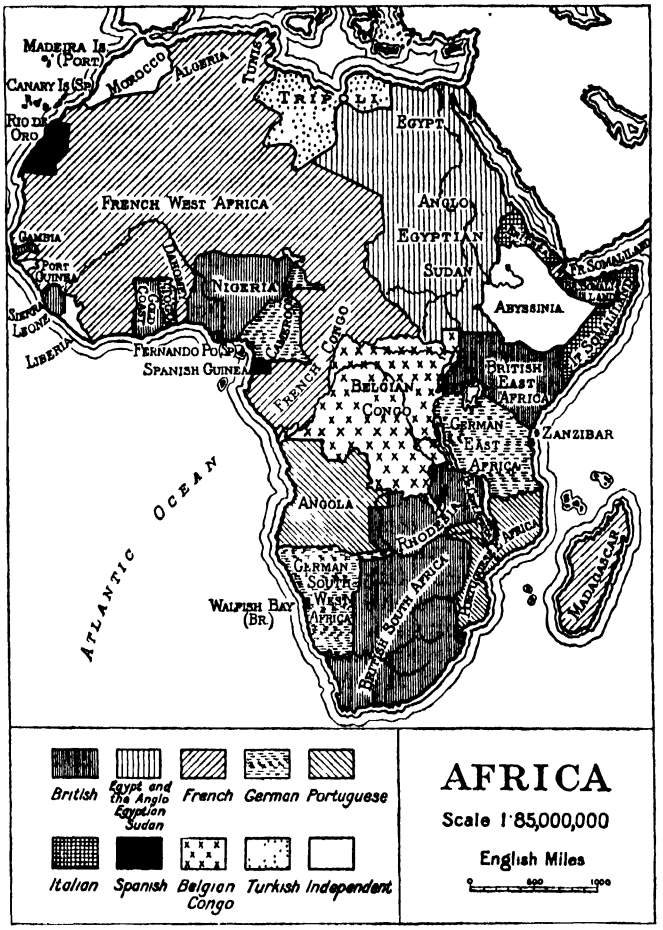
Phoenician and Greek Colonization.—The word Africa was applied originally to the country in the immediate neighbourhood of Carthage, that part of the continent first known to the Romans, and it was subsequently extended with their increasing knowledge. The Arabs still confine the name Ifrikia to the territory of Tunisia. If ancient Egypt and Ethiopia (*q.v.*) be excluded, the story of Africa is largely a record of the doings of its Asiatic and European conquerors and colonizers, Abyssinia being the only State which throughout historic times has maintained its independence. The countries bordering the Mediterranean were first exploited by the Phoenicians. Carthage, founded about 800 B.C., speedily grew into a city without rival in the Mediterranean, and the Phoenicians, subduing the Berber tribes, who then, as now, formed the bulk of the population, became masters of all the habitable region of north Africa west of the Great Syrtis Both Egyptians and Carthaginians made attempts to reach the unknown parts of the continent by sea. The west coast was well known to the Phoenicians as far as Cape Nun, and *c.* 520 B.C. Hanno, a Carthaginian, explored the coast at least as far as Sierra Leone.



A WOMAN OF ZULULAND

Meantime the first European colonists had settled in Africa. Greeks founded the city of Cyrene (*c.* 631 B.C.) and exerted a powerful influence in Egypt. To Alexander the Great the city of Alexandria owes its foundation (332 B.C.), and under the Hellenistic dynasty of the Ptolemies attempts were made to penetrate southward, and in this way was obtained some knowledge of Abyssinia. Neither Cyrenaica nor Egypt was a serious rival to the Carthaginians, but all three Powers were eventually supplanted by the Romans after the fall of Carthage in 146 B.C. Under Rome the settled portions of the country were very prosperous, and a Latin strain was introduced into the land. Though Fezzan was occupied by them, the Romans elsewhere found the Sahara an impassable barrier. The utmost extent of geographical knowledge of the continent is shown in the writings of Ptolemy (2nd century A.D.), who guessed the existence of the great lake reservoirs of the Nile and had heard of the river Niger. (For the history of Africa under the empire, *see* ROMAN EMPIRE, LATER.)

The Arab Conquest.—In the 7th century an Arab host, following the new faith of Mohammed, conquered the whole country from the Red sea to the Atlantic and entered Spain. Throughout north Africa Christianity well-nigh disappeared, save in Egypt (where the Coptic Church was suffered to exist), and Upper Nubia and Abyssinia, which were not subdued. In the 8th, 9th and 10th centuries the Arabs in Africa were numerically weak; but in the



POLITICAL DIVISIONS OF AFRICA IN 1910 AT THE CLOSE OF THE FINAL PHASE OF THE INTERNATIONAL "SCRAMBLE FOR TERRITORY"
Two further adjustments took place before the World War. By the 1911 agreement the Cameroon received two tongue-like extensions—one reaching to the Congo river, the other to the Ubangi. On Nov. 5, 1911, as the result of a brief war with Turkey, Italian sovereignty was extended over Tripoli

11th century there was a great Arab immigration. Even before this the Berbers had very generally adopted the speech and religion of their conquerors. Arab influence and the Mohammedan religion thus became indelibly stamped on northern Africa. Together they spread southward across the Sahara, and became firmly established along the eastern sea-board, where Arabs, Persians and Indians planted flourishing maritime and commercial colonies. Of these eastern cities and States both Europe and the Arabs of north Africa were long ignorant.

The first Arab invaders had recognized the authority of the caliphs of Baghdad. Early in the 10th century the Fatimite dynasty established itself in Egypt, where Cairo had been founded A.D. 968, and from there ruled as far west as the Atlantic. Later still arose other dynasties such as the Almoravides and Almohades. Eventually the Turks, who had seized Egypt in 1517, established the regencies of Algeria, Tunisia and Tripoli (between 1519 and 1551), Morocco remaining an independent Arabized Berber State under the Sharifan dynasty, which had its beginnings at the end of the 13th century. Under the earlier dynasties the spirit of adventure and the proselytizing zeal of the followers of Islam led to a considerable extension of the knowledge of the continent. This was rendered more easy by their use of the camel, which enabled the Arabs to traverse the desert. In this way Senegambia and the middle Niger regions fell under the influence of the Arabs and Berbers, but it was not until 1591 that Timbuktu—founded in the 11th century—became Muslim. That city had been reached in 1352 by the great Arab traveller Ibn Batuta, to whose journey to Mombasa and Quiloa (Kilwa) was due the first accurate knowledge of those flourishing Muslim cities on the east African sea-board. Except along this sea-board, which was colonized directly from Asia, Arab progress southward was stopped by the broad belt of dense forest which, stretching almost across the continent somewhat south of 10° N., barred their advance as effectually as had the Sahara that of their predecessors, and cut them off from knowledge of the Guinea coast and of all Africa beyond One of the regions which came latest under Arab control was Nubia, where a Christian civilization and State existed up to the 14th century.

For a time the Muslim conquests in south Europe had virtually made of the Mediterranean an Arab lake, but in the 11th century the Norman conquest of Sicily was followed by their descent on Tunisia and Tripoli. Somewhat later a busy trade with the African coast-lands, especially Egypt, was developed by the cities of north Italy. The Italians also, in the 14th and 15th centuries, traded with the countries of the Niger bend and were conversant with the routes across the Sahara. Some Europeans even traversed the desert, while one traveller—not a merchant—the Frenchman Anselme d'Isalguier reached Gao on the Niger, in 1405[1] Meanwhile events were impending which were to have a profound effect on north-west Africa. By the end of the 15th century Spain had completely thrown off the Muslim yoke, but even while the Moors were still in Granada, Portugal was strong enough to carry the war into Africa In 1415 a Portuguese force captured the citadel of Ceuta on the Moorish coast From that time Portugal repeatedly interfered in the affairs of Morocco, while Spain acquired many ports in Algeria and Tunisia. Portugal, however, suffered a crushing defeat in 1578 at al Kasr al Kebir, the Moors being led by Abd el Malek I. of the Sherifan dynasty. By that time the Spaniards had lost almost all their African possessions. The Barbary States degenerated into mere communities of pirates, and under Turkish influence civilization and commerce declined. (X.)

MODERN HISTORY

The Portuguese.—But with the battle of Ceuta, Africa had ceased to belong solely to the Mediterranean world. Among those who fought there was Prince Henry "the Navigator," son of King John I., who was fired with the ambition to acquire for Portugal the unknown parts of Africa. Under his inspiration and direction was begun that series of voyages of exploration which resulted in the circumnavigation of Africa and the establishment of Portuguese sovereignty over large areas of the coast-lands. Cape Bojador was doubled in 1434, Cape Verde in 1445, and by 1480 the whole Guinea coast was known. In 1482 Diogo Cam or Cão discovered the mouth of the Congo; the Cape of Good Hope was doubled by Bartholomew Diaz in 1488, and in 1498 Vasco da Gama, after having rounded the Cape, sailed up the east coast, touched at Sofala and Malindi, and went thence to India. Over all the countries discovered by their navigators Portugal claimed sovereign rights, but these were not exercised in the extreme south of the continent. The Guinea coast, as the first discovered and the nearest to Europe, was first exploited. Numerous forts and trading stations were established, the earliest being São Jorge da Mina (Elmina), begun in 1482. The chief commodities dealt in were slaves, gold, ivory and spices. The discovery of America (1492) was followed by a great development of the slave trade, which, before the Portuguese era, had been an overland trade almost exclusively confined to Mohammedan Africa The lucrative nature of this trade, and the large quantities of alluvial gold obtained by the Portuguese, drew other nations to the Guinea coast. English mariners went thither as early as 1553, and they were followed by Spaniards, Dutch, French, Danish, and

[1] D'Isalguier afterwards wrote an account (never published) of his travels, which were made known in 1927 by Charles de la Roncière in vol. iii. of *La Découverte de l'Afrique au Moyen Âge.*

other adventurers. Much of Senegambia was made known as a result of quests during the 16th century for the "hills of gold" in Bambuk and the fabled wealth of Timbuktu, but the middle Niger was not reached. The supremacy along the coast passed in the 17th century from Portugal to Holland and from Holland in the 18th and 19th centuries to France and England. The whole coast from Senegal to Lagos was dotted with forts and "factories" of rival Powers, and this international patchwork persists though all the *hinterland* has become either French or British territory.

Southward from the mouth of the Congo[1] to the inhospitable region of Damaraland, the Portuguese, from 1491 onward, acquired influence over the Bantu-Negro inhabitants, and in the early part of the 16th century through their efforts Christianity was largely adopted in the native kingdom of Congo. An irruption of cannibals from the interior later in the same century broke the power of this semi-Christian state, and the Portuguese activity was transferred to a great extent farther south, São Paulo de Loanda being founded in 1576. The sovereignty of Portugal over this coast region, except for the mouth of the Congo, has been only once challenged by a European Power, and that was in 1640–48, when the Dutch held the seaports.

Neglecting the comparatively poor and thinly inhabitated regions of South Africa, the Portuguese no sooner discovered than they coveted the flourishing cities held by Arabized peoples between Sofala and Cape Guardafui. By 1520 all these Muslim sultanates had been seized by Portugal, Mozambique being chosen as the chief city of her East African possessions. Nor was Portuguese activity confined to the coast-lands. The lower and middle Zambezi valley was explored (16th and 17th centuries), and here the Portuguese found semi-civilized Bantu-Negro tribes, who had been for many years in contact with the coast Arabs. Strenuous efforts were made to obtain possession of the country (modern Rhodesia) known to them as the kingdom or empire of Monomotapa, where gold had been worked by the natives from about the 12th century AD, and whence the Arabs, whom the Portuguese dispossessed, were still obtaining supplies in the 16th century. Several expeditions were despatched inland from 1569 onward and considerable quantities of gold were obtained. Portugal's hold on the interior, never very effective, weakened during the 17th century, and in the middle of the 18th century ceased with the abandonment of the forts in the Manica district

At the period of her greatest power Portugal exercised a strong influence in Abyssinia also. In the ruler of Abyssinia (to whose dominions a Portuguese traveller had penetrated before Vasco da Gama's memorable voyage) the Portuguese imagined they had found the legendary Christian king, Prester John, and when the complete overthrow of the native dynasty and the Christian religion was imminent by the victories of Mohammedan invaders, the exploits of a band of 400 Portuguese under Christopher da Gama during 1541–43 turned the scale in favour of Abyssinia and had thus an enduring result on the future of north-east Africa. After da Gama's time Portuguese Jesuits resorted to Abyssinia While they failed in their efforts to convert the Abyssinians to Roman Catholicism they acquired an extensive knowledge of the country. Pedro Paez in 1615, and, ten years later, Jeronimo Lobo, both visited the sources of the Blue Nile. In 1663 the Portuguese, who had outstayed their welcome, were expelled from the Abyssinian dominions. At this time Portuguese influence on the Zanzibar coast was waning before the power of the Arabs of Muscat, and by 1730 no point on the east coast north of Cape Delgado was held by Portugal.

The English and the Dutch.—It has been seen that Portugal took no steps to acquire the southern part of the continent. To the Portuguese the Cape of Good Hope was simply a landmark on the road to India, and mariners of other nations who followed in their wake used Table Bay only as a convenient spot wherein to refit on their voyage to the East. By the beginning of the 17th century the bay was much resorted to for this purpose, chiefly by English and Dutch vessels. In 1620, with the object of forestalling the Dutch, two officers of the East India Company, on their own initiative, took possession of Table Bay in the name of King James, fearing otherwise that English ships would be "frustrated of watering but by licence" Their action was not approved in London, and the proclamation they issued remained without effect. The Netherlands profited by the apathy of the English. On the advice of sailors who had been shipwrecked in Table Bay the Netherlands East India Company, in 1651, sent out a fleet of three small vessels under Jan van Riebeek which reached Table Bay on April 6, 1652, when, 164 years after its discovery, the first permanent white settlement was made in South Africa. The Portuguese, whose power in Africa was already waning, were not in a position to interfere with the Dutch plans, and England was content to seize the island of St. Helena as her half-way house to the East.[1] In its inception the settlement at the Cape was not intended to become an African colony, but was regarded as the most westerly outpost of the Dutch East Indies. Nevertheless, despite the paucity of ports and the absence of navigable rivers, the Dutch colonists, freed from any apprehension of European trouble by the friendship between Great Britain and Holland and leavened by Huguenot blood, gradually spread eastward.

MODERN EXPLORATION

During the 18th century there is little to record in the history of Africa. The nations of Europe, engaged in the later half of the century in almost constant warfare and struggling for supremacy in America and the East, to a large extent lost their interest in the continent. Only on the west coast was there keen rivalry, and here the motive was the securance of trade rather than territorial acquisitions. In this century the slave trade reached its highest development, the trade in gold, ivory, gum, and spices being small in comparison. In the interior of the continent—Portugal's energy being expended—no interest was shown, the nations with establishments on the coast "taking no further notice of the inhabitants or their land than to obtain at the easiest rate what they procure with as little trouble as possible, or to carry them off for slaves to their plantations in America" (*Encyclopædia Britannica*, 3rd. ed. 1797). Even the scanty knowledge acquired by the ancients and the Arabs was in the main forgotten or disbelieved. It was the period when—

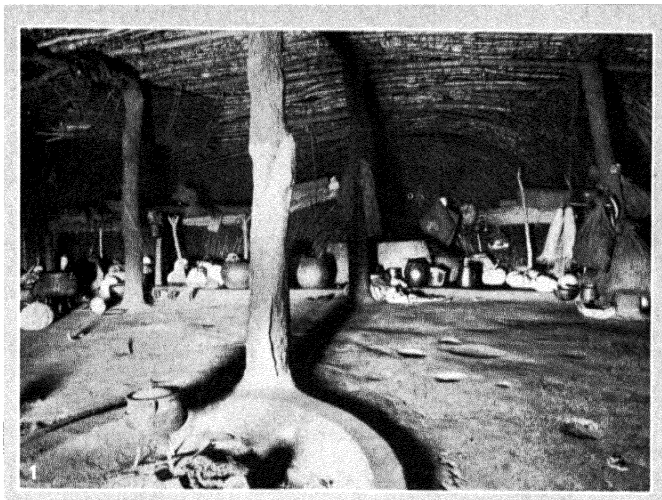
> Geographers, in Afric maps,
> With savage pictures filled their gaps,
> And o'er unhabitable downs
> Placed elephants for want of towns.
>
> (*Poetry, a Rhapsody*. By Jonathan Swift)

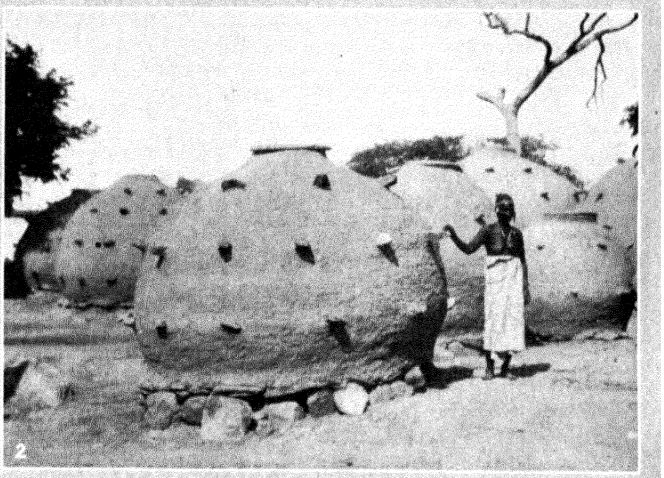
The prevailing ignorance may be gauged by the statement in the third edition of the *Encyclopædia Britannica* that "the Gambia and Senegal rivers are only branches of the Niger." But the closing years of the 18th century, which witnessed the partial awakening of the public conscience of Europe to the iniquities of the slave trade, were also notable for the revival of interest in inner Africa. A society, the African Association,[2] was formed in London in 1788 for the exploration of the interior of the continent. The era of great discoveries had begun a little earlier in the famous journey (1770–72) of James Bruce through Abyssinia and Sennar, during which he determined the course of the Blue Nile. But it was through the agents of the African Association that knowledge was gained of the Niger regions. The Niger was reached by Mungo Park, who travelled by way of the Gambia, in 1795. Park, on a second journey in 1805, passed Timbuktu and descended the Niger to Bussa, where he lost his life, having just failed to solve the question as to where the river reached the ocean. (This problem was ultimately solved by Richard Lander and his brother in 1830.) The first scientific explorer of South-East Africa, Dr. Francisco de Lacerda, a Portu-

[1]This river was called by the Portuguese the Zaire. They appear to have made no attempt to trace its course beyond the rapids which stop navigation from the sea.

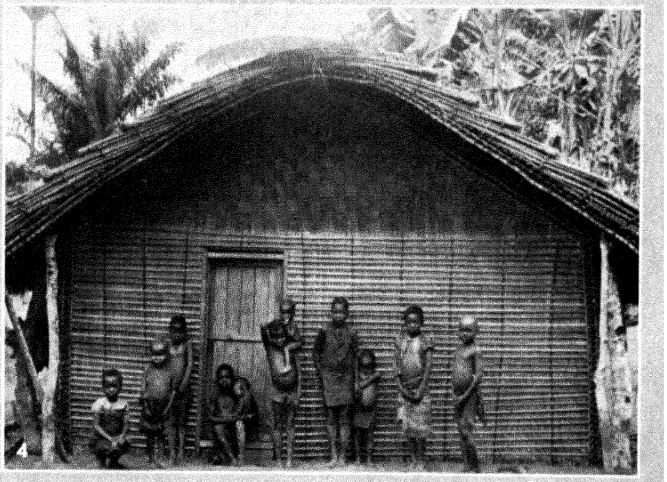
[1]France acquired, as stations for her ships on the voyage to and from India, settlements in Madagascar and the neighbouring islands. The first settlement was made in 1642.

[2]The Association, in 1831, was merged in the Royal Geographical Society.

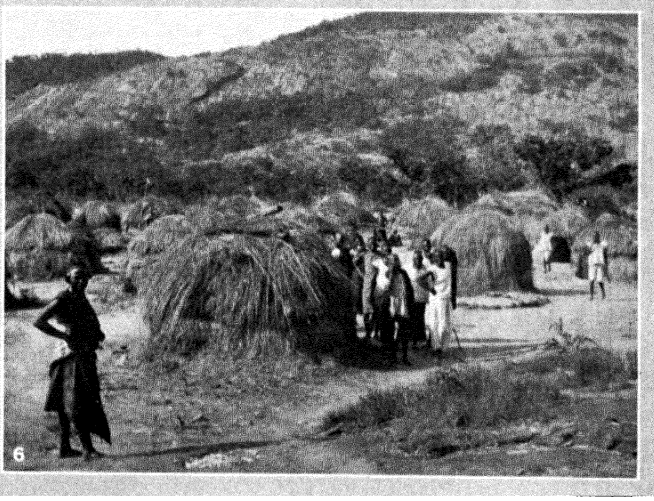












PHOTOGRAPHS BY E.N.A.

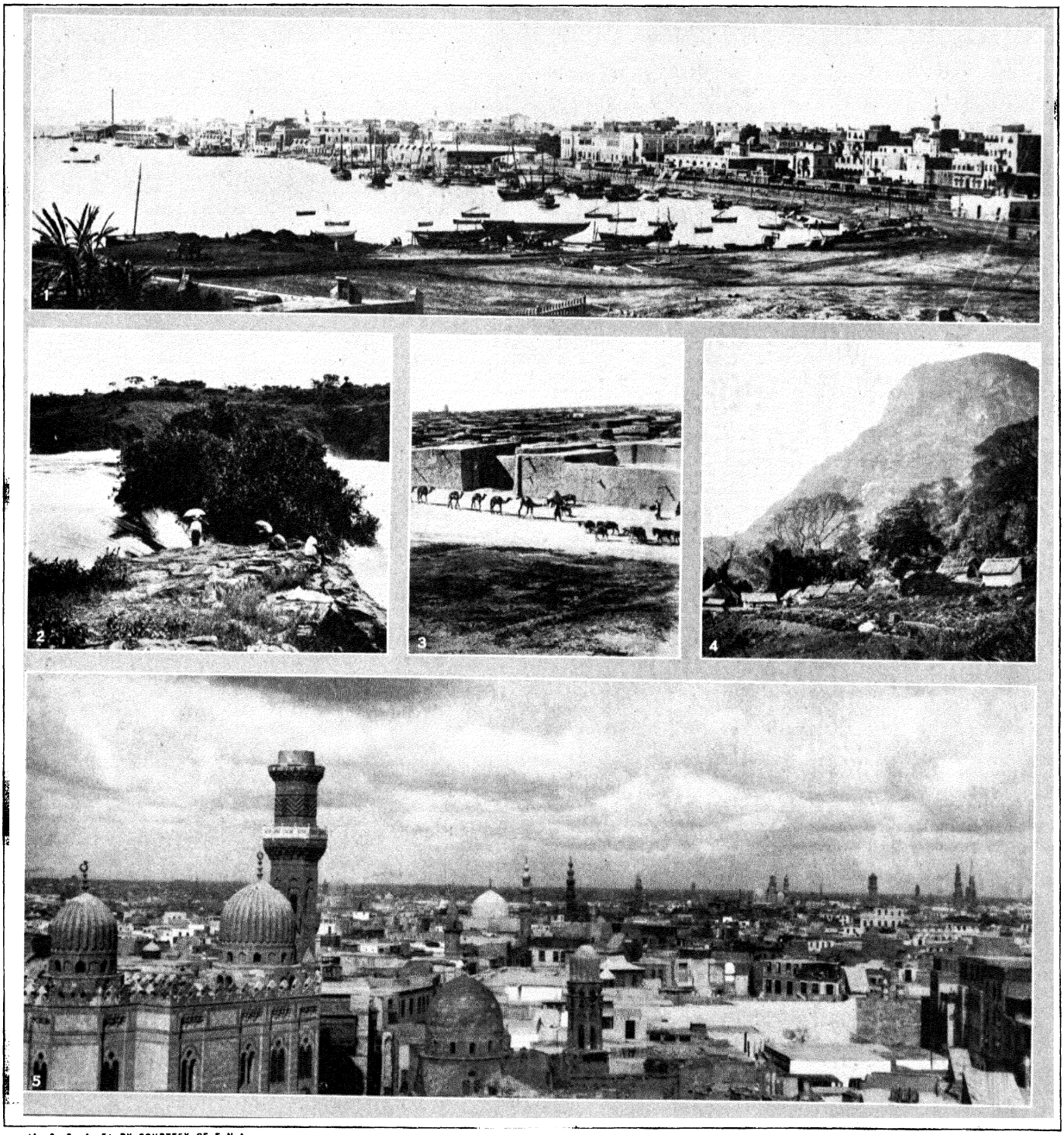
GRASS AND MUD HUTS OF SOUTHERN AFRICA

1. Interior of Zulu hut, showing tree trunk uprights and rafters and primitive utensils around the fireplace
2. Mud granary of upper Niger region with projecting steps on the sides which the natives mount in order to pour the grain through the opening at the top
3. Typical mud building in Kano, at the northerly terminus of the Nigerian railway system
4. Native house in the Congo region constructed of grass and fronds of palm trees
5. Exterior of hut and kraal constructed of reeds and grasses in Zululand
6. A common village arrangement in Nigeria, where the communities are under the rule of small chieftains

AFRICA

A MONUMENT OF STONE 35 KILOMETRES NORTHEAST OF BATNA, IN ALGERIA, ARBITRARILY NAMED SYPHAX'S TOMB AND PROBABLY DATING BACK TO THE PERIOD OF ROMAN DOMINATION

BY COURTESY OF LES ARCHIVES PHOTOGRAPHIQUES D'ART ET D'HISTOIRE



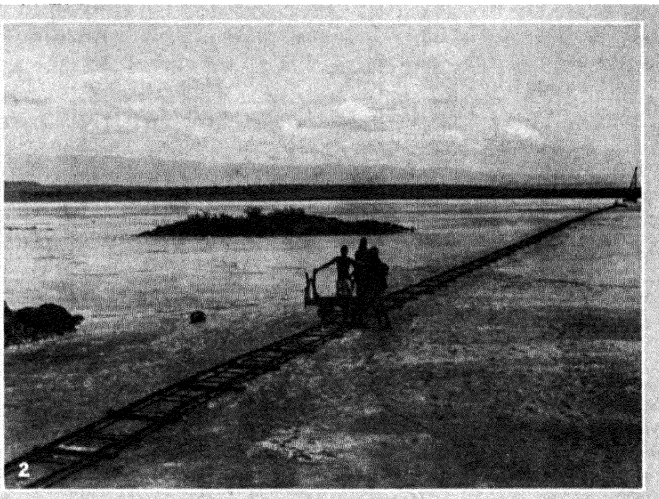
(1, 2, 3, 4, 5) BY COURTESY OF E.N.A.

GENERAL VIEWS OF URBAN AND RURAL AFRICA

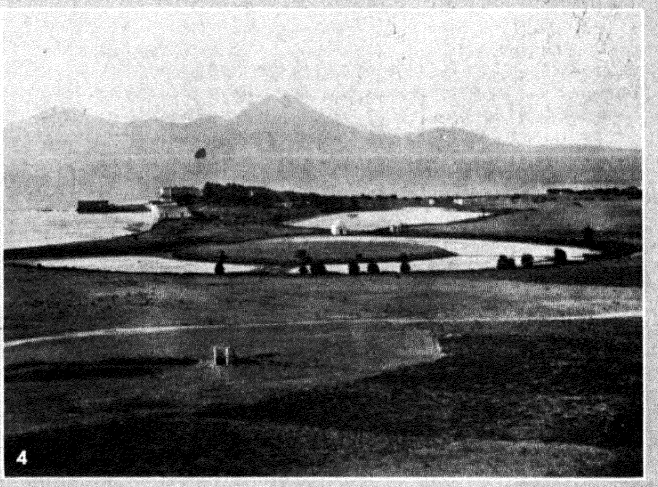
1. General view of Suez from the Battery, showing harbour, town and railway station
2. Ripon Falls, on the north shores of Victoria Nyanza, where the Victoria section of the River Nile has its source
3. Outer wall of the ancient city of Timbuktu, in French West Africa, the central depot of the exchange trade between the northern desert districts and the Niger district
4. Sumbu mission station and Ponella Hill, Tanganyika, formerly German East Africa and now under British mandate
5. Cairo, the Muslim capital of Egypt, showing the domes, turrets and minarets of some of the 260 mosques

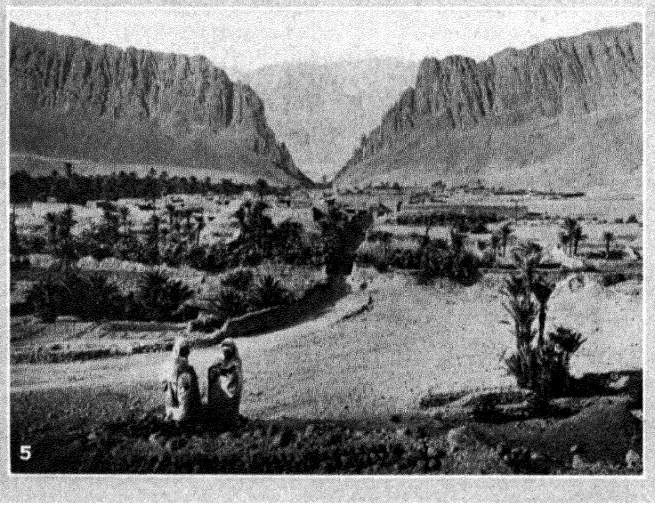
AFRICA













PHOTOGRAPHS (1, 2, 4, 5) BY E.N.A, (3) W. M'GREGOR ROSS, (6) VISUAL EDUCATION SERVICE

CHARACTERISTIC VIEWS OF NORTHERN AND EASTERN AFRICA

1. Wayfarers in the Sahara Desert
2. Magadi Lake, of crystallized soda, 25 miles long by 4 miles wide, British East Africa. The narrow railway connects with the main line of the Uganda railroad
3. Mount Kenya, British East Africa, over 17,000 feet high, photographed at a distance of about 30 miles
4. The sacred mountain of Bu Kurnin, overlooking the gulf of Tunis, where Carthage once stood, with the Punic naval and commercial ports in the foreground
5. El Kantara, a village on the left bank of the Oued, showing the entrance to the gorge
6. Mohammedans grouped on prayer mats

guese, also lost his life in that country. Lacerda travelled up the Zambezi to Tete, going thence towards Lake Mweru, near which he died in 1798. The first recorded crossing of Africa was accomplished between the years 1802 and 1811 by two half-caste Portuguese traders, Pedro Baptista and A. José, who passed from Angola eastward to the Zambezi.

Although the Napoleonic wars distracted the attention of Europe from exploratory work in Africa, those wars nevertheless exercised great influence on the future of the continent, in both Egypt and South Africa. The occupation of Egypt (1798–1803) first by France and then by Great Britain, resulted in an effort by Turkey to regain direct control over that country,[1] followed in 1811 by the establishment, under Mohammed Ali, of an almost independent state, and the extension of Egyptian rule over the eastern Sudan (from 1820 onward). In South Africa the struggle with Napoleon caused Great Britain to take possession of the Dutch settlements at the Cape, and in 1814 Cape Colony, which had been continuously occupied by British troops since 1806, was formally ceded to the British crown.

The close of the European conflicts with the battle of Waterloo was followed by vigorous efforts on the part of the British Government to become better acquainted with Africa, and to substitute colonization and legitimate trade for the slave traffic, declared illegal for British subjects in 1807 and abolished by all other European Powers by 1836. To West Africa Britain devoted much attention. The slave trade abolitionists had already, in 1788, formed a settlement at Sierra Leone, on the Guinea coast, for freed slaves, and from this establishment grew the colony of Sierra Leone,[2] long notorious, by reason of its deadly climate, as "The White Man's Grave" Farther east the establishments on the Gold Coast began to take a part in the politics of the interior, and the first British mission to Kumasi, despatched in 1817, led to the assumption of a protectorate over the maritime tribes heretofore governed by the Ashanti.

An expedition sent in 1816 to explore the Congo from its mouth did not succeed in getting beyond the rapids which bar the way to the interior, but in the central Sudan much better results were obtained In 1823 three English travellers, Walter Oudney, Dixon Denham, and Hugh Clapperton, reached Lake Chad from Tripoli—the first white men to reach that lake. The partial exploration of Bornu and the Hausa states by Clapperton, which followed, revealed the existence of large and flourishing cities and a semi-civilized people in a region hitherto unknown. The discovery in 1830 of the mouth of the Niger by Clapperton's servant, Lander, already mentioned, had been preceded by the journeys of Maj A. G. Laing (1826) and René Caillié (1827) to Timbuktu, and was followed (1832–33) by the partial ascent of the Benue affluent of the Niger by MacGregor Laird In 1841 a disastrous attempt was made to plant a white colony on the lower Niger, an expedition (largely philanthropic and anti-slavery in its inception) which ended in utter failure. Nevertheless, from that time British traders remained on the lower Niger, their continued presence leading ultimately to the acquisition of political rights over the delta and the Hausa states by Great Britain.[3] Another endeavour by the British Government to open up commercial relations with the Niger countries resulted in the addition of a vast amount of information concerning the countries between Timbuktu and Lake Chad, owing to the labours of Heinrich Barth (1850–55), originally a subordinate, but the only surviving member of the expedition sent out.

Meantime considerable changes had been made in other parts of the continent, the most notable being the occupation of Algiers by France in 1830, an end being thereby put to the piratical proceedings of the Barbary States; the continued expansion southward of Egyptian authority, with the consequent additions to the knowledge of the Nile; and the establishment of independent states (Orange Free State and the Transvaal) by Dutch farmers (Boers) dissatisfied with British rule in Cape Colony. Natal, so named by Vasco da Gama, had been made a British colony (1843), the attempt of the Boers to acquire it being frustrated The city of Zanzibar, on the island of that name, founded in 1832 by Seyyid Said of Muscat, rapidly attained importance, and Arabs began to penetrate to the great lakes of East Africa,[1] concerning which little more was known (and less believed) than in the time of Ptolemy. Accounts of a vast inland sea, and the discovery in 1848–49, by the missionaries Ludwig Krapf and J. Rebmann, of the snow-clad mountains of Kilimanjaro and Kenya, stimulated in Europe the desire for further knowledge.

Livingstone and Stanley.—At this period, the middle of the 19th century, Protestant missions were carrying on active propaganda on the Guinea coast, in South Africa, and in the Zanzibar dominions. Their work, largely beneficent, was being conducted in regions and among peoples little known, and in many instances missionaries turned explorers and became pioneers of trade and empire. One of the first to attempt to fill up the remaining blank spaces in the map was David Livingstone, who had been engaged since 1840 in missionary work north of the Orange. In 1849 Livingstone crossed the Kalahari desert from south to north and reached Lake Ngami, and between 1851 and 1856 he traversed the continent from west to east, making known the great waterways of the upper Zambezi. During these journeyings Livingstone discovered, Nov. 1855, the famous Victoria Falls, so named after the queen of Great Britain. In 1858–64 the lower Zambezi, Shiré, and Lake Nyasa were explored by Livingstone, Nyasa having been first reached by the confidential slave of Antonio da Silva Porto, a Portuguese trader established at Bihé in Angola, who crossed Africa during 1853–56 from Benguella to the mouth of the Rovuma While Livingstone circumnavigated Nyasa, the more northerly lake, Tanganyika, had been visited (1858) by Richard Burton and J H Speke, and the last named had sighted Victoria Nyanza Returning to East Africa with J. A Grant, Speke reached, in 1862, the river which flowed from Victoria



FROM STANLEY, "HOW I FOUND LIVINGSTONE"

STANLEY GREETS LIVINGSTONE WITH "DR LIVINGSTONE, I PRESUME" After a hazardous journey of 295 days Stanley, on Oct. 28, 1871, reached Ujiji, where he found Dr. Livingstone, sick, emaciated and depressed. Food, medicine and the cheerful society of his rescuer soon restored the missionary and together they surveyed the north end of Lake Tanganyika

Nyanza and, following it (in the main) down to Egypt, had the distinction of being the first man to read the riddle of the Nile. In 1864 another Nile explorer, Samuel Baker, discovered the Albert Nyanza, the chief western reservoir of the river. In 1866 Livingstone began his last great journey, in which he made known Lakes Mweru and Bangweulu and discovered the Lualaba (the upper part of the Congo), but died (1873) before he had been able to demonstrate its ultimate course, believing indeed that the Lualaba belonged to the Nile system. Livingstone's lonely death in the heart of Africa evoked a keener desire than ever to complete the work he left undone. H. M. Stanley, who had in 1871

[1]The Mamelukes, whom the Turks had overthrown in the 16th century, had regained practically independent power.

[2]In imitation of the British example, an American society founded in 1822 the negro colony (now republic) of Liberia.

[3]The first territorial acquisition made by Great Britain in this region was in 1851, when Lagos Island was annexed.

[1]As early as 1848 an Arab from Zanzibar journeying across the continent had arrived at Benguella.

succeeded in finding and succouring Livingstone, started again for Zanzibar in 1874, and in the most memorable of all exploring expeditions in Africa circumnavigated Victoria Nyanza and Tanganyika, and, striking farther inland to the Lualaba, followed that river down to the Atlantic ocean—reached in Aug. 1877—and proved it to be the Congo In South Africa, Karl Mauch in 1871 discovered the ruins of the great Zimbabwe in Mashonaland; and in the following year F. C. Selous began his journeys over South Central Africa.

Explorers were active also in other parts of the continent. Southern Morocco, the Sahara, and the Sudan were traversed in many directions between 1860 and 1875 by Gerhard Rohlfs, Georg Schweinfurth and Gustav Nachtigal. These travellers not only added considerably to geographical knowledge, but obtained invaluable information concerning the people, languages, and natural history of the countries in which they sojourned [1] Among the discoveries of Schweinfurth was one that confirmed the Greek legends of the existence beyond Egypt of a pygmy race. But the first discoverer of the dwarf races of Central Africa was Paul du Chaillu, who found them in the Ogowé district of the west coast in 1865, five years before Schweinfurth's first meeting with the pygmies; du Chaillu having previously, as the result of journeys in the Gabun country between 1855 and 1859, made popular in Europe the knowledge of the existence of the gorilla, perhaps the gigantic ape seen by Hanno the Carthaginian, and whose existence, up to the middle of the 19th century, was thought to be as legendary as that of the pygmies of Aristotle

Stanley's great journey down the Congo in 1875–76 initiated a new era in African exploration, and since 1875 the map has been filled with authentic topographical details Within their respective spheres of influence each Power undertook detailed surveys, and the most solid of the latest accessions to knowledge have resulted from the labours of hard-working colonial officials toiling individually in obscurity.

In 1877 an important expedition was sent out by the Portuguese Government under Serpa Pinto, Brito Capello, and Roberto Ivens for the exploration of the interior of Angola. The first named made his way by the head-streams of the Kubango to the upper Zambezi, which he descended to the Victoria Falls, proceeding thence to Pretoria and Durban Capello and Ivens confined their attention to the south-west Congo basin, where they disproved the existence of Lake Aquilunda, which had figured on the maps of that region since the 16th century. In a later journey (1884–85) Capello and Ivens crossed the continent from Mossamedes to the mouth of the Zambezi, adding considerably to the knowledge of the borderlands between the upper Congo and the upper Zambezi. More important results were obtained by the German travellers, Paul Pogge and Hermann von Wissmann, who (1880–82) passed through previously unknown regions beyond Muata Yanvo's kingdom, and reached the upper Congo at Nyangwe, whence Wissmann made his way to the east coast. In 1884–85 a German expedition under Wissmann solved the most important geographical problem relating to the southern Congo basin by descending the Kasai, the largest southern tributary, which contrary to expectation, proved to unite with the Kwango and other streams before joining the main river. Further additions to the knowledge of the Congo tributaries were made at the same time by the Rev. George Grenfell, a Baptist missionary, who (accompanied in 1885 by K. von François) made several voyages in the steamer "Peace," especially up the great Ubangi, ultimately proved to be the lower course of the Welle, discovered in 1870 by Schweinfurth.

East Africa.—The first new journey of importance in East Africa was made (1878–80) on behalf of the British African Exploration committee by Joseph Thomson, who after the death of his leader, Keith Johnston, made his way from the coast to the north end of Nyasa, thence to Tanganyika, on both sides of which he broke new ground, sighting the north end of Lake Rukwa on the east. In 1882–84 the French naval lieutenant, Victor Giraud, proceeded by the north of Nyasa to Lake Bangweulu, of which he made the first fairly correct map. North of the Zanzibar-Tanganyika route a large area of new ground was opened in 1883–84 by Thomson, who traversed the whole length of the Masai country to Lake Baringo and Victoria Nyanza, shedding the first clear light on the great East African rift-valley and neighbouring highlands, including Mts. Kenya and Elgon A great advance in the region between Victoria Nyanza and Abyssinia was made in 1887–89 by the Austrians, Count Samuel Teleki and Lieut Ludwig von Hohnel, who discovered the large Basso Norok, now known as Lake Rudolf, till then only vaguely indicated on the map as Samburu At this time Somaliland was being opened up by English and Italian travellers In 1883 the brothers F L and W. D James penetrated from Berbera to the Webi Shebeli; in 1892 Vittorio Bottego (afterwards murdered in the Abyssinian highlands) started from Berbera and reached the upper Juba, which he explored to its source The first person to cross from the Gulf of Aden to the Indian Ocean was an American, A. Donaldson Smith, who in 1894–95 explored the head-streams of the Webi Shebeli and also explored the Omo, the feeder of Lake Rudolf.

In the region north-west of Victoria Nyanza the greatest additions to geographical knowledge were made by H M. Stanley in his last expedition, undertaken for the relief of Emin Pasha. The expedition set out in 1887 by way of the Congo and made its way, encountering immense difficulties, through the great equatorial forest, the character and extent of which were thus for the first time brought to light The return was made to the east coast and resulted in the discovery of the great snowy range of Ruwenzori or Runsoro, and the confirmation of the existence of a third Nile lake discharging its waters into the Albert Nyanza by the Semliki river.

North and West Africa.—Great activity was also displayed in completing the work of earlier explorers in North and West Africa Morocco was in 1883–84 the scene of important explorations by de Foucauld, a Frenchman who, disguised as a Jew, crossed and re-crossed the Atlas and supplied the first trustworthy information as to the orography of many parts of the chain. In 1887–89 Louis Gustave Binger, a French officer, made a great journey through the countries enclosed in the Niger bend, and in 1890–92 Col P. F Monteil went from St. Louis to Say, on the Niger, thence through Sokoto to Bornu and Lake Chad, whence he crossed the Sahara to Tripoli Meantime explorers had been busy in the region between Lake Chad, the Gulf of Guinea, and the Congo The Sanga, one of the principal northern tributaries of the Congo, was reached from the north by Lieut Louis Mizon, a French naval officer, who drew the first line of communication between the Benue and the Congo (1890–92). In 1890 Paul Crampel, who in the previous year had explored north of the Ogowé, undertook a great expedition from the Ubangi to the Shari, but was attacked and killed, with several of his companions, on the borders of the Bagirmi. Several other expeditions followed, and in 1806 Emile Gentil reached the Shari, launched a steamer on its waters and pushed on to Lake Chad Early in 1900 Lake Chad was also reached by F Foureau, a French traveller, who had already devoted 12 years to the exploration of the Sahara, and who on this occasion had crossed the desert from Algeria and had reached the lake *via* Air and Zinder.

Equatorial Africa.—The last ten years of the 19th century also witnessed many interesting expeditions in east Central Africa. In 1891 Emin Pasha, accompanied by Dr. F. Stuhlmann, made his way south of Victoria Nyanza to the western Nile lakes, visiting for the first time the southern and western shores of Albert Edward. Stuhlmann also ascended the Ruwenzori range to a height of over 13,000 feet. In the same year Dr. O. Baumann, who had already done good work in Usambara, near the coast, started on a more extended journey through the region of steppes between Kilimanjaro and Victoria Nyanza, afterwards exploring the head-streams of the Kagera, the ultimate sources of the Nile In the steppe region referred to he discovered two new lakes, Manyara and Eiassi, occupying parts of the East African valley system. This region was again traversed in 1893–94 by Count von Götzen, who continued his route westwards to Lake

[1] Another great traveller of this stamp was Wilhelm Junker, who spent the greater part of the period 1875–86 in the east central Sudan.

Kivu, north of Tanganyika, which, though heard of by Speke over 30 years before, had never yet been visited. He also reached for the first time the line of volcanic peaks north of Kivu, one of which he ascended, afterwards crossing the great equatorial forest by a new route to the Congo and the west coast Valuable scientific work was done in 1893 by Dr. J W. Gregory, who ascended Mt. Kenya to a height of 16,000 feet. In 1893–94 Scott Elliot reached Ruwenzori by way of Uganda, returning by Tanganyika and Nyasa, and in 1896 C. W. Hobley made the circuit of the great mountain Elgon, north-east of Victoria Nyanza. In 1890 Mt. Kenya was ascended to its summit by a party under H. J. Mackinder. The exploration of Mt. Kilimanjaro has been the special work of Dr. Hans Meyer, who first directed his attention to it in 1887 The region south of Abyssinia proper and north of Lake Rudolf, being largely the basin of the Sobat tributary of the Nile, was traversed by several explorers, among whom may be mentioned Capt. M. S. Wellby, who in 1898–99 explored the chain of small lakes in south-east Abyssinia, pushed on to Lake Rudolf, and thence traversed hitherto unknown country to the lower Sobat. Other valuable expeditions of exploration and surveying were conducted by Donaldson Smith (1899–1900), Maj H. H. Austin (1899–1901), Maj A St. H Gibbons (1895–96, 1898–1900), Commander B Whitehouse (1904–06), Lieut Boyd Alexander, Sir H H Johnston, Maj. Powell-Cotton, and the duke of Abruzzi

The first journey through the whole length of the continent was accomplished in the last two years of the century when a young Englishman, E S Grogan, starting from Cape Town, reached the Mediterranean by way of the Zambezi, the central line of lakes and the Nile Other travellers followed in Grogan's footsteps, among the first Maj Gibbons

Additions to topographical knowledge were made from about 1890 onwards by the international commissions which traced the frontiers of the protectorates of the European powers The Anglo-French commission in 1903 traced the Nigerian frontier from the Niger to Lake Chad, and in 1903–04 the Anglo-German commission fixed the Cameroon boundary between Yola, on the Benue, and Lake Chad In 1901–02 a German Congolese commission surveyed Lake Kivu and the volcanic region north of the lake, while the Anglo-German boundary commission of 1902–04 surveyed the valley of the lower Kagera and fixed the exact position of Albert Edward Nyanza

At the same time administrative needs forced the governments concerned to take in hand the survey of the countries under their protection. Before the close of the first decade of the 20th century tolerably accurate maps had been made of the German colonies, of a considerable part of West Africa, the Algerian Sahara, and the Anglo-Egyptian Sudan, mainly by military officers

PARTITION AMONG EUROPEAN POWERS

In the last quarter of the 19th century the map of Africa was transformed After the discovery of the Congo the story of exploration takes second place; the continent becomes the theatre of European expansions Lines of partition, drawn often through trackless wildernesses, marked out the possessions of Germany, France, Great Britain, and other Powers Railways penetrated the interior, vast areas were opened up to civilized occupation, and from ancient Egypt to the Zambezi the continent was startled into new life

Before 1875 the only European Powers with any considerable interest in Africa were Britain, Portugal, and France.

In North Africa the Turks had (in 1835) assumed direct control of Tripoli, while Morocco had fallen into a state of decay though retaining its independence A remarkable change had taken place in Egypt, where the Khedive Ismail had introduced a somewhat fantastic imitation of European civilization In addition Ismail had conquered Darfur, annexed Harar and the Somali ports on the Gulf of Aden, was extending his power southward to the equatorial lakes, and even contemplated reaching the Indian ocean. The Suez canal, opened in 1869, had a great influence on the future of Africa, as it again made Egypt the highway to the East, to the detriment of the Cape route.

In 1875 other European nations—with the occasional exception of Great Britain—were indifferent to Portugal's pretensions, and her estimate of her African empire as covering over 700,000sq m. was not challenged But the area under effective control of Portugal at that time did not exceed 40,000 sq. miles. Great Britain then held some 250,000sq m , France about 170,000sq.m., and Spain 1,000sq. miles The total area of Africa ruled by Europeans did not exceed 1,271,000sq m ; roughly one-tenth of the continent

Egypt and the Egyptian Sudan, Tunisia, and Tripoli were subject in differing ways to the overlordship of the sultan of Turkey, and with these may be ranked, in the scale of organized governments, the three principal independent states, Morocco, Abyssinia, and Zanzibar, as also the negro republic of Liberia There remained, apart from the Sahara, roughly one-half of Africa, lying mostly within the tropics, inhabited by a multitude of tribes and peoples living under various forms of government and subject to frequent changes in respect of political organization In the whole of this vast region the negro and Negro-Bantu races predominated, for the most part untouched by Mohammedanism or Christian influences. The larger States and Sultanates possessed neither the means nor the inclination to extend their influence beyond their own borders. The exploitation of Africa continued to be entirely the work of alien races

Leopold II.—The causes which led to the partition of Africa are to be found in the economic and political state of western Europe at the time Germany, strong and united as the result of the Franco-Prussian War of 1870, was seeking new outlets for her energies—new markets for her growing industries, and with the markets, colonies For different reasons the war of 1870 was also the starting-point for France in the building up of a new colonial empire In her endeavour to regain the position lost in that war France had to look beyond Europe. To the two causes mentioned must be added others. Great Britain and Portugal, when they found their interests threatened, bestirred themselves, while Italy also conceived it necessary to become an African Power The struggle was not, however, precipitated by the action of any of the great Powers but by the ambitious projects of Leopold II , king of the Belgians, who, in Sept 1876, took what may be described as the first definite step in the modern partition of the continent. He summoned to a conference at Brussels representatives of Great Britain, Belgium, France, Germany, Austria-Hungary, Italy, and Russia, to deliberate on the best methods to be adopted for the exploration and civilization of Africa, and the opening up of the interior of the continent to commerce and industry The conference was entirely unofficial The delegates who attended neither represented nor pledged their respective governments Their deliberations lasted three days and resulted in the foundation of "The International African Association," with its headquarters at Brussels It was further resolved to establish national committees in the various countries represented, which should collect funds and appoint delegates to the International Association. The central idea appears to have been to put the exploration and development of Africa upon an international footing. But it quickly became apparent that this was an unattainable ideal The national committees were soon working independently of the International Association, and the association itself passed through a succession of stages until it became purely Belgian in character, and at last developed into the Congo Free State, under the personal sovereignty of King Leopold

Stanley's journey down the Congo had stirred ambition in other capitals than Brussels France had always taken a keen interest in West Africa, and in the years 1875 to 1878 Savorgnan de Brazza had carried out a successful exploration of the Ogowe river to the south of the Gabun. In Portugal, too, the discovery of the Congo, with its magnificent unbroken waterway of more than a thousand miles into the heart of the continent, served to revive the languid energies of the Portuguese, who promptly began to furbish up claims whose age was in inverse ratio to their validity. In Jan. 1879 Stanley left Europe as the accredited agent of King Leopold and the Congo committee De Brazza returned to Africa at the beginning of 1880, and while Stanley,

on behalf of King Leopold, was making treaties and founding stations along the southern bank of the river, de Brazza and other French agents were equally busy on the northern bank

The Scramble for Territory.—Although the Transvaal between the years 1877 and 1881 had become and ceased to be British, in other respects British territory had been extended in South Africa. And in 1883, in order that the trade route to the interior might be kept open for British expansion northward from the Cape Colony, negotiations for the settlement of the western border of the restored republic were opened in London The border was defined in the Convention of London (Feb. 27, 1884), and at the same time the Bechuana peoples were taken under British protection Subsequently, March 23, 1885, the Bechuanaland Protectorate was extended northwards to 22° S latitude, and westward to 20° E longitude (*See* SOUTH AFRICA, TRANSVAAL, etc.) Before the convention was signed measures had been taken—without British opposition—at Berlin to establish German authority on the west coast between the Orange river and the Portuguese province of Angola; and on Sept. 8, 1884, the German Government intimated to the British Government "that the west coast of Africa from 26° S latitude to Cape Frio, excepting Walfish Bay, had been placed under the protection of the German emperor" In the same year, through the activities of Gustav Nachtigal, Togo and the Cameroon district were placed under German protection Before either of these events had occurred Great Britain had become alive to the fact that she could no longer dally with the subject, if she desired to consolidate her possessions in West Africa. The British Government had again and again refused to accord native chiefs the protection they demanded. The Cameroon chiefs had several times asked for British protection, and always in vain. But at last it became apparent, even to the official mind, that rapid changes were being effected in Africa, and on May 16, 1884, Edward Hyde Hewett, British consul, received instructions to return to the west coast and to make arrangements for extending British protection over certain regions. He arrived too late to save either Togoland or Cameroon, in the latter case arriving five days after King Bell and the other chiefs on the river had signed treaties with Nachtigal But the British consul was in time to secure the delta of the River Niger and the Oil rivers district, extending from Rio del Rey to the Lagos frontier, where for a long period British traders had held almost a monopoly of the trade.

Meanwhile the French Government was strenuously endeavouring to extend France's influence in West Africa, in the countries lying behind the coast-line. During the year 1884 no fewer than 42 treaties were concluded with native chiefs, an even larger number having been concluded in the previous twelve-month In this fashion France was pushing on towards Timbuktu, in steady pursuance of the policy which resulted in surrounding all the old British possessions in West Africa with a continuous band of French territory. On the lower Niger, however, in 1877, Mr. Goldie Taubman (afterwards Sir George Taubman Goldie) conceived the idea of establishing a settled government Through his efforts the various trading firms formed themselves in 1879 into the "United African Company," and the foundations were laid of something like settled administration. An application was made to the British Government for a charter in 1881, and the capital of the company increased to a million sterling. Henceforth the company was known as the "National African Company," and it was acknowledged that its object was not only to develop the trade of the lower Niger, but to extend its operations to the middle reaches of the river, and to open up direct relations with the great Fula empire of Sokoto and the smaller states associated with Sokoto under a somewhat loosely defined suzerainty

In North and East Africa also events had moved since 1875. In 1881 France, with the consent of the Powers, undertook to reorganize the finances and administration of the meagre remains of the once splendid and powerful kingdom of Tunis. Two years later, with Lord Granville's circular despatch of Jan. 3, 1883, England's long and onerous tutelage of Egypt began. (*See* EGYPT.) In East Africa, north of the Portuguese possessions, where the sultan of Zanzibar was the most considerable native potentate, Germany was secretly preparing the foundations of German East Africa. Italy, too, had obtained a footing on the African continent. The Rubattino Steamship Company as far back as 1870 had bought the port of Assab as a coaling station, but it was not until 1882 that it was declared an Italian colony. This was followed by the conclusion of a treaty with the sultan of Assab, chief of the Danakil, signed on March 15, 1883, and subsequently approved by the king of Shoa, whereby Italy obtained the cession of part of Ablis (Aussa) on the Red sea, Italy undertaking to protect with her fleet the Danakil littoral One other event must be recorded The king of the Belgians had been driven to the conclusion that, if his African enterprise was to obtain any measure of permanent success, its international status must be recognized; and negotiations for the purpose were opened with various governments.

The Berlin Conference 1884–85.—With these events there had grown up a general conviction that it would be desirable for the Powers interested in Africa to come to some agreement as to "the rules of the game," and to define their respective interests as far as practicable. A treaty between Britain and Portugal, giving undue recognition to Portuguese territorial claims, which was signed by Lord Granville on Feb. 26, 1884, but not ratified in view of the protests it had evoked, brought this sentiment to a head; and it was agreed to hold an international conference on African affairs The conference assembled at Berlin on Nov. 15, 1884, and after protracted deliberations the "General Act of the Berlin Conference" was signed by the representatives of all the Powers attending the conference, on Feb 26, 1885. The Powers represented were Germany, Austria-Hungary, Belgium, Denmark, Spain, the United States, France, Great Britain, Italy, Holland, Portugal, Russia, Sweden and Norway, and Turkey Ratifications were deposited by all the signatory Powers with the exception of the United States The General Act dealt with six specific subjects: (1) Freedom of trade in the basin of the Congo, (2) the slave trade, (3) neutrality of territories in the basin of the Congo, (4) navigation of the Congo, (5) navigation of the Niger, and (6) rules for future occupation on the coasts of the African continent. For the present purpose, however, the results effected by the Berlin Act may be summed up as follows. The signatory Powers undertook that any fresh act of taking possession on any portion of the African coast must be notified by the Power taking possession, or assuming a protectorate to the other signatory Powers. It was further provided that any such occupation to be valid must be effective It is also noteworthy that the first reference in an international act to the obligations attaching to "spheres of influence" is contained in the Berlin Act.

Before the General Act was signed the International Association of the Congo was recognized by all the signatory Powers, with the not very important exception of Turkey. Two months later, in April 1885, King Leopold, with the sanction of the Belgian legislature, formally assumed the headship of the new state; and on Aug. 1 in the same year his Majesty notified the powers that from that date the "Independent State of the Congo" declared that "it shall be perpetually neutral" in conformity with the provisions of the Berlin Act. Thus was finally constituted the Congo Free State, under the sovereignty of King Leopold, though the boundaries claimed for it at that time were considerably modified by subsequent agreements.

Partition Treaties.—In the 15 years that remained of the 19th century the work of partition was practically completed. The international agreements which determined in the main the limits of the possessions of the various powers are:—

I. The agreement of July 1, 1890, between Great Britain and Germany defining their spheres of influence in East, West, and South-west Africa. This agreement was the most comprehensive of all the "deals" in African territory, and included in return for the recognition of a British protectorate over Zanzibar the cession of Heligoland to Germany.

II. The Anglo-French declaration of Aug. 5, 1890, which recognized a French protectorate over Madagascar, French influence in the Sahara, and British influence between the Niger and Lake Chad

III. The Anglo-Portuguese treaty of June 11, 1891, whereby the Portuguese possessions of the west and east coasts were separated by a broad belt of British territory, extending north to Lake Tanganyika.

IV. The Franco-German convention of March 15, 1894, by which the Central Sudan was left to France (this region by an Anglo-German agreement of Nov. 15, 1893, having been recognized as in the German sphere). By this convention France was able to effect a territorial junction of her possessions in North and West Africa with those in the Congo region.

V. Protocols of March 24 and April 15, 1891, for the demarcation of the Anglo-Italian spheres in East Africa.

VI. The Anglo-French convention of June 14, 1898, for the delimitation of the possessions of the two countries west of Lake Chad, with the supplementary declaration of March 21, 1899, whereby France recognized the upper Nile valley as in the British sphere of influence.



BY COURTESY OF NORTHERN BAPTIST CONVENTION

NATIVE CHIEF IN ROYAL ATTIRE, BELGIAN CONGO
When a chief dies, selected members of his retinue are killed, and buried with him; the village is then abandoned

The Congo State.—The Congo Free State, which occupied, geographically, a central position, may serve as the starting-point for the story of the partition after the Berlin Conference. By his will, dated Aug. 2, 1889, King Leopold made Belgium formally heir to the sovereign rights of the Congo Free State. Proposals for Belgium to assume responsibility for its administration were made unsuccessfully in 1895 and 1901. Later, the agitation in Great Britain and America against the Congo system of government and the admissions of an official commission of enquiry concerning its maladministration strengthened the movement in favour of transfer, until in 1905 Leopold II. was forced to yield, and the annexation treaty was approved by the Belgian parliament Thus the Congo state, after an existence of 24 years as an independent power, became a Belgian colony. (*See* CONGO, FREE STATE and BELGIAN CONGO.)

French and British Rivalry.—After the capture of Khartum and the death of Gen. C. G. Gordon, the Sudan was abandoned to the dervishes. The Egyptian frontier was withdrawn to Wadi Halfa, and the vast provinces of Kordofan, Darfur, and the Bahr-el-Ghazal were given over to dervish tyranny and misrule. It was obvious that Egypt would sooner or later seek to recover her position in the Sudan, as the command of the upper Nile was recognized as essential to her continued prosperity. But the international position of the abandoned provinces was by no means clear. The British Government, by the Anglo-German agreement of July 1890, had secured the assent of Germany to the statement that the British sphere of influence in East Africa was bounded on the west by the Congo Free State and by "the western watershed of the basin of the upper Nile"; but this claim was not recognized either by France or by the Congo Free State. From her base on the Congo, France was busily engaged pushing forward along the northern tributaries of the great river. The desire of France to secure a footing in the upper Nile valley was partly due to her anxiety to extend a French zone across Africa, but it was also to a large extent attributable to the belief, widely entertained in France, that by establishing herself on the upper Nile France could regain the position in Egyptian affairs which she had sacrificed in 1882.

In June 1896 Capt. J. Marchand left France with secret instructions to lead an expedition into the Nile valley. On July 10, 1898, he reached Fashoda, having established a chain of posts *en route,* and here the French flag was at once raised, and a "treaty" made with the local chief. Meanwhile, in 1896, an Anglo-Egyptian army, under the direction of Sir Herbert (afterwards Lord) Kitchener, had advanced southwards for the reconquest of the Egyptian Sudan. On Sept. 2, 1898, Khartum was captured, and the khalifa's army dispersed. It was then that news reached the Anglo-Egyptian commander, from native sources, that there were white men flying a strange flag at Fashoda. The sirdar at once proceeded in a steamer up Nile, and courteously but firmly requested Capt. Marchand to remove the French flag. On his refusal the Egyptian flag was raised close to the French flag, and the dispute was referred to Europe for adjustment between the British and French Governments. A critical situation ensued. Neither Government was inclined to give way, and for a time war seemed imminent. Happily Lord Salisbury was able to announce, on Nov. 4, that France was willing to recognize the British claims, and the incident was finally closed on March 21, 1899, when an Anglo-French declaration was signed, by the terms of which France withdrew from the Nile valley and accepted a boundary line which satisfied her earlier ambition by uniting the whole of her territories in North, West, and Central Africa into a homogeneous whole, while effectually preventing the realization of her dream of a transcontinental empire from west to east.

British and Portuguese Spheres Defined.—In the southern half of the continent, between the years 1885 and 1891, the Portuguese possessions on the west and east coasts were delimited, and Matabeleland and Mashonaland were occupied by the British South Africa Company. (*See* RHODESIA.) The relations between the British and Portuguese territories were determined by the treaty of June 11, 1891. Apart from defining the British and Portuguese spheres both south and north of the Zambezi, it contained many other provisions relating to trade and navigation, providing, *inter alia,* a maximum transit duty of 3% on imports and exports crossing Portuguese territories on the east coast to the British sphere, freedom of navigation of the Zambezi and Shirè for the ships of all nations, and stipulations as to the making of railways, roads, and telegraphs. Portugal was given both banks of the Zambezi to a point ten miles west of Zumbo—the farthest settlement of the Portuguese on the river. The boundary between the Portuguese sphere of influence on the west coast and the British sphere of influence north of the Zambezi was only vaguely indicated; but it was to be drawn in such a manner as to leave the Barotse country within the British sphere. Before the conclusion of the treaty the British Government had made certain arrangements for the administration of the large area north of the Zambezi reserved to British influence. On Feb. 1 Sir Harry Johnston was appointed imperial commissioner in Nyasaland, and a fortnight later the British South Africa Company intimated a desire to extend its operations north of the Zambezi. Negotiations followed, and the field of operations of the Chartered Company was, on April 2, 1891, extended so as to cover (with the exception of Nyasaland) the whole of the British sphere of influence north of the Zambezi (afterwards Northern Rhodesia). On May 14 a formal protectorate was declared over Nyasaland, including the Shiré highlands and a belt of territory extending along the whole of the western shore of Lake Nyasa. The name was changed in 1893 to that of the British Central Africa Protectorate, for which designation was substituted in 1907 the more appropriate title of Nyasaland Protectorate.

British and German Rivalry.—In July 1890, the British and German Governments came to an agreement upon the limits of their respective spheres of influence in various parts of Africa, and the boundaries of German South-West Africa were fixed in the position they now hold as those of the territory mandated to the Union of South Africa. These Powers were also the two great rivals on the east coast. Germany, on Dec. 30, 1886, and Great Britain, on June 11, 1891, formally recognized the Rovuma river as the northern boundary of the Portuguese sphere of influence on that coast; but it was to the north of that river, over the vast area of east or east central Africa in which the sultan of Zanzibar claimed to exercise suzerainty, that the struggle between the two rival powers was most acute. By an exchange of notes in Oct.–Nov. 1886, to which the sultan adhered on Dec. 4, 1886, the British and German Governments determined what territories were to be assigned to the sultanate of Zanzibar and agreed to a delimitation of their respective spheres of influence in East Africa. On Sept. 3, 1888, the British East Africa Association

received a charter from the British Government and became the Imperial British East Africa Company. Shortly afterwards the German colony of East Africa was founded. (*See* KENYA.)

Meanwhile, in the country to the west and north of the British sphere of influence a contest for Uganda had arisen between Karl Peters and the British East Africa Company. The contest was decided in favour of the latter by the Anglo-German Agreement of July 1, 1890. The provisions relating to East Africa were these:—In return for the cession of Heligoland, Lord Salisbury obtained from Germany the recognition of a British protectorate over the dominions of the sultan of Zanzibar, including the islands of Zanzibar and Pemba, but excluding the strip leased to Germany, which was subsequently ceded absolutely to Germany. Germany further agreed to withdraw the protectorate declared over Witu and the adjoining coast up to Kismayu in favour of Great Britain, and to recognize as within the British sphere of influence the vast area bounded, on the south, by the frontier line laid down in the agreement of 1886, which was to be extended along the first parallel of south latitude across Victoria Nyanza to the frontiers of the Congo Free State, on the west by the Congo Free State and the western watershed of the Nile, and on the north by a line commencing on the coast at the north bank of the mouth of the River Juba, then ascending that bank of the river until it reached the territory at that time regarded as reserved to the influence of Italy[1] in Gallaland and Abyssinia, when it followed the frontier of the Italian sphere to the confines of Egypt. To the south-west of the German sphere in East Africa the boundary was formed by the eastern and northern shore of Lake Nyasa, and round the western shore to the mouth of the Songwe river, from which point it crossed the Nyasa-Tanganyika plateau to the southern end of the last-named lake, leaving the Stevenson road on the British side of the boundary. The effect of this treaty was to remove all serious causes of dispute about territory between Germany and Great Britain in East Africa. It rendered quite valueless Peter's treaty with Mwanga and his promenade along the Tana; it freed Great Britain from any fear of German competition to the northwards, and recognized that her influence extended to the western limits of the Nile valley. But, on the other hand, Great Britain had to relinquish the ambition of connecting her sphere of influence in the Nile valley with her possessions in Central and South Africa On this point Germany was quite obdurate; and an attempt subsequently made (May 1894) to secure this object by the lease of a strip of territory from the Congo Free State was frustrated by German opposition. (*See* UGANDA; KENYA, and TANGANYIKA.)



BY COURTESY OF FRED B PATTERSON

A SWAHILI ELEPHANT TRACKER DRESSED IN SKINS THESE MEN ARE EXPERTS IN DISTINGUISHING ALL VARIETIES OF SPOORS

On March 31 the union jack was raised, and on May 29 a fresh treaty was concluded with King Mwanga placing his country under British protection. A formal protectorate was declared over Uganda proper on June 19, 1894, which was subsequently extended so as to include the countries westwards towards the Congo Free State, eastwards to the British East Africa protectorate and Abyssinia, and northwards to the Anglo-Egyptian Sudan. The British East Africa protectorate was constituted in June 1895, when the Imperial British East Africa Company relinquished all its rights in exchange for a money payment, and the administration was assumed by the imperial authorities. On April 1, 1902, the eastern province of the Uganda protectorate was transferred to the British East Africa protectorate, which thus secured control of the whole length of the so-called Uganda railway, and at the same time were successful in obtaining access to the Victoria Nyanza.

[1]At this period negotiations between Great Britain and Italy had begun but were not concluded.

Italy.—Early in the 'eighties as already seen, Italy had obtained her first formal footing on the African coast at the Bay of Assab (Aussa) on the Red Sea. In 1885 the troubles in which Egypt found herself involved compelled the khedive and his advisers to loosen their hold on the Red Sea littoral, and, with the tacit approval of Great Britain, Italy took possession of Massawa and other ports on that coast. In May 1889 the Italians concluded with the negus Menelek the Treaty of Uccialli which, besides settling the frontiers between Abyssinia and the Italian sphere, contained the following article:—

XVII. His Majesty the King of Kings of Ethiopia consents to avail himself of the Italian Government for any negotiations which he may enter into with the other Powers or Governments.

In Italy and by other European governments this article was generally regarded as establishing an Italian protectorate over Abyssinia; but this interpretation was never accepted by the emperor Menelek, and at no time did Italy succeed in establishing any very effective control over Abyssinian affairs. By May 1894 under various agreements, the Italian and British Governments had fixed the northern limit of the Italian sphere as running from Ras Kasar on the Red Sea to the intersection of the Blue Nile with 35° E. longitude, and settled the boundary between their respective spheres on the Somali coast. But while Great Britain was thus lending her sanction to Italy's ambitious schemes the Abyssinian emperor was becoming more and more incensed at Italy's pretensions to exercise a protectorate over Ethiopia. In 1893 Menelek denounced the Treaty of Uccialli, and eventually, in a great battle, fought at Adowa on March 1, 1896, the Italians were disastrously defeated By the subsequent Treaty of Addis Ababa, concluded on Oct 26, 1896, the whole of the country to the south of the Mareb, Belesa, and Muna rivers was restored to Abyssinia, and Italy acknowledged the absolute independence of Abyssinia. By later negotiations with his European neighbours, the emperor Menelek secured boundaries on the south and west more favourable to Abyssinia than those assigned under the Anglo-Italian agreement. And Italian Somaliland, bordering on the south-eastern frontier of Abyssinia, became limited to a belt of territory with a depth inland from the Indian ocean of from 180 to 250 miles.

Anglo-French Rivalry in West Africa.—In West Africa the real struggle was between France and Great Britain, and France played the dominant part, the exhaustion of Portugal, the apathy of the British Government and the late appearance of Germany in the field all being elements that favoured the success of French policy. Two phases may be distinguished: the first dealing with the coast colonies, the second with the middle Niger and Lake Chad. On the coast France was wholly successful in her design of isolating all Great Britain's separate possessions in that region, and of securing for herself undisputed possession of the upper Niger and of the countries lying within the great bend of that river. At the date of the Berlin Conference the present colonies of Southern Nigeria and the Gold Coast constituted a single colony under the title of the Gold Coast colony, but on Jan. 13, 1886, the territory comprised under that title was erected into two separate colonies—Lagos and the Gold Coast (the name of the former being changed in Feb. 1906 to the colony of Southern Nigeria). In Aug. 1896, following the destruction of the Ashanti power and the deportation of King Prempeh, as a result of the second Ashanti campaign, a British protectorate was declared over the whole of the Ashanti territories and a resident was installed at Kumasi. But no northern limit had been fixed beyond the 9th parallel, and the countries to the north—Gurunsi (Grusi), Mossi and Gurma—were entered from all sides by rival British, French, and German expeditions. A few days before the meeting of the Berlin Conference Sir George Goldie had succeeded in buying up all the French interests on the lower Niger. The British company's influence had at that date been extended by treaties with the native chiefs up the main Niger stream to its junction with the Benue, and some distance along this latter river. But the great Fula states of the central Sudan were still outside European influence; and the German Government made efforts to secure a footing on the lower Niger until the fall of Prince Bis-

marck in March 1890. On the failure of the half-hearted attempt made later to establish relations with Gando from Togoland, Germany dropped out of the competition for the western Sudan and left the field to France and Great Britain. After its first great success the National African Company obtained a charter from the British Government, and on July 10, 1886, it became "The Royal Niger Company"

Notwithstanding her strenuous efforts, France, in her advance down the Niger from Senegal, did not succeed in reaching Sego on the upper Niger, a considerable distance above Timbuktu, until the winter of 1890–91, and the rapid advance of British influence up the river raised serious fears lest the Royal Niger Company should reach Timbuktu before France could forestall her. In 1892, however, after a troublesome war, France annexed some portion of Dahomey on the coast and declared a protectorate over the rest of the kingdom. Thus was removed the barrier which had up to that time prevented France pushing her way Nigerwards from her possessions on the Slave Coast, as well as from the upper Niger and the Ivory Coast Henceforth her progress from all these directions was rapid, and in particular Timbuktu was occupied in the last days of 1893 It then appears to have been suddenly realized in France that, for the development of the vast regions which she was placing under her protection in West Africa, it was extremely desirable that she should obtain free access to the navigable portions of the Niger, if not on the left bank, from which she was excluded by the agreement of Aug 5, 1890, then on the right bank, where the frontier had still to be fixed by international agreement On Feb. 13, 1895, a French officer, Commander Toutée, arrived on the right bank of the Niger opposite Bajibo and built a fort His presence there was notified to the Royal Niger Company, who protested to the British Government against this invasion of their territory, and eventually Toutée was ordered to withdraw, and the fort was occupied by the Royal Niger Company's troops In 1897 the attempt was renewed in the most determined manner In February of that year a French force suddenly occupied Bussa, and this act was quickly followed by the occupation of Gomba and Illo higher up the river. In Nov. 1897 Nikki was occupied. The situation on the Niger had so obviously been outgrowing the capacity of a chartered company that for some time before these occurrences the assumption of responsibility for the whole of the Niger region by the imperial authorities had been practically decided on; and early in 1898 Capt F D. (afterwards Lord) Lugard was sent out to the Niger with a number of imperial officers to raise a local force in preparation for the contemplated change The advance of the French forces from the south and west was the signal for an advance of British troops from the Niger, from Lagos, and from the Gold Coast protectorate The situation thus created was extremely serious The British and French flags were flying in close proximity, in some cases in the same village Meanwhile the diplomatists were busy in London and in Paris, and in the latter capital a commission sat for many months to adjust the conflicting claims Fortunately, by the tact and forbearance of the officers on both sides, no local incident occurred to precipitate a collision, and on June 14, 1898, a convention was signed by Sir Edmund Monson and M G. Hanotaux which practically completed the partition of this part of the continent (*See* NIGERIA)

Thus in its broad outlines the partition of Africa was begun and ended in the short space of a quarter of a century The result was to divide the continent among the Powers as follows:—

	Square miles
British Africa	2,101,411
Egyptian Africa	1,600,000
French Africa	3,866,950
German Africa	910,150
Italian Africa	200,000
Portuguese Africa	787,500
Spanish Africa	79,800
Belgian Africa	900,000
Turkish Africa	400,000
Independent Africa	613,000
	11,458,811

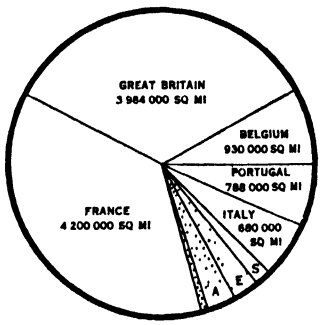
Anglo-French Declaration, 1904.—There were still many finishing touches to be put to the structure, but a large contribution to the process was made by the Anglo-French declaration of April 8, 1904, when a series of agreements relating to several parts of the globe were signed in London by Lord Lansdowne, the foreign secretary, and M. Paul Cambon, the French ambassador, on behalf of their respective Governments With regard to Egypt the French Government declared "that they [would] not obstruct the action of Great Britain in that country by asking that a limit of time be fixed for the British occupation or in any other manner" To understand the equivalent engagement taken by Britain, it must be recalled that to consolidate her position in north-west Africa France desired to make her influence supreme in Morocco In April, 1902, it had been agreed between the French and Shereefian Governments to co-operate in establishing order in the frontier districts of Morocco and Algeria. Meanwhile in the northern districts of Morocco the unrest under the rule of the young sultan, Abd-el-Aziz IV, was attracting attention in Europe and evoking demands for its suppression. It was in these circumstances that in the declaration of April 1904 the British Government recognized "that it [appertained] to France, more particularly as a Power whose dominions [were] conterminous for a great distance with those of Morocco, to preserve order in that country, and to provide assistance for the purpose of all administrative, economic, financial, and military reforms which it may require" Both parties, however, "inspired by their feeling of sincere friendship for Spain, [took] into special consideration the interests which that country [derived] from her geographical position and from her territorial possessions on the Moorish coast of the Mediterranean"; and in these interests the French Government undertook "to come to an understanding with the Spanish Government." The understanding was reached later in the same year, and thus Spain secured a sphere of interest on the Moroccan coast immediately facing the Spanish peninsula Here it may be added that the protectorate of Spain over certain territories on the west coast of Africa, south of Morocco, had been notified to the Berlin Conference, and that by an agreement made with France in 1900 some 70,000sq m of the western Sahara were recognized as Spanish; while at the same time France admitted the claim of Spain to the ownership of the district around the Muni river to the south of Cameroons. The action taken by France in Morocco in accordance with the policy marked out in the Anglo-French declaration aroused the resentment of Germany, but on July 8, 1905, the republic secured from the German Government formal "recognition of the situation created for France in Morocco by the contiguity of a vast extent of territory of Algeria and the Shereefian empire, and by the special relations resulting therefrom between the two adjacent countries, as well as by the special interest for France, due to this fact, that order should reign in the Shereefian empire." Finally, in Jan–April, 1906, a conference of the Powers was held at Algeciras to devise, by invitation of the sultan, a scheme of reforms to be introduced into Morocco (*q v*) French capital was allotted a larger share than that of any other Power in the Moorish state bank which it was decided to institute, and French and Spanish officers were entrusted with the organization of a police force for the maintenance of order in the principal coast towns The new *régime* had not been inaugurated fully, however, when a series of outrages led, in 1907, to the military occupation by France of Oudjda, a town near the Algerian frontier, and of the port of Casablanca on the Atlantic coast of Morocco

LATER POLITICAL DEVELOPMENTS

The political map of Africa changed very considerably between 1910 and 1925. In 1910 the British self-governing colonies of the Cape, Natal, Transvaal, and Orange River were formed into the Union of South Africa, with a single government and one legislature In 1911 a considerable area of French Equatorial Africa was transferred to German Cameroons and in return Germany acknowledged a French protectorate over the greater part of Morocco On March 30, 1912, a protectorate treaty between France and the sultan was signed at Fez; and by a Franco-Span-

ish convention of Nov. 27 the Spanish zones in Morocco were defined In 1912, also, Italy annexed the Turkish vilayets of Tripoli and Benghazi (Cyrenaica), to which the common name of Libya was given. In Dec. 1914 a British protectorate over Egypt was proclaimed, but by a declaration of Feb 1922 Great Britain acknowledged the independence of Egypt The status of the Anglo-Egyptian Sudan remained unchanged

In June 1919, by the Treaty of Versailles, Germany renounced possession of all her oversea protectorates in favour of the principal Allied and Associated Powers. These territories, which had all been conquered by the Allies during the World War, were placed under mandatories. The Union of South Africa became mandatory for German South-West Africa; Togoland was divided between France and Great Britain; and France became mandatory for Cameroons, except for a small portion which was placed under the administration of British Nigeria. Britain became mandatory for German East Africa, renamed the Tanganyika Territory, but by subsequent Anglo-Belgian agreements Belgium became mandatory for the provinces of Ruanda and Urundi. In 1920–25 Italy gained additions to Tripoli and Cyrenaica by arrangements with France and Egypt and to Italian Somaliland by arrangement with Great Britain



HOW AFRICA'S 11 MILLION SQ M ARE DIVIDED AMONG THE NATIONS THE STIPPLED PART IS THE 6 5 PER CENT OF THE CONTINENT OCCUPIED BY NATIVE STATES
S=Spain, 140,000 sq.m.
E=Egypt, 350,000 sq.m.
A=Abyssinia, 350,000 sq.m.
Small wedge=Liberia, 40,000 sq.m.

As a result of these changes Africa was divided among the following Powers. The territories governed under mandate are reckoned in the possession of the Power named —

France	4,200,000	Egypt	350,000
Great Britain	3,984,000*	Abyssinia	350,000
Belgium	930,000	Spain	140,000†
Portugal	788,000	Liberia	40,000
Italy	680,000		

*Including Anglo-Egyptian Sudan
†Including the Spanish zones in Morocco.

These figures give a total of 11,462,000sq m. as the area of Africa In the absence of definite surveys of large areas of the continent this may be regarded as a close approximation to accuracy.

German Policy.—The extinction of Turkish rule in North Africa had long been foreseen and was no matter for regret It ended a connection which had lasted five centuries and had been almost wholly evil in its effects. German sovereignty in Africa had only dated from 1884 and had been rapidly enlarged. Endeavours to extend it further had been a prominent factor in German policy for a decade before the World War. Germany desired a footing on the African coast of the Mediterranean and a port on the Atlantic coast of Morocco. These desires conflicted with Italian and French ambitions, and in 1911 the issue on both points was decided against Germany. As to Morocco, a Franco-German convention of Feb. 9, 1909, had recognized the privileged position of France in Morocco, but not a French protectorate over that country, and the sending of the German gunboat, "Panther," to Agadir, in July, 1911, was a protest against what Germany considered an unwarranted extension of French influence in Morocco, and an intimation that if German treaty rights in Morocco were to be renounced, France must make compensation. The intervention of Great Britain on the side of France put an end to a dangerous situation; Germany, by a convention concluded Nov. 4, 1911, accepted compensation in Central Africa and withdrew opposition to the establishment of a French protectorate in Morocco.

While the Franco-German negotiations were in progress Italy abruptly declared war on Turkey and invaded, and held, Cyrenaica and Tripoli. Thus Germany, who had designed to exploit those vilayets through the medium of an Austro-Hungarian chartered company, was deprived of her last opportunity—short of war—of gaining a foothold in the Mediterranean. She turned her attention to the development of a *Mittel Afrika* policy. This policy aimed at securing Germany's supremacy, primarily economic and ultimately political, in central equatorial Africa. The aim was to reserve the Belgian Congo, Angola and Mozambique, north of the Zambezi, as a German sphere, and thus to link up Cameroons with the South-West and East Africa protectorates. German industries had need of the raw material tropical Africa produces, and, moreover, southern Angola was a good field for European settlement.

British statesmen were not unfavourable to German expansion in equatorial Africa, so long as it was confined to the economic sphere. In 1898 an agreement, signed by Mr. A. J. (afterwards Lord) Balfour and Count Hatzfeldt, had divided Angola and Mozambique into spheres in which Great Britain and Germany respectively were to give financial and economic help to the Portuguese. This was followed in 1899 by the Treaty of Windsor, the object being to reassure Portugal that the Balfour-Hatzfeldt agreement was not in derogation of her sovereign rights in Africa. Neither the agreement with Germany nor the treaty with Portugal was published.

After the settlement of the Morocco crisis, Germany reopened negotiations with Great Britain in respect of Portugal's African colonies, and Prince Lichnowsky (the German ambassador) and Sir Edward (afterwards Lord) Grey reached a new agreement, which was ready for signature in 1913. Nearly all Angola was recognized as a German economic sphere, as well as the northern part of Mozambique. The rest of Mozambique, including Delagoa Bay and the Zambezi valley, was to be a British economic sphere. Sir Edward Grey made it a condition of signing that the 1898 and 1899 documents should be published The German foreign office raised objections, Herr von Jagow (then foreign minister) stating that the German Press would regard the terms of the Treaty of Windsor and the Lichnowsky agreement as contradictory. In July 1914, however, German consent to publication had been given, but before the new agreement could be signed the World War had broken out.

The World War.—During the progress of the campaigns in Africa the whole of the continent, except Abyssinia and the Spanish protectorates, became involved in the struggle. The conquest of the German colonies was foreseen in the negotiation which preceded Italy's entry into the war, and Article 13 of the agreement signed in London on April 26, 1915, between France, Russia, Great Britain, and Italy, laid down that.—

In the event of France and Britain increasing their colonial territories in Africa at the expense of Germany, those two Powers agree in principle that Italy may claim some equitable compensation, particularly as regards the settlement in her favour of the questions relative to the frontiers of the Italian colonies of Eritrea, Somaliland and Libya, and the neighbouring colonies belonging to France and Great Britain

Italian Ambitions.—Italian ambitions had gone beyond the readjustment of frontiers; in particular Italy wished to acquire Jibuti, the port of French Somaliland and the starting place of a railway to Abyssinia. As Jibuti was the only French port on the Suez canal route to the East and to Madagascar, as well as the only approach to Abyssinia that France possessed, she declined to entertain proposals for its surrender. Italy, however, obtained from France a welcome rectification of the Tripoli-Tunisia frontier, as well as valuable railway and commercial concessions in Tunisia.

In regard to the Cyrenaica-Egyptian frontier, the British Government, in 1919, offered Italy a readjustment of territory in the Libyan desert The negotiations had not been concluded when Egypt was granted independence and after that time they were conducted directly between Italy and Egypt. They turned largely on the possession of the oasis of Jaghbub, a place of some strategic importance, where is also the tomb-mosque of the founder of the Senussi sect. On Dec. 6, 1925, an Italo-Egyptian agreement was signed, by which Jaghbub was included in Cyrenaica. The wells to the west of El Sollum were included in

Egyptian territory, thus giving El Sollum a needed water supply South of Siwa the frontier was drawn along longitude 25° E. to the boundary of the Anglo-Egyptian Sudan in latitude 22° North. The southern boundary of Libya—as the combined area of Tripolitania and Cyrenaica is named by the Italians—marches with French equatorial Africa and remains to be defined from Tummo eastwards. In 1925 the Anglo-Egyptian Sudan was verging on the position of a clearly defined British protectorate; the tributary sultanate of Darfur had been conquered in 1915; in 1922–23 the frontier separating it from French equatorial Africa, which had been in question since 1899, was delimited on the spot.

France and Spain.—In the same year (1912) that France obtained her protectorate in Morocco she concluded an arrangement with Spain whereby a Spanish protectorate was set up in the northern part of the sultanate, the port of Tangier and a small area around it being made, however, an international zone. In the French protectorate Marshal Lyautey, the resident-general, adopted a bold and conciliatory policy and won the confidence and respect of the Moors. He was succeeded in 1925 by M Theodore Steeg, the governor-general of Algeria. In their zone the Spaniards met with determined opposition, largely owing to the uprise of a Moor, styled Abdel-Krim. In the territory known, somewhat vaguely, as Er-Rif, there seems to have been, as in the coastward portions of Algeria and Tunisia, a much more marked Iberian element in the population than there is in the south of Morocco, and this part of northern Morocco had shown a great hatred of European interference. The Spaniards suffered a severe reverse in 1921 and there was again heavy fighting in 1924 and 1925. In the last-named year the Rifs invaded the French zone, but were defeated and driven back. In the next year the insurrection was successfully quelled; and in 1927 the king and queen of Spain, when paying a ceremonial visit to the Spanish (northern) zone, were received cordially by the Moorish population.

Abyssinia under Ras Tafari made efforts to attain the position of a civilized power and joined the League of Nations Sept. 28, 1923. In the autumn of 1928 friction between the regent and the empress resulted in the exaltation of Ras Tafari to share the throne with the title of king In Southern Rhodesia the growth of a vigorous white community led to that country being made, in 1923, a self-governing colony of the British empire, and with the assumption of direct imperial control of Northern Rhodesia in 1924 chartered-company rule in British Africa came to an end In East Africa another vigorous and local white community made its influence felt, namely the settlers in the British East Africa Protectorate, which protectorate was annexed to the British Crown in 1920 and renamed Kenya Colony.

A subject which raised large issues was the position of Indians in South and East Africa, but it was of less importance than the growth of race consciousness among the Bantu and the negroes Increase of education and of Christianity, the employment of large numbers of Africans in industries, and the lessons taught by the World War were among the factors which intensified the feeling of racial unity and led to manifestations of a new anti-white movement. This movement was different from the simple objection to interference by Europeans, or Arabs, previously displayed, and had a consciousness of the need of self-development and progress.

France in North Africa.—Apart from the awakening of the African peoples to race-consciousness, two recent developments in the European occupation of the continent are noticeable. France has shown definite progress in the task of restoring north-west Africa to the place in Mediterranean civilization which it held from the 6th century B C. to the 7th century of the Christian era, when the Mohammedan conquest began. Under British administration the peoples of East Africa have emerged rapidly since the World War to industrial and political advancement. Since 1912, when she acquired the protectorate of Morocco, the authority of France has become increasingly effective in the fertile littoral and high plateaux of the western half of North Africa. The political and economic development of this Mediterranean area upon European lines has been assured by the expansion of Algeria southward and the subsequent linking up of Saharan Algeria with the western Sudan, the French west coast colonies, and French Congo in a vast and coherent African empire. Barely a century ago the French expeditionary force landed at Sidi Ferruch on June 14, 1830. The declared purpose of the French cabinet was "to abolish slavery and piracy, to re-establish the security of navigation in the Mediterranean and open up its southern coasts anew to agriculture, civilization, commerce, and the free access of all nations." In the interval the "restricted occupation" of the coast towns has become the "total occupation" of Algeria, and the conquest of "the South"; while the incorporation of Northern Algeria into France has been followed by the protectorates of Tunis (1881) and Morocco (1912). Within these hundred years the European element in North Africa has risen from a handful of consular officials and merchants to well over a million residents, or approximately to one-tenth of the total population. Great European towns have been built. Agriculture and stock-raising have become infinitely more productive, minerals have been found and worked and new industries introduced. Order and public security have been established in regions to which Rome never sought to penetrate and over peoples that the legionaries strove in vain to subdue. The increasing throng of tourists who yearly traverse North Africa by rail and car from Algiers to the Saharan oases and from Carthage to Marrakesh, and the frequency and regularity of the steamship services which maintain intercourse between the European and African shores of the Mediterranean, are evidence of the success with which France has fulfilled her primary task of re-opening to Europe this lost province of the Graeco-Roman world.

British Development.—After the World War appreciable progress was made in the construction of development works and in production in Uganda, Kenya, and Tanganyika (formerly German East Africa); and with a view of increasing further the economic capacity of these and the neighbouring territories of Zanzibar, Nyasaland, and Northern Rhodesia, the possibility of administrative co-operation between the several governments concerned came under consideration. As the result of conferences on this subject held in 1927 the colonial office appointed the Hilton Young Commission to inquire into the question of the federation, or other union, of the British territories from Northern Rhodesia to Uganda. And, by the desire of its ministry, Southern Rhodesia (which became self-governing in 1923) was included in the scope of the commission. The project of an administrative union, of which this official enquiry into the views of the several governments and populations concerned was the first step, acquires a special interest from the character and geographical position of the colonies affected. Both the East, and the South African colonies are mixed African and European states, in which, although the mass of the inhabitants are African, the European minority is politically dominant. But while, broadly speaking, in the former the numerical predominance and economic importance of the African population are such that the interests of this population have priority in the eyes of the administration over those of the European, in the latter, with the exception of the native territories of the high commission, the European population and its economic importance are so relatively great that European interests stand first. In the East Coast colonies, however, African interests are not so predominant as they are in the (British) West Coast colonies; and in this respect these East Coast colonies hold a position midway between the frankly African West Coast colonies and the frankly European Union of South Africa and Southern Rhodesia. The federation, if effected, of a group of colonies of this intermediate type, by showing whether a central administration is a more effective medium for arriving at a due balance between African and European interests, may be expected to provide data germane to the whole subject of the European tutelage of African peoples. And in particular, as the result of the inclusion of Southern Rhodesia in the purview of the commission and the consequent possibility of Northern Rhodesia or its western portion being incorporated into Southern Rhodesia, it is probable that the question whether Northern Rhodesia, with its large area of 300,000sq.m , is to be

administered as a "plantation" colony or to become a new centre of British population will be at length determined.

Tangier.—The status of the Tangier International Zone was regulated by the Act of Algeciras (April 7, 1906), until modified by the conference which formulated the Tangier Statute in 1923. Although certain Powers signatory of the Algeciras Act, notably Italy, withheld their adhesion, this protocol came into force on June 1, 1925. But Spain continued to maintain that the only satisfactory arrangement was the incorporation of Tangier in the Spanish Zone by which it was encircled: while France insisted that her position in Morocco required that Tangier and its communications should be under her control. The visit of a division of the Italian navy to Tangier in Oct. 1927, emphasized Italy's refusal to recognize the statute. On March 3, 1928, agreement was reached between France and Spain. At a second conference (March 20) of France, Spain, Italy and Great Britain the Franco-Spanish Agreement of March 3, was adopted, the statute was modified, and the claims of Italy to participate in the government of Tangier were satisfied (July 17).

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(J. S. K.; H. H. J.; F. R. C.; W. B. W.)

RECENT EXPLORATION

Progress Since 1910.—The largest unknown area of Africa in 1910 was in the Sahara desert; the greatest gaps on the map were in the Libyan desert. In 1920 Hassanein Bey, an Egyptian officer, made a remarkable journey from Cyrenaica to the Kufara oasis, the headquarters of the Senussi sect, collecting valuable cartographical data. He was accompanied by Rosita Forbes, who later made further journeys in northern Morocco, Abyssinia and the lands east of the Nile. Hassanein Bey in 1923 aroused great interest by his journey through the Libyan desert into Darfur and Kordofan, when he examined two "lost" oases. Previous explorations by the French (1912–17) had greatly increased knowledge of the eastern limits of the Chad basin, and had definitely proved its distinction from the western basin of the Nile. Col. Tilho's expeditions had revealed altitudes in Tibesti of 11,200ft. and the height of Mt. Tuside as 10,700ft; lesser altitudes of 9,800ft. were determined at Jebal Marra, in Darfur, and of 4,000 to 5,000ft. on the western borders of the Sudan The Tibesti belt of highland probably played a great part in southward spreads of fauna and flora in Miocene and Pliocene times. In the Nilotic Sudan, east of the main Nile, altitudes of 10,000ft were discovered in 1911–12 by Col. H. D. Pearson. In 1916 Maj. Cuthbert Christy made an interesting journey along the south-western limits of the Nile basin, traversing the ironstone region where adjoining head-streams flow either southwards into the Mbomu and its affluents (Congo basin) or north-east into the Nile basin.



A ZULU WARRIOR IN FULL BATTLE ARRAY

Carefully trained in military tactics, the Zulu warrior was feared by his neighbours as a formidable enemy

French officers, notably Capt. Augiéras, have conducted (from 1904) a scientific survey of the western Sahara, from southern Morocco to the Senegal river and the northern Niger. Augiéras has shown how the intense "desert" conditions of the western Sahara with few oases except on the periphery, accompany the extreme temperatures of the low-lying dunes, which quickly lose heat. The great Juf depression remained unexplored up to 1922; but since then the Citroen expedition from the latitudes of Insalah and Ahaggar in southern Algeria has increased our knowledge of this area. Portuguese Guinea, with its large rivers, has been partly explored, and since 1921 the vast southern part of the Niger basin, and the Black and White branches of the mighty Volta river, have become better known. Northern Togoland, Dahomey, southern Nigeria and the basin of the great Benue river have been mapped in detail.

East and Central Africa.—Much intensive work has been done in East and Central Africa. I. N. Dracopoli in 1912–1913 explored part of Jubaland; he reached the Lorian swamp, which receives the waters of the Uaso Nyiro, and showed its connection with the Juba river in Italian Somaliland. In April 1912 G. F. Archer (later Sir) completed surveys connecting the triangulation of British East Africa with the Abyssinian boundary survey. A survey by Capt E. M. Jack, in 1911, of the region between Lakes Kivu and Victoria added to the knowledge of the Mufumbiro range of active volcanoes; Karisimbi was found to be 14,780ft. high. Since that time the Mufumbiro region and western Uganda have been surveyed in considerable detail. In 1927 geologists of the Swedish Institute found three series of sloping beaches along

the Rift valley between Menengai and Longonot, and also collected much data relative to the glaciation of Mt. Elgon and Kilimanjaro, and to the glacial geology of East Africa in general.

The first survey along its whole length of the Congo-Zambezi watershed was made in 1911–14 by Anglo-Belgian and Anglo-Portuguese boundary commissions. Many rivers run for considerable distances parallel to the divide, which is largely bush-covered. Maj. Reginald Walker, one of the British commissioners, discovered that the Luapula, a main headstream of the Congo, did not issue from Lake Bangweulu, but was a continuation of the Chambezi, which passes through the great swamp south of Bangweulu.

Results of the War.—During the World War, needs of campaigning led to many additions to the knowledge of the topography of inter-tropical Africa, partly through use of aircraft for survey purposes. Thus very useful maps were made of the northern part of Portuguese East Africa. In 1920 Dr. P. Chalmers Mitchell, who flew over the Nile basin proved the value of air reconnaissance to geology by the discovery in the Bayuda desert, north of Khartoum, of the volcanic character of a range of hills A little later the French began to use aeroplanes for survey purposes in the Sahara. (X)

AFRICA, ROMAN, comprised the whole of the continent known to the ancients, except Egypt and Ethiopia. The official and administrative language used the word Africa in a narrow sense, as noticed below The term was borrowed by the Romans from the language of the natives In Latin literature it was employed for the first time by the poet Ennius, who used it of the territory of Carthage and the eastern group of the Atlas. Numerous conjectures have been made as to the etymology of the term Africa; the best is that of Charles Tissot, who sees in the word "Africa" the name of the great Berber tribe, the Aourigha (whose name would have been pronounced Afarika), the modern Aouraghen, in ancient times the principal indigenous element of the African empire of Carthage (Tissot, *Géogr. comp.* i 389). Africa was, in the eyes of the Romans and Carthaginians alike, the country inhabited by the great tribe of Berbers or Numidians called Afarik.

At the time of the Third Punic War the Africa of the Carthaginians was but a fragment of their ancient native empire, the rest of Africa having passed into the hands of the kings of Numidia, who were allies of the Romans.

After the capture of Carthage by Scipio (146 B C) this territory became a Roman province, and a trench, the *fossa regia,* was dug to mark the boundary of the Roman province of Africa and the dominions of the Numidian princes. The remains of this ditch, protected by a low wall or a stone dyke, have been discovered (1907); some of the boundary stones which marked its course, and inscriptions mentioning it, have also been found. From Testur on the Mejerda the *fossa regia* can be followed by these indications for several miles along the Jebel esh-Sheid. The ditch ran northward to Tabarca and southward to Tina. The ditch which in later times divided the provinces of *Africa vetus* and *Africa nova* was at the time of the Third Punic War the boundary of Carthaginian territory. The government of the Roman province thus delimited was entrusted to a *praetor* or *propraetor.* The towns which had fought on the side of the Romans during the Third Punic War were declared *civitates liberae,* and became exceedingly prosperous, *e.g.,* Utica, Hadrumetum and Thapsus.

After the Jugurthine war in 106 B.C. the whole of the *regio Tripolitana* on the littoral of the two Syrtes, was annexed to the Roman province. The battle of Thapsus in 46 B C. made the Romans definitely masters of Numidia which was converted into a new province called *"Africa Nova":* the old province of Africa was known as *"Africa Vetus."*

In 31 B C. Octavius gave up Numidia, or Africa Nova, to King Juba II. Five years later Augustus gave Mauretania and some Gaetulian districts to Juba, and received in exchange Numidia, which thus reverted to direct Roman control, no longer forming a distinct government, but attached to the old province of Africa. [illegible] the Roman province of Africa comprised the region between the mouth of the Ampsaga (Wad Rummel, Wad el Kebir) on the west, and the two tumuli called the altars of the Philaeni, the immutable boundary between Tripolitana and Cyrenaica, on the east (Tissot ii 261). In the partition of the government of the provinces of the Roman empire between the senate and the emperor, Africa fell to the senate, and was henceforth administered by a proconsul.

The province of Africa was the only senatorial province whose governor was originally invested with military powers. The proconsul of Africa had command of the *legio III. Augusta* and the auxiliary corps. But in A D 37 Caligula deprived the proconsul of his military powers and gave them to the imperial legate (*legatus Augusti pro praetore provinciae Africae*), whose special duty it was to guard the frontier zone (Tacitus, *Hist.* iv. 48; Dio Cass. lix 20) The headquarters of the imperial legate were originally at Cirta and afterwards at Lambaesa (Lambessa). The military posts along the frontier of the desert formed an immense arc extending from Cyrenaica to Mauretania. A network of military routes, constructed and kept in repair by the soldiers, led from Lambaesa in all directions, and stretched along the frontier as far as Leptis Magna. The powers of the proconsul scarcely extended beyond the ancient *Africa Vetus* and the towns on the littoral. Septimius Severus detached from the province of Africa the greater part of Numidia to constitute a special province governed by a *procurator,* subordinate to the imperial legate and resident at Cirta (Tissot ii. 34). This province was called Numidia Cirtensis.

In Diocletian's reform, the whole of Roman Africa, with the exception of Mauretania Tingitana (which was attached to the province of Spain), constituted a single diocese subdivided into six provinces Changes were necessitated by the wars with the Moors and the Vandals By a treaty concluded in A D. 476, the Emperor Zeno recognized Genseric as master of all Africa. Reconquered by Belisarius in 534, Africa formed, under the name of *praefectura Africae,* one of the great administrative districts of the Byzantine empire. In A.D. 647 the Arabs penetrated into *Ifrikia,* which was destined to fall for ever out of the grasp of the Romans. In A.D. 697 Carthage was taken.

The population of Roman Africa was composed of three chief elements. the indigenous Berber tribes, the ancient Carthaginians of Phoenician origin and the Roman colonists. The Berber tribes, whose racial unity is attested by their common spoken language and by the Berber inscriptions that have come down to us, bore in ancient times the generic names of Numidians, Gaetulians and Moors or Maurusiani. Besides the Afri (Aourigha) of the territory of Carthage, the principal tribes that took part in the wars against the Romans were the Lotophagi, the Garamantes, the Misulani or Musulamii, the Massyli and the Massaesyli. African epigraphy has revealed the names of some of their deities: *deus invictus Aulisva;* the god Motmanius, associated with Mercury; the god Lilleus; *Kautus pater;* the goddess Gilva, identified with Tellus (Tissot i 486). There were also local divinities in all the principal districts The rock bas-reliefs and other monuments showing native divinities are rare, and give only very summary representations.

During the Roman period the ancient Carthaginians of Phoenician origin and the bastard population termed by ancient authors Libyo-Phoenicians, formed the predominant populations of the towns on the littoral, and retained the Punic language until the 6th century of the Christian era The municipal magistrates took the title of *suffetes* in place of that of *duumvirs,* and in certain towns the Christian bishops were obliged to know the *lingua Punica,* since it was the only language that the people understood. Nevertheless, the Roman functionaries, the army and the colonists from Italy soon brought the Latin element into Africa, where it flourished with such vigour that, in the 3rd century A D, Carthage became the centre of a Romano-African civilization of extraordinary literary brilliancy, which numbered among its leaders such men as Apuleius, Tertullian, Arnobius, Cyprian and Augustine.

Carthage regained its rank of capital of Africa under Augustus, when thousands of Roman colonists flocked to the town. Utica

became a Roman colony under Hadrian, and the *civitates liberae, municipia, castella, pagi* and *turres* were peopled with Latins. The towns of the ancient province of Africa which received *coloniae* were very numerous.

The province of Numidia was at first colonized principally by the military settlements of the Romans. Cirta (Constantine) and Bulla Regia (Hammam Darraj), its chief towns, received *coloniae* of soldiers and veterans, as well as Theveste (Tebessa) and Thamugas (Timgad). The fine ruins which have been discovered at the last-mentioned place have earned for it the surname of the African Pompeii.

AFRICAN LANGUAGES. Language and race have not necessarily common boundaries, but in classifying a group of languages the relation between the two must not be ignored Apart from recent European immigration, Africa has four main types of people: Pygmy-Bushman, Negro, Hamitic and Semitic. These four races correspond to four types of languages, though the Negro group was later subdivided into two different units, viz., Sudanic and Bantu.

There is a certain unanimity regarding the main divisions, and the five groups: Bushman, Sudanic, Bantu, Hamitic, Semitic, may be considered as finally settled. Problems on which no agreement has been arrived at are: the position of Bushman (and Pygmy), the unity of the Sudanic languages, the relation between Sudanic and Bantu, and the comprehension of the term Hamitic languages.

Semitic Languages.—These tongues are spoken in Abyssinia, probably as a result of colonization from southern Arabia. Ge'ez is extinct, Amharic (*q.v.*) is in part a modern representative of Ge'ez. Out of Amharic two new languages have evolved: Tigre and Tigrinya. Other dialects are those of Gurague and Harar. Of greater importance is Arabic, which is the ruling language in north Africa and in parts of eastern Sudan; through Islamic influence it has become a literary idiom in east Africa and the Sudan

Bushman Languages.—The Bushman tribes speak a number of languages, which, however, are all allied and may be divided into three groups, southern, central and northern. Phonetically they are remarkable for the occurrence of the so-called clicks (*q.v.*). Another feature, not only in Bushman languages, but also in Hottentot, Sudanic and Bantu, is intonation (*see* TONES). Each syllable, and sometimes also a single-voiced consonant, has its own level of tone, which is as essential a part of a word as the sounds. Words with identical sounds, but differing in tone, have no etymological relation whatever to each other.

A number of the features of the Bushman languages are found in Sudanic languages, *e g.*, intonation, monosyllabism, non-distinction between verb and noun in form, position of the genitive, formation of plural by "they," but as no etymological relations have as yet been ascertained it seems premature to ally the Bushman languages with the Sudanic group.

Of Pygmy languages nothing can be said, because no Pygmy language is known, the Pygmies having, as far as we know, everywhere adopted the neighbouring Negro speech.

Sudanic Languages.—This group is found, roughly speaking, in the stretch of the continent situated between the Atlantic ocean (Senegambia-Cameroons) and the western slopes of Abyssinia. Some enclaves, as Nuba and Kunama in the north, Gaya and Nyifwa-Kavirondo in east Africa, lie beyond this region.

This large group, stretching through the whole breadth of the continent, does not form a unit in the same sense as do the Bantu languages. It is broken up into numerous subdivisions, each of which has evolved its own type, and in the case of some tongues the divergences are so great that up to the present time, their relationship with others has not been demonstrated. The Sudan has been invaded over its whole area from time immemorial by peoples and languages from north and east. Linguistic conditions to-day are the result of this constant movement and shifting, which modified or destroyed original units and created new ones. Languages, probably whole groups of languages, have perished, or scanty remains have been embodied in new formations. As the invading tongues were largely of types differing radically from the Sudanic, these changes were radical and deeply influenced the original character of the language. Thus languages like Kanuri, Wolof and others, have been so transformed that as yet their inclusion in the Sudanic group may seem to be merely theoretical.

Common Substratum.—While it is thus necessary to emphasize the highly complicated linguistic situation in the Sudan, and the present incomplete exploration of many problems involved, yet the Sudanic group as a whole shows certain common characteristics in phonology and structure, and there are also etymological relationships. There exists a common substratum of Sudanic speech, which is strongest where the original Negro element is strongest in population. This common substratum justifies the use of the term Sudanic languages. Some illustrations may be given: (1) the prevalence of intonation. (2) Monosyllabic stems (Ewe *ku* "death," Nuba *tu* "belly"). (3) Nouns are formed from verbs by a vocalic or nasal prefix (Yoruba *ra* "to buy," *o-ra* "buyer," Shilluk *bugo* "to press the bellows," *o-buk* "bellows"). (4) Plural of nouns is formed by adding to the noun a plural noun or pronoun (Ewe *ati* "tree," *ati-wo* "trees," Nuer *chak* "tick," *ke-chak* "ticks," *-wo* and *ke-* are the pronouns of the third person plural in Ewe and Nuer). (5) Plural of nouns is formed by adding *i* or *a* (Ibo *o-ru* "slave," *i-ru* "slaves"; Nuer *bel* "artist," *bel-i* "artists"; Edo *o-ya*, pl. *a-ya* "man"; Zande *boro*, pl. *a-boro* "man"). (6) Distinction between inanimate things and animate beings (or persons), the latter in most cases having the affix *"o"* (Twi *o-nipa* "man"; in Shilluk *o* designates persons as descendants of other persons: *nayo* "the mother's brother," *o-nayo* "the mother's brother's child"). There is no grammatical sex-distinction. (7) In genitive relation the possessor precedes the possessed (Twi *nipa dua* "a man's figure," Kunama *Ila masa* "Ila's lance"). (8) There is no formal distinction of case The dative form is circumscribed by the verb "to give" (Ewe *edi ga na fofo* "he sought money gave father": he sought money for the father. Nuba *ir iga tir onam* "you say give him": you say to him. (9) Postpositions, *i.e.*, space-denoting nouns, are used in the place of prepositions (Ewe *ati ta* "tree's head": on the tree; Nuba *ka tu* "house's belly": in the house. (10) Verbal combinations are frequent (Ewe *tso va na* "take come give": to bring to; Nuba *atta-den* from *ed-ta-den* "take come give": to bring to). (11) The verbal stem is not changed in conjugation; tenses and modes are expressed by adding grammatical form words which in many cases can be traced to original nouns or verbs (in Twi the future is formed by prefixing *ba* [from *bia*] "to come," in Nuba by prefixing *bi* "to come"). (12) Sounds peculiar to the majority of Sudanic languages are the labio-velar *kp* and *gb*. (13) A considerable number of word-stems are identical. The characteristics just mentioned are not found in each sub-group, but there is no group which does not possess a number of them.

Divisions.—The Sudanic family may be geographically divided into an eastern, a central and a western group. The largest section of the eastern group are the Niloto-Sudanic languages comprising Shilluk with its many subdivisions, Dinka, Nuer and probably also Burun between the White and Blue Niles. Nuba on the Nile, in the Nuba mountains and in Kordofan, is connected with the Nilotic group, while other languages of these mountain regions are of a distinct character, having a class division of the noun.

The central group stretches between the 30th and 10th degree east long, and is subdivided by Delafosse into (*a*) Nile-Congo group, which, however, contains languages that are more closely related to the eastern Sudanic group; (*b*) Ubangi group; (*c*) Shari-Wadai group; (*d*) Shari group; (*e*) Niger-Tshad group; (*f*) Niger-Cameroons group. Our present knowledge concerning the central Sudanic group is so insufficient that the grouping just given is only provisional.

The western Sudanic group is better known and the sub-groups are well-defined. They are the following: (1) *The Kwa languages,* spoken on the coast of Upper Guinea between the lower courses of the Niger and St. Paul's River in Liberia. Their subgroups are: (*a*) Ewe-Akan group (Gold Coast, Togo, Dahome); (*b*) Lagoon group in the littoral regions of the Ivory Coast; (*c*) Kru group, reaching from the western Ivory Coast to the mouth of St. Paul's River; (*d*) Yoruba group; (*e*) Nupe group; (*f*) Ibo group; (*g*) Edo group; (*h*) Ijo (*d–h* in Nigeria). In the Kwa

languages the majority of word-stems consists of one consonant and one vowel. Akan *ka* "to remain," *wu* "to die." They have vocalic and nasal nominal prefixes, whose function is to form nouns out of verbs, and which are only absent in Kru. The prefixes do not form class divisions of the noun, except in rudiments.

(2) *Benue Cross River languages.* They partly coincide with Delafosse's Niger-Cameroons group and with Johnston's group A in his Bantu and Semi-Bantu languages, group (*b*) including Johnston's groups B–G, and group (*c*) comprising Johnston's group H. The languages of this group have many stems which end in a consonant. Efik *wut* "to kill" against Ewe *wu* "to kill." They have the same nominal prefixes as in group (1) (Efik *fime* "to blow," *o-fime* "wind"), but some languages have a system of prefixes which forms classes As the group lies on the borderline between Sudanic and Bantu, some of its languages represent a stage of transition between the two.

(3) *Middle Togo group.* Most of these occupy a very small area, being situated in the mountainous region between the 7th and 8th degree N. lat.; some of them are disappearing or have already disappeared, being absorbed by Ewe and Akan Among those which continue to exist are Avatime, Likpe, Adele, Kposso, Kebu The word-stems in this group consist mainly of one consonant and one vowel. Kposso *wu* "to kill" A class division of nouns is formed by prefixes; some languages use class-suffixes besides the prefixes The group stands between groups (1) and (4), having distinct connections with both.

(4) *Gur (Goor) languages,* in the northern section of the Ivory and Gold Coast, of Togo and of Dahome, and in the adjacent parts of Haute Volta They include the following subgroups: (*a*) Mossi group (Mossi, Dagomba, etc), (*b*) Grussi or Gurunsi group, (*c*) Tem group, (*d*) Bargu, (*e*) Gurma group, (*f*) Kilina, (*g*) Senufo or Siena group, (*h*) Songai. The latter is in fact an isolated language having its own type, but is remotely connected with the Gur languages Stems of the form consonant plus vowel are very frequent, though perhaps not in the majority. Dyan *wu* "to kill" All have class division of nouns by suffixes; Gurma and Tem use prefixes and suffixes

(5) *West Atlantic languages.* These are found in part of the territory between the Senegal and the Atlantic, with a number of enclaves farther east, and are sub-divided into an eastern group, comprising Temne, Bulom, Limba, Kissi, Gola and Adjukru, and a western group, represented by (*a*) Dyola, (*b*) the Bissao-Bolama cluster (Bola, Sarar, Pepel, Kanyop), (*c*) the Geba cluster (Biafada, Padjade), (*d*) Banyun, Nalu, Bulanda, (*e*) Konyagi, (*f*) Bidjogo, (*g*) Wolof and Serer. Neither in general type nor in phonology and etymology do the members of this group form such a close unit as those of the preceding group Almost all have class division of nouns; some, as Bulom, Temne, Adyukru, by prefixes, Gola by prefixes and suffixes, Wolof and Serer have suffixes, but also change the beginning consonant, which perhaps points to prefixes. Stems consisting of a consonant and a vowel are frequent (Bulom *wu* "to die"), but they are in a minority.

(6) *Mandingo or Mande languages,* in the western Sudan between groups (4) and (5). They fall into two groups, named after the numeral for "ten" prevailing in each group. (*a*) *Mande tan,* with Bambara, Soninke, Malinke, Dyula, as main representatives, (*b*) *Mande fu,* comprising Susu, the Kpelle-Mende cluster, in Sierra Leone and Liberia (Mende, Kpelle, Gbande, Gbunde, Toma, Mano, Gio), Djalonka in French Guinea, and a number of small languages reaching as far east as the north-west corner of Nigeria (Boko-Busa). In the Mandingo tongues two-syllabic words prevail; many of these are compositions of two monosyllabic stems, each consisting of a consonant and a vowel. There are no word-forming prefixes, except in rudimentary forms. The word may often have a verbal and a nominal meaning: Bambara *ti* "thatch" and "to thatch."

Bantu Languages.—These, spreading through the southern half of the continent, form a closely united family with clearly defined features. Though the most prominent of these, the class division of nouns by prefixes, also exists in Sudanic groups, it has in Bantu reached a fuller development and has become the dominating factor in their structure. These prefixes also form the plural; thus *m-swahili* a Swahili, *wa-swahili,* Swahili people, *ki-swahili* the Swahili language The prefix belonging to a noun is repeated (though sometimes in a changed form) before every adjective, noun or pronoun agreeing with the noun; Swahili: *ki-su ki-kali ki-moja ki-me-potea* "knife sharp one has been lost": one sharp knife has been lost; *-su* "knife" has *ki-* as its class prefix, and this is repeated before every word agreeing with *-su.* The plural prefix corresponding to *ki-* is *vi-;* thus the plural of the preceding sentence is: *vi-su vi-kali vi-nane vi-me-potea* "eight sharp knives have been lost." The main nominal classes are: (*a*) for "man as an independent personality", (*b*) for "man in dependent position" (slave, messenger, workman), also for physical agents, spirits, diseases, parts of the human body, animals, plants; (*c*) for objects existing in double or divisible form, the plural also designating collectives and liquids, (*d*) for "customs, usages, tools"; (*e*) for animals; (*f*) for individual objects and abstract nouns; (*g*) for diminutives, (*h*) for infinitives; (*i*) (or rather three) for locatives Clicks (probably borrowed from Bushman and Hottentot) and lateral sounds are peculiar to some South African Bantu languages. Intonation is in most tongues not so important as in the Sudanic family. Stress accent is more developed than in the latter, the accent lying generally on the penultimate Two-syllabic stems are prevalent There is no grammatical gender, sex being indicated as in Sudanic languages, and no case inflection. The genitive follows the governing noun. The verb has a large number of derivative forms, which afford a remarkable richness in expression, *e.g.,* Swahili *vunja* "to break," *vunjika* "to be broken"; *penda* "to love," *pendana* "to love each other"; *takata* "to be clean," *takasa* "to cleanse"; from *pata* "to obtain" the following derivatives may be formed: *patana* "make an agreement," *patanisha* "unite," *patia* "obtain for somebody," *patika* "be seized," *patilia* "reach out for something," *patiliza* "make one vexed," *patilizina* "vex each other."

It is more difficult to group the Bantu languages in subdivisions than the Sudanic languages, where the evolution of independent types is evident at first sight.

According to Homburger, Bantu is divided into the following groups (of the individual languages belonging to each group only a certain number can be mentioned here): (1) Northern or Ganda group (Ganda, Nyoro, Kerewe. (2) Ruanda group (Ruanda, Rundi) (3) North-eastern or Kilimanjaro group (Kikuyu, Kamba, Djagga, Moshi, Siha). (4) Northern group of the east coast (Taveta-Taita, Chassu, Pokomo, Nika, Shambala, Bondei, Zigula, Swahili, Comore, Zaramo, Kami, Matumbi). (5) East African group (Nyamwezi, Nyaturu, Gogo, Hehe, Pogoro, Kaguru, Konde, Yao, Nyanja, Sene, Tete, Chwabo or Kilimane). (6) South-eastern group (Makua, Ronga or Thonga, Gwamba or Hlengwe, Chopi or Lenge, Venda, Sotho, Kololo, Chwana). (7) Zulu group (Kafir or Xosa, Zulu, Tebele, Ngoni). (8*a*) Central group (Tabwa, Bemba, Mambwe, Bisa or Wisa, Lala-Lamba, Senga, Tonga, Subiya). (8*b*) Western group (Herero, Ndonga, Kwanyama, Nyaneka, Mbunda, Luyi, Umbundu, Kimbundu, Lunda, Luba or Lua). (9) Congo group (Congo, Kanioka, Kutsu, Kele, Lolo, Nkundu). (10) North-western group (Bangi, Teke, Kalai or Kele, Galoa, Duma, Benga, Noho, Basa, Duala, Bube, Kwiri, Isubu). This division appears to call for a new investigation based on a careful observation of sound-shifting, for which a good start has been made by van Warmelo in his study on South African Bantu languages.

Hamitic Languages.—These represent a linguistic type which is more closely allied with the Semitic than with any other group of African languages. Their main divisions are (1) Eastern Hamitic in north-east Africa, including, among others: Bedauye, Bogos, Danakil, Somali, Galla, Agau, Kaffitsho. (2) Niloto-Hamitic: Masai, Ndorobbo, Tatoga, Nandi, Suk, Turkana, Gimirra. (3) Western Hamitic: The Berber dialects from western Morocco to the oasis of Siwa, Tuareg, and probably the extinct language or languages of the Guanches on the Canary islands. Hausa (*q.v.*), may be called a remoter member of this sub-group. Though it has adopted many elements from neighbouring Sudanic tongues,

its Hamitic affinity cannot be doubted. Hottentot in South Africa also shows certain Hamitic features, but recent investigations, especially those undertaken by Schapera, reveal such undeniable affinities between the Hottentot and Bushman languages (*q.v.*), as can hardly be explained by borrowing, but seem to point to a genetic relation between the two. Distinction of sex, always one of the prominent reasons for including Hottentot in the Hamitic family, is also found in Naron, a Bushman tongue, being in both cases expressed by a suffix. Both Nama and Naron have a dual form besides singular and plural, *|xam* and Nama have inclusive and exclusive forms of the first person plural (including or excluding the person addressed). There are other common features in grammar and a considerable number of words common to both. Schapera's conclusion is "that in spite of the many noticeable differences between them the Hottentot and Bushman tongues must be regarded as belonging to one and the same family of languages."

The characteristic features of Hamitic speech are: (1) Grammatical gender. Shilh masc. *idilk*, fem. *t-idilli-t* "black," Masai *ol dia* "male dog," *en dia* "female dog," Nama *khoib* "man," *khois* "woman," Hausa *ya* "he," *ta* "she." (2) a richness in plural formation, which may form such distinctions as distributive, collective, general and universal plurality. Bilin *dimmū-rā* "an individual of the cat family," pl. *dimmū-t;* but: *dimmū* "cat," pl *diāmū* "cats." Chamir *ieslemā* "a Muslim," pl. *ieslem-en,* but *ieslem-en-t* "the Muslim world." In Hausa (*q.v.*), most nouns have several plural forms; *kunba* "finger-nail" has the plural forms *kunbōbī, kunbuna, kunbai, kunbaibai.* Here as in other Hamitic (and Sudanic) languages re-duplication is frequently used in forming the plural. (3) Inner vowel change (ablaut): Shilh *iliwi,* pl. *ilaw-an* "thorn"; *a-fulu,* pl. *i-fel-en* "string" (the changes are, however, caused by vowel-assimilation, and are thus a phenomenon found likewise in Sudanic languages); in verbs: Shilh *of-aji* "I find," *ufi-ji* "I have found" (4) As in Bantu, the genitive follows the governing noun. In Hottentot, however, as in Bushman and Sudanic (and also Bedauye), the possessor precedes the possessed.

Fulfulde,—Meinhof includes Fulfulde, the language of the Fulbe, in the Hamitic family, but calls it Proto-hamitic or Prehamitic. Fulfulde has the usual Hamitic genitive position, in which the governing noun precedes the genitive, but other features regarded as Hamitic are absent. Fulfulde has no grammatical gender; there is no different plural form of nouns, and there is no inner vowel change. It is decidedly a class language, *i e*, like Bantu and many Sudanic languages it divides nouns into classes by affixes, and this fact separates Fulfulde from the Hamitic stock and draws it near Bantu languages and the Sudanic class languages. The connection between Fulfulde and Bantu is recognized by Meinhof, his opinion being that "originally in the whole of the present Bantu region languages of a Sudanic type were spoken, until from the north tribes with a language similar to Fulfulde penetrated and made themselves lords over the old inhabitants The result of a mixture of these two elements was Bantu." (c D. Kolonial-Lexikon i. p. 133) The essential identity of the class-affixes as used in Fulfulde, in Sudanic class languages and in Bantu, in their etymological form as well as in their function, is evident, while in point of vocabulary Fulfulde and Bantu differ widely

On the other hand there is an original affinity between Bantu and Sudanic languages. This refers not only to class-affixes, but also and still more to etymology. The two families have a considerable number of word-stems in common, and also certain formative elements, apart from class-affixes, are identical in both families

The situation may be summed up as follows: The Negro population of Africa, comprising the Bantu and the Sudanic speaking peoples, has in etymology and in a number of formative elements a common linguistic substratum. The class division of nouns existing in Fulfulde, in Bantu and in certain Sudanic languages is evidently of common origin, where or from what language it may have originated we do not know.

According to Struck, the number of African languages is as follows: Bushman 11, Sudanic 264, Bantu 182, Hamitic 47, Semitic 10. Many of these occupy a small area, and perhaps not more than 12 are spoken by more than a million people. From the practical point of view, some of the most important African languages are (Semitic): Amharic, Arabic; (Hamitic): Hausa; (Bantu): Ganda, Kikuyu, Kongo, Luba-Lulua, Mbundu, Ngala, Nyanja, Sukuma-Nyamwezi, Ruanda-Rundi, Sotho-Pedi-Chwana, Swahili, Swina-Karanga-Ndau, Zulu-Xosa; (Sudanic): Akan, Dinka-Nuer, Efik-Ibibio, Ewe-Aneho-Dahome, Ibo, Kanuri, Kpelle-Mende, Malinke-Djula-Bambara, Mossi-Dagomba, Nupe-Gbari, Temne, Wolof, Yoruba, Zande.

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AFRICAN LILY (*Agapanthus umbellatus*), a member of the family Liliaceae, a native of the Cape of Good Hope, whence it was introduced at the close of the 17th century. It is a handsome greenhouse plant, which is hardy in the south of England and Ireland if protected from severe frosts. It has a short stem bearing a tuft of long, narrow, arching leaves, ½ to 2ft. long, and a central flower-stalk, 2 to 3ft high, ending in an umbel of bright blue, funnel-shaped flowers. The plants are easy to cultivate, and are generally grown in large pots or tubs which can be protected from frost in winter. During the summer they require plenty of water, and are very effective on the margins of lakes or running streams, where they thrive admirably. They increase by offsets, or may be propagated by dividing the root-stock in early spring or autumn. A number of forms are known in cultivation.

AFRICANUS: *see* SCIPIO.

AFRICANUS, SEXTUS IULIUS, a Christian traveller and historian of the 3rd century, was probably born in Libya and lived at Emmaus. He may have served under Septimius Severus against the Osroenians in A.D. 195. He wrote a history of the world (*Χρονογραφίαι*, in five books) from the creation to A.D. 221, calculating the period between the creation and the birth of Christ as 5,499 years, and ante-dating the latter event by three years This method of reckoning, known as the Alexandrian era, was adopted by almost all Eastern Churches. The history, which had an apologetic aim, is no longer extant, but copious extracts from it are to be found in the *Chronicon* of Eusebius. There are also fragments in Syncellus, Cedrenus and the *Paschale Chronicon*

Eusebius also gives a letter to Aristeides, and one to Origen, impugning the authority of the book of Susanna The ascription to Africanus of the *Κεστοί*, a work on agriculture, natural history, military science, etc, has been disputed. Neander suggests that it was written by Africanus before he had devoted himself to religious subjects. For a new fragment of this work see *Oxyrhynchus Papyri* (Grenfell and Hunt), iii 36 *et seq*

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AFRĪDI, the most powerful of the Pathān tribes which hold the mountainous borderland of the N W. Frontier Provinces, India, though less numerous than the Wazīrs. They occupy the eastern spurs of the Safed Koh Through the north of these runs the Khyber pass, and their centre is the great upland country called Tirāh, 6,000 or 7,000ft above sea-level, of which the Orakzais hold the southern half The Afrīdi borders are the Peshāwar district on the east and north, the Mohmands on the north, the Shinwāris on the west, and the Orakzai and Bangash on the south, including the valleys of Bārā and Bāzār The origin of the Afrīdis is unknown They have a curiously Jewish cast of features, but have been supposed to be the Aparytai of Herodotus, though for over 2,000 years their history is untraceable. It is, however, certain that about the 15th century they ousted the Tirāhīs, doubtless absorbing some of their elements, but their conquests were encroached upon by their neighbours, and it was not until Jahāngīr's reign that they retook half of Tirāh from the Orakzai Under Akbar they embraced the Roshanīa heresy, but after its suppression they enlisted freely in the Mughal armies and were subsidized to keep open the Khyber pass. But they failed to defend it against Nādir Shāh, and were content to levy toll on such trade as filtered through it during the Abdāli and Sikh *régimes*. On the British annexation their independence was respected, in spite of their appeal to the Indian government to take Tirāh, and they were subsidized to protect trading caravans travelling through the Khyber, but their internal feuds rendered it unsafe In 1897 the Afrīdis enrolled in the Khyber militia made a gallant defence of Landi Kotal, but eventually surrendered The defection of one of their most turbulent clans the Zakka Khel soon involved the whole tribe and the Orakzai as well. This necessitated a regular invasion of Tirāh under Sir William Lockhart, and after much hard fighting every part of the country was traversed and surveyed, all the disaffected sections of the tribes being punished, the Zakka Khel being the last to submit In 1908 an expedition had again to be launched against the Jawakki Khel The Afrīdis are intensely democratic, the heads of clans having little authority, so that raiders cannot be brought to book or tribal engagements enforced. Though brave and hardy the tribe is reputed cruel and untrustworthy, but it has furnished many good soldiers in the Indian army (H. A. R.)



ORIENT AND OCCIDENT PHOTO

AN AFRIDI TRIBESMAN ON THE INDO-AFGHAN BORDER, WITH HIS HOME-MADE "MAUSER"

Military Operations.—There have been several British expeditions against the separate clans —

(1) Expedition against the Kohat Pass Afrīdis under Sir Colin Campbell in 1850. The British connection with the Adam Khel Afrīdis commenced immediately after the annexation of the Peshāwar and Kohat districts Following the example of all previous rulers of the country, the British agreed to pay the tribe a subsidy to protect the pass. But in 1850 1,000 Afrīdis attacked a body of sappers engaged in making the road, killing 12 and wounding six It was supposed that they disliked the making of a road which would lay open their fastnesses to regular troops. An expedition of 3,200 British troops was despatched, which traversed the country and punished them

(2) Expedition against the Jowaki Afrīdis of the Bori villages in 1853. When the Afrīdis of the Kohat Pass misbehaved in 1850, the Jowaki Afrīdis offered the use of their route instead; but they turned out worse than the others, and in 1853 a force of 1,700 British traversed their country and destroyed their stronghold at Bori. The Jowaki Afrīdis are a clan of the Adam Khel, who inhabit the country lying between the Kohat Pass and the river Indus

(3) Expedition against the Aka Khel Afrīdis under Colonel Craigie in 1855. In 1854 the Aka Khels, not finding themselves admitted to a share of the allowances of the Kohat Pass, commenced a series of raids on the Peshawar border and attacked a British camp. An expedition of 1,500 troops entered the country and inflicted severe punishment on the tribe, who made their submission and paid a fine

(4) Expedition against the Jowaki Afrīdis under Colonel Mocatta in 1877. In that year the government proposed to reduce the Jowaki allowance for guarding the Kohat Pass, and the tribesmen resented this by cutting the telegraph wire and raiding into British territory A force of 1,500 troops penetrated their country in three columns, and did considerable damage by way of punishment.

(5) Expedition against the Jowaki Afrīdis under Brig.-General Keyes in 1877–78 The punishment inflicted by the previous expedition did not prove sufficiently severe, the attitude of the Jowakis continued the same and their raids into British territory went on. A much stronger force, therefore, of 7,400 British troops, divided into three columns, destroyed their principal villages and occupied their country for some time, until the tribe submitted and accepted government terms. The Kohat Pass was afterwards practically undisturbed

(6) Expedition against the Zakka Khel Afrīdis of the Bazar valley under Brig.-General Tytler in 1878 At the time of the British advance into Afghanistan, during the second Afghan War, the Zakka Khel opposed the British advance and attacked their outposts A force of 2,500 British troops traversed their country, and the tribesmen made their submission.

(7) Expedition against the Zakka Khel Afrīdis of the Bazar valley under Lieut.-General Maude in 1879 After the previous expedition the Afrīdis of the Khyber Pass continued to give trouble during the progress of the second Afghan War, so another force of 3,750 British troops traversed their country, and after suffering some loss the tribesmen made their submission. After this both the Khyber and Kohat Passes were put on a stable footing, and no further trouble of any consequence occurred in either down to the time of the frontier risings of 1897, when the Afrīdis attacked the Khyber Pass, which was defended by Afrīdi levies

(8) For the Tirāh campaign of 1897 *see* Tirāh Campaign.

(9) In February of 1908 the restlessness of the Zakka Khel again made a British expedition necessary, under Sir James Willcocks; but the campaign was speedily ended, though in the following April he had again to proceed against the Mohmands, the situation being complicated by an incursion from Afghanistan

See Paget and Mason's *Frontier Expeditions* (1884); Warburton's *Eighteen Years in the Khyber* (1900). (C Li.)

AFRIKANDER BOND, a party, founded in Cape Colony by the Rev. S. J. du Toit in 1879, aiming at federating South Africa in one independent republic. The official optional use of

Dutch in parliament and the law courts was secured, but under the leadership of Hofmeyer and the influence of Cecil Rhodes its anti-British sentiments were greatly modified. It was always, however, essentially an organization for the promotion of the political supremacy of the Cape Dutch. (*See* also HOFMEYER, JAN HENDRIK; CAPE COLONY; and SOUTH AFRICA, UNION OF.)

AFTERBIRTH, a term used to include the placenta, foetal membranes and umbilical cord. They are usually expelled from the womb in a single mass 15 to 30min after the birth of the child. The placenta is a soft, beefy red disk, about 8 to 10in in diameter and 1 to 1½in. in thickness. It is the organ by which the mother nourishes the child and is composed largely of capillary loops from mother and child, in close contact. While the mother's blood does not pass into the blood vessels of the child, the constituents necessary for growth pass through the capillary walls into the child's circulation by a process called osmosis, while the waste products in the foetal blood pass in the other direction and are eliminated by the mother. One surface of the placenta is attached to the inside of the womb, whence it draws its maternal blood. The other surface presents the branching blood vessels of the foetus which unite into one artery and two veins. These vessels form the umbilical cord, which usually starts from the middle of the placenta and enters the body of the foetus at the navel It is about 22in long. Around the edge of the placenta can be found the thin torn membrane which envelops the foetus in the womb. It forms the water bag in which the foetus floats, and usually breaks shortly before the birth of the child. If, however, the child is born with the membranes intact, he is said to be born in a caul.

AFTER-DAMP, in coal-mining, a name given to the poisonous choking gas which forms after a mine explosion It mainly consists of carbon dioxide, and is also known as choke-damp. (*See* CHOKE-DAMP)

AFTERGLOW, a broad high arch of radiance or glow seen occasionally in the western sky above the highest clouds in deepening twilight, or reflected from the high snowfields in mountain regions long after sunset. It is caused by very fine particles of suspended dust in the high atmosphere exercising a scattering effect upon the components of white light. After the eruption of Krakatoa in 1883, a remarkable series of red sunsets appeared all over the world. These were consequent on the spread by atmospheric currents of huge quantities of fine volcanic dust.

AFTER-IMAGE, the immediate recurrence of a sensation, in like or opposite quality, after the removal of its stimulus. After-images are most prominent in vision. If a person gazes steadfastly at a small coloured object for half a minute and then turns his eyes away to a neutral background, he will notice a small coloured spot of complementary hue and brightness. These are called *negative* after-images. If the object was red, the after-image is bluish green; if it was emerald green, the after-image is pink; if it was dark, the after-image is light. *Positive* after-images resemble the stimulus in brightness and hue and usually last only a few seconds. They are favoured by intense illumination in the stimulus, occurring after the eye has been in the dark. Positive after-images occur for pressure, temperature, and the sensations of bodily movement and posture. There are no after-images from sounds or odours.

AFTER-WORK, an expression used in Italy for the organized sociological efforts to provide for the better enjoyment and employment of the leisure created by the contraction of the working day. (*See* DOPOLAVORO.)

AFZELIUS, ADAM (1750–1837), Swedish botanist, was born at Larf, Vestergötland. He founded the Linnaean Institute at Uppsala in 1802, and in 1812 became professor of materia medica at the university. In addition to various botanical writings, he published the autobiography of Linnaeus in 1823.

His brother JOHAN AFZELIUS (1753–1837) known as *Arvidson,* was professor of chemistry at Uppsala; and another brother, PER AF (1760–1843), who became professor of medicine at Uppsala in 1801, was distinguished as a medical teacher and practitioner.

AFZELIUS, ARVID AUGUST (1785–1871), Swedish poet, historian and mythologist. From 1828 till his death he was parish priest of Enköping. He collaborated with the learned historian, Erik Gustaf Geijer, in the great collection of Swedish folk-songs, *Svenska folkvisor från forntiden* (1814–16). He published also translations of the *Sämunder Edda* and *Herwara-Saga* and a history of Sweden to Charles XII. (of which a German translation was published in 1842), as well as original poems.

AGA or AGHA, a word, said to be of Tatar origin, signifying a dignitary or lord. Among the Turks it is applied to the chief of the janissaries, to the commanders of the artillery, cavalry and infantry, and to the eunuchs in charge of the seraglio. It is also employed generally as a term of respect in addressing wealthy men of leisure, landowners, etc.

AGADE, the capital city of "Sargon of Agade." The city is probably identical with Tal-ed-Deir, excavated by Sir E. A. Wallis Budge in 1891. The inscriptions suggest that it was near Sippar, and Langdon identifies it with Sippar-Yakhuru, admitting, however, that the identification is uncertain. At ed-Deir there is a massive city wall forming two sides of a triangle; the third side was formed either by the Euphrates or by a canal. The main gate was at the western apex of the triangle. The city appears to have been constructed all at once, primarily as a fortress Sargon, who is said to have been a gardener of Semitic origin at Kish, overthrew the Sumerian power of Kish and for some unknown reason changed his capital to Agade.

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AGADIR, the best Atlantic harbour of Morocco, 10km. N of Wadi Jus Pop 2,500. It was the scene of Portuguese fisheries from 1500 and became a valuable commercial centre Agadir sprang into prominence during the Moroccan crisis of 1911, and since 1912 it has belonged to France.

AGAIAMBO or **AGAUMBU,** a race of dwarf marsh-dwellers in British New Guinea, now extinct. In 1904 there were six males and four females, living in huts erected on piles in the lakes and marshes. They lived almost entirely in their "dug-outs" or canoes, or actually wading in the water. Their food consisted of sago, the roots of the water-lily and fish In features, colour and hair they closely resembled the true Papuans.

AGA KHAN I., HIS HIGHNESS THE (1800–1881), the title accorded by general consent to HASAN ALI SHAH (born in Persia, 1800), when he settled in Bombay under the protection of the British Government He was believed to have descended in direct line from Ali by his wife Fatima, the daughter of the Prophet Mohammed. Ali's son, Hosain, having married a daughter of one of the rulers of Persia before the time of Mohammed, the Aga Khan traced his descent from the royal house of Persia from the most remote, almost prehistoric, times. His ancestors had also ruled in Egypt, as caliphs of the Beni-Fatimites for a number of years, at a period coeval with the Crusades. Before the Aga Khan emigrated from Persia, he was appointed by the emperor Fateh Ali Shah to be governor-general of the extensive and important province of Kerman. His rule was noted for firmness, moderation and high political sagacity. At last, however, he incurred the mortal displeasure of Fateh Ali Shah. He fled from Persia and sought protection in British territory, preferring to settle down eventually in India, making Bombay his headquarters. In crossing over from Persia through Afghanistan the Aga Khan found opportunities of rendering valuable services to the British army in Afghanistan and thus cast in his lot with the British A few years later he rendered conspicuous services in the course of the Sind campaign, when his help was utilized by Napier in the process of subduing the frontier tribes, a large number of whom acknowledged the Aga's authority as their spiritual head. When he finally settled down in India, his position as the leader of the large Ismailiah section of Mohammedan British subjects was recognized by the Government, and the title of His Highness was conferred on him, with a large pension. From that time until his death in 1881 the Aga Khan continued to discharge his sacerdotal functions, not only among his followers in India, but towards the more numerous communities which acknowledge his religious sway in Afghanistan, Khurāsān, Persia, Arabia, Central Asia, and even distant Syria and Morocco. He remained throughout

unflinchingly loyal to the British *Raj*, and his vast and unquestioned influence among the frontier tribes on the northern borders of India proved of invaluable service in the several expeditions led by British arms on the north-west frontier of India. He was also able to check the fanaticism of the more turbulent Mohammedans in British India.

He was succeeded by his eldest son, AGA KHAN II This prince continued the traditions and work of his father and was a member of the legislative council of Bombay

AGA KHAN III. (1875–) (Aga Sultan, Sir Mohammed Shah), only son of the foregoing, succeeded him in 1885. He was born in 1877, and, under the care of his mother, a daughter of the ruling house of Persia, was given not only that religious and oriental education which his position as the religious leader of the Ismailiahs made indispensable, but a sound European training. The Aga Khan headed the Muslim deputation in 1906 to the Viceroy, Lord Minto, which submitted the case for encouraging abandonment of the studied aloofness of their community from Indian political life; and he was president of the All-India Muslim League, thereupon formed, during its first constructive years. He initiated the fund, for raising the Mohammedan college at Aligarh to university status, which was effected in 1920. In the immediate pre-war years he did much to soothe Indian Muslim sentiment in respect to the Turco-Italian and two Balkan wars. He was touring amongst his followers in East Africa, when the World War broke out, and immediately cabled to the *jamats* or councils of the millions of Ismailiahs within British territories and on their borders directing his followers to place themselves unreservedly at the disposal of the British authorities. When Turkey was drawn into the struggle the Aga Khan issued a stirring manifesto showing that the Allies had no overt designs on Islam, and calling upon the Muslims of the empire to remain loyal and faithful to their temporal allegiance. His immediate followers provided a solid phalanx of whole-hearted support of Britain, which had a most steadying influence in sterilizing the efforts of impatient headstrong elements. His influence was reinforced by his close and intimate contact with leading Allied statesmen and the breadth and liberality of his outlook on the problems of reconstruction His study of Indian and Middle Eastern affairs in *India in Transition* (1918) was not without considerable effect in the final shaping of reforms under the India Act of 1919, and was consistent in broad principle with his post-war criticisms of the British Government's Mesopotamian and Arabian policy.

The Aga Khan joined in many representations, public and private, both at the Peace Conference and subsequently, as to the immense importance to Great Britain, the ruler of the greatest aggregation of Muslims in the world, of not depriving Turkey of a real independent existence. To the G.C I.E. and the G C S I already conferred on him there was added in 1916 a salute of 11 guns and the rank and status of a first-class chief of the Bombay Presidency, the only previous instance of the grant of a salute outside the Indian territorial ruling families being that of the first Sir Salar Jung. The Council of State for India recommended him for the Nobel Peace prize in 1923.

AGALMATOLITE, a soft variety of the mineral pyrophyllite ($HAlSi_2O_6$), also called *pagodite,* used by the Chinese for carving, especially into grotesque figures (whence called "figure-stone").

AGAMEDES (ăg-ă-mā-dās), in Greek legend, king of Orchomenus in Boeotia. He and his step-brother Trophonius were skilled architects and constructors of underground shrines and treasure-houses. When building a treasure-house for the Boeotian king, Hyrieus, the brothers fixed one of the stones in the wall in such a manner that they could remove it whenever they pleased and help themselves to the treasure. Hyrieus set a trap in which Agamedes was caught; Trophonius to prevent discovery cut off his brother's head and fled with it. He was pursued by Hyrieus, and swallowed up by the earth in the grove of Lebadeia. On this spot was the oracle of Trophonius in an underground cave; those who wished to consult it, first offered a ram and called upon the name of Agamedes. A similar story is told of the treasure of Rhampsinitus by Herodotus (ii. 121). The brothers built the temple of Apollo at Delphi. When they asked for a reward, the god promised them one in seven days; on the seventh day they died.

AGAMEMNON, a Homeric hero, son of Atreus, and Aërope, grandson of Pelops, great-grandson of Tantalus and brother of Menelaus. After the murder of Atreus (q.v), Agamemnon and Menelaus took refuge with Tyndareus, king of Sparta, whose daughters, Clytaemnestra and Helen, they respectively married. By Clytaemnestra, Agamemnon had three daughters, Iphigeneia (Iphianassa), Electra (Laodice), Chrysothemis, and a son, Orestes Menelaus succeeded Tyndareus, and Agamemnon, with his brother's assistance, drove out Aegisthus and Thyestes, and recovered his father's kingdom. He extended his dominion by conquest, and became the most powerful prince in Greece. When Paris (Alexander), son of Priam, had carried off his brother's wife, he went round to the princes of the country and called upon them to unite in a war of revenge against the Trojans. He himself furnished 100 ships, and was chosen commander-in-chief of the combined forces. The fleet, numbering 1,200 ships, assembled at the port of Aulis in Boeotia, but was prevented from sailing by calms or contrary winds Calchas announced that the wrath of Artemis could only be appeased by the sacrifice of Iphigeneia (q v.). The fleet then set sail.



BY COURTESY OF AMERICAN WOMEN S HOSPITALS

THE TOMB AT MYCENAE, GREECE, KNOWN FOR YEARS AS THE TREASURE HOUSE OF ATREUS, AND CALLED THE TOMB OF AGAMEMNON

Little is heard of Agamemnon until his quarrel with Achilles (q v). After the capture of Troy, Cassandra, the daughter of Priam, fell to his lot in the distribution of the prizes of war. On his return, after a stormy voyage, he landed in Argolis. Aegisthus, who in the interval had seduced his wife Clytaemnestra, treacherously slew him with her help, Cassandra also perishing. The murder of Agamemnon was avenged by his son Orestes (q.v.). Agamemnon is quite possibly a more or less historical character, overlord of the Mycenaean or Achaean States of the Greek mainland. In Hellenistic times, at Sparta, he was worshipped under the title of Zeus Agamemnon. His tomb was pointed out among the ruins of Mycenae and at Amyclae.

BIBLIOGRAPHY —*See* articles in Pauly-Wissowa's *Realencyklopadie,* and Roscher's *Lexikon der Mythologie;* L. R. Farnell, *Greek Hero-Cults,* p. 321.

AGAÑA, the capital and largest city of the island of Guam. The city is situated on the west coast on a low sandy beach that skirts the bay of the same name, and is about 5m. N E. of Piti, the port of entry for all water shipments, with which it is connected by an excellent road. The population, which is more than 90% native (Chamorro), was 7,027 (1920), or 53·7% of the total for the island. The mean annual temperature is about 81°, and is nearly constant throughout the year; the daily variation is small. It is thought that Agaña was an important village before the coming of the Spaniards, who, during their 300 years of occupation, made it the governmental and religious centre of the island On Feb. 1, 1899, Guam formally passed to the United States and the governor's palace at Agaña became the Government house. Near the centre of the city is the Plaza de España, an open green about 100yd square, bordered on all sides by rows of coconut palms. About the plaza are situated the Government house, the barracks, Dorn hall, which is used as a public school during the day, the court-house and the Catholic church. Beyond the church is the naval hospital Agaña has two elementary schools and the only high school in Guam, a modern sewage system, a good water system, an electric light plant, telephones and a cold storage plant.

AGAPĒ, the early Christian love-feast (Gr. *ἀγάπη*, "Love"). The word seems to be used in this sense in Jude 12, but *cf.* 2 Pet. ii. 13, where the reading is *ἀπάταις* ("deceits") for *ἀγάπαις*. The history of the *agapē* coincides, until the end of the 2nd century, with that of the eucharist (*q.v.*), and Tertullian's detailed account (*Apology*, c. 39) of the *agapē* is not, perhaps, exclusive of an accompanying eucharist: "It is the banquet (*triclinium*) alone of the Christians that is criticized. Our supper (*coena*) shows its character by its name. It is called by a word which in Greek signifies love (*i.e., agapē*). Whatever it costs, it is anyhow a clear gain that it is incurred on the score of piety, seeing that we succour the poorest by such entertainments (*refrigerio*). We do not lie down at table until prayer has been offered to God, as it were a first taste. We eat only to appease our hunger, we drink only so much as it is good for temperate persons to do. If we satisfy our appetites, we do so without forgetting that throughout the night we must say our prayers to God . . . After washing our hands and lighting the lamps, each is invited to sing a hymn before all to God, either taken from holy writ or of his own composition. So we prove him, and see how well he has drunk. Prayer ends, as it began, the banquet."

This evidence is good for Africa. But in Egypt about the same time (180–210), Clement of Alexandria (*Paedagogus*, ii. 1) condemns the "little suppers which were called, not without presumption, *agapē*." This word, he complains, should be used only for the eucharist, not for mere junketings, into which the love-feasts of the church had degenerated. Tertullian too in his tract on fasting (ch. xvii.) mentions grave scandals in connection with the *agapē*.

Ch. xiii of the tract *About Virginity* (printed among the spurious works of Athanasius) describes a ritual meal which like that in 1 Cor. xi. is *agapē* and eucharist in one, and it is held in a private house, not in church, and the celebrants are holy women

The historian Socrates (*Hist Eccl*, v. 22) records the survival (which he characterizes as singular), around Alexandria and in the Thebaid, of love-feasts combined with the eucharist. So Basil of Cappadocia (Ep. 93), *c.* 350, states that in Egypt the laity, as a rule, celebrated the communion in their own houses, and partook of the sacrament by themselves whenever they chose. In the old Egyptian church order, known as the *Canons of Hippolytus*, there are numerous directions for the service of the *agapē*, held on Sundays, saints' days or at commemorations of the dead Chrysostom describes (homily 54, tom v., p 365) how after the eucharistic synaxis the faithful remained in church, while the rich brought out meats and drink from their houses, and invited the poor, and furnished "common tables, common banquets, common symposia in the church itself." The Council of Gangra (A.D. 343?) anathematized the over-ascetic people who despised "the *agapēs* based on faith." But the holding of *agapēs* in church was forbidden by the councils of Laodicea (363) and Carthage (under Aurelius, 388–423), and later by the council in Trullo (692). In the age of Augustine the *agapē* was frequent.

In the east Syrian, Armenian and Georgian churches, respectively Nestorian, Monophysite and Greek Orthodox in their tenets, the *agapē* was from the first a survival, under Christian and Jewish forms, of the old sacrificial systems of a pre-Christian age. Sheep, rams, bullocks and fowls are given sacrificial salt to lick, and then sacrificed by the priest and deacon, who has the levitical portions of the victim as his perquisite In Armenia the Greek word *agapē* has been used ever since the 4th century to indicate these sacrificial meals, which either began or ended with a eucharistic celebration The earlier usage of the Armenians is expressed in two rules recorded against them by a renegade Armenian prelate named Isaac, who in the 8th century went over to the Byzantine church (Combefisius, *Historia Monothelitarum*, col 317) Older mss of the Greek Euchologion contain numerous prayers to be offered over animals sacrificed; and in the form of *agapē* such sacrifices were common in Italy and Gaul on the *natalis dies* of a saint, and Paulinus of Nola, in his Latin poems, describes them (c 400) in detail Gregory the Great sent to Mellitus, bishop of London, a written rite of sacrificing bulls for use in the English Church of the early 7th century In Augustine's work against Faustus the Manichean (xx 4), the latter taxes the Catholics with having turned the sacrifices of the heathen into *agapēs*, their idols into martyrs, whom they worship with similar rites. The early Christian *agapē* admitted of adaptation to the older funeral and sacrificial feasts, and was so adapted. The association in the synoptics of the earliest eucharist with the paschal sacrifice provided a model, and long after the eucharist was separated from the *agapē* on other days of the year, we still find celebrated on the evening of Maundy Thursday the sacrifice of the paschal lamb, immediately followed by an eucharist. The council of Carthage enacted that the eucharist should be received fasting, except on the anniversary of the Lord's supper. It is clear that at an earlier date the *agapē* preceded the eucharist.

Pagan Analogues.—In ancient states common meals called *sussitia* (*συσσίτια*) were instituted, particularly in the Doric States; *e g*, Lacedaemon and Crete Plato advocated them, and perhaps the later Jews imitated the Spartan community. Trade and other guilds in antiquity held subscription suppers or *ἔρανοι*, similar to those of the early Corinthian Church, usually to support the needs of the poorer members. These *hetauriai* or clubs were forbidden (except in cities formally allied to Rome) by Trajan and other emperors, as being likely to be centres of disaffection; and on this ground Pliny forbade the *agapē* of the Bithynian churches, Christianity not being a lawful religion licensed for such gatherings. The custom which most resembles the eucharist and *agapē* was that known as *charistia* described by Valerius Maximus ii. 1. 8: a solemn feast for members of one clan, at which those who had quarrelled were at the sacrament of the table (*apud sacra mensae*) reconciled. Ovid alludes to it (*Fasti*, ii. 617).

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AGAPEMONITES or Community of the Son of Man. A sect founded in 1846 by the Rev. Henry James Prince, a clergyman of the Church of England (1811–1899). He studied medicine, obtained his qualifications in 1832 and was appointed medical officer to the general hospital in Bath, his native city Compelled by ill-health to abandon his profession, he entered himself in 1837 as a student at St David's theological college, Lampeter, where he gathered about him a band of earnest religious enthusiasts, known as the Lampeter Brethren, and was eventually ordained to the curacy of Charlinch in Somerset, where he had sole charge in the illness and absence of the rector, the Rev. Samuel Starkey. His work at this period reveals an almost hypnotic power over his converts; but soon he was mastered by delusions. He persuaded himself that he had been absorbed into the personality of God and had become a visible embodiment of the Holy Spirit. During his illness Mr Starkey read one of his curate's sermons, and was not only "cured" forthwith, but embraced his strange doctrines, and together they procured many conversions in the countryside and the neighbouring towns. Forbidden the right to officiate in the Church of England, Prince and Starkey established themselves at Weymouth. Money flowed in; and with these resources they obtained the house at Spaxton, which became the "Abode of Love."

On the death of "Brother" Prince, the Rev. T. H. Smyth-Pigott, pastor of the "Ark,"—a branch church established at Clapton, London—became the acknowledged head of the sect. He was born in 1852, of an old Somersetshire county family, and, after a varied career as university man, sailor before the mast, soldier, coffee-planter, curate in the Church of England and evangelist in the Salvation Army, was converted about 1897 to the views of Prince. For five years after this he was not heard of outside his own sect In Sept. 1902, however, he began to make claims similar to those of his predecessor, and proclaimed himself to be Christ. By the outside world the affair was greeted with mingled ridicule and indignation, and the new Messiah had to be protected by the police from the violence of an angry mob. Scandal was soon renewed through Pigott's relations with his female followers; and in Aug. 1908, an attempt to "tar and feather" him resulted in two men being sent to prison. Later in the month proceedings were instituted against him by the bishop of Bath and Wells under the Clergy Discipline Act.

See Law Reports, Court of Chancery, June 4–8, 1860, art "Agapemone" in Hastings' *Encyclopaedia of Religion and Ethics.*

AGAPETAE, a name given to female Christian ascetics who dwelt with men under a vow of continency. This practice essentially belongs to the history of Christian asceticism Its beginnings can be traced in the earliest Christian times, but it was preserved in monasticism down to the early middle ages

See Hastings, *Encyclopaedia of Religion and Ethics,* "Agapetae"; *see* also ASCETICISM.

AGAPETUS, the name of two popes:

AGAPETUS I, pope from 535 to 536, collaborated with Cassiodorus in founding at Rome a library of ecclesiastical authors. King Theodahad sent him on an embassy to Constantinople, where he died, after having deposed Anthimus, the Monophysite bishop of that town, and ordained Menas his successor

AGAPETUS II, pope from 946 to 955, at the time when Alberic, son of Marozia, was governing the independent republic of Rome under the title of "prince and senator of the Romans" He did his best to restore church discipline and to regain temporal power His appeal to Otto the Great to intervene in Rome remained without immediate effect, since Alberic's position was too strong to be attacked, but it bore fruit after his death Agapetus died on Nov 8 955

AGAPETUS, a deacon of the church of St. Sophia at Constantinople, and author of a series of exhortations on the duties of a Christian prince, addressed (*c.* 527) to the emperor Justinian The work was often reprinted, and has been translated into Latin, French and English

AGAR-AGAR, a vegetable product resembling gelatine and made from various East Indian seaweeds. In China it is used as an ingredient of "bird's nest soup," but its main employment is as a culture-medium for bacteria. It is occasionally utilized also as a laxative.

AGARDE, ARTHUR (1540–1615), English antiquary. As a member of the Society of Antiquarians, he prepared papers for its meetings on such subjects as the origin of parliament, the office and privileges of heralds, six of these essays being printed, after his death, in Thomas Hearne's collection of *Curious Discourses written by Eminent Antiquaries* (1720). Agarde was for 45 years deputy chamberlain of the Exchequer. He bequeathed to the Exchequer his collection of papers relating to that court, and to his friend, Sir Robert Cotton, his other manuscripts, most of which are now in the British Museum.

AGARDH, KARL ADOLF (1785–1859), Swedish botanist, was born on Jan. 23, 1785, at Badstad. He was educated at Lund, where in 1807 he became lecturer in mathematics, and in 1812, professor of botany and rural economy. After being ordained in 1816, he was elected to the diet where, as a leading Liberal, he worked for the promotion of education In 1834 he became bishop of Karlstad, where he died on Jan. 28, 1859. Agardh's chief works are *Systema Algarum* (1824), *Species Algarum* (1823–28), *Icones Algarum Europaearum* (1828–35), *Essai de réduire la physiologie végétale à des principes fondamentaux* (1828), *Lärobok i botanik,* 2 vols. (1830) and (with Ljungberg) *Försök till en statsekonomisk statistik öfver Sverige,* 4 vols. (1852–63).

AGARIC, the name applied to many mushrooms and toadstools (*qq.v*) from their generic name, *Agaricus* (*see* FUNGI).

AGAS, RADULPH or **RALPH** (*c.* 1540–1621), English land surveyor, was born at Stoke-by-Nayland, Suffolk. He is best known for his maps of Oxford (1578), Cambridge (1592) and London. Copies of the first two are preserved in the Bodleian library. Of the map of London and Westminster, which was probably prepared about 1591, two copies have been preserved, one by the Corporation of London and the other in the Pepysian collection at Magdalene college, Cambridge. The map is over 6 ft. long, printed from wooden blocks, and gives a valuable picture of the London of Elizabeth's time

AGASIAS. There were two Greek sculptors of this name. Agasias, son of Dositheus, signed the statue called the Borghese Warrior in the Louvre. Agasias, son of Menophilus, is the sculptor of another striking figure of a warrior in the museum of Athens Both belonged to the school of Ephesus and flourished about 100 B C.

See E. A. Gardner, *Handbook of Greek Sculpture,* ii. p. 475.

AGASSIZ, ALEXANDER EMANUEL (1835–1910), American man of science, son of J. L. R. Agassiz, was born in Neuchâtel, Switzerland, on Dec. 17, 1835. He came to the United States with his father in 1846; graduated at Harvard in 1855, subsequently studying engineering and chemistry, and taking the degree of bachelor of science at the Lawrence scientific school of the same institution in 1857; and in 1859 became an assistant in the U S coast survey. Thenceforward he became a specialist in marine ichthyology, but devoted much time to the investigation, superintendence and exploitation of mines, being superintendent of the Calumet and Hecla copper mines, Lake Superior, from 1866 to 1869, and afterwards, as a stockholder, acquiring a fortune, out of which he gave to Harvard, for the museum of comparative zoology and for furthering the study of biology at Harvard and elsewhere upwards of $1,000,000 In 1875 he surveyed Lake Titicaca, Peru, examined the copper mines of Peru and Chile, and made a collection of Peruvian antiquities for that museum, of which he was curator from 1874 to 1885 He assisted Sir Wyville Thomson in the examination and classification of the collections of the "Challenger" exploring expedition, and wrote the *Revision of the Echini* (1872–74) in the reports. Between 1877 and 1880 he took part in the three dredging expeditions of the steamer "Blake," of the U S coast survey, and presented a full account of them in 1888. Of his other writings on marine zoology, most are contained in the bulletins and memoirs of the museum of comparative zoology; but he published in 1865 (with Elizabeth Cary Agassiz, his stepmother) *Seaside Studies in Natural History,* a work at once exact and stimulating, and in 1871 *Marine Animals of Massachusetts Bay.* He died at sea on the "Adriatic" bound for the United States on March 27, 1910

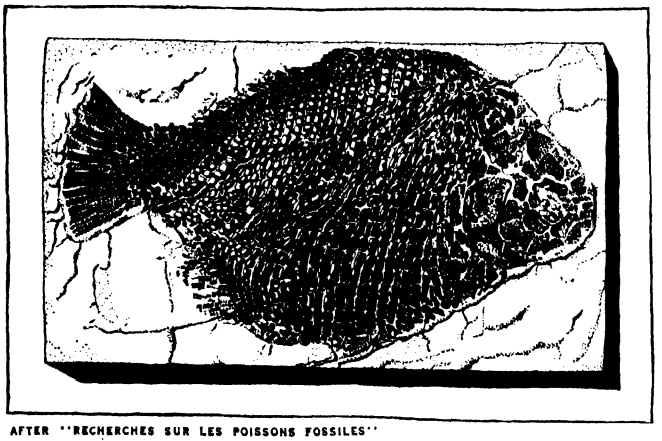
See G. R. Agassiz, ed., *Letters and Recollections of Alexander Agassiz; With a Sketch of his Life and Work* (Boston, 1913).

AGASSIZ, JEAN LOUIS RODOLPHE (1807–1873), Swiss-American naturalist, geologist and teacher, was born on May 20, 1807, the son of the Protestant pastor of Motier, on the shore of Lake Morat, Switzerland. His father was the last of a long line of clergymen, the first of the series having been driven from France by the revocation of the Edict of Nantes. His mother, Rose Mayor, was a gifted woman from whom especially he inherited his love of animals and plants In boyhood he spent four years at the gymnasium in Bienne and later attended the academy at Lausanne. He then entered, successively, the universities of Zurich, Heidelberg and Munich On completion of his academic courses, Agassiz took at Erlangen the degree of Doctor of Philosophy and at Munich that of Doctor of Medicine

Although as a youth he gave some interested attention to the ways of the brook fish of western Switzerland, his permanent and lifelong interest in ichthyology arose from his being chosen to study the fishes of Brazil In 1819 and 1820 two eminent naturalists of Munich, J. B. Spix and C. P. J. von Martius, had made an extensive tour in Brazil, bringing back a large collection of

fishes, mostly from the Amazon river. The classification of these species was begun by Spix; he died in 1826, however, and the whole collection was then turned over by Martius to Agassiz. The work was completed and published in 1829, as *Selecta Genera et Species Piscium*. This splendid accomplishment was a monument to youthful industry and enthusiasm, the author being at that time only 22 years old. The study of fish-forms became henceforth the prominent feature of Agassiz's scientific research. In 1830 he issued a prospectus of a *History of the Fresh Water Fishes of Central Europe*, a valuable contribution printed in parts from 1839 to 1842.

The year 1832 proved the most significant in Agassiz's early career, because it took him first to Paris, then the centre of



AFTER "RECHERCHES SUR LES POISSONS FOSSILES"

A FOSSIL FISH, ETCHED ON STONE UNDER AGASSIZ'S SUPERVISION, AFTER A SPECIMEN DISCOVERED DURING HIS RESEARCHES AT NEUCHÂTEL

general scientific as well as medical research, and afterwards to Neuchâtel where he spent many years of amazingly fruitful effort. While in Paris he lived the life of an impecunious student of the *quartier latin*, supporting himself, helped at times by the kindly interest of friends, such as Humboldt, who soon secured for him a professorship at Neuchâtel, and Cuvier, the most eminent ichthyologist of his time. At Paris his scientific activities largely centred in the Natural History museum of the great park now known as the Jardin des Plantes.

Already Agassiz had become interested in the rich stores of the extinct fishes of Europe, especially those of Glarus in Switzerland and of Monte Bolca near Verona, of which only a few at that time had been critically studied. As early as 1829, Agassiz planned a comprehensive and critical study of these remains. To this end he gathered material wherever possible. His epoch-making work, *Recherches sur les Poissons Fossiles*, appeared in parts from 1833 to 1844. In it the number of named fossil fishes was raised to nearly 1,000, and the ancient seas were made to live again through disclosure of their inhabitants. The great importance of this foundation work rests on the impulse given to the study of extinct life itself. Turning his attention to other extinct animals found with the fishes, Agassiz published in 1839–40 two quarto volumes on the fossil echinoderms of Switzerland, and later (1840–45) his *Études Critiques sur les Mollusques Fossiles*.

From 1832 to 1846 he served as professor of natural history in the University of Neuchâtel, where may still be found evident traces of the activity and enthusiasm of its youngest and most eager teacher. In Neuchâtel he acted for a time as his own publisher, his private residence even becoming a hive of activities. Numerous young men were co-workers with him, dividing between themselves the scanty returns from his lectures and publications. He now began his *Nomenclator Zoologicus*, a catalogue, with references, of all the names applied to genera of animals from the beginning of scientific nomenclature, a date since fixed at Jan. 1, 1758. "This," said Agassiz, "is a work of patience. It is a barrier against the Babel of confusion which threatens to overwhelm the domain of zoological synonomy." The practical value of the compilation can hardly be overestimated.

In 1836 Agassiz began a new line of studies, that of the movements and effects of the glaciers of Switzerland. Several writers had expressed the opinion that these rivers of ice had once been much more extensive, and that the erratic boulders scattered over the region and up to the summit of the Jura mountains, were carried by moving glaciers. On the ice of the Aar glacier he built a hut, the "Hôtel des Neuchâtelois," from which he and his associates traced the structure and movements of the ice. In 1840 he published his *Études sur les glaciers*, in some regards the most important of all his works. In it he was able to show that at a period geologically recent Switzerland was covered by one vast ice-sheet. His final conclusion was that "great sheets of ice, resembling those now existing in Greenland, once covered all the countries in which unstratified gravel (boulder drift) is found."

In 1846 Agassiz was led to visit the United States for the general purpose of studies in natural history and geology, but immediately to give a course of lectures in the Lowell institute in Boston. These were followed by another series in Charleston, and afterwards by lectures both popular and technical in various cities, his brilliant and engaging personality at once winning all hearts. In 1848 he accepted a professorship of zoology at Harvard university, and from that time on became more and more enthusiastically American. Indeed, half his scientific career, and that not the least important, was lived in this country. "He came in a spirit of adventure and curiosity; he stayed because he loved a land where he could think and act as he pleased; a land where nature is rich but tools and workmen are few, and traditions none."

In America his chief volumes of scientific research were the following: *Lake Superior* (1850); *Contributions to the Natural History of the United States* (1857–1863, in several quarto volumes, the most notable being on the embryology of turtles); and the *Essay on Classification*, a brilliant production, which, however, failed to grasp the trend of modern zoology. Besides these extensive contributions appeared a multitude of short papers on natural history and especially on the fishes of America. His two excursions of highest importance were, first, to Brazil in 1865, and second, to California in 1871, the latter trip involving both shores of South America. *A Journey in Brazil* by Mrs. Agassiz and himself, published in 1868, gives a very interesting account of their experiences on the earlier voyage. His most important paper on American fishes dealt with the remarkable group of viviparous surf-fishes of California.

During many years, also, Agassiz was deeply absorbed in his cherished plan of developing at Harvard university a comprehensive museum of research in zoology. This institution, which was established in 1859 and ultimately grew into the present splendid museum of comparative zoology, enjoyed his fostering care during the rest of his lifetime. In America Agassiz's industry and devotion to scientific pursuits were as strongly marked as in Europe, but two other traits here assumed a much greater importance. As a teacher of science he was extraordinarily skilful, certainly the ablest America has ever known. In addition he was personally devoted to his students, who were in the highest sense co-workers with him—"the best friend that student ever had." His warmth of feeling moreover went out equally to colleagues and neighbours. It was said that "one had less need of an overcoat in passing Agassiz's house than any other in Cambridge." Such qualities, endeared him to all, while his amazing command of lucid and picturesque English impressed every listener. He was also as much at home before an audience of labourers or farmers as with the most erudite leaders of research.

Agassiz's method as teacher was to give contact rather than information. He discouraged the use of books except in detailed research. Among his favourite expressions were "If you study nature in books, when you go out-of-doors you cannot find her." "It's not text-books we want, but students. The book of nature is always open." "Strive to interpret what really exists." The result of his instruction at Harvard was a complete revolution in natural history study in America. The purpose came to be not a category of facts taken from others, but the ability, through contact, to gather the needed facts. As a result of his activities

every notable teacher of natural history in the United States for the second half of the 19th century was at some time a pupil of Agassiz or of one of his students.

In the interests of better teaching and of scientific enthusiasm, he organized in the summer of 1873 the Anderson school at Penikese, an island in Buzzard's bay. The details of this remarkable venture, brief in actual period but having a profound effect on science teaching and the precursor of all American summer schools and establishments for marine research, cannot be given here. But "the school of all schools which has had the greatest influence on science teaching in America was held in an old barn on an uninhabited island, 18 miles from the shore; it lasted but three months; it had virtually but one teacher. It existed in the personal presence of Agassiz. When he died, it vanished." (David Starr Jordan, *Agassiz at Penikese*)

As Agassiz was beyond question one of the ablest, wisest and best informed of the biologists of his day, it is often asked why his attitude towards Darwinism was, throughout all his lifetime, cold and unsympathetic. It seems possible that his position was determined in part by a misunderstanding, but more particularly by his philosophy of biology. He seemed to regard Darwinism as a theory of continued progress instead of one of divergence, tempered by the weeding out of unadapted individuals. He failed to recognize the importance of separation and segregation in the development of new specific forms. He once said that in his studies of fossils he "was on the verge of anticipating Darwinism," but was withheld by the discovery that "we had the higher fishes first." In a sense this was true, for the brain development of the sharks is higher, as a whole, than that of the bony fishes But the latter are far more specialized in fitness for aquatic life. More important to Agassiz was the fact that in his philosophy each species of animal or plant was in itself "a thought of God." Their homologies or fundamental unities were "associations of ideas in the Divine Mind." He had an intensely religious mind, although he was totally out of sympathy with sects and creeds and the outer shell of Christianity.

In physical appearance Agassiz was a striking figure, nearly six feet tall, compactly built, with noble head and broad handsome face, usually illuminated by an especially charming smile This last, however, would suddenly turn into a frown in the presence of careless or trivial work or pretence on the part of a student. He married twice. His first wife, Cecile Braun, was the sister of an eminent botanist. In 1850, after his first wife's death, Agassiz married Elizabeth Cabot Cary, of Boston, well known as a writer and as a promoter of the education of women.

Agassiz died on Dec. 12, 1873. He was buried in Mt. Auburn at Cambridge, and by his grave stands a boulder from the moraine of the Lauteraar. At his death, Theodore Lyman, one of his students, wrote, "We buried him from the chapel that stands among the college elms. The students laid a wreath of laurel on his bier and their manly voices sang a requiem. For he had been a student all his life long, and when he died he was younger than any of them."

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(D. S. J.)

AGATE, a term applied, not to a distinct mineral species, but to a group of amorphous and crypto-crystalline forms of silica. According to Theophrastus the agate (ἀχάτης) was named from the river Achates, now the Drillo in Sicily, where the stone was originally found Most agates occur in eruptive rocks or ancient lavas where they fill the cavities which were produced by the liberation of gas during the solidification of the molten rock. These agates have a banded structure, successive layers being approximately parallel to the sides of the cavity. A number of varieties of agate are characterized by peculiarities in the shape and colour of the bands, which are seen in sections cut at right-angles to the layers. In riband-agate they are straight or slightly curved. Such an agate with cloudy bands alternating with bands of another colour, the two sets being sharply marked off from one another, is known by the general term onyx. A ring or eye agate is one in which the differently coloured bands are disposed in concentric circles. A Mexican agate, showing only a single eye has received the name of "cyclops." When the banding forms re-entrant and salient angles, its outline resembling that of the plan of a fortress, it is called fortification-agate. Certain agates also occur, to a limited extent, in veins, of which a notable example is the beautiful brecciated agate of Schlottwitz, near Wesenstein in Saxony—a stone mostly composed of angular fragments of agate cemented with amethystine quartz. A variety having included matter of a green colour, embedded in the agate and disposed in filaments and other forms suggestive of vegetable growth, is known as moss agate. Dendritic markings of black or brown colour, due to infiltration of oxides of manganese and iron, produce the variety known as Mocha stone.

It is probable that agates occurring in cavities in igneous rocks have been formed in a number of ways, and various theories of their origin have been proposed. The theory which is now generally accepted is as follows. During the solidification of the rock an accumulation of gas or steam causes a bubble to form. Long after, when the rock has solidified, water carrying silica in solution, probably as alkali silicate, penetrates into the region where the bubble is located. It then diffuses into the cavity and subsequently the solution coagulates to a silica gel. The alkali present with the silica attacks the iron-bearing rock surrounding the cavity, giving rise to iron salts. These diffuse into the silica gel and produce the regular layers of iron hydroxide after the manner of Liesegang's rings. Finally the whole mass gradually hardens with loss of water and crystallization of much of the silica as quartz or chalcedony. During the process of crystallization the coloured bands are not disturbed and hence we have the final agate as it is now found.

Agates are cut and polished chiefly in the Idar-Oberstein district situated on the Nahe, a tributary of the Rhine at Bingen. Here the industry grew up many centuries ago by reason of an abundance of agates in the amygdaloidal melaphyre of the district. The stones used now are mostly imported from Brazil (Rio Grande do Sul) and from Uruguay.

Most commercial agate is artificially stained so that stones naturally unattractive by their dull grey tints come to be valuable for ornamental purposes. The colouring matter is absorbed by the porosity of the stone, but different stones and different layers of the same stone exhibit great variation in absorptive power. To produce a dark brown or black colour, the stone is kept perhaps for two or three weeks in a saccharine solution, or in olive oil at a moderate temperature. After removal from the solution, the agate is well washed and then digested for a short time in sulphuric acid, which, entering the pores, carbonizes the absorbed sugar or oil. Certain layers of chalcedony are practically impermeable and these consequently remain uncoloured, so that an alternation of dark and white bands is obtained, giving rise to an onyx. Agate is stained red, to imitate cornelian and sardonyx, by means of ferric oxide. Other colours are detained in other ways.

Among the uses to which agate is applied may be mentioned the formation of knife-edges of delicate balances, small mortars and pestles for chemical work, burnishers and writing styles, umbrella handles, paper knives, seals, brooches and other ornaments. Real cameos are cut from banded agates, one layer forming the medallion, the other the design in relief.

Agates are found in England in the Cheviot Hills, in the neighbourhood of Bristol and at Lichfield in Staffordshire. In Scotland they occur at Montrose in Forfarshire, in Perthshire, and at many other localities. The majority of agates are produced in countries outside Europe, notably in South America, North America and India; they are also found in South Africa and Australia.

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(W. A. W.)

AGATHA, ST., the patron saint of Catania, Sicily, where her festival is celebrated on Feb. 5. The legend is that she was a native of Sicily (probably of Catania, though Palermo also claims her) of noble birth and great beauty. She repelled the advances of the Roman prefect sent by the emperor Decius to govern Sicily, and was by his orders brutally tortured and finally sent to the stake. As soon as the fire was lighted an earthquake occurred and the people insisted on her release. She died in prison on Feb. 5, 251. The rescue of Catania from fire during an eruption of Mt. Etna was later attributed to St. Agatha's veil.

AGATHANGELUS, AGATHANGE or **AKATHANKELOS,** Armenian historian, lived during the 4th century, and wrote a *History of the Reign of Dertad, or Tiridates, and of the Preaching of St. Gregory the Illuminator.* This history was translated into several languages, and Greek and Latin translations are found in the *Acta Sanctorum Bollandistarum,* tome viii The history consists of three parts, a history of St. Gregory and his companions, the doctrine of Gregory, and the conversion of Armenia to Christianity.

See V. Langlois, *Collection des Historiens anciens et modernes de l'Arménie* (Paris, 1868).

AGATHARCHIDES or **AGATHARCHUS,** of Cnidus, Greek historian and geographer, lived in the time of Ptolemy Philometor (181–146 B.C.) and his successors. Amongst other works, he wrote treatises on *Asia, Europe* and *the Red Sea.* Interesting extracts from the last, of some length, are preserved in Photius (cod. 213).

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AGATHARCHUS, the name of an Athenian painter of the 5th century B.C. He is said by Vitruvius to have been the first to paint a scene for the acting of tragedies.

AGATHIAS (*c.* A.D. 536–582), of Myrina in Aeolis, Greek poet and historian. He studied law at Alexandria, completed his training at Constantinople and practised as an advocate (*scholasticus*) in the courts. He wrote a number of short love-poems in epic metre, called *Daphniaca.* He next put together a kind of anthology, containing epigrams by earlier and contemporary poets and himself, under the title of a *Cycle of New Epigrams.* About a hundred epigrams by Agathias have been preserved in the *Greek Anthology.* After the death of Justinian (565), some of Agathias's friends persuaded him to write the history of his own times. This work, in five books, begins where Procopius ends, and is the chief authority for the period 552–558.

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AGATHO, pope from 678 to 681, was born in Sicily. He ordered St Wilfrid to be restored to his bishopric at York in 679, and was the first pope to cease payment of the tribute hitherto paid on election to the emperor at Constantinople. Agatho died on Jan. 10, 681.

AGATHOCLES (361–289 B.C.), tyrant of Syracuse, was the son of a potter, born at Thermae Himeraeae (mod. *Termini Imerese*) in Sicily. He removed to Syracuse and served with distinction in the army. In 333 B.C. he married the widow of his patron Damas, a distinguished and wealthy citizen. He was twice banished for attempting to overthrow the oligarchical party in Syracuse (*q.v.*); in 317 B.C. he returned with an army of exiles and Campanian mercenaries. He banished or murdered some 10,000 members of the senate and the oligarchical party, proclaiming himself the champion of the people, and thus made himself master of Syracuse. His tyranny was confirmed by a virtually unanimous vote of the people, and, despite his continuous wars, he seems to have been generally popular. He enriched Syracuse with many public buildings, and his reign was looked back to as a period of orderliness and tranquillity. His foreign policy was inevitably part of the almost continuous 200 years' war between the Sicilian Greeks and their secular enemy, Carthage (*q.v.*). In these wars Syracuse had always taken the lead, and Agathocles only continued the policy of Dionysius the Elder, Dionysius the Younger and Timoleon (*qq.v.*).

In 310 B.C. Agathocles, defeated and besieged in Syracuse, took the desperate resolve of breaking through the blockade and attacking the enemy in Africa. He besieged Carthage, which was at the time troubled by internal dissensions, but after several victories he was at last completely defeated (306) and fled secretly to Sicily. After concluding peace with Carthage, Agathocles styled himself king of Sicily and established his rule over the Greek cities of the island more firmly than ever. Even in his old age he displayed the same energy and is said to have been meditating a fresh attack on Carthage at the time of his death, which was followed by a recrudescence of Carthaginian power in Sicily. Agathocles was something more than the typical leader of mercenaries. He was a born leader, who know how to inspire devotion.

BIBLIOGRAPHY.—*See* Justin xxii., xviii; Diodorus Siculus xix, xxi., xxii. (follows generally Timaeus who had a special grudge against Agathocles); Polybius ix. 23; Schubert, *Geschichte des Agathokles* (1887); Grote, *History of Greece,* ch. 97; also SICILY. *History*

AGATHODAEMON, an early map designer of Alexandria, who probably lived in the 2nd century A.D. Some manuscripts of the *Geography* of Ptolemy contain 27 maps, which are stated to have been drawn by Agathodaemon of Alexandria, who "delineated the whole world according to the eight books of Ptolemy's geography." About 1470, Nicolaus Doris, a Benedictine monk, produced an edition of them in which the names were inserted in Latin instead of Greek.

See Bunbury, *History of Ancient Geography,* ii.

AGATHODAEMON, an important god in Greek mythology, the "good spirit" of cornfields and vineyards, protective spirit of individuals and the State. The Greeks drank a cup of pure wine in his honour at the end of each meal (Aristophanes, *Equites,* 106). Often accompanied by *Agathē Tuchē* (good fortune), he may be compared with the Roman *Bonus Eventus* (Pliny, *Nat. Hist.,* xxxvi., 23) and *Genius* (q.v.). He is represented in works of art in the form of a serpent, or of a young man with a horn of plenty and a bowl in one hand, and a poppy and ears of corn in the other.

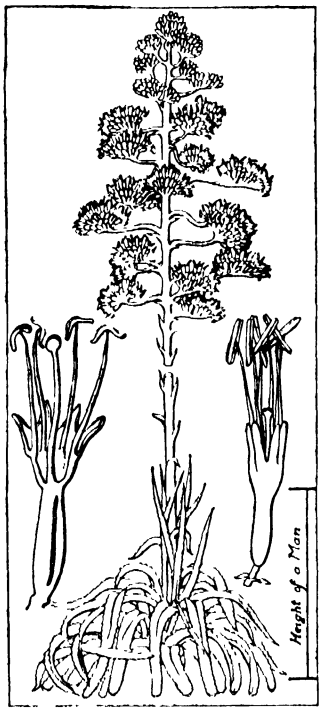
AGATHON (*c.* 448–400 B.C.), Athenian tragic poet, friend of Euripides and Plato. He won his first victory in 416 (at the Lenaea), and his plays seem to have been successful, despite their artificial style. He appears to have been the first to invent an original plot, and to write choral odes unconnected with the plot. His effeminacy made him a butt of Aristophanes. Before 406 he retired to the court of Archelaus, where he died.

See Aristotle, *Poetica* 9, and 18; Aristophanes, *Thesmoph.* 59, 106, *Eccles.* 100, Plato, *Symp.* 198 c.; Plutarch, *Symp.* 3; Aelian, *Var. Hist.* xiv. 13; Ritsch, *Opuscula,* i.; fragments in Nauck, *Tragicorum Graecorum Fragmenta. See* also Haigh, *Tragic Drama of the Greeks.*

AGATHYRSI, a people of Thracian origin, who in the earliest historical times occupied the plain of the Maris (Maros), in the region now known as Transylvania. They are described by Herodotus (iv. 104) as of luxurious habits, wearing gold ornaments (the district is still auriferous) and having wives in common. They tattooed their bodies (Virgil, *Aeneid,* iv. 136), degrees of rank being indicated by the manner in which this was done, and coloured their hair dark blue. Valerius Flaccus (*Argonautica,* vi. 135) calls them Thyrsagetae, probably in reference to their celebration of orgiastic rites in honour of some divinity akin to the Thracian Dionysus. In later times the Agathyrsi were driven farther north, and their name was unknown to the Romans in their original home.

See Pliny, *Nat. Hist.* iv. 12 [26], 88.

AGAVE, a large botanical genus of the family Amaryllidaceae, chiefly Mexican, but occurring also in the southern and western United States and in central and tropical South America. The plants have a large rosette of thick fleshy leaves generally ending in a sharp point and with a spiny margin; the stout stem is usually short, the leaves apparently springing from the root. They grow slowly and flower but once after a number of years, when a tall stem or "mast" grows from the centre of the leaf-rosette and bears a large number of short, tubular flowers. After development of fruit the plant dies down, but suckers are frequently produced from the base of the stem which become new plants. The most familiar species is *Agave americana* (*see* fig), a native of tropical America, the so-called century plant or American aloe (the Maguey of Mexico). The number of years before flowering occurs, which may be 100, hence the name, depends on the vigour of the individual, the richness of the soil and the climate; during these years the plant is storing in its fleshy leaves the nourishment required for the effort of flowering. During the very rapid development of the immense peduncle, or flowering stalk, there is a rush of sap to the base of the young flower stalk, by removing this large bud just as it is ready to emerge and by scooping out a cavity in the heart of the plant, a large quantity of sweet sap is obtained; and this *aguamiel,* removed, carried in pigskin bottles to the central repository, undergoes two kinds of fermentation, and when it has become thick, milky and more or less ropy (the sugars then being changed into alcohol) it is marketed as *pulque* (*q.v.*), the national drink of Mexico, notwithstanding its objectionable odor and consistency it is undoubtedly a wholesome and nourishing drink, and many train-loads are brought daily to Mexico City from the vast *pulque* plantations in the surrounding region. By distillation of *pulque fuerte,* or completely fermented juice, a very strong liquor, *mescal,* is obtained.



LONGITUDINAL SECTION FROM BAILLON, "HISTORIE DES PLANTES"

THE AGAVE, COMMONLY CALLED THE CENTURY PLANT BECAUSE IT IS SUPPOSED TO BLOSSOM AFTER A HUNDRED YEARS AND THEN DIE
Showing long flower stem and rosette of spiny leaves; vertical section and single flower enlarged

The leaves of several species yield commercial fibres: *A. rigida elongata* or *A. fourcroydes* is the henequen, or Yucatan sisal, formerly the principal sisal hemp (*q v*) *A. rigida sisalana* or *A. sisalana* is the Bahama sisal, the culture of which is expanding greatly in East Africa and Haiti.

A. cantula is the Maguey, or Philippine sisal.

A. zapupe is the Mexican *Zapupe* fibre.

A. americana produces one of the *Pita* fibres, now grown in southern Europe and parts of the West Indies as well as in Mexico.

A. neglecta is the Florida sisal, one of the largest species, the flower-stalk of which may exceed 42 feet in height.

The firm white pith of the interior of the flowering stem of any of these species, when dried and cut in slices has a variety of uses—as natural razor-strops, as lining of insect-boxes, insulating material, etc. The gummy, soapy juice expressed from the leaves will lather like soap and may be used as a detergent where alkali would be injurious. The thick reddish roots of various species are reputed to have medicinal properties The concentrated sap exuded into the scooped-out central bud cavity is also used as a medicine and is a source of agavose ($C_{12}H_{22}O_{11}$), one of the rare sugars. In the Madras Presidency the plant is widely used for hedges along railroads. *Agave americana* was introduced into Europe about the middle of the 16th century and is now extensively cultivated for its handsome appearance; in the variegated forms the leaf has a white or yellow marginal or central stripe from base to apex. As the leaves unfold from the centre of the rosette the impression of the marginal spines is very conspicuous on the still erect younger leaves

AGDE, a town of south France, in the department of Hérault, 2½m from the mouth of the Hérault, and 32m. S W. of Montpellier on the Southern railway Pop (1926), 8,503. It lies at the foot of an extinct volcano, the Montagne St Loup, and is surnamed "La Ville Noire" from the dark volcanic basalt of which it is built. Agde is said to have been founded as a port by Phocaeans under the name of *Agathe.* It was the seat of a bishop from 400 to 1790. Overlooking the river is the old Cathedral of St. Étienne, a grim fortress-like structure of the 12th century. The machicolations of the parapet are said to be the oldest existing instance of the kind The *Canal du Midi,* uniting the Garonne with the Mediterranean, passes under the town walls The maritime commerce of the town has declined, because Cette is near and the Hérault shallow, but the fishing industry is still alive. The town has a tribunal of commerce

SYNOD OF AGDE (*Concilium Agathense*).—The 47 genuine canons of the synod (Sept. 11, 506), dealt with discipline, church life, alienation of ecclesiastical property and treatment of Jews. While favouring sacerdotal celibacy the council laid rather rigid restrictions on monasticism. It commanded that the laity communicate at Christmas, Easter and Whitsuntide. The canons of Agde are based in part on earlier Gallic, African and Spanish legislation; and some of them were re-enacted by later councils.

AGE. The subject of the duration of human and animal life does not fall within the scope of this article, and the reader is referred to LONGEVITY. But the word "age" has been used by physiologists to express certain natural divisions in human development and decay. These are usually regarded as numbering five, viz., *infancy,* lasting to the seventh year; *childhood* to the 14th; *youth* to the 21st; *adult life* till 50; and *old age.*

The division of human life into periods for legal purposes is naturally more sharp and definite than it can be for physiological purposes. In Roman law the legal divisions were (1) *infantia* lasting till the close of the seventh year; (2) the period between *infantia* and *pubertas,* males becoming *puberes* at 14 and females at 12; (3) *adolescentia,* the period between puberty and majority, and (4) the period after the 25th year, when males become *majores.* By English law, life is divided into two main periods—*infancy,* which lasts in both sexes until the 21st year, and manhood or womanhood. The period of infancy, again, is divided into several stages, marked by the growing development both of rights and obligations. Thus at 12 years of age a male may take the oath of allegiance; at 14 both sexes are held to have arrived at years of discretion, and may therefore choose guardians, give evidence, and consent or disagree to a marriage. A female has the last privilege from the 12th year, but the marriage cannot be celebrated until the majority of the parties without the consent of parents or guardians At 21 both males and females obtain their full legal rights and become liable to all legal obligations. Thus both sexes may enter parliament and be called to the bar, upon attaining majority. In the Church of England, however, a candidate for deacon's orders must be 23 (in the Roman Catholic Church, 22), and for priest's orders 24 years of age; and no clergyman is eligible for a bishopric under 30. In Scotland infancy is not a legal term. The time previous to majority, which, as in England, is reached by both sexes at 21, is divided into two stages. *pupilage* lasts until the attainment of puberty, which the law fixes at 14 in males and 12 in females; *minority* lasts from these ages respectively until 21. *Minority* obviously corresponds in some degree to the English *years of discretion,* but a Scottish minor has more personal rights than an English infant in the last stage of his infancy, *e g.,* he may dispose by will of movable property, make contracts, including that of marriage, carry on trade and become liable to be declared a bankrupt. Throughout the British Empire the age of majority is usually 21, but the

nubile age is 20 in the Channel Islands; 18 in New Brunswick and Ontario; 18 for females in the North-West Territories and 15 for native females in Fiji. In Belgium and France the age of majority is 21, and the nubile age 18 for males and 15 for females, but marriage cannot be contracted without the consent of the parents or guardians if the parties are under 25. The age of majority is in Argentina 22; in Chile, Spain and Austria 24; in China 20; in Brazil, Denmark, Holland, Germany, Greece, Italy, Mexico, Norway, Peru, the Philippines, Poland, Portugal, Rumania, Sweden, Switzerland and Tunis, 21. In Denmark the nubile age is 18 for males and 16 for females; in Germany 20 for males and 16 for females, subject to the consent of the parents or guardians, and without such consent the males must be 25 and the females 24. But a person of 18 may be declared of full age by a competent court. In Spain majority is reached at 23; the nubile age is 18 for males and 16 for females. In Greece the nubile age is 16 for males and 14 for females; in Holland 18 for males and 16 for females; in Italy 18 for males and 15 for females; in Switzerland 21 for males and 19 for females, but the canton authorities may in extraordinary cases reduce these figures to 19 and 18 respectively. Marriage by minors is subject to the consent of their parents or guardians.

By the constitution of the United States the President must be not less than 35; a senator not less than 30, and a representative not less than 25 years of age. The age of majority, as a rule, is 21 for both males and females, but in Arkansas, California, Colorado, Dakota, Idaho, Illinois, Iowa, Kansas, Maryland, Minnesota, Missouri, Nebraska, Nevada, Ohio, Oregon, Vermont and Washington females attain majority at 18. In Maryland, Oregon, and Texas a female attains majority upon marriage. In Iowa Texas and Louisiana both males and females attain majority upon marriage, and in Washington a female minor married to a male of age is regarded as herself of full age. (H. H. L. B.)

AGE-GRADES means a system of compulsory association or classification by age and sex, whereby groups of coevals are admitted by a series of initiatory rites of varying complexity, including generally the payment of a due, into a tribal association with definite functions both within the age-group itself and in relation to the tribe as a whole, promotion to higher degrees, where such exist, being at regular intervals jointly compulsory on all the individuals comprising a group.

Though superficially resembling secret societies (*q.v.*), and though the ritual of initiation and subsequent ceremonies and esoteric beliefs are secret where a knowledge of them is confined to those who have been initiated and is moreover commensurate with the degree of their initiation, age-grades are differentiated from other forms of association, including secret societies, by the following distinctive features: (1) Admission depends primarily on age and is associated with puberty rites. (2) Every member of the tribe must be affiliated to the system at the proper age. (3) There is no individual admission, but groups of coevals are jointly initiated. (4) Promotion to higher degrees of initiation is similarly compulsory and automatic with the passage of years, even when fees have to be paid or further rites have to be undergone. (5) The system is strictly unilateral, confined to males, though a corresponding institution for females may exist but, where it exists, functions independently. (6) The system is democratic.

Primitive societies are conspicuously divided vertically into families and clans and are horizontally stratified by a variety of associations: religious, occupational, political, social, and so on. Distinction by age and sex cuts across the bonds of consanguinity and creates a new orientation of social activity. Mere classification by age or sex, however, does not of itself indicate an age-grade, for a variety of other factors is involved. A physiological classification of a tribe into boys, youths, adults and old men, with their feminine counterparts, stereotyped by custom into a conventional nomenclature, often lacks the distinctive sociological features of an age-grade: just as we find puberty (*q.v.*) rites in almost all primitive societies, whereas age-grades, though associated with puberty ceremonies and retaining them as an essential element in the complex, are comparatively rare.

Many of the institutions which are reported from different parts of the world, though analogous to age-grades, differ in one or more essential factors and are therefore to be excluded from this survey. Such institutions are found in Australia, New Guinea, in the Banks Islands, among some of the Naga tribes of Assam, and in certain American Indian societies. The *aluzhi* of the Sema Naga, for instance, are working gangs, with few sociological obligations on the members. They are bisexual, coevality is not essential, and members can be ejected from the group. When clan feeling runs high in a community the *aluzhi* groups break up, indicating that the lateral stratification of society has not the same validity as the vertical. In short, all the essentials of an age-grade are lacking. The Kimta of Bartle Bay, though it has a superficial resemblance to an age-grade, admits of individual members being degraded or promoted to lower or higher degrees, thus invalidating the paramount theory of group-solidarity. Again, though age is the theoretical basis of Banks Islands' societies it is in fact an unimportant factor, and at every stage of initiation except perhaps the lowest, increasingly prohibitive admission fees have resulted in "a commensality of varying years and vastly different social prospects." This is no less true of America and even in the military societies of the Hidatsa, which approach nearest to the definition, the bases of membership are purchase and age, and group-promotion is not automatic but depends on purchase.

Only in Africa, and within a limited area, is the true age-grade system found functioning as a sociological element in tribal life and of the utmost importance. Nowhere do we find age-grades and secret societies concurrently, for secret societies are associated with the evolution of monarchies and powerful aristocracies, which they both limit and reinforce, whereas age-grades are democratic and are incompatible with any system of centralized and individual authority. This accounts for the absence of age-grades in Bantu societies generally, with the exception of a few Bantu tribes of the eastern group, such as the Akikuyu, Akamba, Giriyama and Chaga, who have been considerably influenced by neighbouring Hamites and have a culture which is no longer characteristically Bantu. Similarly, on the west coast of Africa we find a system analogous to age-grades among the Kru, where secret societies are almost negligible and are subordinate to the Sedibo class of age-grades, which comprises the tribal legislature and executive.

The age-grade is the distinctive feature of Hamitic culture and is found in all the tribes of East Africa which belong to the Hamitic or Nilo-Hamitic groups, including the Nilotic Lango. The Galla, with their very complex system, are the centre and source of this culture, and from them it has permeated all the Nilo-Hamitic tribes which cluster round them, the Masai and the Nandi, the Topotha, the Turkana and the Didinga.

There are naturally modifications and variations in the system adapted to the cultural requirements of each tribe, but the essentials are basically the same. At the puberty rites (which recur at regular intervals) a group of boys is initiated and they are thus aggregated into tribal, as opposed to family and clan, life. Henceforth they are no longer classed with the women but find themselves in a group of coevals, with a variety of life-long privileges and obligations towards each other. Hospitality within the age-group is compulsory, and at a later stage, when the members are permitted to marry, this often includes access to the wives of age-mates. The group on the formal side is distinguished by a variety of emblems, such as shield designs, bodily markings and ornaments, and a special name assumed jointly and individually at initiation by every member of the group and retained throughout life. Promotion to higher degrees of the system is automatic after a given number of years, and each degree has its own special functions, appropriate ceremonials and emblems, and often a particular diet and distinctive tabus; the warrior degree, for instance, being generally prohibited smoking, beer and marriage. The final degree usually enables the group-members to retire from the active life of the tribe to the more passive rôle of an elder.

The essence of the system is the corporate unity of the group, which moves from degree to degree as a single entity. This unity

makes the group so significant an element in tribal culture. At the puberty schools and at subsequent initiations on promotion to higher degrees the age-groups receive a systematic education which, as among the Galla, may extend over 32 years. Candidates are instructed in the duties of citizenship, in tribal history and tradition, ethics, the law, hunting, war, religion, husbandry, medicine, sex, in short, in every aspect of individual and communal life. They are disciplined by hardships and privations and trained to endure all manner of physical discomforts and dangers, in order to be the better able to perform the rôle traditionally allotted to the group at each degree in its initiation Among the Galla the system provides for the government of the country by each group in turn during its last eight years of active existence. The Masai and the majority of kindred tribes use the system for military and governmental purposes, and the Lango, thanks to a changed environment, have endowed their age-grade system with functions which are almost exclusively religious. Finally, the system as a whole makes for greater tribal unity by cutting across the narrow limits of the family and the clan, by giving every individual an interest in tribal, rather than parochial, concerns, and by making every individual feel that with his group he is for the time the repository of tradition and the custodian of his tribe, both heir to the past and the pledge of posterity

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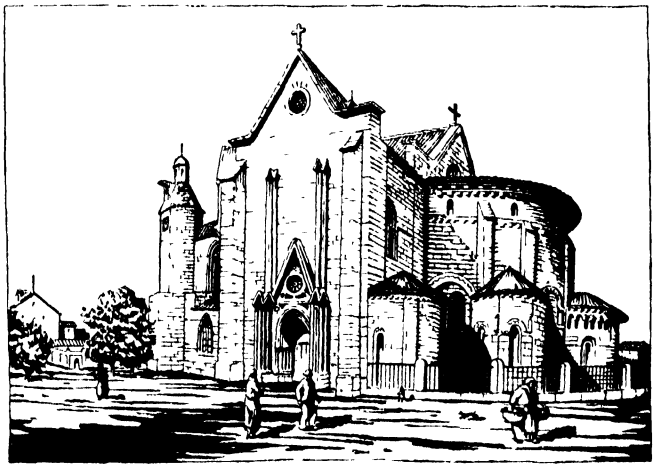
AGELADAS or (as the name is spelt in an inscription) HAGELAIDAS, a great Argive sculptor who flourished in the latter part of the 6th and the early part of the 5th century B C. Ageladas was said to have been the teacher of Myron, Pheidias, and Polycleitus, this tradition is a testimony to his wide fame, though historically doubtful

AGEMA, the name of the bodyguard of Alexander of Macedon It was drawn from the distinguished corps of "shield bearers" or esquires (*ὑπασπισταί*). While in Bactria, Alexander reorganized the agema and included some Persians

AGEN, south-west France, capital of the department of Lot-et-Garonne, 84m S E of Bordeaux by the Southern railway. Pop



THE CATHEDRAL OF ST. CAPRAIS, AGEN, DATING FROM THE 12TH CENTURY, IS MODERN COMPARED WITH THE TOWN ITSELF WHICH WAS A CELTIC STRONGHOLD AND CONSIDERED OLD IN ROMAN TIMES

(1926) 19,619. It is skirted on the west by the Garonne, here crossed by a stone bridge and by a canal-bridge

Agen (*Aginnum*) was the capital of the Nitiobroges, and extensive Roman ruins have been discovered Later it was the capital of the Agenais. Its bishopric was founded in the 4th century Agen frequently changed hands during the Albigensian wars, and at their close a tribunal of inquisition was established here. In the religious wars of the 16th century Agen took the Catholic side and joined the League in 1589. The cathedral of St. Caprais has an apse of the 12th century and three apse-chapels: the rest dates from the 12th–16th centuries, the tower flanking the south façade is modern. The church of the Jacobins is a 13th century brick building. The prefecture (18th century) was once the bishop's palace. The *hôtel de ville* occupies the former *Hôtel du Presidial,* an obsolete tribunal, and contains the municipal library. Two houses of the 16th century, the *Hôtel d'Estrades* and the *Hôtel de Vaurs,* are used as the museum Through its excellent water communication, Agen affords an outlet for the agricultural produce of a rich district, and forms an *entrepôt* between Bordeaux and Toulouse, dealing in poultry, prunes (*pruneaux d'Agen*), and other fruit, wine, vegetables and cattle. Flour, dried plums, *pâté de foie gras* and other delicacies, manures, drugs, woven goods and tiles are made. Agen is the seat of a bishop It has a court of appeal and a court of assizes, tribunals of first instance and of commerce and a chamber of commerce.

AGENAIS or **AGENOIS,** a former province of France. In ancient Gaul it was the country of the Nitiobroges with *Aginnum* for its capital, and in the 4th century it was the *Civitas Agennensium,* which formed the diocese of Agen. Having in general shared the fortunes of Aquitaine during the Merovingian and Carolingian periods, Agenais next became an hereditary countship which was purchased in 1038 by the dukes of Aquitaine The marriage of Eleanor of Aquitaine with Henry Plantagenet in 1152 brought it under the sway of England; but when Richard I. married his sister Joan to Raymund VI , count of Toulouse, in 1196, Agenais formed part of her dowry With the other estates of the last independent count of Toulouse it lapsed to the Crown of France in 1271, but was restored to the king of England in 1279 During the Hundred Years' War, Agenais was frequently taken and retaken, the final retreat of the English in 1453 at last leaving the king of France in peaceable possession. Thenceforth Agenais was no more than an administrative term At the end of the *ancien régime* it formed part of the "Gouvernement" of Guienne, and at the Revolution it was incorporated in the department of Lot-et-Garonne, of which it constitutes nearly the whole. The title of count of Agenais was revived by the kings of France, and in 1789 was held by the family of the dukes of Richelieu.

AGENT: *see* PRINCIPAL AND AGENT

AGENT-GENERAL, the term given to the representatives in England of certain of the self-governing British colonies They are appointed, and their expenses and salaries provided, by the governments of the colonies they represent. Their duties are to look after the political and economic interests of their colonies in London, to assist in all financial and commercial matters in which their colonies may be concerned, and to make known the products of their colonies. Those colonies which are not under responsible government are represented in London by Crown agents.

AGENTS IN BUSINESS. An agent in the most general sense is any person who transacts business for another without being a direct employee, and in the majority of cases his function is to assist a principal in the purchase, sale or distribution of goods for a remuneration which usually takes the form of a commission on the price obtained It is a term very loosely applied Assistance may be rendered to principals irrespective of the commercial undertakings in which they are engaged. Consignment agents and credit enquiry agents are examples of this category as compared with factors or brokers who operate continuously for principals in particular industries and with manufacturers' agents who are more particularly associated with special lines of goods There is an intermediate class of agents not directly concerned with the sale of goods and therefore not remunerated on a commission basis but who are of vital importance to the producer and manufacturer, the two most important being (*a*) advertising agents, whose function is to promote the commercial activity which is the beginning and the end of every undertaking, and (*b*) patent agents whose services are needed in most cases before manufacture can be commenced and who are also in a position to introduce their clients to the agents best qualified to market the product.

Manufacturers' Agents.—In the early stages of a manufacturing business when problems of production absorb the energies of the proprietor he is frequently glad to be relieved of all market-

ing problems by handing over the entire output to be disposed of by one or more manufacturers' agents on the commission basis which maintains this important section of the trading community. The method usually adopted is to sell by sample, the principal making arrangements for delivery and collecting accounts But some manufacturers' agents operate on a much larger scale, especially in the textile industry, maintaining warehouses, stock rooms and administrative departments. The intimate knowledge possessed by the manufacturers' agent of the various requirements of the public is of great value to the principal; so much is this the case that the advisory services of the agent may be vital to the success of the undertaking and his influence on the policy of the business as powerful as if he were a partner. An agent of this standing is invariably consulted before new lines are introduced and he periodically brings forward suggestions calculated to increase trade which will bring him increased commission and the principal increased turnover.

Factors.—The tendency of modern business is to shorten the chain between producer and consumer, the chief forces operating being the extension of advertising in all directions, the growth of consumer co-operation and the increase in competition which leads to producer co-operation and the formation of trusts or buying groups. The effect on the manufacturers' agent is for him to accept greater personal responsibilities and virtually to take over the functions of a *factor* who, whilst his remuneration is also on a commission basis, is much more independent of his principal than is the manufacturers' agent. Invariably the factor has possession of the goods of the principal; he is generally able to get a better price and sells the goods as though they were his own leaving the buyer no clue to identity. He also frequently acts as banker for his principal owing to the necessity of his carrying a large stock for disposal in anticipation of increased demand It is in his interests to induce the manufacturer to produce on a larger scale at a lower cost than if the production were small and this is done by his relieving the manufacturer of the necessity of recouping the expenditure of production with a quick sale. The factor is a large scale operator in a number of industries, produce, textile, grain, hide, etc., and like the manufacturers' agent is continually exposed to the pressure of the forces making for a shorter chain between producer and consumer The tendency is for him to discharge other marketing functions, to buy up manufacturing businesses and do the work of a wholesale merchant.

Brokers.—A broker is an intermediary whose function is simply to buy or sell on behalf of a client and who does not have possession of the goods dealt with. He is present at all exchanges where produce is disposed of and business arranged. He has a specialized knowledge of particular classes of goods, their sources of supply and the avenues of marketing. His duties are of a personal character, only a small establishment being required as his business is carried on by negotiation at the exchange and in the offices of clients. In the produce market brokers are indispensable—they study the crop reports, watch cargoes, take samples, collect statistics and furnish market reports. Pressure of competition and the shortening of the producer-consumer chain impels the broker to buy and sell on his own account.

Agency as a Career.—Employment as an agent in business on a commission basis is often the last resource of a person out of employment, without any connection to assist him to secure orders and foredoomed to failure or a precarious livelihood. The ambitious youth without capital should consider agency possibilities as a stepping stone to greater remuneration as soon as he has been able to accumulate a reserve. A few years of training and experience in a merchant or factor's office will give him a knowledge of the methods of production and distribution of particular articles of manufacture until presently he has an opportunity of proving his value to his employer by suggesting new openings for agency development.

A new agency offers scope for ability and ambition to an extent presented by very few occupations. Whilst it is true that modern merchandising tends more and more towards larger units and the elimination of middlemen the increase of wealth everywhere creates new wants and an increasing market for new products. There were 30,000 applications for patents filed at the London Patent Office in the year preceding the World War and 32,000 in the year following it. The inventive genius is always bringing forward possibilities of marketing for which at first the agent is the natural instrument of development. The life is attractive to an adventurous spirit, a large circle of friends and acquaintances is formed and there is an excellent prospect of meeting the desired opportunity of entering the inner circle of manufacture and commerce. (*See* ADVERTISING AGENT, BOOKING AGENT, REAL ESTATE AGENT) (A B. C)

AGENTS OF PRODUCTION, in economics, a term used to describe the factors which combine in the production of wealth, as land, capital, labour (*qq v*) and organization. (*See* ENTREPRENEUR; ECONOMICS; and AGRICULTURAL ECONOMICS)

AGESANDER, a Rhodian sculptor who is mentioned by Pliny (*Nat. Hist* xxxvi 37) as author (with Polydorus and Athenodorus) of the group of the Laocoön. Inscriptions found at Lindus in Rhodes date Agesander and Athenodorus to the period 42–21 B C

AGESILAUS II., king of Sparta, of the Eurypontid family, succeeded his step-brother Agis about 401 B C. through the influence of Lysander. In 396 he led an expedition to Asia to secure the Greek cities against a Persian attack Before sailing, he tried to offer a sacrifice at Aulis as Agamemnon had done before the Trojan expedition, and never forgave the Thebans for preventing him During 396, Agesilaus made a profitable raid into Phrygia; in the following year he defeated Tissaphernes near Sardis and then ravaged the satrapy of Pharnabazus. It was said that he was planning a campaign in the interior when, to his deep regret, he was recalled to Greece owing to the war between Sparta and the combined forces of Athens, Thebes, Corinth, Argos and several minor states After a rapid march through Thrace and Macedonia he met the confederate forces at Coronea in Boeotia and in a fierce battle was technically victorious, but the success was a barren one and he had to retire to the Peloponnese.

Agesilaus took a leading part in the Corinthian War, making successful expeditions into Corinthian territory, and capturing Lechaeum. But the destruction of a *mora* by Iphicrates neutralized these successes, and Agesilaus returned to Sparta. In 387 the Peace of Antalcidas (*q v*), which was warmly supported by Agesilaus, put an end to hostilities. When war broke out afresh with Thebes the king twice invaded Boeotia (378, 377) and it was on his advice that Cleombrotus marched against Thebes in 371. Cleombrotus was defeated at Leuctra and the Spartan supremacy overthrown. In 370 Agesilaus tried to restore Spartan prestige by invading Mantinean territory and his heroism saved Sparta when Epaminondas penetrated Laconia that same year, and again in 362 when he all but succeeded in seizing the city. Sparta stood aloof from the general peace of 362 hoping to recover her supremacy. In order to gain money for the war Agesilaus had supported the revolted satraps; in 361 he went to Egypt at the head of a mercenary force to aid Tachos against Persia, and died, at the age of 84, on his way home.

Agesilaus was a small man, somewhat lame from birth. He was a successful leader in guerilla warfare, alert and quick, yet cautious, and his bravery was unquestioned. He lived in the most frugal style and enriched the state and his friends with the spoils of his campaigns, returning himself as poor as he had set forth. He was sincerely patriotic; but the worst trait in his character was his implacable hatred of Thebes, which led to the battle of Leuctra and Sparta's fall from supremacy.

See lives of Agesilaus by Xenophon (the panegyric of a friend), Cornelius Nepos and Plutarch; Xenophon's *Hellenica* and Diodorus xiv., xv. Among modern authorities, besides the general histories of Greece, J. C F. Manso, *Sparta* (1800–05) iii. 39 ff.; G. F. Hertzberg, *Das Leben des Königs Agesilaos II. von Sparta* (1856); Buttmann, *Agesilaus Sohn des Archidamus* (1872); C. Haupt, *Agesilaus in Asien* (1874); E. von Stern, *Geschichte der spartanischen und thebanischen Hegemonie* (1884).

AGGLOMERATE, in geology, the name applied to the coarse, fragmental accumulations that accompany explosive erup-

tions (*see* VOLCANO). The material may consist of blocks of lava, or of fragments of rock torn off from the sides of the volcanic pipe, or of both. An agglomerate differs only from a volcanic ash in the larger size of the fragments, which are usually sharply angular.

AGGLUTINATION, a term used technically in philology for the method of word-formation by which two significant words or roots are joined together in a single word to express a combination of the two meanings each of which retains its force (Lat. *ad* and *glutinare,* lit. to fasten together with glue). This juxtaposition or conjoining of roots is characteristic of languages such as the Turkish and Japanese, which are therefore known as agglutinative, as opposed to others, known generically as inflexional, in which differences of termination or combinations in which all separate identity disappears are predominant.

The term was also formerly used by associationist philosophers for those mental associations which were regarded as peculiarly close. W. Wundt applies this term to those simplest cases of apperceptive synthesis in which the simpler ideas composing the complex idea retain their independence—as, for instance, in the idea expressed by "church-steeple"

AGGRAVATION (Lat. *ad,* "increasing," *gravis,* "heavy"), the making anything graver or more serious, also used as synonymous with "irritation." In the canon law, "aggravation" was a form of ecclesiastical censure, threatening excommunication after three disregarded admonitions.

AGGREGATE, a term used in building and construction to designate the material with which cement, lime, gypsum or other adhesive material, such as bitumen, is mixed to form a concrete or mortar (*q v*). The most common aggregates are sand, crushed or broken stone, gravel or pebbles, broken blast-furnace slag, boiler ashes or clinker, burned shale and burned clay. The purpose of the aggregate is to provide volume, freedom from change in volume, and resistance to wear or erosion and other desired physical properties, in the finished product.

Aggregates are divided into two general classes commonly known as fine aggregate and coarse aggregate. The fine aggregate is generally sand, crushed stone or crushed slag screenings; the coarse aggregate is gravel (pebbles), fragments of broken stone, slag and the other substances above mentioned. The dividing line between fine and coarse aggregate is usually a ¼in. screen opening, sometimes a ⅛in. opening. Aggregates are mixed with the cement or binding material in proportions varying from one part of cementing material to one part of fine aggregate for a "rich" mortar to one part of cement to nine or ten parts of mixed fine and coarse aggregates for a "lean" concrete. The theory upon which such mixtures are proportioned is that there shall be sufficient cementing material to coat all of the particles in the fine aggregate, and that there shall be sufficient mortar so produced to fill all the voids in the coarse aggregate. The ideal concrete would consist of closely packed fragments of crushed stone, slag or pebbles in which all the fragments are coated with mortar, and all the voids between the coarser fragments filled with mortar. Under actual conditions in construction work there is practically always an excess of mortar.

Nearly all natural sands require washing or rinsing to remove loam, clay, organic material, etc. A gradual variation in size from about 50 mesh (50 openings per linear inch) to ¼in. mesh is desirable for the strongest mortar or concrete. The preparation of commercial fine aggregate therefore often requires artificial grading or mixing of the various sizes. This is usually accomplished by hydraulic separation of the undesirable fine sizes, which usually are in excess. For coarse aggregate any hard, tough, durable rock may be crushed, screened and graded. The common commercial sizes vary from ¼in. to 3½in. in largest dimension. The most desirable rocks for general construction purposes are basalt, commonly called trap, and fairly pure limestone. Such rocks are not only durable but fire-resisting, which is important in building work. Common siliceous rocks, particularly flint and many granites, expand sharply at moderately high temperatures and tend to destroy the concrete of which they form the aggregate.

In this age of concrete construction and road building the business of supplying aggregates for construction work has grown to large proportions. In the United States alone production amounts to approximately 300,000,000 tons per annum, valued roughly at $300,000,000, requiring an investment of about $500,000,000 in washing, screening and crushing equipment and accessory machinery for mining and conveying the raw and finished materials. (N. C. R.)

AGGREGATES, THEORY OF. An *aggregate* may be defined, for the moment, as a collection of elements of some kind or other which is subjected to laws of operation and, on occasion, provided with a structure in such a way as to make it capable of being used to facilitate the arguments and calculations of mathematical analysis. From the point of view of pure philosophy such collections are of considerable interest in themselves and there is an extensive subject, which may be called for purposes of reference the theory of classes, which has grown up around them. This theory involves, as might be expected, considerable difficulties of a somewhat metaphysical nature and is in parts highly controversial. It is, however, possible to isolate from the rest of the theory a part which is of much practical value and almost completely free from controversy. This is the theory of aggregates. It concerns classes considered not as entities to be subjected to logical scrutiny and philosophical analysis but simply as symbols of a certain kind which are used to facilitate mathematical calculations in much the same way that numbers are used The progress that has been made in some branches of mathematics since the introduction in the subject of the theory of aggregates is very striking.

Preliminary Notions.—It will be assumed that there is given a set of elements of some kind or other each of which can be distinguished from all the others and so may be indicated by an appropriately attached name. This set is described as the *field of operations* and the individual constituents which it contains are its *elements.* Specified elements are conveniently denoted by letters *a, b, c,* ... and unspecified elements by letters *x, y, z,* ... . There are, naturally, a great many fields of operations available. It is supposed that a particular one is selected and the subsequent theory is then relative to this field. The theory of classes, of course, has to take into account all possible fields of operations. The theory of aggregates is at most concerned with the realization of a single field of operations which shall satisfy the conditions which may at the time be imposed. The question of realizing the field of operations is almost the only part of the subject which is controversial.

Aggregates are, roughly speaking, collections of elements of the field of operations. This definition is, however, subject to the criticism that it is not very precise Moreover, the idea of a collection involves certain metaphysical difficulties which, although some of them have been known for several thousands of years, have not been completely resolved An alternative definition has therefore been adopted by some authorities. Nothing is said about the nature of aggregates but instead their use is defined. Aggregates are taken to be symbols the sentences containing which are interpreted by given conventions in such a way that the resulting formal laws are, up to a point, identical with those which would result from the application of the rough definition originally given. The requirements of mathematics are simply that the conventions used should be consistent. Experience seems to show that this is the case. The requirements of the mathematician are that the conventions should be easily applied. These are met by treating aggregates as though there were actual collections. Experience again shows that this procedure, if certain quite simple safeguards are employed, never leads to error. Specified aggregates may be denoted by letters A, B, C, ... and unspecified aggregates by letters X, Y, Z, ...

The Relations ϵ *and* ω.—Between any element x of the field of operations and any given aggregate A one or other of two mutually exclusive relations must hold Either x *belongs* to the aggregate, in a sense that will presently be made precise, or x is *excluded by* the aggregate. In the first case $x \epsilon A$ is written and in the second $x \omega A$. The elements which belong to A are described as its *members* and of them A is said to be *composed*

The aggregate of which the elements which do not belong to A are the members is the *complement* of A. An interchange of ϵ and ω plainly interchanges an aggregate and its complement.

Propositional Forms.—A sentence like "*a* is blue" expresses a property of the element *a*. On the other hand a form of words and symbols like "*x* is blue," where *x* denotes an unspecified element of the field of operations, expresses nothing. It may be described as a *propositional form*. When the variable *x* which it contains is replaced by a name it becomes a proposition. Certain forms of words and symbols which have the appearance of propositional forms can be shown to be incapable of yielding propositions when treated in the above way What results when the name is substituted is necessarily a meaningless array of words The convention is therefore made that only propositional forms that are significant over the field of operations are taken into consideration in the theory of aggregates associated with any given field of operations.

The Fundamental Convention.—It is assumed that to each significant propositional form there corresponds a definite aggregate. This is described as the aggregate *determined* by the form. If the form is denoted by $f(x)$ the corresponding aggregate is denoted by $[f(x)]$.

The main convention governing the use of aggregates is that sentences involving $[f(x)]$ are to have the same meaning as corresponding sentences involving $f(x)$ Thus, to take a rough example, if A is the aggregate [*x* is blue] then "A is extensive" is taken to mean "'*x* is blue' is often true." More precise examples are: "$a \epsilon [f(x)]$" means "$f(a)$ is true" and "$a \omega [f(x)]$" means "$f(a)$ is false." It is possible to interchange the conventions involving ϵ and ω without causing any alteration in the formulae, provided that certain simple precautions are taken. In this way each formula can be made to yield two propositions. For this reason it is convenient, at any rate for mathematical purposes, to keep the notion of an aggregate distinct from that of a propositional form.

Null Aggregates.—An aggregate determined by a propositional form which never reduces to a true proposition, no matter what name is substituted for its variable, is described as *null* A null aggregate is denoted by the symbol o Null aggregates have formal properties closely resembling those of the number o The complement of a null aggregate is the aggregate consisting of all the elements of the field of operations

Arithmetical Theory.—Between any two aggregates operations similar to those of arithmetic may be defined. Thus.—

$$A+B = [x \epsilon A \text{ or } x \epsilon B],$$
$$AB = [x \epsilon A \text{ and } x \epsilon B],$$
$$A-B = [x \epsilon A \text{ and } x \omega B].$$

The addition or multiplication of any number of aggregates presents no difficulty. In this respect the theory of aggregates is considerably easier than the theory of numbers Operations involving limits can also be defined. Calculations in the arithmetical theory are not much different from those in the arithmetic of numbers. It is often found that the results of extremely elementary calculations involving aggregates have an interpretation which sheds considerable light on comparatively difficult problems in other branches of mathematics.

Geometrical Theory.—A completely different but equally useful theory results when the aggregates considered are endowed with a structure in some way. Between any two points of a given aggregate, for instance, a distance may be defined. Any aggregate which has been given a structure is described as a *space*. A considerable variety of spaces is known and their consideration provides much information as to the nature of the more familiar spaces, such as the Euclidean spaces.

Application to the Theory of Functions.—There are many problems in the theory of functions (*q.v.*) which have been solved either wholly or in part by means of the theory of aggregates. This is in measure due to the intrinsic power of the theory and also to the concise and expressive way in which the theory allows the formulation of ideas. A notable advance is due to the fact that numerical functions can be defined by means of a table of aggregates. In order to know a function $\phi(x)$ it is sufficient to know the aggregates $[\phi(x) > p]$ for only the rational values of p, whereas in the ordinary way it is necessary to know $\phi(x)$ for all values, irrational as well as rational of x.

See F. Hausdorff, *Mengenlehre* (1927, bibl); C. J. de la Vallée Poussin, *Intégrales de Lebesque, fonctions d'ensemble, classes de Baire* (1916) Hausdorff's work provides an unusually interesting general introduction to the subject. The reader already familiar with the theory of functions of a real variable will find some valuable applications of the theory of aggregates in the tract by de la Vallée Poussin.
(S. Po.)

AGGREGATION, in physics, a collective term for the forms or states in which matter exists. Three primary "states of aggregation" are recognized—gaseous, liquid and solid. Generally, if a solid be heated to a certain temperature, it melts or fuses, assuming the liquid condition (*see* FUSION); if the heating be continued the liquid boils, and becomes a vapour (*see* VAPORIZATION). On the other hand, if a gas be sufficiently cooled and compressed, it liquefies; this transition is treated theoretically in the article CONDENSATION OF GASES, and experimentally in the article LIQUID GASES

AGGTELEK, a village in northern Hungary in that portion of the county of Gómor that remains within Hungarian rule. Although small (pop 555) it is world-renowned for its remarkable limestone grotto, the Aggtelek or Baradla cavern, one of the largest of its kind in Europe. It is composed of a labyrinth of passages and halls of various sizes, the total length including its ramifications exceeding 5 miles. A stream traverses the caves, which are rich in fantastic stalactite forms

AGINCOURT (AZINCOURT), a village of northern France in the department of Pas de Calais, 14m N W of St. Pol by road, famous on account of the victory, on Oct 25, 1415, of Henry V of England over the French. The battle was fought in the defile formed by the wood of Agincourt and that of Tramecourt, at the northern exit of which the army under d'Albret, constable of France, had placed itself so as to bar the way against the English forces which, after the capture of Harfleur, had set out to march through Picardy to Calais Torrential rains hindered the English in crossing the Somme, and the delay allowed the French to concentrate in overwhelming numbers—d'Albret, indeed, refused to avail himself of the offer of 6,000 crossbowmen of the Paris citizen militia Worse still, the English became so short of supplies that had the French but been content to block the path without risking an attack, hunger would have brought them the victory. The night of Oct 24 was spent by the two armies on the ground, and the English had but little shelter from the heavy rain which fell Early on the 25th, St. Crispin's day, Henry arrayed his little army (about 1,000 men-at-arms, 6,000 archers, and a few thousands of other foot) It is probable that the usual three "battles" were drawn up in line, each with its archers on the flanks and the dismounted men-at-arms in the centre; the archers being thrown forward in wedge-shaped salients, almost exactly as at Crécy (*q.v.*). The French, on the other hand, were drawn up in three lines, each line formed in deep masses. They were at least four times more numerous than the English, but restricted by the nature of the ground to the same narrow front 1,100yds, they were unable to use their full weight (*cf.* Bannockburn); further, the deep mud prevented their artillery from taking part, and the crossbowmen were as usual relegated to the rear of the knights and men-at-arms. All were dismounted save a few knights and men-at-arms on the flanks, who were intended to charge the archers of the enemy. For three hours after sunrise there was no fighting; then Henry, finding that the French would not advance, moved his army farther into the defile. The archers fixed the pointed stakes, which they carried to ward off cavalry charges, and opened the engagement with flights of arrows. The chivalry of France, undisciplined and too obtuse to have assimilated the lesson of Crécy and Poitiers, was quickly stung into action, and the French mounted men charged, but their slow-moving horses made easy targets, soon shot down or driven back in confusion. The constable himself headed the leading line of dismounted men-at-arms; weighted with their armour, and sinking deep into the mud with every step, they yet reached and

engaged the English men-at-arms; for a time the fighting was severe. The thin line of the defenders was borne back and King Henry was almost beaten to the ground. But at this moment the archers, taking their hatchets, swords or other weapons, penetrated the gaps in the now disordered French, who could not move to cope with their unarmoured assailants, and were slaughtered or taken prisoners to a man. The second line of the French came on, only to be engulfed in the *mêlée;* its leaders, like those of the first line, were killed or taken, and the commanders of the third sought and found their death in the battle, while their men rode off to safety. The closing scene of the battle was a half-hearted attack made by a body of fugitives, which led merely to the slaughter of the French prisoners, which was ordered by Henry because he had not enough men both to guard them and to meet the attack. The slaughter ceased when the assailants drew off. The total loss of the English is stated at 13 men-at-arms (including the duke of York, grandson of Edward III) and about 100 of the foot The French lost 5,000 of noble birth killed, including the constable, three dukes, five counts and 90 barons; 1,000 more were taken prisoners, amongst them the duke of Orleans (the Charles d'Orléans of literature). The moral lesson of the battle was the incapacity of a military caste to learn from experience, and to adapt their traditions intelligently to new needs. The material lesson was that armour stultified its own purpose when it fettered mobility. The 15th-century soldier pinned his faith as obstinately on an increasing weight of armour as the 19th-century soldier on an increasing weight of numbers.

See Sir Harris Nicolas, *Battle of Agincourt;* Fortescue, *History of the British Army,* vol. i ; and H B George, *Battles of English History;* Oman, *History of the Art of War in the Middle Ages,* vol ii. 379–386.

AGIO, a term used in commerce in three connections

(a) The variations from fixed pars or rates of exchange in the currencies of different countries For example, in most of the gold-standard countries, the standard coin is kept up to a uniform point of fineness, and so bears a constant relation to coins of other countries in a similar condition This is what is known as the mint par of exchange. The balance of trade between the various countries is the factor determining the rate of exchange Should the balance of trade be against England, money must be remitted to France as payment for the indebtedness. But owing to the cost for the transmission of specie there will be a demand for bills as a cheaper and more expeditious method of sending money, and it therefore will be necessary to pay a premium for it, called the agio

(b) The term is also used to denote the difference in exchange between two currencies in the same country, where silver coinage is the legal tender, agio is sometimes allowed for payment in the more convenient form of gold, or where the paper currency of a country is reduced below the bullion which it professes to represent, an agio is payable on the appreciated currency

(c) Lastly, in some states the coinage is so debased, owing to the wear of circulation, that the real is greatly reduced below the nominal value. Supposing that this reduction amounts to 5%, then if 100 sovereigns were offered as payment of a debt in England while such sovereigns were current there at their nominal value, they would be received as just payment; but if they were offered as payment of the same amount of debt in a foreign state, they would be received only at their intrinsic value of £95, the additional £5 constituting the agio Where the state keeps its coinage up to a standard value no agio is required. (*See* BALANCE OF TRADE.)

AGIRA (formerly San Filippo d'Argirò), town in the province of Catania, Sicily, with a railway station 4½ m. to the south; 35 m. W. of Catania. Pop. (1901) 17,738; (1921) 23,735 (town), 24,697 (commune). *Agyrion,* an ancient Sicel city, was ruled by tyrants, one of whom, Agyris, was contemporary of Dionysius I., and with him successfully resisted the Carthaginians in 392 B.C Agyrion was not colonized by the Greeks until Timoleon drove out the last tyrant in 339 B.C.

AGIS, the name of four Spartan kings:

(1) Son of Eurysthenes, founder of the royal house of the Agiadae (Pausanias iii. 2. 1). His genealogy was traced back to Heracles (Herodotus vii. 204), and he belongs rather to mythology than to history. Tradition ascribed to him the capture of Helos, and the institution of the class of serfs called Helots. (*q.v.*). *See* Ephorus ap. Strabo, viii. p. 365.

(2) AGIS I, son of Archidamus II., Eurypontid, succeeded his father, probably in 427 B.C, and from his first invasion of Attica in 425 down to the close of the Peloponnesian War was the chief leader of the Spartan operations on land After the conclusion of the peace of Nicias (421 B C.) he marched against the Argives in defence of Epidaurus, and after skilful manoeuvring surrounded the Argive army, and seemed to have victory within his grasp when he unaccountably concluded a four months' truce and withdrew his forces. The Spartans were indignant, and when the Argives and their allies broke the truce Agis escaped having his house razed and a fine of 100,000 drachmae imposed only by promising to atone for his error by a signal victory. This promise he fulfilled by routing the forces of the Argive confederacy at the battle of Mantinea (418) In the winter 417–416 a further expedition to Argos resulted in the destruction of the half-finished Long Walls and the capture of Hysiae In 413, on the suggestion of Alcibiades, he fortified Decelea in Attica, where he remained directing operations until, after the battle of Aegospotami (405), he took the leading part in the blockade of Athens, which was ended in the spring of 404 by the surrender of the city Subsequently he invaded and ravaged Elis. He fell ill on his return from Delphi, where he had gone to dedicate a tithe of the spoils, and died at Sparta, probably in 401.

BIBLIOGRAPHY —*See* Thuc. iii. 89, iv. 2. 6, v., vii. 19. 27, viii.; Xenophon, *Hellenica,* i. 1, ii. 2. 3, iii 2. 3; Diodorus xii 35, xiii. 72, 73, 107, Pausanias iii 8. 3-8, Plutarch, *Lysander* ix 14. 22, *Alcibiades* 23-25, *Lycurgus* 12, *Agesilaus* i. 3, *de Tranquill. Anim.* 6. (*See* PELOPONNESIAN WAR.)

(3) AGIS II, son of Archidamus III, of the Eurypontid line, succeeded his father in 338 B C, on the very day of the battle of Chaeronea During Alexander's Asiatic campaign he revolted against Macedonia (333 B C) and, with the aid of Persian money and ships and a force of 8,000 Greek mercenaries, gained considerable successes in Crete. In the Peloponnese he routed a force under Corragus and, although Athens held aloof, he was joined by Elis, Achaea (except Pellene) and Arcadia, with the exception of Megalopolis, which the allies besieged. Antipater marched rapidly to its relief at the head of a large army, and the allied force was defeated after a desperate struggle (331) and Agis was slain

BIBLIOGRAPHY —*See* Pausanias iii 10 5; Diodorus xvii 48, 62, 63; Justin xii 1, Quintus Curtius iv, 1, 39, vi, 1; Arrian, *Anabasis,* ii. 13.

(4) AGIS III, son of Eudamidas II, of the Eurypontid family, succeeded his father, probably in 245 B C, in his 20th year, at a time when the unequal distribution of land and wealth and the diminution in the number of full citizens threatened to ruin Sparta. He determined to restore the traditional institutions of Lycurgus. Lysander as ephor proposed on behalf of Agis that all debts should be cancelled and that Laconia should be divided into 19,500 lots, of which 4,500 should be given to Spartiates, whose number was to be recruited from the best of the perioeci and foreigners, and the remaining 15,000 to perioeci who could bear arms The abolition of debts was carried into effect, but the land distribution was put off on various pretexts by Agesilaus, the king's uncle, who wished to preserve his estates. At this point Aratus appealed to Sparta to help the Achaeans in repelling an expected Aetolian attack, and Agis was sent to the Isthmus at the head of an army. During his absence his enemies gained the upper hand, and on his return Agis, after a mock trial, was strangled in prison, his mother and grandmother sharing the same fate (241)

See Plutarch's biography. Pausanias' accounts (ii. 8. 5, vii 7. 3, viii. 10. 5-8, 27. 13) of his attack on Megalopolis, his seizure of Pellene and his death at Mantinea fighting against the Arcadians, Achaeans and Sicyonians are without foundation (J C. F Manso, *Sparta,* iii. 2 123–127, 1800–05). *See* also Manso, *op. cit* in I 276–302; B Niese, *Geschichte der griechischen und makedonischen Staaten,* ii 299–303 (1884).

AGISTMENT. To "agist" is, in law, to take cattle to graze, for a remuneration. The word is derived through O. Fr from Lat. *iacere,* to lie. "Agistment," in the first instance, referred

more particularly to the proceeds of pasturage in the king's forests but now means either (*a*) the contract for taking in and feeding horses or other cattle on pasture-land, for the consideration of a weekly payment of money, or (*b*) the profit derived from such pasturing Agistment is a contract of bailment, and the bailee is bound to take reasonable care of the animals entrusted to him, he is responsible for damages and injury which result from ordinary casualties if it be proved that such might have been prevented by the exercise of reasonable care

There is no lien on the cattle for the price of the agistment, unless by express agreement Under the Agricultural Holdings Act, 1883, agisted cattle cannot be distrained on for rent if there be other sufficient distress to be found and if such other distress be not found, and the cattle be distrained the owner may redeem them on paying the price of their agistment

AGITATION, THERMAL, the motion of the molecules within a body which they possess by virtue of their absolute temperature (*q.v.*) (*See* KINETIC THEORY OF MATTER, THERMODYNAMICS.)

AGITATO (Ital.) a musical term implying that the composition or passage so marked is to be played in a restless, agitated manner, a rapid *tempo* being usually indicated at the same time by the accompanying time-direction *e.g.*, *presto agitato*

AGITATORS or ADJUTATORS the name given to representatives elected in 1647 by the different regiments of the English parliamentary army Early in 1647 the Long Parliament wished either to disband many of the regiments or to send them to Ireland The soldiers whose pay was largely in arrear, refused to accept either alternative, and eight of the cavalry regiments elected agitators called at first commissioners, who laid their grievances before the three generals, and whose letter was read in the House of Commons on April 30, 1647 The other regiments followed the example of the cavalry, and after a temporary conciliation Parliament decided to disband the army on June 1 The agitators determined to resist, a mutiny occurred in one regiment and the attempt at disbandment collapsed There followed the seizure of the king by Cornet Joyce, Cromwell's definite adherence to the policy of the army the signing of the manifestos a *Humble Representation* and a *Solemn Engagement,* and the establishment of the army council composed of officers and agitators The agitators finally demanded a march towards London and the "purging" of the House of Commons Subsequent events are part of the general history of England Gradually the agitators ceased to exist, but many of their ideas were adopted by the Levellers (*q.v.*), who may perhaps be regarded as their successors

See S. R. Gardiner, *History of the Great Civil War,* vols. iii. and iv. (1905)

AGNANO, LAGO DI, a crater lake, 5 m. W. of Naples, Italy, 4 m. in circumference, not mentioned in antiquity, probably formed in the Middle Ages, drained in 1866 It has a large modern thermal establishment with springs, natural sulphurous vapour baths and a grotto with constant exudation of warm carbonic-acid gas from the floor There are extensive Roman remains (V. Macchioro, *Monumenti dei Lincei,* xxi. p. 225 *sqq.,* 1911) On the north side of the crater is a race-course

AGNATES, in Roman law, persons related through males only, as opposed to cognates Agnation was founded on the idea of the family held together by the *patria potestas, cognatio* involves simply the modern idea of kindred

AGNES, SAINT, a virgin martyr of the Catholic Church The legend of St Agnes is that she was a Roman maid, by birth a Christian, who suffered martyrdom at the age of 13 during the reign of the emperor Diocletian, on Jan. 21 304 The prefect Sempronius wished her to marry his son, and on her refusal condemned her to be outraged before her execution, but her honour was miraculously preserved When led out to die she was tied to a stake, but the faggots would not burn whereupon the officer in charge of the troops drew his sword and struck off her head St Agnes is the patron saint of young girls, who, in rural districts, formerly indulged in all sorts of quaint country magic on St Agnes' Eve (Jan. 20–21) with a view to discovering their future husbands This superstition has been immortalized in Keats's poem, "The Eve of St Agnes" St Agnes's bones are supposed to rest in the church of her name at Rome, originally built by Constantine and repaired by Pope Honorius in the 7th century Here on her festival (Jan. 21) two lambs are specially blessed after pontifical high mass, and their wool is later woven into pallia

AGNES OF MERAN (d. 1201), queen of France, was the daughter of Bertold IV., duke of Meran in Tirol She is called Marie by some of the chroniclers In June 1196 she married Philip II. king of France, who had repudiated Ingeborg of Denmark in 1193 The pope espoused the cause of Ingeborg, but Philip did not submit until 1200, when, interdict having been added to excommunication, he consented to a separation from Agnes She died in July of the next year

See the notes of Robert Davidsohn in *Philipp II. August von Frankreich und Ingeborg* (Stuttgart, 1888) A genealogical notice is furnished by the *Chronicon* of the monk Alberic (Aubry) of Trois-Fontaines (Albericus Trium Fontium) in Pertz, *Scriptores,* Vol. xxiii.

AGNESI, MARIA GAETANA (1718–1799), Italian mathematician, linguist and philosopher, was born at Milan on May 16, 1718 She was an extremely precocious child Her father was a professor of mathematics Maria was only fourteen when she began to read a series of theses on philosophical questions to the learned men of Bologna who met regularly in her father's house (*see* Brosse, *Lettres sur l'Italie*) Her family resisted her early desire to enter a convent, but from her 20th year onward she lived in complete seclusion at home devoting herself to the study of mathematics When her father fell ill in 1752 Pope Benedict XIV. appointed her to his chair in the university But on his death in 1754 she became directress of the Hospice Trivulzio of the Blue Nuns at Milan and eventually joined the sisterhood She died on Jan. 9, 1799 Her principal work is *Instituzioni analitiche ad uso della gioventu italiana* (2 vols., Milan 1748, French trans. of vol. i., Paris 1775, complete Eng. trans. by John Colson, 1801)

Her sister, MARIA TERESA AGNESI (1724–80), composed several cantatas, two pianoforte concertos and five operas

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AGNEW, DAVID HAYES (1818–1892), American surgeon, was born in Lancaster county, Pa., on Nov. 24, 1818 He graduated from the medical department of the University of Pennsylvania in 1838, and a few years later set up in practice at Philadelphia and became a lecturer at the Philadelphia School of Anatomy He was appointed surgeon at the Philadelphia hospital in 1854 and was the founder of its pathological museum For 26 years (1863–89) he was connected with the medical faculty of the University of Pennsylvania, being elected professor of operative surgery in 1870 and professor of the principles and practice of surgery in 1871 From 1865 to 1884—except for a brief interval—he was a surgeon at the Pennsylvania hospital During the American Civil War he was consulting surgeon in the Mower Army hospital, near Philadelphia, and acquired considerable reputation for his operations in cases of gun-shot wounds He attended as operating surgeon when President Garfield was fatally wounded by the bullet of an assassin in 1881 He was the author of several works, the most important being *The Principles and Practice of Surgery* (1878–83) He died in Philadelphia on March 22, 1892

AGNI, the fire god of the Hindus, second only to Indra in the Vedic mythology of India He is invoked as "priest of sacrifice" in the first verse of the *Rig-Veda,* and, as messenger, between gods and men, sacrifices to him are upborne to the deities On earth his parents are the two sticks of the fire drill, and every day he is reborn an immortal, living among men and supreme director of religious rites and duties His form is however three-fold, fire on earth, lightning and the sun, and in art he is depicted as ruddy, with two faces, beneficent and malignant, three-legged (as in the fylfot, with seven arms) Later he was identified with Rūdra (*q.v.*) In modern India he has no professed sect, but is invoked in many ceremonies, and specially

affected by Agnihotri Brahmans who perform the 'fire sacrifice' (*agnihotra*)

See A A Macdonell, *Vedic Mythology*, and F Washburn Hopkins, *Epic Mythology* (1897 and 1915), J N Farquhar, *Outlines of the Religious Literature of India* and Mrs Sinclair Stevenson, *Rites of the Twice-born* (1920)

AGNI, inhabitants of the Gold Coast and the French Ivory Coast between the Fanti territory and the Comoe river south of the Abron (*q v*) people They are of the same origin and have the same physical, social and linguistic characteristics as the Baule

AGNOETAE, a minority of adherents to the Monophysite movement who (contrary to the general tendency of that form of Christology) maintained that Christ as man was ignorant of many things (Mark xiii 32, Luke ii 25) (Gr ἀγνοέω, "be ignorant of") The doctrine was condemned by Gregory the Great (See MONOPHYSITES)

AGNOIOLOGY (the theory of ignorance) The term was used by J F Ferrier (*Institutes of Metaphysics*, 1854) as a set-off to *Epistemology* (theory of knowledge) The theory was intended to counter the sceptical contention that Absolute Being may be beyond human knowledge, that the human mind may be condemned to remain ignorant of it Ferrier's contention is that man cannot be said to be ignorant of what cannot be known, he can only be said to be ignorant when he does not know what can be known On such lines Ferrier concludes that, since Absolute Being must either be something that we know or something that we are ignorant of, it cannot be subject only or object only but a synthesis of both

AGNOSTICISM. Whereas scepticism, as a technical term in philosophy, denotes varying degrees of doubt as to whether some or all of the psychological processes, purporting to yield knowledge, really do so, agnosticism rather asserts that, of certain kinds of objects or facts, we possess assured knowledge, while as to certain other kinds of alleged existents we have, and can have none The kinds of alleged objects, knowledge as to which the agnostic believes to be impossible, are such as are the primary concern of metaphysics and theology God, the soul and its immortality, and—more generally speaking—the ultimate realities of which phenomenal things such as the sciences study, are appearances Of these phenomenal things, we have ever-increasing and irrefragable knowledge, as to the things *per se*, the ontal or noumenal existents, of which the "things" of common sense and science are the knowable shadows or appearances, we can never have knowledge pure and subjectively undefiled If we know *that* they are, we cannot know *what* they are, if we can assert their existence, we are ignorant as to their essence

The name "agnosticism" was coined by Huxley about 1870 to distinguish this philosophical attitude from others, but the attitude had been professed before It is, in fact, one of the issues of Kant's imposing theory of knowledge, and it had become through the investigations of Sir W Hamilton, Dean Mansel and Herbert Spencer, more sharply defined and more elaborately developed Huxley, who was perhaps its most widely-known champion in the latter half of the 19th century, gave definiteness to its exposition by forcibly contrasting metaphysical and theological belief with scientific knowledge We can now see that the controversial issue was confused, through failure at that time to realize that the word "knowledge" denotes not one sole psychological process and product, but several that are distinguishable, and also that what is called scientific knowledge is not quite so simple in its psychological structure, nor so logically "positive" in its nature, as the philosophically-inclined representatives of science in Huxley's day were wont to assume The positivists who were led by the progress and prestige of physical science to regard science as constituted entirely by sense-data, linked together solely by relations such as could be read-off with the inevitableness and self-evidence of similarity, temporal sequence, etc, overlooked the fact, which had been clearly discerned by Hume, that we have no *logical* right to pass from our sporadic and evanescent sense-data, which yield evidence only as to here and now, to belief in a stable system of permanent things governed by law The right is not a matter of logical necessitation but of psychological inevitableness, not of logical certification but of pragmatic verification, not of logical certainty but of personal certitude or sanguine confidence Thus science is not knowledge, in the strict sense of reading-off supplemented by logical inference Such knowledge and indeed the phenomenal objects about which it claims to know, are constituted such by suppositions that, in the first instance, are read *into* the data Thus knowing" means, in science of the actual, something different both from the immediate "acquaintance' of sense-perception and from the truth" that is yielded by pure sciences, such as mathematics whose "objects" are ideas—such as the line without breadth—and not actual things This is also the doctrine of Kant But Kant held that the reading-in that is involved in scientific knowledge is *a priori* necessary, so that such knowledge is knowledge in the strictest sense, whereas the reading-in that is involved in metaphysics and theology is but tentative and humanly expedient This hard line between what Kant called understanding and reason—we might say between knowledge and mere belief—is now seen to be psychologically arbitrary, not so hard as he thought, and indeed to be drawn at the wrong place Hence the rigid separation, once wont to be alleged between science and philosophy, and, on the strength of which, metaphysics and theology were disparaged, is no longer possible The agnostic can no longer have that certainty as to the foundations of his science, in virtue of which he asserted nescience as to the non-phenomenal The difference between the knowledge which he asserted and the knowledge which he disclaimed is one of degree of verifiability, not of kind or of intrinsic constitution

But agnosticism, which issues out of Kant's phenomenalism, is imbued with consequences of what may be said to be another oversight of Kant perhaps still more significant in import Kant tried to work with the supposition that, though facts compel us to assert the existence of things *per se*, we can know no more about them His doctrine implies that we can only know the phenomenal This is the teaching that was developed by Hamilton into the dogmas that we can have no knowledge of the absolute or of ultimate reality, and no absolute or pure knowledge of anything all knowledge is but relative As to its Kantian foundation, it seems obvious that if we must posit things *per se* in order to account for our sense-data being forthcoming so must relations between things *per se* be posited to account for the stable connections between sense-data, which science elaborates into laws of nature Indeed unless we create most of our data out of nothing or out of our subjective states, etc, there must be structure and detail in the ontal corresponding to that which we observe in the phenomenal Appearance cannot be appearance of nothing Hence, instead of the Kantian formula, that we only know phenomena it is more correct to say that we know the noumenal through the phenomenal Thus there is not absolute nescience as to the noumenal, as agnosticism would assert The most that can be urged is that we do not see the noumenal, so to say, through plate glass, but through the irremovable spectacles of the mind which make a difference to the noumenal object or phenomenalize it It is at this point that Hamilton's doctrine of the relativity of knowledge applies He would regard phenomenal knowledge of the noumenal as not knowledge at all, because, in having it, we are not identical with the objects known nor become acquainted with them as they are in themselves Our knowledge falls short of the ideal standard, in that it is impure—which is what he chiefly means by "relative" But it may be doubted whether knowledge suffers in value on that account There is no reason to assume that in imaging the real, the phenomenon veils it or caricatures and misrepresents it, it may reveal it, and reveal its significance just as effectually as would seeing face to face What matters is that phenomenal knowledge should be *relevant* to reality, not that it should mirror its naked structure An ordnance map serves all purposes of the tourist, though it may not mirror the coloured landscape or the geological formations of the district, it is relevant, if but appearance and not a copy There is point-to-point correspondence between the lines and contours on the map and the streams, roads gradients, etc, of the country which

it represents. Our phenomenal knowledge may bear—nay, must bear—much the same sort of relation as this to the realities which manifest themselves in and through the sensible and phenomenal It enables us to "find our way about" our world, to be on terms of understanding with it and it may minister as much to spiritual wisdom as to practical prudence, for all that it is but phenomenal. That "we see through a glass, darkly" may be our lot here; but it does not follow that we are wholly blind as to all that concerns our souls' health. Thus it would appear that agnosticism is superfluously modest. Its demurrer to the philosopher's claim that knowledge as to ultimate reality in general is inaccessible is not sustained If it would refuse the name of knowledge to such cognition it would seem to be cherishing a conception of knowledge to which no actually forthcoming "knowing" corresponds. For science itself, wont to be taken as the paradigm of knowledge, is at bottom interpretative, constructive, ejective and partly symbolical. Its inductive method involves faith, for which there is reasonable, but not logical, justification And knowledge as to the objects with which metaphysics and theology are concerned, is but a further extension of the same method and the same sustaining faith as science uses, applied to such facts as evince meaning or purpose and value or significance, as well as to those which yield laws as to physical structure and connections.

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AGNUS DEI, the figure of a lamb bearing a cross, symbolizing the Saviour as the "Lamb of God" The name is especially given in the Roman Church to waxen discs impressed with this figure and blessed by the pope When first mentioned (*c* 820) they were made of the remnants of the preceding year's paschal candle. In modern times they are blessed on Easter Wednesday and distributed on the following Saturday, only in the first year of each pontificate and every seventh year after

Agnus Dei is also the name for the invocation (based on John i 29) *Agnus Dei, qui tollis peccata mundi, miserere nobis,* which appears to have been introduced into the Mass by Pope Sergius I (687–701). It is there repeated thrice (the third time with *dona nobis pacem* for *miserere nobis*) between the Lord's Prayer and the communion; it is also appended to many of the litanies The legality of its use in English, under certain conditions, in the Anglican communion service was upheld by the judgment in the Lincoln case (1890).

For the various ceremonies in the blessing of the *Agnus Dei, see* A Vacant, *Dict de Théologie* (cols 605–613)

AGOBARD (*c* 779–840), Carolingian prelate and reformer, became coadjutor to Leidrad, archbishop of Lyons, in 813, and on the death of the latter succeeded him in the see (816). Deposed in 835 by the council of Thionville, he made his peace with the emperor and was reinstated in 837. Agobard occupies an important place in the Carolingian renaissance. He wrote extensively not only theological works but also political pamphlets and dissertations directed against popular superstitions. He denounced the trial by ordeal of fire and water, the belief in witchcraft, and the ascription of tempests to magic, maintained the Carolingian opposition to image-worship, but carried his logic farther and opposed the adoration of the saints. In his purely theological works Agobard was strictly orthodox, except that he denied the verbal inspiration of the Scriptures. Agobard was reverenced as a saint in Lyons, and although his canonization is disputed his life is given by the Bollandists, *Acta Sanctorum,* Jun ii 748.

BIBLIOGRAPHY.—Agobard's works were lost until 1605, when a manuscript was discovered in Lyons and published by Papirius Masson, again by Baluze in 1666. For later editions *see* Potthast, *Bibliotheca Historica Medii Aevi.* The life of Agobard in Ebert's *Geschichte der Litteratur des Mittelalters* (1880), is still one of the best to consult. For further indications *see* A. Molinier, *Sources de l'histoire de France.*

AGONALIA, in ancient Rome, festivals celebrated on Jan. 9, Mar. 17, May 21 and Dec 11 in each year in honour of various divinities (Ovid, *Fasti,* i, 319–332). The word is derived either from *agonia,* "a victim," or from *agonium,* "a festival," but there is no certainty as to the etymology of the word.

AGONOTHETES, in ancient Greece, the president or superintendent of the sacred games At first the person who instituted the games and defrayed the expenses was the Agonothetes. But in the public games, such as the Olympic and Pythian, these superintendents represented different States, or were chosen from the people in whose country the games were celebrated; thus at the Panathenaea at Athens ten *athlothetai* were elected for four years to superintend the various contests. They were variously called "regulators," "arbitrators," "judges of contests," "stewards of the games" (at Athens), "rod-bearers" (from the rod or sceptre emblematic of their authority), but their functions were generally the same.

AGONY COLUMN, a term often applied to the column in newspapers devoted to personal advertisements, such as announcements of losses or bequests. At as early a date as 1800 the "agony column" was a medium also for matrimonial advertisements. It is sometimes known as the personal column

See Alice Clay, *The Agony Column of the "Times" 1800–1870* (1881).

AGORA, originally an assembly of the people of one of the Greek city States, called by the king or other authority to receive a decree or to discuss a policy. At an early period the word was used to describe the places where these meetings were held and in historic times any open space for general meetings, either official or commercial, was termed an agora The agora of the historic Greek city was thus similar to the Roman forum or the mediaeval English market place As the agora was the centre of the city life, it was surrounded by, or adjacent to the most important civic buildings, the prytaneum or official residence of the general, the basilica where the court sat, the *bouleuterion* or council hall, the thesaurus or treasury and the prison As the market place, it had ranges of sheds or colonnades for shops; frequently the colonnades were divided into parts, each named after the particular merchandise sold therein

After the Persian wars the architectural treatment of the agora became much more monumental and lavish colonnades were frequently added to the older agorae, such as the Stoa of Attalus in the agora at Athens (between 159 and 138 B C) Of these later agorae many fine examples exist in various states of preservation. That at Ephesus was a square court over 500 ft on the side, connected with additional courts containing a gorgeous nymphaeum and the lavish Roman library At Priene the agora was traversed by streets but arranged so that through traffic was carried below on a detour. The substructures of the hillside agorae at Aegaea and Alinda still remain almost complete. In these cases the agora on a high terrace had large storage warehouses below. The great terrace wall at Alinda, with its striking rusticated masonry and large Roman arched openings, is especially impressive Most important of all, however, is the agora at Assus, of which extensive remains still exist in a good state of preservation, with enough fragments to enable a complete and definitive restoration. This, like the two foregoing, is a hillside agora, supported on massive terrace walls. Its main architectural feature is the great two-storey portico.

The forum at Pompeii, in plan, dates probably from the time of the Greek colony It therefore forms a connecting link between the Greek agora and the Roman forum With its surrounding colonnade, its basilica, the city temple at one end and the civic offices at the other, it gives a perfect picture of what the typical Greek agora was like. (For the agora at Athens *see* ATHENS.)

For a general discussion, *see* Cornish, *Dictionary of Greek and Roman Antiquities* (1898). The typical plan given is, however, absurd through its obvious misinterpretation of a passage in Pausanias in which he refers to colonnades separated by streets. Pausanias plainly refers to streets traversing the agora and thus dividing the enclosing colonnade into separate sections. *See* also S. H Bacon and Robert Koldewey, *Expedition of the Archaeological Institute of America* (investigations at Assus in 1881–83, 1902–21); Anderson and Spiers, *Architecture of Ancient Greece,* new ed by W. B. Dinsmoor (1927).

AGORACRITUS, a Parian and Athenian sculptor of the age of Pheidias, and said to have been his favourite pupil. His most noted work was the statue at Rhamnus of Nemesis, by some

attributed to Pheidias himself. Of this statue part of the head is in the British Museum; some fragments of the reliefs which adorned the pedestal are in the museum at Athens.

AGORANOMI. Magistrates in Greece, whose duties were similar to those of the aediles of Rome. In Athens there were ten, five of whom took charge of the city and five of the Peiraeus. They maintained order in the markets, tested weights and measures, collected the harbour dues, and enforced the shipping regulations.

AGORDAT, a town of Eritrea, North-east Africa, on the route between Massawa and Kassala. It is connected by a railway, 194 miles long, with Massawa, via Asmara. At Agordat (Dec. 21, 1893) Italians under Colonel Arimondi defeated the followers of the khalifa. (*See* ERITREA and SUDAN; *History*)

AGOSTINO and **AGNOLO** (or ANGELO) **DA SIENA,** Italian architects and sculptors in the first half of the 14th century. Della Valle and other commentators deny that they were brothers They certainly studied together under Giovanni Pisano, and in 1317 were jointly appointed architects of their native town, for which they designed the Porto Romana, the church and convent of St. Francis, and other buildings. On the recommendation of Giotto (q.v), they executed in 1330 the tomb of Bishop Guido Tarlati in the cathedral of Arezzo, which Giotto had designed. This monument was destroyed by the French under the duke of Anjou.

AGOSTINO or **AGOSTINI (AUGUSTINUS), PAOLO** (1593–1629), Italian musician, was born at Valerano, and studied under G. B Nanini. He succeeded Ugolini as conductor of the pope's orchestra in St Peter's. Among his compositions is an *Agnus Dei* for eight voices, once greatly admired.

AGOULT, MARIE CATHERINE SOPHIE DE FLAVIGNY, COMTESSE D' (1805–1876), French author, whose *nom de plume* was "Daniel Stern," was born at Frankfurt-on-Main on Dec. 31, 1805. Her father was a French officer who had served in the army of the emigrant princes, and her mother was the daughter of a Frankfurt banker. She was married in 1827 to the comte Charles d'Agoult. In Paris she gathered round her a brilliant society which included Alfred de Vigny, Sainte-Beuve, Ingres, Chopin, Meyerbeer, Heine and others She was separated from her husband, and became the mistress of Franz Liszt. During her frequent travels in Switzerland, France and Italy she made the acquaintance of George Sand, and figures in the *Lettres d'un voyageur* as "Arabella." By Liszt she had three children—a son who died young; Blandine, who married Émile Ollivier; and Cosima, who married first Hans von Bulow and later Richard Wagner. The story of her breach with Liszt is told under a very slight disguise in her novel *Nélida* (1845). On her return to Paris in 1841 she began to write for the *Presse,* and later for the *Revue des deux Mondes* and the *Revue indépendante.* Mme. d'Agoult was an ardent apostle of the ideas of '48, and from this date her *salon,* which had been literary and artistic, took on a more political tone; revolutionists of various nationalities were welcomed by her, and she had an especial friendship and sympathy for Daniele Manin. In 1857 she produced a national drama, *Jeanne Darc,* which was translated into Italian and presented with success at Turin. The most important section of Daniel Stern's work is her political and historical essays: *Lettres républicaines* (1848), *Esquisses morales et politiques* (1849), *Histoire de la Révolution de 1848* (1850–1853), *Histoire des commencements de la République aux Pays-Bas* (1872). Mme. d'Agoult died in Paris March 5, 1876.

See Mme. d'Agoult, *Mes Souvenirs* (1806–33), 1877; J. Mazzini, *Lettres de Joseph Mazzini à Daniel Stern* (1872); A. Pommier, *Madame la comtesse d'Agoult* (Daniel Stern), 1876; A. Cuvillier Fleury, *Portraits révolutionnaires,* vol. i. (1889); A. Ungherini, "Daniel Stern" in the *Revista repubblicana* (1880, No. 9); S. Rocheblave, *Une Amitié romanesque, George Sand et Madame d'Agoult* (1895); R. Bory, *Une Retraite romantique en Suisse; Liszt et la comtesse d'Agoult* (1923), with an appendix containing letters; Daniel Oliver, *Mémoires de la comtesse d'Agoult: 1833–54* (1926).

AGOUTI or **AGUTI** (a-gōō-tĕ), rodent (*Dasyprocta aguti*), of the size of a rabbit, common to Trinidad and Guiana, and classed in the family *Caviidae.* Agoutis are slender-limbed rodents, with five front and three hind toes (the first front toe very minute), and short tails. The hair is coarse and rough; the colour being rufous brown. In habits agoutis are nocturnal, dwelling in forests, where they conceal themselves during the day in hollow tree-trunks, or in burrows among roots. They take readily to water and swim well. Their food comprises leaves, roots, nuts and other fruits. They do much harm to plantations of sugar-cane and bananas.



BY COURTESY OF N Y ZOOLOGICAL SOCIETY

THE AGOUTI, COMMON IN EASTERN SOUTH AMERICA, AND DESTRUCTIVE TO SUGAR CANE AND BANANA PLANTS

AGRA, the headquarters of a district and division in the United Provinces, was for long periods the capital city of India. It stands on the Jumna which, though now at this point a mere trickle in the dry season, was formerly one of the chief arteries of commerce with the rest of India and at the same time a powerful frontier defence. Of the original Agra, which apparently lay on the left bank of the river, practically no traces remain The present city on the right bank was the creation of the Mohammedan conquerors. The earlier dynasties fluctuated between Delhi and Agra as their centre of power; but it was at Agra that Sikander Lodi (A.D. 1500) set up his court, deeming it the strategic point for holding in check his turbulent vassals to the south In 1526 the city was captured by Baber, the Koh-i-nur diamond being part of his booty. It was here that he decided to occupy India in permanence; here also that he died. It was his grandson Akbar who began to build the present fort (still by the people called Akbarabad), ruled India from within the walls, died in it, and was buried at Sikandra a few miles beyond the city gates. Agra fell from its pride of place when Aurangzeb moved to Delhi, and was never again the seat of monarchy. In the latter half of the 18th century, it was captured successively by the Jats, the Mahrattas, the Mohammedans and Scindhia; but it was finally taken by Lord Lake in 1803. After British rule was extended to upper India, it became the capital of the North-West provinces until at the close of the Mutiny the seat of that Government was transferred to Allahabad. The city is now a busy railway and commercial centre with cotton mills, gins and presses, flour mills and an important carpet industry. There are two large colleges and several other educational institutions, including a medical school for men and women; and the establishment of a university is under contemplation. Pop. in 1921, 185,532.

Although to travellers Agra is essentially the city of the Taj, it enshrines several other magnificent specimens of Mogul architecture, each perfect of its kind. The fort, with its lofty walls of red sandstone 1½m. in circumference, contains at least two such gems. Separated from each other by the main block of the buildings of the imperial court, stand on the north the Pearl Mosque, built by Shah Jahan, and on the south the Jahangiri Mahal or palace built by Akbar; the former unequalled for the beauty and purity of its proportions, material and constructive design in simple white marble; the latter a perfect adaptation of stately solidity and commanding symmetry of the Hindu style. If we leave the fort and cross the river, we find another gem of its kind in the tomb of Itmad-ud-Daulah, father of Jahangir's empress. Its architecture is transitional between the virile conceptions of Akbar and the poetic richness of Shah Jahan; elegant, elaborate and scholarly, it was the first triumph of marble inlaid work in direct imitation of Persian pottery decoration. Five miles from Agra is Sikandra, where Akbar was buried, though his remains were desecrated and scattered by Jat freebooters in later years. His tomb is a noble building in a noble setting, and the marble sarcophagus on its roof is strikingly impressive in its simple dignity. Far exceeding all the others in glory is the Taj, the most beautiful mausoleum in the world. It was built by Shah Jahan for his empress, who died in A.D. 1631; and from one of her titles, Taj Mahal or Crown of the Palace, it takes the name by which it is most generally known outside India. Built of pure white marble, it stands on a vast marble terrace, crowned by a great dome in the centre and smaller domes at each of its corners. From the angles of the terrace rise

four slender minarets. Subservient and supplementary to the glory of the outline is the beauty of the ornamentation. "All the spandrils of the Taj," writes Fergusson, "all the angles and more important architectural details are heightened by being inlaid with precious stones such as agates, bloodstones, jaspers and the like. These are combined in wreaths, scrolls and frets as exquisite in design as they are beautiful in colour, and relieved by the pure white marble in which they are inlaid, they form the most beautiful and precious style of ornament ever adopted in architecture."

The architect of the Taj was Ustad Isa, variously described as a Byzantine Turk, and as a Persian from Shiraz. The artificers engaged during the 17 years of its construction came from all



BY COURTESY OF CANADIAN PACIFIC STEAMSHIPS

THE TAJ MAHAL AT AGRA, ERECTED BY THE EMPEROR SHAH JAHAN AS A MAUSOLEUM FOR HIS EMPRESS WHO DIED IN A.D. 1631. THE ARCHITECT WAS USTAD ISA

parts of Asia and probably included a French goldsmith, Austin de Bordeaux.

The district of Agra has an area of 1,856 sq. miles. Its general appearance is that common to the Doab, a level plain intersected by watercourses with fringes of ravines. Its general elevation is estimated at from 650 to 700ft. above the level of the sea. The district is intersected by the Jumna, and is also watered by the Agra canal. The principal crops are millets, pulses, barley, wheat, cotton and a little indigo. The population in 1921 was 924,155.

The division of Agra has an area of 8,545 sq. miles. In 1921 the population was 4,182,825. It comprises the five districts of Aligarh, Muttra, Agra, Mainpuri and Etah.

AGRA CANAL, primarily an irrigation project opened in 1874, but widely used for navigation. It is supplied with water from the Jumna river and beginning at Okla, 10 m. below Delhi it passes through the districts of Delhi, Gurgaon, Muttra and Agra as well as the Bharatpur state. It finally joins the Banganga river about 20 m. below Agra.

AGRAM: *see* ZAGREB.

AGRAPHA, the name given to certain utterances ascribed, with some degree of certainty, to Jesus, which have been preserved in documents other than the Gospels, *e.g.*, Acts xx. 35; 1 Tim. v. 18; 1 Cor. vii. 10–12, and the Logia (*q.v.*) discovered in 1897 and 1903 at Oxyrhynchus.

BIBLIOGRAPHY.—*See* A. Resch, *Agrapha* (Leipzig, 1889); J. H. Ropes, *Die Sprüche Jesu* (Leipzig, 1896); and the article "Sayings" in J. Hastings's *Dictionary of Christ and the Gospels.*

AGRARIAN LAWS, law dealing with the disposal of the public land (*ager publicus*) of ancient Rome. No gratuitous disposition of state property could be made without the consent of the people. Hence many of the ordinances affecting the public land were laws (*leges*) in the strictest sense of that word. It is, however, convenient to consider in this article all the regulations that were made for the administration of the public land by the executive authorities, as well as by the people during the republic, and by the commands of the emperor, which had the force of law during the principate.

Public land was the prize of conquest and was one of the means of defraying the expenses of state administration. For this purpose land was often leased on the condition of the payment of dues. But it was made to fulfil another purpose, the satisfaction of the individual needs of poorer citizens. To this end land was assigned, and on assignment ceased to be the property of the state. But it often happened that the state was not disinterested in such acts of assignment. It gained security and territorial control by planting garrisons in conquered country, and it relieved itself of the necessity of providing for its poorer classes by state-aid. The connection between agrarian legislation and colonization can be seen at once, and also the two aspects of colonization—the military and the social. These two objects were connected throughout the whole of the earlier period of Roman agrarian assignation. After the time of the Gracchi social motives continued to be operative when military precautions had ceased to be necessary. One of the motives which prompted infant Rome to war with her neighbours was the land-hunger of her citizens. This hunger she satisfied after conquest by annexing a portion of the enemy's territory. The amount thus confiscated varied. It was usually a third, but sometimes a half or even two-thirds, and after the fall of Capua in the Second Punic War the whole territory of the state was annexed. By the close of the 2nd century B.C. one-half of the land of Italy belonged to Rome whether in private ownership or as the property of the state. Annexation was carried on in the provinces on a smaller scale; but Rome retained as domain-land much of the territory of communities which had been destroyed (*e.g.*, Carthage and Corinth), and the estates of former kings. This peculiar property of the Roman state in the provinces must be carefully distinguished from the general overlordship which Rome was supposed to hold over all provincial soil, expressed in the statement that provincials had only possession or usufruct of land.

Methods of Handling Public Land.—Such portions of the territories of conquered cities as were not claimed by Rome were left in the possession of these cities. If the city was a federate state (*civitas foederata*) this possession was guaranteed by a treaty; if it was a free city, the guarantee was made by charter; where Rome had marked out territory for assignment to her own citizens, but where, in or near the limits of the assignment, some of the land had been left in the hands of its former proprietors, such land was noted in the state registers as *redditus veteri possessori.*

The State dealt in two ways with such land as it retained. It alienated it, in exchange for a price or gratuitously; or it kept it as a source of revenue, whether on lease or on some system of remunerative occupation. The land might be sold for the benefit of the treasury. Typical instances of this treatment are furnished by the sale of some Campanian land during the Second Punic War. The censors may have directed the sale, but it was executed by the quaestors as the regular officials of the treasury. Hence such land was described as *ager quaestorius.* The land was sold in definitely marked out plots, and when this sale had been effected the lots fell under the absolute ownership of their purchasers.

The second mode of alienation was that by assignation. Lands thus assigned were known as *agri dati adsignati.* The gift on the part of the State was gratuitous, and ownership passed wholly to the assignee. The land so given was definitely surveyed, marked out, and registered. Such an assignment might take one of two possible forms. It might be the means of establishing a new "plantation" (*colonia*), with some independent organization of its own, or it might be the means of providing allotments for individuals who remained domiciled at Rome or in some already existing municipality. The amount granted to individuals in assignments of both types varied from time to time. It was reckoned in terms of the *iugerum,* which was approximately five-eighths of an English acre. The earliest and smallest assignment was two *iugera:*

14 *iugera* was the maximum amount granted before the time of Ti. Gracchus (133 B.C.), and it was held by representatives of the old school that seven *iugera* were as much as any frugal Roman should want. The division was carried out by commissions appointed by the people. The land which the State retained as *ager publicus* was always placed in the hands of individuals, who occupied it in some manner remunerative to the State. These individuals (*possessores*) were never regarded as owners of the land thus occupied. It remained the property of the State, was held without a contract (*precario*), and could be resumed by the State at will. But though the tenants had no claim against the State, their ownership could be defended against all other claimants; from an early date the praetor's possessory interdict was used to protect all occupiers, provided their tenure had not been acquired by force (*vi*), by seizure of land in its occupiers' absence (*clam*), or by mere permission of the previous holder to occupy (*precario alter ab altero*). Tenants of this type could transfer their land by inheritance, and the land was accepted as security by creditors. This kind of occupation, therefore, though clearly distinguished from ownership (*dominium*), was yet regarded as a perfectly secure form of tenure. All occupiers of public land paid dues to the State through a state contractor (*publicanus*). These dues varied in amount and in the method of their collection. We learn from Appian that the ordinary dues paid by occupiers of arable land in Italy were one-tenth of seed crops and one-fifth of plant produce. Owners who turned cattle or sheep on pasture land belonging to the state also paid fixed dues to the treasury. The occupiers of the Roman public land in Campania paid a large rent. The conditions of the tenure of the Roman public land in Africa are known to us from the *Lex Agraria* of 111 B.C. The *publicanus* is the middleman between the State and the *possessor* and purchases from the censor the right of collecting dues. The law places no restriction on bargaining between the censor and the *publicanus*, but enacts that no *possessor* or *pastor* shall ever be required by the *publicanus* to pay more than the amount prescribed by the censors of 115 B.C. These conditions may be regarded as typical for the occupation of public lands. When Cicero speaks of public land as let on lease (*locatus*) by the censor, he refers to the leasing of the taxes to a *publicanus* for a fixed period, and not to the letting of the land. This seems clear from a passage (*In Verr.* iii. 6. 12) where he speaks of land in Sicily which had been restored by Rome to former owners as being leased. The land itself could not be leased by Rome if it belonged not to Rome but to the Sicilian inhabitants; but the collection of the revenues due to Rome could be so leased to *publicani* (*q.v.*). The same explanation would apply to Cicero's statements that the Campanian land was let on lease by the censors. Cicero's repeated statement that the Campanian land was expressly exempted from the legislation of the Gracchi shows that there was not sufficient distinction between the Campanian tenure and that of other public land in Italy to make this definite exception by name superfluous. The Sempronian law could obviously not touch land which the State had leased to occupiers on the basis of a definite contract. It seems certain that in every case the *possessor* occupied *precario*, and that only in the bargain between the censor and the middleman was there room for contract. Thus the State was justified in the claim to resume public land which it made in many of the agrarian laws.

Survey of Agrarian Legislation.—The earliest agrarian measures of which we have any record are the distributions to poor citizens of land conquered in war, which later authorities attribute to Numa and Servius Tullius. Such assignments were a voluntary surrender on the king's part of his own portion of the spoils. The agrarian law of Spurius Cassius (486 B.C.) distributed *ager publicus* among the plebeians. Another agrarian law proposed by the tribune Lucius Icilius in 456 B.C. regulated the tenure of public land on the Aventine. In 376 B.C. the tribunes Licinius and Sextius introduced into their laws, for the promotion of the privileges of the *plebs*, a clause enacting that no more than 500 *iugera* of land should be occupied by a single cultivator; the law also enacted that only 100 cattle and 500 sheep might be turned by one owner on the public pastures. But it failed of its object because it did not provide any adequate machinery for the resumption by the state of land held in excess of the prescribed amount, and was therefore easily evaded. The next agrarian law was a measure dealing with lands conquered from the Senones (*q.v.*) and Picentines. In 232 B.C. C. Flaminius, tribune of the *plebs*, proposed to resume these lands for the state, although they were already occupied by large landholders, and to distribute them in allotments to poor citizens. The measure met with much opposition from the richer classes, and did not gain the sanction of the senate; but C. Flaminius ignored constitutional usage and brought it direct before the council of the *plebs*, by which it was made law. In 133 B.C. the tribune Tiberius Gracchus (*q.v.*) re-enacted the earlier measure of Licinius and Sextius, with the additional provisions that each owner might occupy 250 *iugera* for each son, in addition to the original 500, and that a commission of three (*III. viri agris dandis adsignandis*) should be appointed to carry out the terms of the law He also enacted that the land occupied in excess of the prescribed amount, and on that account resumed for the State by the land commission, should be distributed in inalienable lots to poor citizens. Subsequent modifications of those provisions which dealt with the powers of the land commission led to a re-enactment of the whole by C. Gracchus (*q.v.*), the brother of Tiberius, tribune in 123 B.C. But within 15 years from the tribunate of C. Gracchus the whole of his law had been rendered null by three further enactments. The first of these permitted the sale of land allotted under the law, which thus tended to return into the hands of its former occupiers as private property, which the State had no longer any right to resume. The second abolished the commission appointed to carry out the terms of the law, thus putting a stop to further resumption and distribution, and also transformed existing occupiers into owners of the land they occupied, paying only a small due to the treasury. The third abolished the payment. That law belonged to the year 111 B.C.

From that time forward a change came over land legislation. The ordinary public land in Italy, in the hands of occupiers, which had given rise to all the agrarian legislation between 376 and 111 B.C. had practically ceased to exist. The Campanian land still remained, but the same reasons which led to its exemption from the Gracchan legislation seem to have continued to protect its holders until 63 B.C. In the meantime several agrarian laws were passed which provided for the distribution of land placed in some other way at the disposal of the State. In 100 B.C. Apuleius Saturninus (*q.v.*) tribune, proposed the allotment of lands recently taken from the Cimbri in Gaul. This law was passed but eventually declared null by the senate, with the rest of Saturninus's laws. A more dangerous precedent was set by Sulla in his dictatorship (82–81 B.C.). He was the first to confiscate the lands of his political opponents and of communities which had resisted him and, treating them as *ager publicus*, assign them to his veterans as a prize. This example was followed by Octavian (Augustus) and Antony (M. Antonius) after their proscriptions in 43 B.C. A third method of providing land for distribution was that adopted by Servilius Rullus (*q.v.*) in 63 B.C. His bill enacted that land should be purchased in Italy with money gained by the sale of Roman territories abroad, and allotted to citizens. A commission of ten (*X viri agris dandis adsignandis*), annually elected by nine out of the 35 tribes, was to carry out the terms of the law. Rullus also ventured to propose the distribution of the Campanian land which had hitherto been respected by all agrarian reformers. It was chiefly on this ground that Cicero in his three speeches on the Agrarian law succeeded in exciting such a general feeling against it that it was eventually withdrawn In 60 B.C. the tribune L. Flavius brought forward a bill for the distribution of lands to Pompey's veterans. The Campanian land was certainly to be included in the distribution, and it is clear from Cicero that the bill in some way dealt violently with the rights of private owners. It also, however, enacted that land should be purchased by the State with the wealth which Pompey's conquests had brought into the treasury. The last proposal was supported by Cicero, but the bill seems to have been dropped, only to reappear in more moderate form in the following year. A consular bill, the *lex Iulia Campana*, was passed by Julius Caesar in 59 B.C., which provided for the settlement of Pompey's veterans on the Campanian land, and other lands pur-

chased by the state from private owners in Italy with the full consent of the latter. In its original form, the bill omitted all reference to the Campanian land, which seems to have been included by Caesar in the distribution only when the continued and unreasoning opposition of the senate had goaded him to extreme measures. A commission of twenty was to be appointed to carry out the law, from which Caesar himself was expressly excluded. This measure finally settled the question of the Campanian land, which now passed out of the category of *ager publicus*. The last agrarian law of the republic was that passed in 44 B.C. on the proposal of the consul M. Antonius. We have no detailed account of the measure, but it seems to have provided grants of land for veterans, and was to be administered by seven commissioners. The law was afterwards cancelled by decree of the senate.

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AGRARIAN MOVEMENT: *see* LAND TENURE: *Economic and Agrarian Aspects.*

AGREDA, MARIA FERNANDEZ CORONEL, ABBESS OF, known in religion as Sor (Sister) Maria de Jesus (1602–1665), was born at Agreda, on the borders of Navarre and Aragon, on April 2, 1602. All her family were powerfully influenced by the ecstatic piety of Spain in that age. From childhood she experienced ecstasies and visions. When she was fifteen the whole family entered religion. Maria, her mother and sister established a Franciscan nunnery in the family house at Agreda, which, when Maria's reputation had extended, was replaced by the existing building. She began it with one hundred reals (one pound sterling) lent her by a devotee, and it was completed in fourteen years by voluntary gifts. Much against her own wish, we are told, she was appointed abbess at the age of 25. Though the rule required the abbess to be changed every three years, Maria remained the effective ruler of Agreda till her death. In the earlier part of her life, while the Franciscan, Francisco Andres de la Torre, was her confessor, she wrote an *Introduction to the History of the Most Blessed Virgin.* It was destroyed by the direction of another confessor. Later on, under the guidance of her Franciscan confessor, Andres de Fuen Mayor, she wrote *The Mystic City of God.* It is an extraordinary book, full of apocryphal history, visions, and scholasticism. In 1642 she sent to Philip IV. an account of a vision of a council of the infernal powers for the destruction of Catholicism and Spain. The king visited her when on his way to Aragon to suppress the rebellion of Catalonia. A long correspondence, which lasted till her death on March 29, 1665, was begun. The king folded a sheet of paper down the middle and wrote on the one side of the division. The answers were to be written on the other and the sheet returned. How far Maria was only the mouthpiece of the Franciscans must of course be a matter of doubt. Her correspondence was apparently suspended whenever her confessor was absent. The letters are in excellent Spanish, are curious reading, and are invaluable as illustrations for the second part of the reign of Philip IV.

The correspondence of Sor Maria with the king has been published in full by Don F. Siluela, *Cartas de la Venerable Madre Sor Maria de Agreda y del Señor Rey Don Filipe IV.* (1885). *The Mystic City of God* continued to be much in favour with supporters of the dogma of the Immaculate Conception. It appeared in Madrid in 1668, with a biographical introduction by Samaniego, has been often reprinted, and was translated into French and Italian. It was for a time reserved by the Index, both Spanish and Papal, but was taken off by the influence of the Franciscans and of Spain, the chief supporters of the Immaculate Conception. An account of Maria de Agreda will be found in the *Tracts* of Michael Geddes (1706), vol. iii., written by a competent critic and Anglican divine of the 18th century who detested "enthusiasm."

AGRÉMENTS (Ital. *abbellimenti;* Ger. *Manieren;* Eng. *ornaments*), in music, are supplementary notes, or embellishments, introduced for the purpose of enriching, elaborating or otherwise altering the effect of the phrase or melody to which they are applied. As employed in connection with the older types of music, alike vocal and instrumental, they assumed a large variety of forms (acciaccatura, appoggiatura, arpeggio, mordent, shake, turn, and so on) which in course of time became definitely standardized and so formed an essential part of the music, although nominally left to the discretion of the performer and indicated, if at all, only by conventional signs.

AGRIANES, a warlike tribe anciently inhabiting Upper Macedonia, and part of what is now south-western Bulgaria. They provided some of the most active and dangerous of the troops of Alexander's army, distinguishing themselves at the Granicus, Issus and on the banks of the Jhelum.

AGRICOLA, GEORG (1490–1555), German scholar and man of science, known as "the father of mineralogy," was born at Glauchau in Saxony on March 24, 1490. The name Agricola is the Latinized form of the German Bauer. His early studies were in philology, but he took his degree in medicine in Italy. On his return to Germany he settled as practising physician in the Joachimstal, a centre of mining and smelting works, his object being partly "to fill in the gaps in the art of healing," partly to test what had been written about mineralogy by careful observation of ores and the methods of their treatment. *Bermannus, sive de re metallica dialogus,* the first attempt to reduce to scientific order the knowledge won by practical work, brought Agricola into notice. (This work was translated by Mr. and Mrs. Herbert Hoover.) In 1530 Prince Maurice of Saxony appointed him historiographer with an annual allowance, and he migrated to Chemnitz, the centre of the mining industry, in order to widen the range of his observations. His chief interest was in mineralogy; but he occupied himself also with medical, mathematical, theological, and historical subjects, his chief historical work being the *Dominatores Saxonici a prima origine ad hanc aetatem,* published at Freiberg. In 1544 he published the *De ortu et causis subterraneorum,* in which he laid the first foundations of a physical geology and criticized the theories of the ancients. In 1545 followed the *De natura eorum quae effluunt e terra;* in 1546 the *De veteribus et novis metallis,* a comprehensive account of the discovery and occurrence of minerals; in 1548 the *De animantibus subterraneis;* and in the two following years a number of smaller works on the metals His most famous work, the *De re metallica, libri xii*, was published in 1556, though apparently finished several years before, since the dedication to the elector and his brother is dated 1550. It is a complete and systematic treatise on mining and metallurgy, illustrated with many fine and interesting woodcuts and containing, in an appendix, the German equivalents for the technical terms used in the text. He died at Chemnitz on Nov. 21, 1555.

See article by Gümbel in *Allgem. Deutsche Biog.* (1875); F. A. Schmidt, *Georg Agricola's Bermannus mit Einleitung* (Freiberg, 1806).

AGRICOLA, GNAEUS IULIUS (A.D. 37–93), Roman general, father-in-law of the historian Tacitus, was born on June 13, A.D. 37 (according to others, 39) at Forum Iulii (Fréjus) in Gallia Narbonensis. His grandfathers were of equestrian rank; his father became a senator, but was put to death by Caligula. Agricola was brought up by his mother at Massilia. He entered the army and served (59) under Suetonius Paulinus in Britain. In 61 he returned to Rome, where he married Domitia Decidiana, a Roman lady of distinction. In 63 he was quaestor in Asia, in 65 tribune, in 68 praetor, and when Vespasian was proclaimed emperor, he immediately declared himself his supporter. In 70 he was appointed to the command of the 20th Legion in Britain, then stationed at Deva (Chester). On his return to Rome, at the end of three years, he was made censor, raised to the rank of patrician, and appointed governor of Aquitania (74–78). Appointed *consul suffectus* in the following year, he was admitted into the college of pontiffs and made governor of Britain. In the same year he betrothed his daughter to Tacitus.

Agricola spent at least seven years in Britain. After conquering the Ordovices in North Wales and the island of Mona (Anglesey), during the next two years he advanced to the Taüs (Tay; others read Tanaus, perhaps the north Tyne), and in his fourth campaign fortified the country between Clota and Bodotria (the firths of Clyde and Forth) as a protection against the attacks of the Caledonians. Having explored the coasts of Fife and Forfar, he gained a decisive victory over the Caledonians under Galgacus at the

Graupian hill. (*See* BRITAIN: *Roman.*) Between campaigns he busied himself in helping forward the Romanization of his province. But his successes had aroused the suspicion of Domitian. He was recalled to Rome, where he lived in retirement, refusing the proconsulship of Asia. He died in 93, poisoned, it was rumoured, by the emperor's orders.

See Tacitus, *Agricola;* Urlich's *De Vita et Honoribus Agricolae* (1868); Dio Cassius, xxxix. 50, lxvi. 20; T. Mommsen, *Provinces of the Roman Empire* (Eng. trans., 1886), i. 183–184, 194.

AGRICOLA, JOHANNES (originally Schneider, then Schnitter) (1494–1566), German Protestant reformer, was born April 20, 1494 at Eisleben, whence he is sometimes called *Magister Islebius.* He studied at Wittenberg, where he met Luther. In 1519 he accompanied Luther to the great assembly of German divines at Leipzig, and acted as recording secretary. He taught and preached the Lutheran doctrine in Frankfurt, Eisleben and Wittenberg, but in 1536 an old controversy broke out more violently than ever. Agricola was the pioneer of the Antinomian heresy, which maintained that while the unregenerate were still under the Mosaic law, Christians were entirely free from it, being under the gospel alone. During the bitter controversy with Luther that followed, Agricola in 1540 left Wittenberg secretly for Berlin, where he addressed a letter to the elector of Saxony, which was generally interpreted as a recantation of his views Luther, however, was not satisfied, and Agricola remained at Berlin, where Joachim II. of Brandenburg appointed him court preacher and general superintendent. With Julius von Pflug and Michael Helding, he prepared the Augsburg Interim of 1548. He endeavoured in vain to appease the Adiaphoristic controversy (*see* ADIAPHORISTS). He died during an epidemic of plague on Sept. 22, 1566.

BIBLIOGRAPHY—*See* Cordes, *Joh. Agricola's Schriften möglichst verzeichnet* (Altona, 1817), *Life* by G. Kawerau (1881), who also wrote the notice in Hauck-Herzog, *Realencyk. fur prot. Theol.*

AGRICOLA, RODOLPHUS (properly ROELOF HUYSMANN) (1443–1485), Dutch scholar, was born at Baflo near Groningen, Aug. 23 1443. He was educated at Louvain, Paris, and at Ferrara, where he attended the lectures of the celebrated Theodorus Gaza (1400–78) on the Greek language. In 1482, on the invitation of Johann von Dalberg, bishop of Worms (1445–1503), he accepted a professorship at Heidelberg, and for three years delivered lectures there and at Worms on the literature of Greece and Rome By his personal influence much more than by his writings he did much for the renaissance of learning in Germany; and Erasmus and other critics of the generation immediately succeeding his own are full of his praises. He died at Heidelberg on Oct 28 1485. His principal work is *De inventione dialectica, libri iii*, in which he attacks the scholastic philosophy of the day. His collected works were edited by Alard (Cologne, 1539).

See T. F. Tresling, *Vita et Merita Rudolphi Agricolae* (Groningen, 1830); v. Bezold, *R. Agricola* (Munchen, 1884); and Ihm, *Der Humanist R. Agricola, sein Leben und seine Schriften* (Paderb., 1893).

AGRICULTURAL ARTICLES. Agriculture is treated in these pages under various headings, an enumeration of which will help the reader to consult any part of the subject.

For a general account of agriculture, reference should be made in the first place to the article AGRICULTURE: *A General Survey,* and to the sections on agriculture appended to the articles on the different nations.

As to the operations of agriculture, *see* the articles CULTIVATION; SOIL; SOWING; FERTILIZERS; DRAINAGE; PLANT BREEDING; ROTATION OF CROPS; DRY FARMING; ARABLE; WEED DESTRUCTION; REAPING; THRESHING; AGRICULTURAL MACHINERY AND IMPLEMENTS; ELECTRICAL POWER IN AGRICULTURE; TRACTORS; etc.

The business and organization of agriculture will be found treated under AGRICULTURAL CO-OPERATION; AGRICULTURAL CREDIT; AGRICULTURAL ECONOMICS; AGRICULTURAL EDUCATION; AGRICULTURAL INSURANCE; AGRICULTURAL ORGANIZATION, and AGRICULTURAL RESEARCH. Reference should also be made to the articles on ALLOTMENTS; SMALL HOLDINGS; FARM ORGANIZATION AND EQUIPMENT; FARM MANAGEMENT, and FARM VALUATION. LAND TENURE is treated under that heading, and there is an article on FARM RENTS. The various institutions connected with agriculture are treated under the headings: INTERNATIONAL INSTITUTE OF AGRICULTURE; AGRICULTURE, CHAMBER OF; AGRICULTURAL SOCIETIES AND SHOWS; ALLOTMENTS ORGANIZATION SOCIETY, etc.

On the statistical side, articles will be found under AGRICULTURAL STATISTICS; AGRICULTURE, CENSUS OF, and AGRICULTURAL PRICES.

As to agricultural employment, the articles AGRICULTURAL LABOURER; AGRICULTURAL WAGES; AGRICULTURAL WAGES BOARD, and RURAL SOCIOLOGY should be consulted.

Coming to the products of agriculture, in addition to general articles entitled CEREALS and CROPS, each main product is given special treatment under its own heading. Thus, the cereals WHEAT, BARLEY, OATS, MAIZE are the subject of special articles. GRAIN PRODUCTION AND TRADE have lengthy treatment

ROOT CROPS are given a heading, while TURNIP, POTATO, MANGOLD, etc , have separate articles

There are also articles on GRASS AND GRASSLAND, HAY and LUCERNE.

As to animals and meat, articles may be consulted on CATTLE, SHEEP, PIG, BEEF, MUTTON, PORK, BACON AND HAM, in addition to the general account under MEAT. There are articles on FEEDING STUFFS and ENSILAGE.

As to dairy work, reference should be made to DAIRIES AND DAIRY FARMING (a general account), and to the articles BUTTER, CHEESE and MILK.

On special subjects, articles will be found under EGGS, FRUIT FARMING, FLOWER FARMING, FLAX, HOPS, BEET, BEE-KEEPING, POULTRY AND POULTRY FARMING.

Finally, the exceedingly important subject of agriculture in the tropics, upon which the livelihood and daily bread of a large section of the world's population may come to depend, will be found treated under the heading TROPICAL AGRICULTURE, while separate headings are provided for tropical and sub-tropical products such as TEA, COFFEE, COCOA, JUTE, RUBBER, GUTTA PERCHA, HEMP, TOBACCO, ARROWROOT, etc

AGRICULTURAL BUSINESS METHODS: *see* FARM ORGANIZATION AND EQUIPMENT; FARM MANAGEMENT.

AGRICULTURAL CO-OPERATION. The development of agricultural co-operation has taken widely different courses in various countries according to their specific needs. The main difference to be observed is between countries which are primarily producers of agricultural commodities for export, and those which produce mainly for home consumption In the former, the co-operative movement has chiefly concentrated upon the organization of marketing; in the latter—apart from the development of rural credit and insurance—mainly upon the purchase of farm requisites, or the formation of co-operative dairy, bacon or other producing societies Although this broad distinction holds good, it is nevertheless true that practically all types of co-operation are to be found to a greater or lesser extent in the principal agricultural countries.

Co-operation in Great Britain.—Agricultural co-operation in Great Britain may be said to have begun with isolated experiments during the 19th century, but very little resulted from these early attempts. The Agricultural Organization Society in 1901 was the centre of the movement from its formation until it was wound up in 1924 During this period a considerable number of societies were established, as is shown by the fact that their number rose from 33 in 1901 to 1,558 in 1920, and the total membership from 517 to over 200,000.

The post-war period brought forth a considerable intensification of the efforts to promote co-operation amongst British farmers, and the Agricultural Organization Society was assisted by grants from the State. A number of new societies were formed between 1918 and 1924. Unfortunately these efforts met with only limited success, and the creation of new societies was largely offset by a considerable number of failures. This was due to several factors—to the rapid fall in agricultural prices which took place after the spring of 1920, to the fact that a large number of the

new societies were small and financially weak and were therefore unable to secure competent management, to the failure of many societies to adopt certain principles in co-operation which in other countries had proved to be essential, and to the lack of interest shown by farmers themselves.

Amongst agricultural co-operative societies in Great Britain the most successful have been the relatively large-scale societies concerned with the supply of farm requisites, a few dairy societies, and a certain number of others engaged in the sale of eggs, wool, fruit and vegetables, etc. A full description of the requisite societies may be found in the report on "The Co-operative Purchase of Agricultural Requisites" (Economic Series, No. 5) and of societies engaged in the marketing of agricultural produce in the report on "Co-operative Marketing of Agricultural Produce in England and Wales" (Economic Series, No. 1), both published by H. M. Stationery Office.

Mention should be made of the formation of the Agricultural Wholesale Society in 1918, which was an attempt to provide a central wholesale organization from which the local requisite societies could obtain their supplies; its relation to the latter was similar to that between the co-operative wholesale societies and the retail consumers' co-operative societies. Such central wholesale societies had for some years been an integral part of the agricultural co-operative organization in several European countries, as will be seen below. Although the turnover of the Agricultural Wholesale Society amounted to no less than £1,800,000 in 1919, with the sharp fall in prices which began in 1920, the society was involved in difficulties, and for this and other reasons it failed and was brought to an end in 1924. (*See* AGRICULTURE)

In 1924 the total number of agricultural co-operative societies in Great Britain were 1,631 (including 52 societies connected with the fishing industry), having a total membership of 298,401.

Co-operation in Europe.—In western Europe, where the majority of countries are importers of food or are approximately self-supporting, the growth of co-operation has been mainly in the direction of developing rural credit societies (*see* AGRICULTURAL CREDIT) or of societies for the purchase of agricultural requisites, though often combining these functions with that of the sale of produce. But even here, Denmark, conducting a considerable export trade, has developed its marketing organizations on co-operative lines in addition to its highly organized system of supply societies; indeed it has been the model upon which many of the marketing organizations in the newer countries have been based.

Leadership in agricultural co-operation belongs to Germany and Denmark. Of the 38,000 agricultural co-operative societies in Germany in 1924, there were 19,000 rural banks, 4,700 purchase and sale societies, 3,500 dairies and 10,000 societies for other purposes, together with 98 "central" societies. In 1920 Denmark possessed more than 5,000 co-operative associations, including over 1,600 consumers' societies, 1,100 creameries, 40 bacon factories, besides a number of central associations, export associations and co-operative bodies for various minor purposes.

A general characteristic of the European co-operative movement is that both in its origin and subsequent development there has been a certain idealism which has given it a special vitality. Thus, in Denmark, the movement was associated with a moral educational revival accompanied with the development of the people's high schools; in Belgium the co-operative organization had a basis of religious and social culture; in Germany the birth of the co-operative credit movement was largely a question of the social regeneration of the rural population. In most of these cases it started with the clubbing together of a small number of villagers to carry out a common object, whether it was the purchase or sale of produce, or the provision of credit. But, although built up upon this small foundation, the movement has gradually assumed a different character through the consolidation of the small units into large federated organizations, the gradual centralization of control, and the development of many of the features of big-scale enterprise. Indeed, federation describes in a word the modern development of the co-operative movement in most agricultural countries.

The main divisions of the co-operative movement in Europe are supply, production, marketing, credit and insurance. Other minor, but important, branches, are the co-operative use of farm machinery, cattle breeding, the supply of electric light and power, the manufacture of potato meal and potato alcohol, forestry and fishing.

Supply Societies.—These have aimed at purchasing agricultural requisites in bulk at wholesale prices and delivering them to members at cost. They have been widely developed upon "Rochdale" principles, the goods being delivered to members at certain fixed prices and the profits of the societies being distributed amongst its members as a "dividend" in proportion to the gross amount of their purchases. This principle applies in many European countries, though an exception is to be found in France, where the profits of the "syndicats" go to the formation of a reserve fund which belongs to the members equally, irrespective of the amount of their purchases. The recent tendency in the development of these societies is to federate the local distributive societies to central wholesale societies on the general plan of the British distributive movement.

In Germany, the pioneer society in the movement towards wholesale federation was the Haas Society at Insterburg, founded in 1871. This example was subsequently followed by the rest of Germany, membership of the provincial wholesales being usually confined to the local distributive societies. The first permanently successful federation amongst consumers' stores in Denmark started in 1884 with the formation of the Co-operative Wholesale Society of Denmark amongst the societies on Zealand (Själland), for the supply of farm requisites as well as ordinary household requisites. Four years later a similar wholesale society was started in the Jutland Peninsula, and in 1896 these two were amalgamated into one organization—the Co-operative Wholesale Society of Denmark Since then it has made remarkable growth, the number of consumers' societies which were members of the wholesale having risen from 310 in 1896 to 1,250 in 1910 and 1,805 in 1922. The Co-operative Wholesale Society is a member of the Scandinavian Co-operative Wholesale Society, which is a joint buying organization for the wholesale societies of Denmark, Norway and Sweden.

In Switzerland very similar progress has been made. The Verband-Ost-Schweizerischer-landwirtschaftlicher-Genossenschaften was formed as a central society. The business was divided into two departments—the agricultural, dealing with seeds, manures, cattle food, etc., and the store department, dealing with household requisites. The organization has also undertaken the sale of members' produce, though its supply side remains its more important function.

In France, the local, and more particularly the communal, "syndicats agricoles," have united in departmental unions, and these unions have formed the starting point of larger organizations —the "unions regionales." The growth of the movement in France may be judged from the fact that the number of syndicats rose from 39 in 1885 to 4,948 in 1910, and to 6,667 in 1914. In the latter year the total membership exceeded 1,000,000 persons.

Production Societies.—Probably the most successful branch of productive co-operation is to be found in the dairy societies existing in large numbers in all countries in which agricultural co-operation is firmly established. Leadership again belongs to Germany and Denmark, the former having as many as 3,491 co-operative dairies in 1924, while the latter had some 1,118 at the outbreak of the World War. Switzerland, France, Holland, Belgium and some of the countries of south-eastern Europe have also made considerable progress in recent years. Ireland, one of the most successful countries in developing co-operative creameries, had, in 1921, 336 of these societies. (*See* CREAMERIES.)

Mention should also be made of the bacon factories and egg and poultry societies, the former of which have been brought to a high degree of efficiency in Denmark. In 1922 there were 40 bacon factories, dealing with 2,215,000 pigs per annum. These are factories requiring a considerable amount of capital and provided with subsidiary plants for the disposal of by-products. They are usually financed by loans jointly and severally guaranteed by the

members, and receive the pigs from members under contracts binding them to supply their whole output for a period of years. The individual bacon factories are federated in the National Federation of Danish Co-operative Bacon Factories, with head offices in Copenhagen. One of the most remarkable achievements of this co-operative organization is the improvement of breed which it has enabled producers to bring about. A close study of the requirements of the British market (the principal export market) combined with scientific pig breeding under the supervision of the Government and the National Federation of Co-operative Bacon Factories, has led during the last 30 years to an improvement in quality, without parallel in other countries.

Marketing.—To Denmark also belongs the credit of co-operative marketing which has lately been developed on an enormous scale in the newer countries. The tendency is to establish strong central selling or export agencies of which local productive societies are members. The need for co-operation amongst the local co-operative societies gave the impulse towards the centralization of marketing, and the formation of provincial and ultimately national associations, but many difficulties were experienced before the structural development of the marketing organizations was complete. The turning point was reached when the principle of binding contracts for the supply of produce was adopted. Under this system the members of a local co-operative marketing association undertook to supply the whole of their produce to their society for a term of years The term ranges from one to as many as 20 years. On this firm foundation it has been found possible to build up the modern organization which markets the greater part of Danish agricultural produce. The local units, having a democratic membership control, are usually federated to the central society on "commodity" lines, that is to say, the federation of local societies is usually concerned with one agricultural commodity or commodities of closely allied character. Members are paid for produce by an advance at the time of delivery followed by a distribution of the profits at certain intervals. The produce thus delivered is classified and graded at the headquarters of the association, and the initial payment is made on the basis of this classification. For the purpose of marketing, the produce is "pooled." These principles—contracts, commodity organization and pooling—form the basis upon which a great part of Danish co-operative marketing is conducted, and have been widely copied in America, Canada, Australia and elsewhere.

The benefits which agriculture has derived from the European co-operative system are many. By the centralization of purchase and of sale, considerable economies have been effected, not merely in consequence of the elimination of the middleman and of bulk handling of the produce, but by the removal of the powers of exploitation which buyers and sellers of agricultural commodities not infrequently exercised over unorganized farmers. In organized marketing, large-scale handling has enabled scientific grading and standardization to be carried out, which in turn has led to the production of standard grades of produce and standard breeds of live stock on the farms. This again, as in the case of bacon, has led to a general improvement in the quality of farm produce, and has greatly added to the competitive strength of the central export associations in foreign markets. Their products have earned a reputation for uniformity and sustained high quality against which unorganized farmers have found it increasingly difficult to compete.

Canadian Wheat Pools.—Canada affords some remarkable examples of the development of large scale co-operative marketing enterprise, of which the wheat organization is the most significant. The Saskatchewan Co-operative Elevator Company (which handled in 1922–23 about one-fifth of the grain produced in the province, amounting to over 40,000,000 bu.) originated in the widespread discontent which was felt by farmers at the growing powers of the elevator companies. In 1924 it owned 425 country elevators, and as development took place it was found necessary for the institution to own terminal elevators and "hospital" elevators for treating damaged grain, and it has at the present time over 6,500,000 bu. of capacity in terminal and hospital storage.

Alberta followed the lead of Saskatchewan by setting up the Alberta Farmers' Co-operative Elevator Company in 1913, and four years later this company was taken over by the United Grain Growers, Limited. Within recent years, the movement towards centralized marketing has undergone further important developments. For the purpose of selling, an organization known as the Saskatchewan Co-operative Wheat Producers, Limited, was formed, with headquarters at Regina. Members of the company, who already form a substantial proportion of the wheat growers in the province, enter into a five years' contract to sell the wheat through the company. Very similar arrangements have been made in Manitoba and Alberta, the respective organizations being the Manitoba Co-operative Wheat Producers, Ltd., with headquarters at Winnipeg, and the Alberta Co-operative Wheat Producers, Ltd., with headquarters at Calgary. To complete the system of centralization only one step remained, namely, to unite the three provincial pools into one organization. This step has now been taken. The Canadian Co-operative Wheat Producers, Ltd , with headquarters at Winnipeg, was formed as the central selling agency for the above three producers' pools, and operated for the first time in respect of the 1924–25 crop. It then represented more than 127,000 farmers. The handling of milk, butter and cheese, the marketing of wool, live stock, poultry and eggs, fruit and other produce by co-operative enterprise has also made considerable advance in Canada since the World War.

Australian Wheat Pools.—The co-operative wheat pools of Australia are an example of a somewhat different character, since they came into being as the result of direct State action in order to meet the abnormal conditions during the War. They have brought about a fundamental change in the system of marketing wheat in that country The original scheme was compulsory. It was entered into by the Governments of the Commonwealth, the States of New South Wales, Victoria, South Australia and Western Australia for the purpose of realizing to the best advantage the wheat harvests of the respective States, and for making advances to farmers pending the realization. The scheme was first applied to the 1915–16 crop, and it was subsequently decided to deal with the succeeding crops on the same principle. This actually took place in respect of each crop up to that of 1920–21. The duty of realizing the crop was placed in the hands of the Australian Wheat Board, consisting of ministerial representatives of the Governments of the Commonwealth and the respective States, and one representative of the growers from each State.

In each State a local board or commission controlled the operations of the scheme within its area, and the local board effected all local sales, including sales to millers. Under arrangements with the Australian banks made by the Commonwealth and State Governments, advances were made to farmers upon delivery of their wheat at railway stations to the appointed representatives. The proceeds of the wheat sales were applied, as realized, in reduction of the bank over-drafts which had been used for the payment of advances and expenses. In 1922 the compulsory pooling of wheat was abandoned, but the principle of pooling the exportable surplus was continued on a voluntary basis under the respective State Governments. Under this scheme, as in the case of the compulsory scheme, each State ultimately receives, in respect of the grain actually shipped, the average net profit from the overseas realizations, which, after paying expenses, is distributed *pro rata* amongst the growers. This system of pooling remains in operation (though some doubt has been expressed as to its future), and the grain exported to the United Kingdom is distributed there through the Australian Wheat Pools Agency, consisting of two firms, which receive and market the whole of the wheat exported by the respective wheat pools (with the exception of Victoria, which sells independently) operating upon the British corn exchanges, mostly in London.

Mention must also be made of the rapid growth of agricultural co-operation in India, which has mainly taken place during the present century. Indian co-operation bears a much closer resemblance to European than to the American or Australian systems. As in Germany, it has been developed largely to provide credit (and insurance) facilities, and to a limited extent for the

purchase of requisites and the sale of produce. Its remarkable growth may be judged from the figures. The total number of co-operative societies in 1907 was 149; in 1914 it was 15,673; at the end of the War 26,465; and in 1922 it had reached 52,000. Of this total, 46,700 are agricultural societies, 3,600 are non-agricultural, 1,200 are supervising and guaranteeing unions, and 480 are central societies, including provincial and central banks, and banking unions. Of the agricultural societies all except 1,165 are credit societies. Production is represented by 302 societies, the remainder being organized for purchase and sale. (R. E.)

THE UNITED STATES

Farmers' Large-scale Co-operation.—In the spacious lands of the world more newly settled, we meet with different economic and social conditions. Great cities are fewer and wider apart. Farmlands extend over broad regions in which masses of cultivators possess a common interest in production of a particular kind. Britain in 1921 had fewer than 500,000 farms. The United States in 1920 included 6,500,000, and these are more specialized. Co-operation can gather together 17,000 Californian farmers interested in raisins, 67,000 in the Eastern States concentrating on milk, 500,000 in the Middle West dependent on exports of grain. Again, of the 6,500,000, nearly 4,000,000 were owned by the occupiers. The position is similar in Canada where a wheat production of 50,000,000 quarters means a mass interest different both in character and in volume from that associated with the 7,000,000 of Britain. So with the wool and wheat of Australia, the fruit of South Africa, the butter and cheese of New Zealand. Add that the farmers are of enterprising, immigrant quality, and nearer to fixed-income conditions than the money-seekers of new industries and commercial cities, and it becomes reasonable to expect forms of co-operation thriving amongst them on a scale comparable with that of consumers' co-operation in Europe.

In 1874 in the United States, the National Grange proposed "working together, buying together, selling together and, in general, acting together for our mutual protection and advancement," and the name of the American Society of Equity, of 1902, recalls that of the Rochdale Equitable pioneers But it is the selling together which has most appealed to American and Dominion farmers. In the United States, especially aided since 1921 by the Co-operative Marketing Act passed in Texas in that year, and soon adopted in 36 States (in New York in 1924) grain, fruit and vegetables, milk, cheese, eggs, nuts, tobacco, cotton and wool are co-operatively sold. Associations under this law (other bodies may be simply joint-stock) are not to make profits for stockholders as such, but only for members as agricultural producers. Membership must be open to all the producers; interest on stock is not to exceed 8%; and selling for non-members is limited, while the definitive co-operative rule is laid down of no member possessing more than one vote. The solid basis of consumers' co-operation is potential custom. With farmers' co-operation it is the coming crop; and while the co-operative consumer is morally bound to give reasonable custom, the farmer must contract for the season or for a longer period up to five years. In return, instead of having to borrow on his crop or else wait for ready money until it arrives in full, he receives part-payments in advance; and finally he obtains a share in the business surplus in proportion to his contribution to the turnover. Failures are more numerous than in the more closely-organized movements of Western Europe, and bad management was the confessed reason in nearly 30% of the failures during 1900–23; but the very great majority of the associations are successful. And these not only help the grower commercially; they also mitigate the farmers' feeling that he feeds the world, yet is exploited in the very process.

American and Other Examples.—The New York Dairymen's League is an example of success. The league, dating from 1921, is a non-profit (all profits to members on the Rochdale lines) and non-stock organization, the working capital being derived from membership fees guaranteed by contracts and sales. The league, the largest association of its kind in the world, collects milk yielded by 750,000 cows, grazing at up to 400 miles from New York, has a complex pooling system, owns refrigerating plants and shops, has research and statistical departments, conducts great advertising campaigns, and employs 3,000 persons. In Canada the wheat pools of Alberta, Manitoba and Saskatchewan—representing 137,000 farmers—and their joint agency, the Canadian co-operative wheat producers, form another conspicuous example. In 1926, this selling agency handled 190,000,000 bushels of wheat, marketed or held back according to conditions. The pool movement exists also in the United States and in Australia (the English C.W.S. through its bank, assisting to finance the latter), and a joint-committee for these continental areas has existed since 1926. The prospect of a producers' restrictive monopoly might be feared, but the pool leaders deny even its possibility, the organizations tending rather to improve the crops both in quality and quantity.

These examples from North America sufficiently resemble those forms which are found in the Argentine, in Australasia and in South Africa, except that since 1921 the co-operative dairy farmers of New Zealand, without actually tying buyer or seller, have entered into a definite partnership with British co-operative consumers through the C.W S. and the jointly-owned New Zealand Produce Association. The Overseas Farmers' Co-operative Federations of Australia have relations only less close with the same market. (A W. McK.)

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AGRICULTURAL CREDIT. The credit needed in agriculture is of two kinds. The first is long term credit, required to facilitate land purchase or the execution of improvements; the second is short term or personal credit, required to finance the growing, harvesting or marketing of crops, etc. Systems of agricultural credit as they exist to-day in various parts of the world may be roughly distinguished according to whether they are based on a co-operative principle or not. Co-operative credit has been successfully developed in Europe (with the marked exception of Great Britain) and in India. In most of the newer countries co-operative systems have been relatively unsuccessful, and other means of financing agriculture have had to be found.

Great Britain.—There are very few British institutions specifically engaged in providing credit for agriculture, the bulk of farm credit being furnished by the joint stock banks and tradespeople, insurance companies and private mortgages. In regard to long term credit, two institutions (the Farmers' Land Purchase Company and the Lands Improvement Company) have, however, sought to specialize in this business. The former has aimed at lending money on mortgage for land purchase, but its operations have been on a very restricted scale. The latter, founded in 1858 and operating under special acts of parliament, has lent upwards of £13,000,000 for the purpose of carrying out certain types of land improvement. Apart from these, farmers and landowners have mainly had to rely for long term loans on bank overdrafts secured by the deposit of title deeds and private mortgages. In regard to short term credit, for several years prior to the World

War attempts were made to establish co-operative credit societies in Great Britain on the Raiffeisen model (which had had such widespread success in Germany and other continental countries). In 1910 there were 31 co-operative credit societies in Great Britain with 663 members; during and after the War there was a substantial decline in their number and membership.

In 1922 the subject of credit was considered by a committee appointed by the Minister of Agriculture, and its report was published early in 1923. Its recommendations were adopted by the Government, and the Agricultural Credits act 1923 was passed in July of that year. The objects of this measure were: (1) to enable persons who bought their holdings during the currency of the Corn Production acts (April 5, 1917 to June 27, 1921) when prices were exceptionally high, to obtain mortgage loans from the State repayable within a maximum period of 60 years; (2) to establish co-operative credit societies with powers to borrow from the State. The latter were based on limited liability, each member being entitled to hold any number of £1 shares upon which 5s. had been paid up, and to borrow in proportion to his share holding. The credit societies could borrow from the State £1 for each share so held

Under the first of the above provisions, mortgage loans were granted to the gross value of £5,000,000. Very little interest was, however, taken by farmers in the formation of co-operative credit societies, only nine societies being actually registered under the act, of which four never commenced operations In view of the small response to this measure, State advances to credit societies were discontinued in March 1927. Subsequently, the Government stated its intention of introducing a bill dealing with this subject.

Germany.—Germany may be regarded as the birth place of co-operative credit in Europe The typical organizations have been the Landschaften or Credit Unions (for long term credit) and the Raiffeisen banks (for short term credit). The former originated as far back as 1770, and gradually extended not only in Germany, but to Denmark, Hungary, Russia, Poland, Norway and elsewhere The basic principle was the issue by the Landschaft of bonds based on estates mortgaged in its favour—the bonds being secured upon the collective guarantee of the members of the Landschaft. The borrower was paid not in cash but in bonds which he could realize on the market He had the right to repay by annuity or by special instalments, or to cancel the loan by purchasing and tendering bonds. Landschaften bonds were regarded as first-class securities, and during the period 1910–14 were quoted on nearly equal terms with the loan bonds of the empire The principle of the Raiffeisen banks, which were empowered both to make loans and to take deposits, was originally that loans were secured by the collective unlimited liability of all the members. Limited liability was, at a later date, adopted by a small number of these societies. In some cases they added to their credit business that of purchasing supplies for the members, such as seeds, fertilizers, coal, etc. Under Raiffeisen's personal guidance the local credit societies were affiliated to central loan banks, which subsequently received assistance from the State. The wonderful growth of these societies into a vast banking organization, without incurring any serious losses, is perhaps without parallel in the history of finance In 1924, out of 38,000 registered agricultural co-operative societies in Germany over 19,500 were rural banks

The post-War inflation in Germany, involved the whole credit organization in acute difficulties, and with the collapse of the paper mark, confidence was destroyed and depositors ceased to lend their money. For these reasons German agriculture found itself faced with an extreme shortage of capital, interest rates rose to a very high figure and farm mortgages became, for a period, unobtainable. After the stabilization of the currency and the introduction of the rentenmark, drastic reorganization of the credit machinery became necessary. A central institution of agricultural credit, the Rentenbank-Kreditanstalt, an off-shoot of the Rentenbank, was established, which operated through the previously existing credit institutions. Ultimately, with the aid of loans raised in the United States, the situation was considerably relieved and rates of interest substantially reduced.

France.—The conspicuous feature of agricultural credit in France is the State subsidy which it carries with it. Under the Méline act of 1894 all or part of the members of one or more agricultural *syndicat* could constitute a credit society, whose capital was obtained by subscription of members. The credit society became a *filiale* of the *syndicat*. A considerable growth of these societies took place with the assistance of a voluntary organization which prepared model rules In 1897 it was made a condition of the renewal of the charter of the Bank of France that it would place at the disposal of the State without interest 40,000,000 francs, together with an annual share in the profits of the bank, for the assistance of agricultural credit In 1899 regional banks were created, the members of which were the local credit societies, and the above subsidy enabled the regional banks to reduce their rate of interest to the credit societies, and consequently to provide cheap credit to farmers The number of regional banks in 1921 was 69, with nearly 5,000 credit societies affiliated to them The extension of the system to the provision of long term credit was made under Acts of 1910 and 1920, which permit a maximum loan of 40,000 francs to individuals to facilitate the acquisition and management of rural properties

Canada.—In Canada credit unions have been more successful, and over 150 with a membership of more than 66,000 have been organized since 1906, mainly in Quebec and neighbouring provinces. By a number of acts the provinces of Canada have also sought to extend the facilities for short term credit to farmers These include the Livestock Encouragement act 1917 of Alberta, under which persons may form an association and jointly apply to the Livestock Commissioners for a loan; the Livestock Purchase and Sale act 1913 of Saskatchewan; the Rural Credits act 1917 of Manitoba, and a similar act in Alberta, both designed to promote co-operative credit. Mention should also be made of the Ontario Farm Loan act and the Agricultural Development act passed by the Ontario Legislature in 1921—designed both to assist land settlement and to provide short term loans As regards long term credit, legislation has been enacted by the separate provinces. Manitoba passed Manitoba Farm Loan act, which became effective in 1917, and was subsequently amended in 1919 and 1921 The act established the Manitoba Farm Loans Association, which serves as the lending agency between the provincial government and the farmers, and is governed by a board of five members including a Commissioner of Farm Loans. Loans are secured upon first mortgages on farm lands and are repayable by annual instalments in 30 years Saskatchewan has passed legislation on similar lines (the Saskatchewan Farm Loan act 1917), and Alberta has followed the general lines of the Farm Loan act in the United States.

Australasia.—The development of agricultural credit has received and is still receiving a considerable amount of attention in Australia and New Zealand. In most States of Australia State credit institutions, such as State savings banks, make a speciality of providing agricultural credit A number of acts have been passed in recent years dealing with the subject of rural credit, among which mention should be made of the Commonwealth Bank (Rural Credits) act 1925 making provision for financing producers' organizations in marketing their produce. An account of these measures is to be found in the Australian Year Book 1925. In New Zealand a Royal Commission on rural credit published a report in 1926 which was followed by two acts of parliament, the Rural Advances act 1926 and the Bank of New Zealand act 1926, both designed to assist the development of long term agricultural credit

India.—The development of agricultural credit in India has mainly followed the European model, and has made consistently steady progress The first act legalizing co-operative credit societies was passed in 1904. This act was replaced by an Act in 1912 which closely followed the English Friendly Societies act and permitted other forms of co-operation. The number of rural credit societies under this act exceeds 40,000 and these are mainly modelled on the Raiffeisen plan.

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THE UNITED STATES

Since the middle of the last century the need for credit in American agriculture has broadened enormously. Primitive pioneer farming required but little capital. During the past seventy-five years, however, a veritable agricultural revolution has taken place. Transportation opened new markets, free lands disappeared and land values soared, farming with machinery became prevalent, hired labour in part replaced family labour, commercial fertilizers came into general use, and improved farming methods were widely adopted.

These changes necessitated larger working capital and farmers became heavy borrowers. The outstanding farm debt (1928) is estimated at more than $12,250,000,000, carrying an annual interest charge of roughly $772,000,000.

While the demand for rural credit was thus rapidly expanding, the development of farm credit facilities seriously lagged. Capital was inadequate and often difficult to obtain. This, coupled with serious periodic depressions in agriculture, created chronic discontent with rural credit conditions. After 1900, systematic effort was made to improve the situation. Commissions investigated European rural credit and helped crystallize sentiment in favour of a farm mortgage credit system, which was established under the Federal Farm Loan Act (1916). Although satisfactory provision for farm mortgage and short-time loans apparently had been made, the disastrous years after 1920 strengthened the belief that commercial banks alone could not meet all short-time credit needs of the farmers. As a result the Intermediate Credit System was established (1923). The rural credit system thus includes commercial and private agencies, supplemented with Government-owned or Government-supervised institutions.

Long-term Credit.—Farm mortgage credit for purchasing land or making permanent improvements is used more extensively by farmers than any other form of credit; perhaps two-thirds of the credit obligations of owner-operator farmers is of this type. The first year for which data are available (1910), the mortgage indebtedness of farmers was about $3,598,985,000. By 1920 it was over $7,857,000,000; by 1925 it was $9,000,000,000. Almost 61% of this indebtedness in 1920 was carried by farmers in the East North-Central and West North-Central States, and over two-thirds was on owner-operated farms.

State and national banks have always been primary sources of both long and short-time rural credit. In 1924 loans for agricultural purposes amounted to about 14% of the total bank loans and discounts. In industrial States such loans are relatively small, amounting, in some States, to less than 1% of all bank loans (1924). In the agricultural States, agricultural loans predominate, amounting in some States to 75% of all bank loans and discounts. Bank farm mortgage loans increased from roughly $740,000,000 in 1914 to $1,450,000,000 in 1921.

Life insurance companies have been an important factor in the farm mortgage field during the past fifty years. Their farm loans, (principally in the better regions of the Central West and South), increased from $694,000,000 (1914) to about $2,000,000,000 in 1927. Insurance companies were responsive to farmers' needs during the recent depression.

Formerly funds for buying land were frequently obtained from neighbours or other individuals in the older sections. Farm mortgage companies, which sold farm mortgages to eastern investors, grew out of this situation. Much farm mortgage credit is advanced by former land-owners and private investors.

The Federal Farm Loan System.—Capital was formerly brought into deficit areas through banks or realty firms, and the practice developed of selling farm mortgage notes in their original form. Usually it was necessary to find a borrower who desired a mortgage of a given amount, and given period, and with definite terms. An institution was needed through which farm mortgages could be standardized and held as collateral against which bonds could be marketed.

To meet this situation the Federal Land Bank System was established, partly on European models (1916), under the Federal Farm Loan Act. It provides for two types of credit institutions, the Federal Land Banks and the Joint Stock Land Banks, under the supervision of the Federal Farm Loan Board.

There are 12 Federal Land Banks with a paid-up capital of $750,000. This capital, originally subscribed by the U.S. Treasury, has been largely retired by the borrowers. Loans are made through national farm loan associations, organized by ten or more farmers desiring loans totalling at least $20,000. In 1928 there were 4,500 to 5,000 farm loan associations serving nearly every county. Each borrower must subscribe to the stock of the Federal Land Bank to the extent of 5% of his loan, and assumes a liability of twice the par value of his stock for losses sustained by the association. It had been intended that the Federal Farm Loan Banks should be co-operative, but the co-operative features did not develop as anticipated, and the Act was amended (1923) to maintain Government control over the System.

Federal Land Banks lend only to actual or prospective farmers. The maximum loan was raised from $10,000 to $25,000. Loans average slightly over $3,000 and are granted primarily to small farmers. Lands on which loans are made are appraised on their earning capacity. Appraisals have usually been conservatively made, which explains in part the growing popularity of the bonds issued by the System. Loans may be made up to 50% of the appraised value of the land, plus 20% of the insured permanent improvements. The term may extend from 5 to 40 years, at the option of the borrower; it is usually from 33 to 35 years. All loans are made on the amortization plan. Pre-payment privileges are allowed after 5 years. The funds are obtained through the sale of tax-exempt bonds secured by farm mortgages. Each bank may issue such bonds up to 20 times its unimpaired capital and surplus, and is jointly liable for the bonds of the other 11 banks. These bonds are not obligations of the Federal Government, but their supervision by the Federal Farm Loan Board and their tax-exempt feature create a market for them at low interest rates. American farmers are now obtaining farm mortgage credit at rates that compare favourably with those paid by other groups.

Since the organization of the Federal Land Banks 448,958 loans, aggregating $1,365,060,822 have been closed. Net mortgage loans outstanding December 31, 1927, amounted to $1,155,643,871.38. Loans are rather uniformly distributed throughout the country, and are made especially in regions where credit has been scarce and costly.

The Federal Farm Loan Act authorized the establishment of Joint Stock Land Banks, privately owned and operated under the Federal Farm Loan Board. They may be organized with a minimum capital of $250,000. They operate much as do the Federal Land Banks, but they have special features which differentiate them from those banks. Each may operate in only two contiguous States. They may loan to farmers and to owners of land who are not farmers. Their loans are made direct, and not through associations Borrowers need not purchase stock in the bank, nor is joint liability carried by the borrower. The Joint Stock Land Banks may loan up to $50,000 to individual borrowers. Their funds are obtained through tax-exempt bonds, which may be issued up to 15 times the unimpaired capital and surplus of the bank, each being liable for its own bonds only.

Early growth of the Joint Stock Land Banks was relatively slow, but since 1921 their development has been rapid. Through liquidations or consolidations only 56 are now in operation out of 80 chartered. These 80 banks have loaned to 114,809 farmers, totalling $790,304,647. Their net mortgage loans outstanding December 31, 1927, totalled $609,476,969.56. In contrast with the Federal Land Banks, loans of the Joint Stock Land Bank are concentrated primarily in the best farming regions and are usually considerably larger than those of the Federal Land Banks.

The Federal and Joint Stock Land Banks are playing a vital part in the rural credit system. They have helped to channel funds from surplus to deficit areas and to reduce and equalize

interest rates. They have permitted refunding shorter time loans on terms more suitable to the farming business, and they have minimized foreclosures in times of depression. But there is room for improvement in the operation of the system. Lands are not always scientifically appraised on the basis of their earning capacity. There has been lack of adequate supervision, and practices have crept in, particularly in the administration of the Joint Stock Land Banks, which are not conducive to success. In the main, however, the Federal Farm Loan System has gone far to solve the farm mortgage credit problem.

In some States the permanent school or the teachers' retirement funds are used to make farm loans at low rates and on suitable terms; in others there are State Rural Credit systems patterned on the Federal Farm Loan System. In the main, State credit systems have not been successful; it is doubtful if there is a place for them in the Rural Credit System.

Terms and Conditions of Farm Mortgage Loans.—Additional charges enter into the cost of credit, but interest rates are used as the only available measure of changes in the cost of credit. The trend in interest rates on farm mortgage loans was gradually downward between 1850 and 1909, upward from 1910 to 1921 and then downward again. Significant variations in rates appear between institutions as well as sections. The Federal and Joint Stock Land Banks may not charge borrowers in excess of 6%. During the last few years the rates of Federal Land Banks have varied between 5 and 6% throughout the country. Rates on life insurance loans compare favourably with these rates in regions where they make most of their loans, and at times life insurance loan rates may be slightly lower, but interest rates on bank farm mortgage loans are usually somewhat higher. Even more significant are variations in rates between sections of the country. The level of rates in the East and Central West is much lower than in the South and West—a contrast even more marked in personal and collateral loans. These variations are due, in part, to differences in credit supply and demand, to risk resulting from geographic conditions, to differences in type of farming and in moral hazards, and to defects in the present commercial banking system.

Following the lead of the Federal and Joint Stock Land Banks, there has been a marked tendency for life insurance and farm mortgage companies to extend the term of their loans. State and national banks, however, continue to make farm mortgage loans for shorter periods. Use of the amortization plan of repayment has been gradually extended.

Short-term Credit.—Short-term credit is used to produce and market crops. It probably amounts to from 30 to 35% of the total farm credit. It is largely obtained from commercial banks, but large advances are made by local merchants, implement dealers, live stock and produce commission firms, canning factories, fertilizer companies, cotton factors, live stock loan companies and private lenders.

Short-term cash loans form by far the most important short-time farm credit. Commercial banks are the principal source of such credit Short-time farm loans in 1920 totalled somewhat under $4,000,000,000. Since then the volume of such loans apparently has declined. The cost of short-time loans varies from time to time and between sections. Decline in the cost of short-time bank loans has been most marked in regions where the level of rates formerly was abnormally high. Apparently, at least two-thirds of the short-time loans are made on personal security, although live stock, crops, warehouse receipts, stocks and bonds also serve as collateral.

Most complaint has been registered against the term for which banks have made their short-time loans; most of the loans have been made for six months or less. Such periods do not correspond to the needs of the farmers. Renewals are usually granted, and in good times this arrangement is mutually satisfactory to banker and borrower, but in times of distress the borrower is often placed in a precarious position. This complaint was the primary factor in the establishment of the Intermediate Credit System.

To strengthen State and national banks in the general credit structure, the Federal Reserve Act creating the Federal Reserve System was passed in 1913. The Federal Reserve System controls a large reservoir of capital upon which banks can draw to provide funds for agriculture and industry. Credit is not advanced direct to farmers through the Federal Reserve Banks, but through member banks, which may rediscount their notes, drafts, or bills of exchange acquired from customers. The Act has special provisions favourable to agriculture. Paper issued for farm purposes was admitted for discount and the Federal Reserve Board, under which the System functions, has liberally defined such paper, and the maturity was extended to nine months. Provisions for discounting paper of co-operative marketing associations were also liberalized. Notes, with maturities up to nine months, are now eligible for discount, if the proceeds are advanced to association members for agricultural purposes or for financing the operations of the association. Special recognition is given bankers' acceptances drawn to finance agricultural operations. Those acceptances are eligible for discount with maturities up to six months, provided they are secured by warehouse receipts conveying title to readily marketable staples. The Federal Reserve System is thus an important channel through which banks may obtain additional funds to finance the short-time farm credit needs.

In the South much short-time credit is advanced by merchants, either on open account or on crop lien. In general it is costly, and is frequently a handicap to the unimpeded marketing of crops. Fruit and vegetable commission dealers and brokers advance much credit to growers. Until recently, live stock loan companies were active in financing the western live stock industry, but the crash in live stock prices ruined most of them. In some sections Credit Unions or associations have been formed to promote thrift among their members, but Credit Unions are not essentially rural institutions.

The Intermediate Credit System.—Collapse of farm prices in 1920 brought a crisis in rural credit conditions, with which commercial banks were unable to cope. Emergency credit proved necessary. Emergency seed loans were made by Federal or State Governments, and the War Finance Corporation was authorized to permit advances for agricultural purposes. Resort to emergency credit emphasized the inadequacy of the commercial-banking system.

The Intermediate Credit System was formed under the Agricultural Credit Act (1923) to provide production and marketing credit for periods longer than those ordinarily supplied by commercial banks. It was intended to supplement and strengthen the commercial banks and not to supersede them. There are twelve Intermediate Credit Banks with districts corresponding to those of the Federal Land Banks. Each has a capital stock of $5,000,000 subscribed by the Federal Treasury. Funds with which to make advances are obtained from capital stock and sale of collateral trust debentures, which may be issued to ten times the unimpaired capital and surplus of each bank. The banks are jointly liable for all debentures issued. The debentures are tax-exempt and find a ready market. Advances are made either direct to Co-operative Marketing associations or on the security of warehouse receipts or shipping documents covering staple agricultural products, or in the form of discounts. The rate charged on direct loans to these associations may not exceed by more than one per cent the interest rate at which the last issue of debentures was sold. As the debentures sell well, the banks have been able to make direct advances to Co-operative Marketing associations at rates between 4½ and 5½%.

Federal Intermediate Credit Banks may discount for local banks, Live Stock Loan companies, and other credit agencies, agricultural paper maturing in from six months to three years. The discount rate may not exceed by more than one per cent the rate paid on the last debentures sold. On the other hand, institutions using the Intermediate Credit Banks may not charge a rate that exceeds the discount rate by more than 1½% except by special ruling of the Federal Farm Loan Board.

The Act provides for Agricultural Credit corporations in regions where established credit institutions do not provide the necessary facilities. Such corporations may be formed by any group of citizens under State laws, with a maximum paid-up capital stock of $10,000. They may rediscount agricultural paper with the Intermediate Credit Bank up to ten times their capital and surplus.

Several types of credit corporations have been organized.

There is provision for National Agricultural Credits corporations with a minimum capital of $250,000. These are privately operated competitors of the Federal Intermediate Credit Banks, and operate under the supervision of the Comptroller of the Currency. Few National Agricultural Credit corporations have been organized, partly because of the high initial capital and rigid reserve requirements.

The direct loans of the Intermediate Credit System outstanding Dec. 31, 1927, were $31,990,596.65 The influence of such loans is not to be measured by their volume alone; availability of such funds for co-operatives has encouraged private banking institutions to advance more liberally to co-operatives. Rediscounts of the system as of the same date totalled $43,923,940.42. Most of these advances were to Agricultural Credit corporations and Live Stock Loan companies.

The Intermediate Credit System has not been in existence long enough fully to demonstrate its place in our rural credit system. The best methods of organizing and operating Agricultural Credit corporations still remain to be found. While State and national banks do not yet use the system, experience probably will show how it may be used in handling their longer-term agricultural paper. The greatest influence of the system will probably be in regions now lacking adequate banking resources, and where the cost of credit is unduly high.

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AGRICULTURAL ECONOMICS. From the earliest times the art of husbandry has been not only the preoccupation of those who practise it, but also the subject of innumerable treatises explaining its principles and suggesting methods for its improvement. Within the last century the application of the results of scientific investigation to the cultivation of the soil has been expounded with ever-increasing voluminousness. But the consideration of farming as a business has been only recently recognized as a subject for systematic study Farming in many countries is a means of subsistence, and can only be described as a business in a limited sense, but commercial agriculture is yearly becoming more widespread and more important.

Agricultural economics may be defined as the special application of the general principles of economics to the special conditions of the production and sale of agricultural products. It comprises therefore the consideration of the factors of production, the cost of production, and the disposal of the produce. It is not concerned directly with the technique of farming but it assumes that experience, skill and energy in the use of the land will not suffice for commercial success without knowledge of the economic as well as the practical details of farm management. The subject of agricultural economics includes within its scope many subjects which are, so to speak, self-contained, such as farm accounts, farm valuations, and agricultural co-operation, which are considered under their separate headings.

In the United States, the systematic study of agricultural economics forms a part of the curriculum of State universities and agricultural colleges and of the larger endowed universities. A well equipped bureau of the U.S. Department of Agriculture has done admirable work in research and in expounding and popularizing the subject. Its work covers a wide range of subjects: Land problems; agricultural finance, including credit, insurance and taxation as they affect agriculture; farm management and cost of production; statistical and historical research on a wide range of subjects; co-operative marketing; foreign competition and demand, as affecting agriculture; and other subjects. The State agricultural experiment stations, supported by State and Federal funds, conduct research on various phases of agricultural economics. In 1925 Congress passed the Purnell Act, under which Federal support to each State for agricultural research will reach the maximum of $60,000 a year in 1929, in addition to the $30,000 available under earlier acts of Congress. The Purnell Act specifies that a part of the funds shall be used for research in agricultural economics, home economics and rural sociology. Among the privately supported institutions conducting research in this field are: The Institute for Research in Land and Public Utility Economics (Northwestern university) established under the direction of Dr. Richard T. Ely, and the Food Research institute of Leland Stanford university. The field of research in agricultural economics in the U.S. may be divided into three general groups of problems: (1) Problems which may be dealt with mainly by individual effort. These include farm management, embodying the organization of the factors of production on the individual farm and the adjustment of farming according to changes in costs of production and in prices of farm products. (2) Problems that may be solved by joint effort of farmers acting through co-operative organizations or other associations In 1926 Congress created the Division of Agricultural Co-operation in the Bureau of Agricultural Economics, to conduct research and to render services to farmers on all phases of co-operation. Legislation to remove legal obstacles to co-operative organizations, notably the Capper-Volstead Act, has been passed in recent years. (3) Economic problems of agriculture that may be dealt with by governmental policy expressed through laws and public institutions. This group includes agricultural credit, land policies, public expenditures and taxation as they affect agriculture, regulation of transportation systems in their relation to agriculture, tariff problems and other phases of public policy. In addition to these groups of problems, research is also concerned with the functions of private agencies in merchandising, transporting and processing farm products.

In Great Britain the subject was taken up by the agricultural department (Board of Agriculture and Fisheries), but with very limited resources, shortly before the war, and with assistance from the Development Fund, and from the University of Oxford an institute of agricultural economics was established at Oxford. Its activities were at first mainly directed to the improvement of farm accounts, especially by the adoption of the cost accounting system, but as further resources became available its scope was widened and it has made a number of important investigations into the economic conditions of different areas. At Cambridge, also, the farm economics branch of the department of agriculture of the university has, more recently, vigorously taken up the work. Throughout the country an agricultural economist is now a recognized and important member of the staff of all institutions which are concerned in the development of agricultural education.

Factors of Production.—The primary factors of agricultural production are land, labour and capital.

The utility of land for producing crops depends on soil, climate, situation and aspect. Nearly all kinds of soil are actually or potentially fertile, although over large areas the fertility is dormant by reason of the lack of some constituent essential to plant growth. The deficient constituent is frequently water, but in many cases it is some ingredient which may be identified by chemical analysis and conceivably supplied by man. Climate is in a large degree a matter of situation. The tropics and the temperate zone comprise all land suitable for productive use, but advantages of situation depend not only on latitude but also on altitude. By aspect is meant in a hilly country the relation of the land to the sun, as, for example, whether it lies on a northern or on a southern slope.

For the purpose of agricultural use the farmer must have exclusive control of the land. If he does not acquire its ownership the form and terms of tenure will materially affect the economic possibilities of his enterprise. From an economic point of view, holdings are of three classes: viz. (1) those which are occupied by persons who do not depend on them for their livelihood; (2) those which are cultivated for subsistence by the occupier and his family without extraneous labour (sometimes termed "family farms"); and (3) those on which hired labour is regularly employed. It is with the third class "commercial farms," that the subject of agricultural economics is mainly concerned.

In considering the capital employed in agricultural production, that which is invested in the acquisition of the land may be disregarded. In many new countries free grants of land are made to settlers. In countries where agriculture has been long established, the capital value of a holding includes its equipment as a farm and the proportion which represents the bare land may be comparatively small. The capital employed in working a farm in Great Britain, where holdings are more commonly rented than owned by the occupiers, is termed "tenant's capital." It consists of the amount invested in machinery, implements and other movable equipment of the farm, in the horses and other live stock, and in the seed, fertilizers and labour for growing crops. The amount varies greatly, but on an average farm in Great Britain it probably ranges from about £10 to £12 per acre. On specialized farms, such as those devoted to fruit or vegetables, the amount may be £40 or even more per acre.

Labour as a factor of production includes not only the manual work and skill of hired labourers but also that of the farmer, whether employing labourers or not (*see* AGRICULTURAL LABOURER), and animal and mechanical energy applied to the processes of the farm partly in supplement of, and partly in substitution for, human energy. Oxen are the most widely used animals for farm work, but in Great Britain they have been replaced by horses during the last 200 years, although they were still in use in some districts up to the latter part of the 19th century. In those countries, such as the United States and the Dominions, where systematic agriculture has been recently established, horses were from the first generally used. Mechanical labour includes not only motive power, such as steam or other engines, but also machines and implements such as thrashers, reapers, haymakers, ploughs, etc, which either economize human energy or enable it to be more effectively applied in the operations of the farm.

Costs of production may be divided into two classes, viz, fixed charges and current expenses The ordinary tenant farmer regards rent as ranking foremost in his costs of production, but strictly speaking only that part of it which represents interest on capital spent in equipping the farm can be so described. The interest on capital expended on equipment, whether permanent or temporary, is a fixed charge and so also are rates and (where they exist) land-tax and tithe-rent charges. Current expenses include outlay on seed, fertilizers and feeding stuffs, fuel for engines and repairs. The payment of wages is a current expense, but it might also be described as a fixed charge, though of a variable amount. Where the occupier himself cultivates his holding it is evident that the remuneration of his labour is a fixed charge without which there would be no produce from the land. Where he employs labour his "wages of management," and such other wages as are necessary for production, may similarly be regarded as a fixed charge on the land. In all farming operations the turnover is slow, as compared with other forms of productive enterprise. This "economic lag" has been investigated on the basis of the accounts of two farms by Mr. Dampier Whetham. It was found to be greatest in the case of cattle, where the average "lag" was 18 months, and least in the case of poultry and eggs, where it was three months.

Disposal of Produce.—The simplest method by which the cultivator of the soil can dispose of its products is to consume them in his own household, but even in "subsistence" or "family" farming there is usually some surplus for sale. There are three methods by which farm products may be sold: viz., (1) by direct sale to the consumer, (2) through intermediaries, (3) by co-operative association. Direct sale is usually adopted by "small scale" producers and for "minor" products, such as eggs, poultry, fruit and vegetables, but "large scale" producers may also adopt the method by opening a shop in an adjacent town or establishing a "milk round." Direct sale of fat stock by farmers to butchers was very common in Great Britain, but it is now generally replaced by the auction system. The bulk of agricultural produce is sold through intermediaries. The commercial organization of the distribution of the main products is elaborate. Where the products are the subject of international trade, as in the case, notably, of wheat and meat, the system by which they are collected, shipped and distributed is remarkably efficient. But where the producer, as in Great Britain, sells his products in his own country, the distributive system is, from his point of view, unsatisfactory. The difference between an export and an inland trade accounts in a large degree for the difference in the machinery of distribution. For an export trade collection of bulk consignments at fixed points for shipment is imperative. The producer has no other outlet except under these conditions. In an internal trade producers usually have a choice of alternative markets, and are not compelled to adopt a uniform method of sale. The result is that imported produce, with its highly efficient distributive organization, tends more and more to dominate the wholesale trade, and the home producer finds that his natural advantages of proximity to markets, and, generally, of superior quality, are not sufficient to enable him to maintain his position. The adoption by British farmers of a system of "orderly," or organized, marketing has been vigorously advocated (*see* AGRICULTURAL CO-OPERATION). The term "marketing" is now commonly used as synonymous with sale, but it perpetuates the fact that in old countries the sale of commodities, and particularly of food, was permissible only in duly constituted markets. Many of these remain, but in Great Britain they have long lost the monopoly which they once possessed, although market tolls and regulations still survive in many towns. For information on various American aspects and applications of this subject *see* AGRICULTURE: *Agriculture in the United States*. *See* also AGRICULTURAL CREDIT and AGRICULTURAL INSURANCE

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AGRICULTURAL EDUCATION. Though agriculture is the oldest and greatest of industries, agricultural education in any organized form is among the recent activities of modern states. In Great Britain, or at least in England and Wales, it may be said to go back only to 1890. It would be untrue, however, to say that before then nothing was done. Chairs of agriculture and rural economy were founded at Edinburgh in 1790 and at Oxford in 1796; the Royal Agricultural college at Cirencester was established in 1840. But agricultural education provided in universities or colleges was beyond the reach of the bulk of the agricultural population. Little or nothing was offered to the children of farmers, smallholders, and labourers until nearly the end of last century. In 1890, however, the Local Taxation (Customs and Excise) Act placed at the disposal of county councils a sum of money (popularly known as the "Whiskey Money," because it was derived from an increase of the taxation on spirits which was originally destined for another purpose), amounting roughly to £750,000 a year, and authorized them to apply it to purposes of technical instruction, including instruction in agriculture. From

1890 onwards there was a considerable, if slow, increase both of the higher education provided by university departments of agriculture and agricultural colleges, and of instruction provided by county councils. By 1912 the State was granting £19,000 a year for higher education, and the English and Welsh county councils were spending £70,000 a year on the more elementary instruction. The World War stopped the development of plans already prepared for further expansion on a relatively large scale.

Post-War Development.—The present system, though it follows pre-war lines in its organization, is largely the creation of the years since 1918. It falls into two main parts; the university departments of agriculture and agricultural colleges, whose distinctive mark is that they provide a long course, two years at least, usually three, leading to a diploma or degree; and the education provided by county councils, which is essentially an education of short courses intended for the boy or girl who is already working on the land and proposes to return to it.

Higher agricultural education in England and Wales (excluding veterinary education) is provided at 14 centres, of which seven are departments or schools of universities, and the other seven are agricultural colleges, each possessing its own governing body, and not forming an integral part of a university. Eleven of these institutions (all except the Royal Agricultural college at Cirencester and the two women's colleges at Swanley, in Kent, and Studley, in Warwickshire), discharge an important function outside the actual teaching of students. Each is an "Advisory centre" for a group of counties forming its "Province"; it is provided with specialists in the more important branches of science bearing on agriculture, such as chemistry and entomology, who supplement the more general advice provided for farmers by the technical staffs of county councils, and it acts as a unifying and co-ordinating influence for the experimental and advisory work of county councils. All the 14 institutions are recognized and aided by the State. The cost to the student varies considerably between the two Welsh colleges (Aberystwyth and Bangor) at one end of the scale and Oxford or Cambridge at the other end.

Education of a less elaborate character is provided by county councils; in some counties by means of a farm institute (a simpler and smaller agricultural college, usually possessing residential accommodation and a farm attached), in practically all counties through organized classes, held at no special institution, or through discussion clubs, evening lectures, and similar less systematic methods. In 1927 there were 16 farm institutes, four in Wales (including Monmouthshire) and the remainder in England, all but one supported and governed by county councils. On the average they can accommodate 40 students each; the fees for board, lodging, and tuition vary between 17s. 6d. a week for students coming from the county which supports a particular institute to £2. 10s. 0d. a week for other students. The main course at a farm institute is normally a six months' winter course in practical agriculture, extending from October to March, and designed for young people, from the age of 16 upwards, who have been working on the land and are going straight back to it. During the summer months the institute is used for courses in dairying, poultry keeping, and other special subjects. The great majority of county councils, however, do not possess farm institutes, but attempt to take agricultural education to the landworker by such means as the "Organized day course" (a continuous course of instruction held at regular times, usually one day a week, in any town or village where there is a demand for it, and extending over several weeks or perhaps months), evening classes, travelling dairy schools, courses for instruction in manual processes (ploughing, hedging, ditching, milking, and the like), and lectures or demonstrations.

In 1925–26 the cost of the education provided by county councils in England and Wales was £312,000, of which the Government provided a fraction over two-thirds and county rates the remainder. One other activity deserves mention. In 1922 the Government started a scheme of scholarships in agriculture for the sons and daughters of agricultural workmen and of other rural workers in a similar economic position. Under this scheme approximately 100 scholarships are awarded every year, of which the great majority are short-term scholarships to farm institutes. The cost is £20,000 a year.

In Scotland, agricultural education has followed a rather different course, though it started on the same lines. The organization is not divided between universities and colleges on the one side and county councils on the other; the colleges control and direct the whole system. Apart from the small sums received as fees, the whole cost is met by grants from the State, which in 1925–26 amounted to £75,000. But in the education given, as distinct from the organization for giving it, the Scottish system resembles the English. The three colleges in alliance with their respective universities provide long courses (three winter sessions) for the university degree or college diploma; they take the place of the English farm institutes by including in their curricula short courses for farming; and through the appointment of organizers resident in the counties they conduct extension work similar to that done in England and Wales by the staffs of county councils. Two special institutions should be mentioned: the Kilmarnock dairy school and the Craibstone School of Domestic Economy for Women, the former associated with the Glasgow college and the latter with Aberdeen.

Other Systems.—Broadly speaking, and with considerable variations due to differences of national character and environment, Continental systems tend to fall into the main divisions already enumerated, of two or three years at universities or agricultural colleges; in the second place, there are short courses of a few weeks or months in the dead season, or of a year at most, at a residential institution—sometimes a college, more usually a farm institute or farm school: thirdly, miscellaneous courses, lectures, and demonstrations given by peripatetic instructors who endeavour to bring technical education to the farmer's door, or at least to his town or village. But there are one or two features of foreign systems which ought to be mentioned, if only by way of contrast to the British system.

Of these the most striking is, perhaps, the large part taken in Germany, Denmark, Sweden, and in fact nearly all over the continent of Europe, by voluntary societies and associations; in Denmark, for instance, agricultural societies own and manage many of the Folk high schools and support many "agricultural counsellors"—experts who combine teaching, lecturing, and advisory functions. But the Folk high schools of Denmark are notable not merely as an example of voluntary effort; they are a great and successful attempt to add a finish to the education of the adult land-worker by giving him or her a six to nine months' course, not entirely agricultural and sometimes not agricultural at all, at a residential institution. In Belgium, a country of smallholders, there is a highly developed system of instruction for women and girls in a combination of practical agriculture and rural domestic economy; the system centres in the national institution at Laeken. In Sweden also (besides the usual agricultural colleges, agricultural schools, and farmers' sons' schools, the last providing a three months' theoretical course for young men, usually about the age of 22) there are something like 40 schools of agricultural economy for women.

Changes in the British System.—From 1924 or thereabouts two movements affecting agricultural education have gained prominence. The first is the movement for imparting into the ordinary subjects of instruction taught at rural elementary and secondary schools what is known as a "rural bias"—*e.g.*, arithmetic may be taught through simple farm accounts, or geography with at least some reference to the physical characteristics of the district in which the school is situated. Provided it does not degenerate into a premature attempt at vocational training, there is everything to be said in favour of such a change.

The second change is a change of emphasis in the subjects usually taught in agricultural institutions and courses. Hitherto syllabuses of instruction have tended to be dominated by science, or rather sciences—chemistry, physics, botany. A school of thought has arisen which starts from the fact that the farmer is not only a grower of crops, a producer of eggs or milk, a breeder of stock, but also a manager of labour, a buyer of goods, and a seller of products—in the ordinary phrase, a business-man. There

is consequently a steady pressure towards modifying courses of instruction, particularly the short winter courses, by giving a larger place to such subjects as accounts (the foundation of business), the management of labour, and the elements of marketing technique. There can be little doubt that this side of agricultural education has been relatively neglected; but the teaching of management is not easy.

Defects in the British System.—But though these changes may be beneficial, the British system still reveals several notable defects. First, it is far too small, not, perhaps, for the demands which are actually made on it, but for the demands which ought to be made. In the second place, the larger part of the English and Welsh system—the part organized and directed by county councils—is "patchy." There is no power to compel county councils to supply even the barest modicum of agricultural instruction, and accordingly the provision made for it in a county varies with the character and finances of the county council and its electorate. Thirdly, provision for the residential education of adults—one of the most marked and successful features of Continental systems—is noticeably absent. Lastly, provision for instruction in manual processes and in the handling of machinery, though not absent, is not so common as it should be.

Progress Being Made.—Some of these defects are being slowly remedied. In spite of financial exigencies, college and county education does progress and grow; and, best of all signs, authorities are agreed that in the last 20 or 30 years there has been a remarkable change of attitude on the part of the agricultural community. Farmers welcome the assistance of college and county staffs; and a first attempt has been made, through private enterprise, to provide at Avoncroft, near Evesham, an institution very similar to the Folk high school of Denmark for adult landworkers. If that experiment proves a success, it may be the beginning of a new era. Moreover, the education of women and girls has recently been investigated by a strong committee, who have surveyed the whole field; and the Ministry of Agriculture has put before county councils a detailed scheme for extending instruction in manual processes. In 1925–26 the number attending such instruction rose to 1,900—a number which, however small in itself, was at least an increase of 50% on the previous year.

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IN THE UNITED STATES

Agricultural education in the United States finds its beginnings in the striving of individual land-owners toward higher levels of production. This created interest and discussion in agricultural communities, induced the making of tests, trials and observations, pointed to the advantages of concerted action, and slowly but steadily laid the foundation on which present-day educational machinery was built.

Agricultural Schools.—Among the early attempts to provide agricultural instruction in schools of less than college grade the following may be noted: In 1821 the State legislature of Maine granted to Robert Hallowell Gardiner an annual appropriation of $1,000 for the maintenance of an institute for agricultural and mechanic arts. The Gardiner Lyceum was opened at Gardiner, Me., in 1823. It employed a professor of agriculture, maintained a farm and offered short winter courses in agriculture. An agricultural school was founded at Derby, Conn., in 1826. So-called manual labour schools were established in New York State in the period 1825–40. They laid stress, in their curricula, on vocational training in agriculture and the industries. In 1845–50 several agricultural schools were founded, through private initiative, in New York and Connecticut. After the middle of the 19th century conditions became more propitious for the teaching of agriculture in elementary and secondary schools. A period of agitation was followed by the establishment of an agricultural high school at the University of Minnesota (1888). District and county agricultural schools were created a few years later, among them the agricultural schools in the nine congressional districts of Alabama. By 1898 there had been established ten agricultural high schools. In 1909, there were 60 separate agricultural high schools. Agricultural courses were then being offered in 346 other high schools. Several States, among them Massachusetts (1911), New York (1913), Pennsylvania (1913), New Jersey (1913) and Indiana (1913) had established definite systems of vocational agricultural education. It is estimated that in 1912–13 there were about 2,300 State agricultural schools, district agricultural schools, agricultural departments of high schools and ordinary schools that maintained systematic instruction in agriculture.

The Smith-Hughes Vocational Education Act (1917) provides Federal aid for vocational training, including the teaching of agriculture and home economics in secondary schools. Since the passage of this Act many vocational agricultural schools, as well as agricultural departments of general high schools, have been established in the several States. Of the 11,561 rural high schools, 3,339 or 29% maintained vocational agricultural departments in 1927. They had an enrolment of 129,032 students. In that year there was available for the support of vocational agricultural education nearly $7,500,000, compared with about $740,000 in 1918. Aside from these institutions, agriculture is being taught in some of the private high schools, in normal schools, and in special schools for negroes and Indians. It may be noted, further, that many States have special laws which concern the teaching of agriculture in elementary rural schools.

Agricultural Colleges.—Simeon de Witt, surveyor-general of New York, published, in 1819, a pamphlet entitled *Considerations on the Necessity of Establishing an Agricultural College, and Having More of the Children of Wealthy Citizens Educated for the Profession of Farming*. A State agricultural college was established in New York in 1853. The oldest surviving state agricultural college is that of Michigan (1857). Similar colleges were established in Pennsylvania and Maryland (1859) and the incorporation of agricultural colleges authorized in Iowa and Minnesota (1858). The Federal Land Grant Act (also called the first Morrill Act) was passed in 1862. It created a group of State institutions of higher learning, known as the land grant colleges and universities (*q.v.*). This legislation was far-reaching in its effects on the social and economic development of the country. The second Morrill Act (1890) and the Nelson amendment of the Morrill Act (1907) provided additional funds for the State colleges.

The State colleges and universities are intimately associated with the U.S. Department of Agriculture. This had its inception in the collection and distribution of seeds and plants by the Patent Office in 1839. The service was expanded to furnish information on various agricultural topics. In 1862 the Department of Agriculture was organized as such and in 1889 its head became a member of the President's cabinet When the Hatch Act was passed (1887) funds were made available for the establishment of experiment stations as departments of the State colleges. Prior to that, State agricultural experiment stations had been established in Connecticut (1875), California (1877), North Carolina (1877), New York (1879 and 1882), New Jersey (1880), Ohio, Tennes-

see and Massachusetts (1882), Alabama and Wisconsin (1883), Nebraska (1884), and Michigan, Indiana, Kentucky, Maine and Minnesota (1885). A private sugar-planter's experiment station was established in Louisiana in 1885, and State stations in Louisiana, Vermont and New Hampshire in 1886.

In keeping with the provisions of the Hatch Act, an office of experiment stations was organized in the Department of Agriculture for the purpose of maintaining contracts with the stations. Subsequent legislation referred to as the Adams (1906) and Purnell (1925) Acts augmented the income of the stations, established better correlation of research on a regional and national basis and encouraged co-operation among the stations themselves and with the Department of Agriculture. The stations are primarily research institutions. As such they are maintaining many hundreds of research projects of direct significance to agriculture and the farm home, and creating a vast body of knowledge from which facts and generalizations are being drawn for the benefit of resident instruction and of extension teaching.

The Smith-Lever Act was passed in 1914. It represents a national scheme of extension teaching in agriculture and home economics and is the culmination of a long series of local, State, regional and national efforts to stimulate agricultural progress by bringing technical and general information to the farm and farm home. The antecedents of the Smith-Lever Act include the almanacs, agricultural journals and newspapers, agricultural societies, boards of agriculture, farmers' institutes and demonstrations and lectures by public-spirited individuals. The Act provides for county agents, home demonstration agents, club leaders and extension specialists. It makes the Department of Agriculture responsible for co-ordinating and supervising the extension activities in the several States.

The agricultural teaching, research and extension of the land grant colleges and universities is being generously supported by the local, State and Federal Governments. In 1928, the Federal Government was appropriating about $7,000,000 for the support of agricultural extension, while the States, counties, farm organizations and individuals were expending for the same purpose about $13,000,000

See A. C. True, *Education and Research in Agriculture and Home Economics in the United States* (1922); C. B. Smith, *Co-operative Extension Work, 1924, with ten years' Review* (1926), Walter J. Greenleaf, "Land Grant Colleges," Bureau of Education *Bulletin*, No. 37 (1927). (J. G. L.)

AGRICULTURAL ENGINEERING is that specialized branch of engineering which deals with agriculture; it seeks scientifically to direct the forces and facts of nature to the advantage of the farmer.

The distinction between agricultural and the other branches of engineering may be illustrated by examples—irrigation and drainage, for instance. The agricultural engineer concedes to the civil engineer the problems incident to the extensive storage and arterial distribution of irrigation water, and to the design and construction of large community drainage outlets. The benefits of such works, however, are realized only to the extent that contact is made with individual farms. It is at this point that the agricultural engineer claims jurisdiction. In irrigation, the water made available to the farm must be economically distributed and applied with reference to the topography, the character of the soil and the crops to be irrigated. In drainage, ditches and underdrains must be planned with regard for the peculiarities of each field and of the use to be made of the land. Again, although the agricultural engineer does not ordinarily concern himself with the commercial design and the manufacture of farming implements, he does claim a share in securing not only the best use of such equipment as is at hand, but also better designed equipment.

Agricultural engineering is the outgrowth of a realization that many of the farmers' problems lie within the field of engineering and therefore should be attacked from that point of view. It is generally recognized that the marked advance in agriculture since 1850 has been due in large measure to improved engineering practice. Thus the development of farm-land from its primal state by clearing, the control of erosion by terraces, the disposal of surplus water and the acquiring and regulating of the water needed for plant growth and for human and animal consumption, the erection of structures of all types, with their problems of light, heat, ventilation, etc., and the best use and design for the machinery and implements used in farm operations and transportation, as well as the sources of the power which operates them, are all problems for the agricultural engineer. This is common sense, and in the United States this view is generally accepted. In England and Continental Europe, however, the scope of agricultural engineering is less defined, the tendency being rather to give practical recognition to two distinct divisions of the science, dealing respectively with the mechanical phases (implements, machinery and power) and those of the soil (irrigation, drainage, erosion control, etc.).

In the United States in 1928 12 State agricultural colleges maintained courses leading to a degree in agricultural engineering, while several others, though they did not grant degrees, offered courses that constituted a virtual recognition of the science. Such German universities as are equipped to give instruction recognize agricultural engineering by offering a doctor's degree. Up to the present time agricultural engineering has been looked upon chiefly as one of the many agencies through which, by research and dissemination of information, governmental and educational institutions are striving to improve the condition of the farmer. One does not, therefore, often meet with the practising or consulting agricultural engineer. (*See* also articles on RECLAMATION OF LAND; ELECTRICAL POWER IN AGRICULTURE, DRAINAGE, etc.)

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AGRICULTURAL GANGS, groups of women, girls and boys organized by an independent gang-master, under whose supervision they execute agricultural piece-work for farmers in certain parts of England. The evils of this system were so great as to lead to the passing of the Agricultural Gangs Act 1867, forbidding the employment of any child under eight years old, and of any female under a male gang-master unless a female licensed to act as gang-mistress were also present. Gang-masters must be licensed by two justices, and may not hold a liquor licence. Later legislation made more stringent the regulations under which children are employed in agricultural gangs. By the Elementary Education Act 1876, repealing and re-enacting the principal provisions of the Agricultural (Children) Act of 1873, employment of all children under 11 was forbidden and restricted under 13. Now, by the Education act of 1921, it is forbidden under 12 and restricted under 14.

AGRICULTURAL INSURANCE. The risks against which farmers have to provide are those incurred in growing, harvesting and storing crops; animal diseases; condemnation of carcases in slaughter-houses; and those risks commonly covered by ordinary life, accident and property insurance. The nature of the risks to which farming is exposed vary between one country and another according to its situation and climate. Thus losses from wind-storms are more common in North America than in many countries of Europe (it has been stated that between 1916

and 1923, 752 tornadoes occurred in the United States—an average of 94 annually); in Great Britain animal diseases, and in Scandinavia forest fires, are more important risks, while in Canada damage by hail causes heavy losses to farmers.

Insurance against these risks may be carried out either through ordinary joint-stock insurance companies, or through farmers' mutual insurance societies. Both methods are used, but the latter is held to have certain advantages. Local mutual insurance societies operating in a small area frequently cover the risk by re-insurance.

In Great Britain there is very little co-operative insurance. A number of joint-stock companies specialize in livestock insurance in addition to covering ordinary accident and fire risks. There appears, however, to be little inclination on the part of British farmers to take advantage of these facilities except in the case of pedigree cattle and other valuable stock. The number of registered mutual insurance societies has declined since 1913, but several unregistered cow and pig clubs exist for the insurance of their members' livestock. Under the Diseases of Animals Act 1894 compensation is payable by the State in case of animals slaughtered in consequence of foot and mouth disease, swine fever, and other diseases. In other countries agricultural insurance has made considerably more progress.

The insurance of crops after harvest is a relatively simple matter, and the risk (mainly a fire risk) is often covered by ordinary joint-stock insurance companies. The insurance of growing crops is a more specialized business. Under this head the most successful development is insurance against damage by hail. In the United States, 43 joint-stock fire insurance companies, 41 mutual companies and four State insurance departments carried hail risks estimated in 1919 at $560,000,000. Since 1919 the amount of hail insurance written in the United States has declined. Total premiums received on hail insurance, which in 1919 amounted to $28,000,000, had dropped by 1923 to $18,000,000 In Canada, the Hail Insurance District of Alberta was formed under the Municipal Hail Insurance act of 1918, having in 1919 67 municipal districts. Hail taxes are paid by ratepayers to the municipal districts which in turn pay to the municipal board. The total risk borne by the Hail Insurance Board for the four years 1919-22 amounted to $72,000,000. In Saskatchewan the Municipal Hail Insurance Association carried an insurance of about $25,000,000 in 1921 and 1922.

Hail Insurance in Europe has been developed to a less degree, but organizations to cover this risk are to be found in Germany, Austria, Denmark, Switzerland, France, Spain, Italy and elsewhere. In France 29 mutual societies existed for this purpose in 1921, and Italy had 51 societies in 1922. Some progress has been made, particularly in the United States, in the provision of frost insurance.

Farmers in aggregate have large sums invested in livestock which is liable to suffer loss by disease and other causes. Insurance against these risks through mutual insurance societies or otherwise has made greater progress in certain European countries than elsewhere, although the United States has some 30 mutual livestock insurance companies. France provides perhaps the leading example of European livestock insurance; its development has depended partly on state subsidies. Out of the 14,896 subsidised co-operative insurance and re-insurance societies in France in 1921, over 10,000 were societies for the livestock insurance, and 78 for re-insurance.

Co-operative insurance in Germany has not made progress comparable with that of other forms of agricultural co-operation. Only a small fraction of the livestock in the country is covered by insurance. In certain States, notably Baden and Bavaria, cattle insurance has received State assistance. Insurance of carcases against condemnation by the sanitary authorities has also been adopted on a small scale.

Fire insurance is almost universally undertaken by the ordinary joint-stock companies but in some countries, notably the United States, it has also been largely developed on a co-operative basis. Indeed mutual fire insurance is one of the most successful as well as the oldest co-operative services which have grown up in that country, where, in 1926, there were about 2,000 farmers' mutual fire insurance companies carrying risks amounting to over $10,000,000,000. At the close of 1926 well over half of the total farm property of the United States insurable against fire was insured in farmers' mutual companies

See *International Review of Agricultural Economics.* (R. E.)

AGRICULTURAL LABOURER. An agricultural labourer is a person, male or female, employed by an occupier of agricultural land. In America and some other countries the term "hired man" is generally used. In Scotland the term "farm-servant" is equivalent to that of "agricultural labourer" in England where the alternative term "farm worker" has recently come also into common usage. Conditions of employment vary widely. The contract of service may be by the day, the week, the month, the half-year, or the year. Remuneration for services may be wholly in cash, or partly in cash and partly in kind. In Scotland, in the greater part of Wales and in the north of England the majority of agricultural labourers live in their employer's house or in quarters specially provided for them on the farm. They receive wages in addition and in England and Wales the amount which may be reckoned in respect of board and lodging as part payment of wages is fixed. Where the engagement is on such terms the contract of service is usually for a year, or, in some cases, for a half-year. Over the greater part of England the ordinary contract of service is by the week at a fixed cash wage. (*See* AGRICULTURAL WAGES.)

In addition to agricultural labourers permanently employed there are large numbers of men and women who are employed only for short periods to assist in particular operations, such as corn-harvesting, fruit-picking, hop-picking, etc. In countries such as Canada where wheat and other corn-crops are grown on an extensive scale it is usual to engage additional men for the period of harvest. In England a large number of men and women are engaged in the districts where hops are grown for picking the crop, and in some of the districts where fruit and vegetables are cultivated a similar practice prevails. Persons so employed are often not agricultural labourers in the strict sense but are in many cases townsfolk unskilled in farm work

Enumeration.—Returns collected by the Ministry of Agriculture, from all occupiers of agricultural holdings in England and Wales show that there were, in June, 1926, 704,809 agricultural labourers employed, of whom 654,361 were classified as "regular workers" and 140,538 as "casual workers." The term casual worker has a wide significance. It includes not only those employed on unskilled seasonal work for short periods but also large numbers whose chief occupation is farm work but who find employment in other occupations, such as roadmending, in the winter when the demand for labour on the farm is at its lowest.

Work on the farm is necessarily dependent on the time of year and the weather. It was formerly the practice to suspend men (to "stand them off" as the phrase ran) in wet weather. As labour became more mobile and migration from the villages became common, employment on farms tended to be more stable and every farmer aimed at keeping a permanent staff all the year round, engaging casual workers only in times of greatest pressure. The practice of "standing off" in wet weather was gradually discontinued, and, in effect, finally abolished by the Agricultural Wages Board established in 1917.

The "gang" system of organizing casual and seasonal labour was general in the last century but it gradually fell into disrepute. Under this system a number of men and women were collected by a gangmaster and travelled from farm to farm for seasonal operations. The gangmaster made a contract with the farmer to do certain work for a specified amount and divided the payment among the members of the gang. The system obviously lent itself to abuse by unscrupulous gangmasters while the association of men and women for considerable periods without fixed abodes and often without decent accommodation either by day or night led to scandal and disorder.

Classes.—The popular belief that the work of the agricultural labour is "unskilled" is not justified by the facts. Adam Smith compared agricultural and industrial labour thus: "Many inferior

branches of country labour require much more skill and experience than the greater part of mechanic trades. The man who works upon brass and iron works with instruments and materials of which the temper is always the same, or very nearly the same. But the man who ploughs the ground with a team of horses or oxen works with instruments of which the health, strength and temper are very different on different occasions. The condition of the material which he works upon too is as variable as that of the instruments he works with, and both require to be managed with much judgment and discretion." The introduction also of numerous machines and implements in farm work calls for greater versatility and resourcefulness on the part of the farm worker to-day.

Those who are regarded as specially skilled in farm work, and are usually paid a higher wage than the ordinary labourer, are those who have charge of stock. Their additional remuneration is partly in respect of longer hours but it is also paid in consideration of their knowledge and experience and of the responsibility placed on them. Shepherds are generally the most highly paid men on a farm, and where the flocks are large the responsibility placed on them is great. During the lambing season they not only have to be in constant attendance day and night but they must possess some elementary knowledge of veterinary science. It is a common practice to give shepherds a bonus, in addition to their wages, on the number of lambs successfully reared by them.

Men who have charge of cattle are termed in various districts cattlemen, stockmen or cowmen. In Norfolk there are also classes known as bullock-tenders and sheep-tenders who receive generally the same rate of wages as cowmen. Men who have charge of horses are termed carters, waggoners, horsemen or teamsmen.

On the larger farms there is usually a foreman (termed in Scotland a grieve) who is responsible for the general oversight of the men and the organisation of labour. His position and emoluments vary according to the size of the farm, the number of men under him and the extent to which the employer himself takes an active part in the management of the farm.

Organization.—The combination of workers for the advancement of their economic interests and particularly for collective bargaining with their employers has taken comparatively little permanent hold of agricultural labourers in any country. In England, apart from a few spasmodic local efforts, the first organized attempt to establish an agricultural trade union was made in 1872 under the leadership of Joseph Arch. A National Agricultural Labourers' Union was formed which in a short time enrolled about 70,000 members. In the face of strenuous and organized opposition from farmers it soon collapsed and no serious attempt to revive it was made until the beginning of the present century. In 1911 the National Agricultural Labourers' and Rural Workers' Union was started and by the end of 1913 had a membership of nearly 12,000. The establishment of the Agricultural Wages Board and its district committees, in which organization agricultural labourers were given by act of parliament equal rights and representation with farmers, gave an impetus to the organization of farm-workers. In 1919 it was reckoned that about half the agricultural labourers were enrolled, but after 1921 the membership again rapidly diminished and in 1926 not more than about 6 per cent. retained their membership.

Agricultural labourers are not included in the Unemployment Insurance act. In 1926 a departmental committee recommended, by a majority of one, the establishment of a special system of unemployment insurance for agricultural labourers in England and Wales, but the recommendation was not adopted by the Government. (R. H. R.)

United States.—Over the United States as a whole there is less than one hired agricultural labourer per farm. The total number of farms is approximately 6¼ million, while the number of farm-labourers varies from about 3 million in January to at least 4 million in the cropping seasons. The January figure represents mainly the permanently employed—the class that makes agricultural labour its steady occupation.

The relatively small number of farm-labourers is due to the fact that the typical American farm is a family enterprise. Ordinarily the family is large. In some regions there is also considerable exchange of work among farmers on adjacent farms. The number of hired labourers is steadily though slowly diminishing, as the increasing knowledge of agricultural science and the perfection of agricultural machinery cause the production per man constantly to grow. At certain times of the year much casual labour is employed on farms, as for fruit picking and wheat harvesting. The extra labour employed in the latter amounts to approximately 100,000 men per season. In a country the size of the United States the wheat in various regions ripens at different times, and the labourers follow the harvest from place to place. They constitute a heterogeneous group, ranging from university students earning money in their vacations to unskilled, sometimes illiterate, labour from cities.

The extent to which labour is employed throughout the year varies with the region and the type of farming practised. Dairying and live stock husbandry, coupled with diversified cropping, make for a fairly uniform employment of labour at all seasons. On the other hand, the vast wheat farms of the Great Plains offer principally a seasonal demand for labour. Some of these farms are wholly uninhabited by human beings during most of the year. New England and New York have had for generations a tradition in favour of permanent employment of farm-labour, with a strong preference for keeping the same persons year after year. The tendency has been for the farmer to assume a patriarchal attitude toward his help. The unmarried farm-labourer used to occupy a real place in all the life of the farm family. In early days the comparatively high wages and low prices for land—when an acre could be purchased with a single day's labour—attracted a fairly high type of labour to the farms. With the increased price of land, the growth of opportunities in the cities, and increasing dislike of labourers for absolutism in their employers, the type of farm-labour has doubtless declined. There is also a tendency to depart from the custom of making the hired man practically a member of the family, although the old practice still prevails to a large extent, especially in the East.

The average prevailing farm wage rate for the United States on Jan. 1, 1928, was $32.50 a month with board, and $46.75 a month without board. The highest wage rates—about 50% above these figures—are found in the Western States, and the lowest—about 25% beneath these figures—in the South Central States. The wages of casual labour at rush seasons, of course, are much higher. A large proportion of farm-labourers are single men. These almost invariably receive board. Married men usually are supplied with a house or cabin and with some such perquisites as fuel, some food, use of horses and farm tools and garden space. Not infrequently a man and his wife are both employed on the farm—he at farm work, she in domestic matters. Hours of labour on the farm average considerably longer per day, at least throughout the cropping seasons, than in industrial life, although, except in harvest and similar rush times, there is freedom from the pressure characteristic of factory work.

American farm-labour is largely unorganized. The Industrial Workers of the World at one time had a considerable membership of casual farm as well as other labour, but the number is apparently diminishing. The Sheep Shearers' Union of North America, with headquarters at Butte, Mont., has branches in several States. It has no connection with any other union. A few scattered local organizations of farm-labourers have sprung up from time to time, but have developed only to a slight extent. Operating farmers generally are hostile to unions. (N. A. C.)

AGRICULTURAL MACHINERY AND IMPLEMENTS. At the dawn of history we find man practising the most elementary method of modifying soil conditions. He broke up the surface and prepared a seed bed, using for this purpose the most primitive of all cultivating devices, a digging implement in nature like a hoe. The seed was sown by hand and the husbandman either drove his domesticated animals over the land to cover the seed and consolidate the ground, or used a form of harrow or similar implement or a bundle of twigs for the purpose. In early times the principal crops were cereals or pulse and a fibre crop—flax. Harvesting was performed by means of a sickle, an early

example of which, found in the Fayum in Egypt, consists of a wooden rod fitted with flint blades; metal was employed later, and a bronze sickle of about 1000 B.C. is the counterpart of the modern sickle. The crops were carried to a threshing floor where the grain was trodden out by animals, crushed out by sledges or beaten out with flails. The corn was winnowed by casting it through the air with a spade or shovel and fanning or allowing the wind to separate the heavy grain from the lighter husks.

The greatest mechanical advance during these early days of agriculture was the evolution of the plough from the primitive hoe. This transition is very clearly seen in ancient Egypt. The advent of the plough enabled man to supplement his labour by animal power and is one of the great landmarks of agricultural progress. Mesopotamia furnishes evidence of the use of a primitive combined plough and drill, but it is doubtful whether the implement had any advantage over the customary methods; at all events it was lost to later civilization. By Roman times a primitive ridging plough had been evolved by the use of a device resembling the modern double mould board. When the single mould board was developed or when wheels were added to the plough is not definitely known. Pliny, the elder, who lived in the first century, mentions a wheel plough, but the use of such ploughs did not become general until much later. Pliny also reported the use in Gaul of a harvesting device, which was pushed by oxen, for heading or stripping the grain. But ancient civilizations did not make any considerable progress on the mechanical side of agriculture and such mechanical contrivances as were used disappeared with the barbarian invasions.

During the middle ages and until after the Renaissance the variety of implements at the disposal of the husbandman had advanced but little, though the roller was known but was not employed generally in agriculture. It must not, however, be supposed that there was absolute sameness or an uncritical acceptance of the implements handed down from previous generations. Fitzherbert's *Book of Husbandry,* printed in England in 1523, mentions the different types of plough used in different districts and attempts to give reasons for the differences in design. Fitzherbert appears to have realized that the design of the plough must be modified to reduce the draught in different kinds of soil. Hand tools had been perfected and often represent, even in small details, the hand tools in use to-day. By the year 1600 more elaborate implements were coming into use, and more than one book published in England about this time deals with the "new and admirable art of setting of corn." About 1730 Jethro Tull (*q v.*), who is renowned for his horse-hoeing husbandry, developed a seed drill which was really workable, although its general adoption was hampered by Tull's advocacy of impracticable methods of cultivation.

In the eighteenth century there was a conscious and organized attempt to improve agricultural implements, and in England the Society of Arts, which had been founded in 1754, encouraged the movement by the offer of premiums. Ploughing matches were held in many parts of the country and attracted general support from farmers and their men. There were also competitions in the use of drills and horse-hoes. New methods and inventions were being applied to most farming operations, and new conditions were being created favourable for the great advance which followed.

The Steam Engine.—By the 19th century such a complexity had been introduced as to justify the use of the term "agricultural machinery." In agriculture, as in the manufacturing industry, the use first of water-power and then of steam had immensely stimulated the invention of machinery supplementing or replacing manual labour. A workable threshing machine was invented late in the 18th century and was gradually coming into use early in the 19th; it was driven by water or wind power, sometimes by horse labour, and later by steam. But it was not until the '30s of the 19th century that steam began to be applied at all extensively to agriculture. A system was then introduced whereby one or two engines were employed to draw multi-furrowed ploughs, by means of cables, backwards and forwards across the field, and after a good deal of experimentation the established system of steam-ploughing with a double-engined cable set was devised in the fifties. Heavy implements such as the cultivator and mole plough were later added to the equipment of steam tackle; mechanical threshing became popular and steam-engines were also used to some extent to drive barn machinery. Nevertheless, for the most part the development of agricultural machinery upon the farm owes little directly to steam. The mowing machine and the self-binder, the tedder and swath-turner, the drill, the potato-digger, chaff-cutters and root-cutters, all have been developed in the first instance for horse or manual labour, though doubtless receiving a fresh stimulus from the general mechanization of industry applied to the farm and the still greater stimulus, in Britain as in America, arising from a shortage of cheap labour.

The Internal-combustion Engine.—In still more recent times an important practical contribution to the mechanization of the farm came from the discovery of the internal-combustion engine. Used first of all to drive stationary machinery, as chaff-cutters, root-cutters and corn-mills in the barn, in the second decade of the 20th century the internal-combustion engine also made headway as a source of power for field operations. Steam-engines, though widely used for traction on the road, suffered the disadvantage of being heavy for use on the land for the direct haulage of machinery and implements; it was not until the internal-combustion engine had been perfected that agricultural tractors made their appearance in any number.

This type of tractor has now an established position on the farm on both sides of the Atlantic; it supplies power for ploughing, cultivating and harvesting; it can both drive and haul the threshing-machine, and there can be no doubt it contains the promise of still further usefulness. The practice of mole-draining, for example, has been greatly stimulated not only in Britain but on the Continent of Europe by the invention of mole-ploughs that can be hauled by a suitable agricultural tractor. The cost of the work is substantially less than when performed by steam tackle and is far more expeditious than when performed by horses. The tractor has also rendered it easier for the farmer to undertake deep ploughing and subsoiling, which are very important for growing a crop such as sugar beet. Subsoiling had been looked on with disfavour because of the heavy strain imposed upon the teams and, when carried out at all, had been left in great measure to steam tackle. The application of the internal combustion engine has also enabled designers to produce machines of more moderate size and weight than formerly.

Another direction in which the internal-combustion engine is likely to prove its usefulness is in rotary tillage. This is a system which may ultimately replace ploughing and subsequent cultivating by a single operation. It has been advocated since the first half of the 19th century, and many attempts have been made to devise an effective machine, the best known being the Darby digger which inverted the soil by an action somewhat resembling that of the spade. The most promising machines make use of revolving tines for disintegrating the soil and the tines revolve in such a way as to assist the propulsion of the machine. The advantages and limitations of rotary tillage have still to be tried out. In a climate like that of Great Britain the combined effects of autumn or winter ploughing and frost may not be attainable by rotary tillage. Given suitable soil and climatic conditions, however, the potential advantages of preparing a seed-bed at one operation and on a considerable scale are obvious

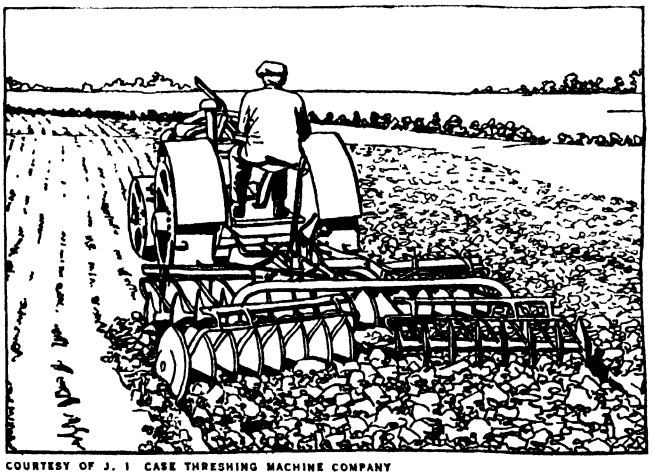
The internal-combustion engine thus enables operations to be efficiently performed which were beyond the resources of the ordinary farmer, or which were little more than ideas in the days of steam and horse labour. But this is not its only or perhaps its chief usefulness. It enables operations to be performed far more speedily with an equal labour force and is therefore an ally to the farmer in his struggle against adverse weather conditions. Obviously, if five or six acres can be ploughed in a day by a tractor where formerly a plough-team accounted for less than one acre, another factor than the unit cost of the ploughing, namely, that of speed or of the time conditions, has entered into the operations. Again, if 20 acres can be reaped in a day as against ten or 12 acres by two teams of horses, the same factor enters. Full advantage, however, cannot be taken of the tractor when the implements

and machines used with it are those designed and constructed for horse haulage; to obtain the full benefit implements expressly designed for tractor work must be employed.

In the cable system of ploughing and cultivating, the internal-combustion engine appears likely also to replace steam. The ease of handling oil fuel as compared with the difficulties often attending the transport of water and coal or wood must, it would seem, in the long run prove the decisive factor. The advent of the producer-gas plant for use with tractors and lorries is also likely to extend the use of the internal-combustion engine in countries where liquid fuel is scarce and suitable materials for producing gas are available. The possibilities of the production of power alcohol on a commercial scale must also be borne in mind when considering the future sources of energy for the farmer.

Electricity.—But a still newer source of power which has made its appearance upon the farm is electricity. Owing to the shortage of coal and oil fuel during the War period, a stimulus was given to the exploitation of water-power and electricity undertakings. Although employed at first principally for lighting, electricity, when it is available at low cost relatively to other forms of power, is gradually coming into use for driving stationary machinery on the farm. Its further use for cultivating the land has scarcely gone beyond the experimental stage as yet, although systems of cable ploughing in which electric motors are employed are actually in operation in several European countries. The principal difficulty is the transmission of current to every part of the farm where it may be needed, since equipment with transmission lines may involve serious expense.

Other Mechanical Progress.—The gradual mechanisation of the farm is apparent, however, not only in those branches of agriculture and methods of operations which are of long standing. As new crops are introduced or old crops revived, mechanical means are devised to deal with them. Each crop indeed demands its appropriate machines. A crop such as sugar beet, when introduced into a country where labour is dear, requires effective mechanical means for dealing with it at all its stages, but particularly for harvesting—the most arduous of the whole cycle of operations; consequently it is necessary to devise mechanical lifters and toppers as substitutes for the hand labour employed in countries where wages are low. Similarly with the flax crop; its revival in Britain has led to concentration on the problems of harvesting and the preparation of the fibre for the spinner. Machines for pulling the crop and for scutching (or dressing) the straw have been devised, and new mechanical processes have been advocated to supersede entirely the traditional hand methods.



COURTESY OF J. I CASE THRESHING MACHINE COMPANY

A DISC-HARROW DRIVEN BY A GENERAL UTILITY TRACTOR TO WHICH A PLOUGH OR A SMALL GRAIN SEEDING DEVICE CAN ALSO BE HITCHED

Classification of Machinery.—Agricultural implements and machines are now very numerous and very diversified and may be considered under five main groups, namely: (1) *prime-movers, i.e.*, engines of all kinds, tractors, water-wheels, windmills, etc.; (2) *cultivating machinery,* including ploughs of all kinds, rotary tillers, harrows, hoes, scarifiers, rollers, manure distributors, drills, mole-ploughs, etc.; (3) *harvesting machinery,* including mowers, rakes, swath-turners, tedders, reapers, self-binders, threshing machines, elevators, potato lifters, beet toppers and lifters, crop drying plants, etc.; (4) *stationary* or *barn machinery,* including such food-preparing machines as cake-breakers, chaff cutters, grinding and crushing mills, root-cutters, etc.; (5) *dairy machinery,* including milking machines, separators, churns, butter workers, sterilizing and bottling machines, etc. In addition, there are a number of miscellaneous machines, including sprayers, sheep-shearing and horse-clipping machines.

Economics of Machinery.—From the development of such mechanical devices it does not, however, follow that every farmer can economically use machinery for all possible purposes. With his small acreage of grass and cereals the small-holder, for example, would probably not feel justified in purchasing any harvesting machinery, except a horse rake and a combined mower and reaper, whilst the farmer with a holding of 300 acres or so of mixed arable and pasture land would find it necessary to have a complete outfit of cultivating, harvesting and stationary machinery, besides many dairy appliances if milk production were also an important part of his enterprise. In suitable circumstances he would probably also find it desirable to supplement horse labour by one or more tractors and would probably thresh his own produce But on very large arable farms, such as extend in some parts of the world to several thousands of acres, the range of agricultural machinery would include cable sets and possibly even trenching machines for excavating and grading drains and ditches.

The economic use of machinery in agriculture is dependent on a number of factors which vary from country to country, from district to district, and from one type and size of farm to another, but there is one principle common to all cases: a machine must do sufficient work to repay its capital outlay and working costs over a reasonable period. To meet this requirement the minimum amount of work must be available before any particular machine can be employed economically. The potato crop furnishes an excellent illustration. The cheapest way to lift a small plot of potatoes is by hand forking; the lifting of an area of an acre or so will repay the cost of a simple potato plough; while a larger area will justify the purchase of a potato-lifting machine. But the use of machinery depends also on other factors besides cheapness in comparison with other methods. Speed of work and ability to take advantage of favourable weather are factors which may influence considerably the adoption of mechanical devices, although it may be difficult for any system of farm costings to take cognisance of these advantages. Emphasis must at present be laid on the paucity of accurate knowledge regarding the cost of farming operations in general, though efforts have in recent years been made in Europe and America to analyse farm costs and to stimulate the adoption by farmers of some simplified system of cost accounting. The comparative cost of individual operations or units of work is, however, not sufficient; the problem from the farmer's point of view is rather the production of food units at a minimum cost, and the marketing of them either directly or by feeding to stock in such a way as to obtain a maximum return on the capital outlay involved.

Social Effects of Machinery.—It is sometimes supposed that the introduction of machinery has led to rural depopulation and will intensify it. But even in older countries machinery has more often than not been introduced because a labour supply of a particular kind has failed; for example, the falling-off of casual and migrant labour at harvest time due to a number of social causes has encouraged the widespread adoption of the self-binder. In newer countries the introduction of machinery has had the effect of populating waste areas, for the vast tracts of new land in the United States, Australia, Canada, etc., could not be farmed in present circumstances without the aid of machinery; the alternative would be timber production or stock raising.

The use of machinery also requires skilled workers, and the more widespread the use of machinery becomes in agriculture the more highly skilled will be the farmworkers. The mechanisation of agriculture also means that a higher wage can be paid because the unit

of production is enlarged, but as a corollary it also indicates larger farms or groups of small farms worked as one economic unit. The alternative is a system of peasant holdings with primitive methods; but the Western world is steadily moving away from the social conditions which made such a system possible.

See CULTIVATING MACHINERY; DAIRY MACHINERY; HARVESTING MACHINERY; STATIONARY (BARN) MACHINERY. Also such articles as SHEEP SHEARER; TRACTORS; DRAINAGE, etc.

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UNITED STATES

As industry has developed and has built great cities, it has called man-labour from the country This labour has been replaced by agricultural machinery and implements. The extent to which this has happened in the United States is indicated in fig. 1. Although the total population of the United States in 1927 was a little more than five times as great as in 1850, and although the acreage of improved farm land increased about 4½ times during the same period, yet the number of agricultural workers in 1927 was a little less than three times the number in 1850 Seventy-five years ago the proportion of total population to agricultural workers was slightly over six to one. Better adaptation of crops to soils and climate, and increased yields per acre, are probably the main reasons why the acreage of improved farm land has not kept pace with the increase in total population. But had it not been for the introduction of machinery which increased the effectiveness of man-labour on the farm, an increasing number of acres to feed and help clothe a rapidly increasing population must have been accompanied by a much more nearly equal increase in agricultural workers.

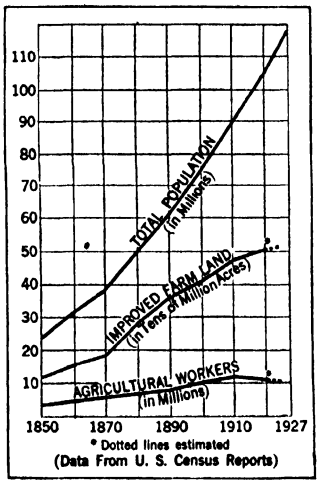


FIG. 1.—GRAPH SHOWING VARIATION IN POPULATION, IN AGRICULTURAL WORKERS AND IN ACREAGE OF IMPROVED FARM LANDS IN THE UNITED STATES

Effect on Time, Man-labour and Production.—Since 1850, when the application of machinery to farming began in earnest, the average acres of improved land per agricultural worker in the United States increased steadily from 30·4 acres to 47·2 acres in 1920; and the value of agricultural implements and machinery per agricultural worker increased from $40 77 in 1850 to over $200 in 1925. The 13th annual report of the United States Department of Labor shows that the man-labour requirement to produce twenty bushels (one acre) of wheat by the hand methods of 1830 was 61 hours and 5 minutes, at a labour cost of $4 00; by the machine methods of 1895, only 3 hours and 19 minutes, at a labour cost of $1.12 were necessary to produce the same amount. By the hand methods of 1855 an acre of corn required nearly 39 hours of man-labour; in 1894 it required slightly over 15 hours with machinery. Using the estimates of the Department of Labor for nine important crops (barley, corn, cotton, hay, oats, potatoes, rice, rye, wheat) and comparing the machine methods of about 1895 with the hand methods of earlier times, H. W. Quaintance (*The Influence of Farm Machinery on Production and Labour*) states: "Taking the per cent of labour saved as indicating the average proportion of these crops due to the use of machinery, it appears that the quantity of products is almost five times as great, per unit of labour, as it formerly was." This suggests how machinery has freed labour from agriculture for service in industry and commerce. After an extensive study and presentation of data on 15 crops (barley, broom corn, corn, cotton, hay, oats, onions, peas, potatoes, rice, rye, sugar cane, sweet potatoes, tobacco, wheat) grown in the United States, the same author says: "Surely it will not be too much to say that during the last half of the 19th century the cost of production[1] of these crops was reduced by one half." That the influence of machinery on labour has continued since 1895 is evidenced by the fact that now it is not uncommon to hear of farmers in the United States and Canada who, by the most modern machine methods, produce wheat and corn with a man-labour requirement per acre of only two and six hours respectively.

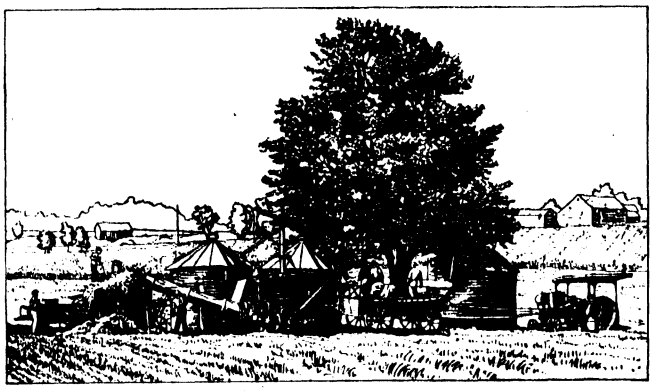
Influence on Quality of Work and of Product.—As inferred previously, increased yields per acre, and improved quality of product, are due to a number of factors; but the importance of one of these is not to be overlooked here. The improved methods in farming made practicable by machinery have a marked influence on the quality of work done by the farmer, and on the quantity and quality of the product By the use of better designed, better adapted and more effective soil working, grain grading, seeding and harvesting machinery, sounder seed is more evenly sown in a better seed bed; a larger yield is promised and a more uniform and cleaner product is marketed. Modern spraying equipment not only saves the fruit crop, but its use also means better quality; then modern sorting and packing machines grade the product to command the best market price. These are but a few of scores of illustrations; yet, that is not all Up-to-date machinery in agriculture permits better utilization of products; for instance, the feed grinder, silage cutter and shredder have increased the feeding value of roughage, and the manure spreader permits better utilization of animal refuse to help maintain fertility and good tilth.

Other Effects.—Although the average acreage of improved land per farm in the United States has fluctuated somewhat since 1850, economists point out that in the north central states, in which machinery has been more widely applied to general farming than in other divisions, the improved land acreage per farm has steadily increased; likewise, the average number of crop acres per farm in these states has increased during the period for which data are available. In other sections of the country where general farming has been practised and where machinery has not been so widely adapted, not only are the tendencies just mentioned less apparent but, even at times, there is a marked tendency toward smaller farms. In Canada, the average acreage of improved land per farm has increased steadily from 59 acres in 1901 to 99 acres in 1912; during the same period agricultural implements and machinery increased approximately from six to ten per cent of the total value of all farm property. If the total investment in all farm property in the United States is considered, the increase since 1850 has been much greater in the agricultural divisions of the country in which machinery is widely used. The greatest item in the value of farm property is the value of the land itself; and land values are based somewhat upon earning capacity. Of course, the increase in value of all farm property may be due to several factors; but, the ability of machinery to cut down the cost of production and thereby increase net profit is not to be overlooked as having had and continuing to have an influence on land value.

By lessening the time necessary to perform farm work, machinery has assisted in shortening the working day. Also, it has changed the character of the work in a way that has important social bearing. In 1880 it was easier physically and more pleasant

[1]Cost of production here is based on cost of labour and does not include differences in machine overhead between hand and machine methods. This discrepancy, if it seems such, is more than offset by the fact that labour by hand methods is figured at the rate of about 1850, while for machine methods it is computed on the basis of the higher wages current about 1895.

mentally to thresh grain with a threshing machine than to use the flail of 1820. Likewise, it is easier to-day to sit upon a combination harvester-thresher, guide the machine and control the power than it was to pitch bundles and straw in the days of 1880. In this sense, agricultural machinery is truly "labour saving" in that it has relieved farm work of much of the old, arduous, physical exertion so often characterized as drudgery, and demanded in its place greater skill and more intelligence on the part of the operator. The modern farmer whose business demands extensive use of agricultural machinery is just as busy, if not



BY COURTESY OF H. A. STROHMEYAR, JR.

THRESHING ON A MODERN FARM. A QUICKER AND EASIER OCCUPATION THAN IT WAS 50 YEARS AGO WHEN POWER MACHINES WERE UNKNOWN

busier, than his grandfather, but his work is more mental and less manual. Modern farming is a complex business requiring study, wise planning and careful execution. To be sure, the farmer of to-day works hard physically as well as mentally, but, by lessening the time requirement for various farm operations and by eliminating much of the old drudgery, farm machinery and household conveniences allow the farmer and his wife and children more time for reading, for thinking, for recreation and for self-improvement.

Classification.—Types, kinds and sizes of agricultural machinery and implements form a complex subject. Agricultural conditions into which machinery must fit vary widely between the one-mule farms of the cotton-belt and the great wheat ranches of Canada; the operation of a New England farm varies from that of a corn-belt farm, and the latter, in turn, is vastly different from the California fruit ranch. Differences in sizes of farms, in size of fields, in kinds of crops grown, and in the kind and size of power units most economical or practical—all cause variation in type and size of machine or implement. For a small field, one can buy a one-horse implement for a very few dollars, or, for a great plantation one may buy a special harvester which costs several thousand dollars. Because of the wide variation in soil types, the large manufacturer selling nationally finds it necessary to make over one hundred different shapes and kinds of moldboards for ploughs in addition to the disc type of plough which is demanded in very hard, in very fluffy or in very sticky soils. Land values have some influence. Then, last but not least, the human equation enters; differences in peoples and in regional customs add complication. The farm labourer of low mental calibre and of little mechanical skill requires a smaller, simpler implement than the skilled operator who commands a 60-horsepower tractor hauling a combination of implements which performs two or three operations in one trip over the ground.

Space does not permit description of all kinds of agricultural machines and implements. Fortunately, however, the subject lends itself to classification according to the purpose of the machine. Most of the agricultural machines, implements and tools used by farmers in the United States and Canada may be classified according to purpose. The list includes only those items considered part of the business of raising or making agricultural products up to the moment those products are sold. It does not include the strictly household conveniences, devices and utilities which are becoming so widely adapted to assist the housewife and to enable the farmer and his family to enjoy more the art of living.

Machines and Implements for the Reclamation, Maintenance or Improvement of Land: stump pullers, pilers; brush breakers, cutters, burners; open ditch, tile ditch and mole ditch machines; land drain cleaners; land levellers; terracing scrapers, graders; irrigation pumps, sprinklers, water controls, ditchers; sub-soilers; limestone crushers; lime and fertilizer distributors; manure loaders, spreaders; straw spreaders.

Machines and Implements for Seed-Bed Preparation: mouldboard and disc ploughs; drags; spike-tooth, spring-tooth, disc and special harrows; smoothers and pulverizers; plain, corrugated and bar rollers; surface and subsurface packers; clod crushers; special tillers; sweeps; listers; ridge busters; stalk cutters, shavers; cotton stalk choppers; stubble diggers, pulverizers; markers.

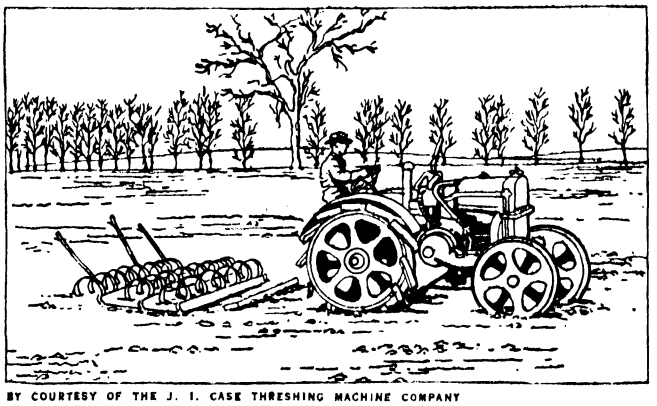
Machines and Implements for Seed Preparation: fanning mills; grain, pea, bean, cotton seed, peanut, flax, onion set, rice, potato and corn cleaners, graders and sorters; seed scarifiers; seed testers; seed stringers; seed driers; butters and tippers; potato cutters.

Machines and Implements for Seeding and Planting: broadcasters; grain, beet, grass and garden seed, bean, pea, corn, onion and rice drills; corn, cotton, beet, potato, pea, bean, onion and peanut planters; transplanters; seeders; markers; lister-planters; fertilizing attachments.

Machines and Implements for Cultivating: corn, beet, cotton, potato, sugar cane, vineyard, orchard and garden cultivators; celery, potato and tobacco hillers; drags; spike-tooth, spring-tooth and disc harrows; weeders; rotary hoes; ridgers; renovators; sweeps; root blockers; cotton scrapers, choppers; thinners.

Machines and Implements for Harvesting: mowers; tedders; "flop-over," dump and side delivery rakes; "bull" and sweep rakes; hay, shock, bundle and cane loaders; stackers; bunchers; windrowers; reapers; grain and corn binders; grain and corn headers; header-binders; combination harvester-threshers; corn, cotton, potato, peanut and fruit pickers; root and plant lifters; potato and peanut diggers; root toppers; bean, pea, beet, celery, grass seed and onion harvesters; field ensilage harvesters; seed and cotton strippers; sugar cane cutters, harvesters; corn and hemp cutters; grain and corn shockers; shock compressors, movers, sweeps; huskers; milking machines; wool clippers; tree fellers.

Machines for Preparing Products for Market: grain, pea, bean, peanut and rice threshers and cleaners; alfalfa, clover, almond, bean, pea, grain and rice hullers; grain, pea, bean, cotton seed, peanut, onion set, rice, potato, corn, berry and fruit cleaners, graders and sorters; cotton gins and presses; balers; produce washers; grain polishers; corn, peanut, rice and pop-corn shellers; vegetable bunchers; cream separators; milk emulsifiers, pasteurizers, sterilizers, coolers, aerators; churns; butter workers; bottling machines; cheese and lard presses; sugar, fruit, sorghum and syrup evaporators; honey extractors; berry and fruit crushers; cider and juice mills, presses,



BY COURTESY OF THE J. I. CASE THRESHING MACHINE COMPANY

A POWER DRIVEN SPRING-TOOTH HARROW, OPERATED BY ONE MAN AND EMPLOYED IN PREPARING AND CULTIVATING THE SEED BED

extractors; bleachers; pitters; parers; sugar cane and sorghum mills; hemp breakers and cleaners; saw mills; baggers; weighers.

Machines for Feed Preparation and Feeding: cutting boxes; ensilage and fodder cutters; feed mills, grinders, mealers; roughage mealers; feed mixers; shredders; root and vegetable cutters, pulpers; feed cookers; stock feeders; bone cutters; corn and cob crushers; silo packers.

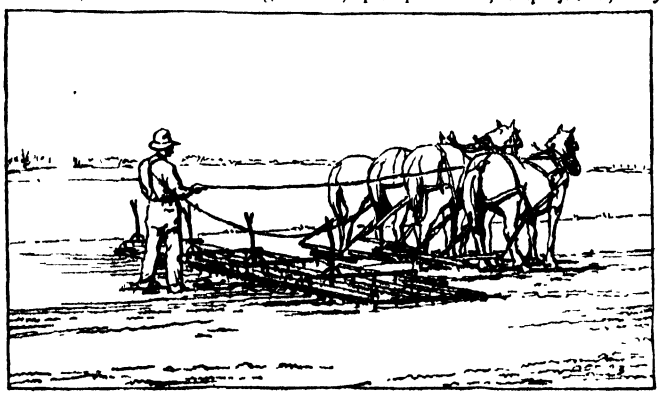
Machines and Implements for Combating Crop Enemies: sprayers; dusters; field burners; stubble pulverizers; insect sweeps, catchers, traps; tobacco bed burners; seed treaters; smut cleaners; fumigators.

Machines, Implements and Conveyances for Transportation: automobiles; motor trucks; wagons; carriages; horse and hand carts; sleighs; bobs; stone boats; wheelbarrows; farm, wagon, log, lumber, header and sugar-cane gears; racks and barge boxes; hay carriers,

forks, slings; blowers; grain dumps, elevators; car loaders; feed and litter carriers.

Power, Light and Heat Generators: gas, petrol, paraffin, distillate, hot air and steam engines; steam and internal combustion tractors; boilers; windmills; turbines; water wheels; hydraulic rams; tread mills; power sweeps; electric motors, dynamos, generators; lighting plants; tank heaters.

Miscellaneous Machines, Implements and Tools: incubators and brooders; disc and knife grinders; pumps and pump jacks; hay



BY COURTESY OF THE J. I CASE THRESHING MACHINE COMPANY

BEFORE THE ADVENT OF THE TRACTOR THE HORSE-DRAWN SPIKE-TOOTHED HARROW AS ABOVE WAS AN IMPLEMENT IN COMMON USE

knives and hooks; hand hoes, rakes, shovels, forks; corn, cane, tobacco and cabbage knives; pruning and grafting hooks, knives, shears and saws; fence stretchers; hog rubs; post hole augers, lifting jacks; animal pokes and leads; dehorners; horse and cattle clippers; grooming machines; milk and cream testers; utensil washers, sterilizers; scales; ladders; hand tools and machines for wood and iron work

Historical Sketch.—Attempting to determine whether changes in agriculture were the cause or the result of the introduction and improvement of machinery is like trying to decide which came first—the hen or the egg. Undoubtedly, a change in agriculture at times caused sharp changes in agricultural machinery; at other times, advancement in agricultural machinery permitted, if not actually caused, marked changes in agriculture. The two are so interdependent that a historical sketch should review the status of machinery and implements in each of the five great periods in the history of American agriculture, as well as point out the high spots in the history of machinery itself.

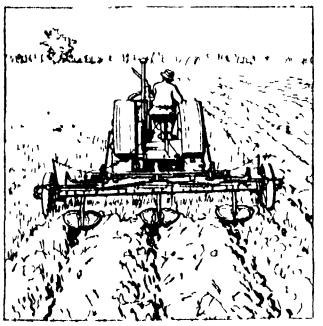
During the colonial period (1607 to 1783), farming was on a self-sufficing basis; that is, the farmer made his own shelter, he and his family made much of what they wore, and, with the exception of some wheat, tobacco, rice and indigo, the farmer raised but little more than was required for his own family. The ground was spaded or hoed up, or it was ploughed with a crude, "bull" plough which carried a wooden mouldboard sometimes stripped with iron. Farmers who were fortunate enough to own these home-made ploughs often ploughed for others If the seedbed was harrowed at all, a "peg tooth" harrow was used; this was a wooden frame with wooden spikes for teeth. Small grain was sown broadcast by hand; sometimes it was harrowed in or was trodden in by animals. The new crop was cut with a hand sickle, scythe or cradle, threshed with hand flail or by driving animals over it on a treading floor; then the grain was winnowed by casting it against a light wind. Corn was dropped, covered, cultivated and harvested entirely by hand. Wooden-wheeled carts were used; but evidently these were not as popular as one would suppose, because there is evidence that tobacco was placed in huge barrels which were rolled to the market point. Thus, with the exception of a great number of hand tools, crude forms of the plough, harrow and wagon were the only agricultural implements of the colonial period.

With only one or two notable exceptions the same conditions held and the same old implements were used throughout the second period (1783–1830) of agricultural history. This period was characterized by the beginnings of the public land policy and of expansion westward, and by the increasing importance of cotton in the South. Early in the 1790's the Ely cotton gin appeared; this made the removal of the seed from the cotton mechanically possible and was a great boon to the young cotton industry The influence of the cotton gin has been so far-reaching economically, commercially and socially that it is considered one of the high lights in the history of agricultural machinery.

About 1797 Newbold demonstrated his cast-iron plough. It was similar to the cast-iron ploughs which had been demonstrated shortly before in England. Records indicate that farmers feared detrimental effects from so much iron in contact with the soil, and evidently this first American cast plough was never repaired after its mouldboard became broken. Hence wooden ploughs, some of which carried wrought-iron cutting edges, continued well throughout the period. Between 1814 and 1820, however, Wood, evidently continuing the meditations of Thomas Jefferson on the mathematics and mechanics of the mouldboard, began to give the plough bottom scientific shape for better turning, pulverizing and for lighter draft. To secure these shapes Wood had to cast his ploughs, and he introduced the important feature of having parts of the plough renewable.

During the latter part of this period a cutting box to cut up roughage for feed, a cultivator for row crops, a horse rake and the Bailey mower appeared. The mower cut by means of a large circular blade which revolved against the grass evidently to imitate the cutting action of the old scythe blade. The cutting box, cultivator and rake ideas were perpetuated, but this device for mowing was not further developed. It is claimed that a few "chaff piler" or "ground hog" threshers were used as early as 1825; these rubbed the grain from the heads but did not separate it from the chaff or straw. These implements, although their use did not become general until later, are mentioned here to show that, as farming moved westward and larger or new tracts of land became available to the farmer, there began a real attempt to furnish machinery to supplant a growing shortage of labour.

At no time has American agriculture undergone such changes as during its third historical period (1830–1860), and at no time has agricultural machinery been so involved in a transitory period. At the beginning of this period the farmer produced first for himself and family; at the close he was raising crops chiefly to sell As the new railroads opened up the interior, agricultural products were shipped into the East to be laid down on the seaboard in such quantities as to affect almost the entire world. The repeal of the Corn Laws in England, the rapid development of manufacturing both in England and America, the potato famine in Ireland and the settling of western lands by thousands of immigrants following the German revolution of 1848 all gave stimulus to American agriculture. Not only did breaking and cultivating the black lands of the Middle West present new problems in soil working implements, but also over the entire country farmers awoke to the pressing need of a cheaper, faster way of doing things This led to an outstanding period of invention and to the real beginning of implement factories to supplant the country blacksmiths who for years had been supplying local patrons with crude implements fashioned largely after their own individual ideas.



BY COURTESY OF THE J I CASE THRESHING MACHINE COMPANY

THE POTATO TRENCHER MARKED A FORWARD STEP IN THE PROGRESS OF AGRICULTURAL MACHINERY

The obstinate scouring qualities of the soils in the Mississippi valley led to the use of steel instead of iron strips to face the mouldboards of ploughs. In 1833 John Lane built the first steel mouldboard, using cross-cut saws for the purpose. John Deere starting in 1837, and William Parlin beginning in 1842, were other pioneers in the steel plough business of the Middle West. Much credit is due also to James Oliver who, beginning his experiments in 1853, greatly advanced the process of chilling cast plough parts, thus securing greater durability and improving the scouring qualities of this type of plough.

Early in the '30s the Manning, the Hussey and McCormick

patents brought out the idea of cutting grass and grain by a reciprocating knife passing through fingers or guards. It is this principle upon which modern mowers, binders, headers and combination harvester-threshers still operate.

Other patents and developments of note during the early part of this period related to corn shellers, fanning mills, grain drills, and to tread-powers and power-sweeps, whereby the power of horses or oxen could be utilized to drive the rotating parts of such stationary machines as threshers. In 1834 Pitts combined a "ground-hog" thresher and a fanning mill and thus started the development of the modern grain separator which threshes, cleans, weighs and bags the grain. Although they did not become popular until years afterward, nevertheless grain strippers and headers were patented during the twenty years prior to 1850.

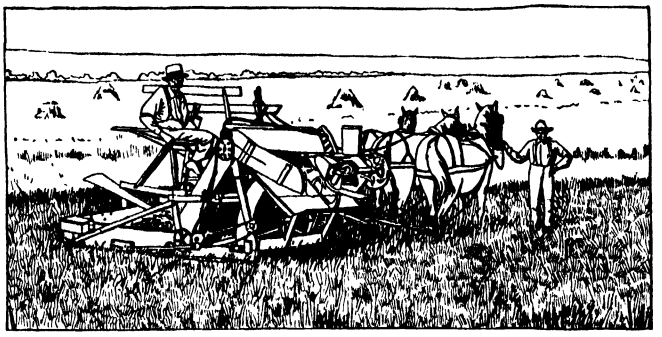
By 1850 several factories had been established for the manufacture and sale of what were then improved and successful ploughs, harrows, grain drills, reapers, mowers, threshers, strippers and power-sweeps. Of course much work on the farm still had to be done by hand, and much improvement and many new devices were to appear after that date But by that time the farming public was accepting mechanical devices so rapidly that 1850 is recorded by historians as the close of the period of "hand production" and the beginning of the machine era in American agriculture. The advent of machinery and implements placed farming on a commercial or production basis on which the farmer raised products to sell rather than simply to sustain himself and family. It is interesting to note that from 1850 to 1860 the number of establishments manufacturing agricultural machinery increased from 1,333 to 2,116.

From 1850 to 1860 patents appeared and development work was carried on on each of the following: force-feed devices in grain drills, stalk cutters, baling presses, two row corn planters, disc harrows, feed grinders and "straddle row" cultivators. Improvements continued on all classes of implements, especially on mowers, threshers and reapers. One of the most interesting developments concerned mechanical binding attachments made for and used to some extent on reapers. Most of these attachments used wire instead of twine; wire was costly and objectionable in the straw, and one step—that of elevating the grain and getting it automatically into good binding position—was lacking. At the time that the wire binding attachments were being developed, the Marsh brothers, about 1856, conceived the idea that two men, standing on a special platform at one side of the reaper, could bind the grain by hand providing it was elevated from the platform of the reaper and delivered to them on a binding table which they faced. Although the Marsh harvester of 1858 was originally designed to facilitate hand binding, nevertheless it is very important historically because it so materially solved the problem of grain delivery. It supplied the step just referred to as lacking with the early wire binding attachments, and became the foundation for the later binding machines which were simply to substitute automatic binding and tying devices for the two men that stood on the first Marsh harvester.

The fourth period in the history of American agriculture extends from 1860 to 1887. It was characterized by remarkable expansion, a chief cause of which was the passage of the Homestead Acts. The disbanding of the armies of the Civil War sent men and mules back to the land, and, machinery being available, many sought the agricultural opportunities of the far west, which was about to be opened up by the completion of the trans-continental railroads. The perfection of the twine binder and the introduction of the roller process for flour manufacture also stimulated agricultural expansion.

The drain of the Civil War on farm labour forced farmers to the use of more and more machinery. During the war mowers came into very general use, and early in the period there was much done to perfect horse rakes which, as an accompaniment to the mower, could displace more labour in the haying process. This was to be followed soon, in 1872, by the development of hay forks, slings and carriers by which hay could be moved from the wagon to the mow or to the stack by horse power rather than by hand. Thus the production of hay had become mechanical save for one step—that of loading. This gap began to be closed in 1874 when the mechanical hay loader appeared; the implement was considerably improved about 1880 and came into use about 1885. Although they had been patented years previously, two-wheeled sulky and gang ploughs did not appear in good quantities until about 1870 In 1868 John Lane, Jr., patented soft-centre steel for plough bottoms. About the same time disc harrow manufacture began in earnest.

The first automatic grain binder—that is, the first harvester of the Marsh type to carry an automatic bundle forming, compressing and tying attachment—appeared in 1870, and was known as the Locke machine. At last the tedious process of binding



BY COURTESY OF THE INTERNATIONAL HARVESTER COMPANY

THE McCORMICK TWINE BINDER OF 1881 WAS AMONG THE FIRST TO INTRODUCE AUTOMATIC BINDING OF WHEAT

sheaves by hand was doomed, and the importance of this development in history of agriculture can hardly be overestimated. Attachments using twine as the binding material, and some using wire, followed quickly. About 1878 the famous tying device known as the Appleby knotter appeared It has become the standard tying mechanism of nearly all modern grain, rice and corn binders. Thus, the grain binder was the result of 40 years of struggle in which some men lost fortunes while others became prosperous The grain binder is the product of no one man; it is the culmination of many ideas, only the fittest of which could survive.

Although combination harvesters and threshers had been thought of as early as 1826, it was not until about 1875 that the "combine" came into use, and then it appeared in the vast wheat fields of the Pacific coast states These were large machines, drawn by from 12 to 30 horses, cutting a swath of grain from 16 to 24ft. wide, and threshing, cleaning and sacking the grain in one trip over the field.

In 1875, largely through the activities of the Haworth brothers, automatic check-rowers for planting corn became practical The dropping mechanism in these machines was operated by regularly spaced buttons on a wire stretched across the field, instead of by an extra man on the planter. Thus one man, and the previous operation of marking off the field, were eliminated from the planting process In 1876 manure spreaders of the wagon type were developed to the practical stage. About the same time ensilage cutters, or silo fillers, and disc ploughs appeared, the latter, however, did not become commercially practicable until about 1890. Although stationary steam engines, and steam engines on trucks which could be hauled from place to place, had been used previously, the self-propelled steam traction engine did not appear in agriculture until about 1880. This was the forerunner of the modern tractor. In 1884 three-wheeled sulky and gang ploughs were developed; these were of high-lift design and the prototype of the modern riding plough used so extensively in both the United States and Canada. About 1885 a combination machine for husking corn and shredding the stalk made its appearance.

The fifth period in American agriculture, 1887 to the present time, began with the practical exhaustion of those public lands in the United States which could be converted easily and cheaply into quick producing farms. Since 1887 agriculture has been settling down to more intensive cultivation accompanied by improvement in farms and the subsequent rise in land values. (The same tendency is in evidence in Canada, though there the cor-



(1, 5, 9) BY COURTESY OF JOHN DEERE & CO., (2) J. I. CASE THRESHING MACHINE CO., (3) UNIVERSITY OF WISCONSIN, (4, 6) INTERNATIONAL HARVESTER CO., (7, 8) NATIONAL ASSOCIATION OF FARM EQUIPMENT AND MACHINERY

IMPROVED FARM MACHINERY USED IN THE UNITED STATES

1. Sarge tractor ploughing outfit of the northwest
2. Combination disc harrow, spike tooth harrow and grain drill preparing the soil and sowing grain in one operation
3. Four row corn planter hook-up on the University of Wisconsin experimental farm in 1926
4. General purpose tractor with a four row cultivator attachment, which cultivates 40 acres a day
5. Corn binder used on large ranches in Middle Western States
6. Latest form of cotton picking machine, which has reduced marketing costs
7. Hay mower drawn by tractor
8. Side delivery hay rake which has improved the feed and speeded up hay harvesting
9. Modern hay loader, which simplifies and hastens hay loading

responding periods are from ten to twenty years later.) Obviously, attempts to intensify and diversify agriculture involved machinery and implements in no small way. Increasing land values must sooner or later force a greater return per acre; this is possible by increasing the production per acre or by lessening the cost of production, either one of which involves machinery and power.

The period opened with many of the most fundamental types of agricultural machinery well established. Minor improvements continued in all classes of implements. Sled corn harvesters, corn binders, and side delivery rakes to facilitate loading hay with hay loaders, came in early in the period. These were great labour savers. Inasmuch as one man with three horses on a two-row cultivator can cultivate 90% more acreage per day than one man with a single-row machine, it was only natural that attention should be given the two-row cultivators which began to appear early in the '90s. About 1890 the Babcock device and system was developed for determining the butterfat content of milk and cream. The Babcock test helps the farmer cull the unprofitable cows from his herd. Cream separators appeared about 1890, and a great labour saver—the milking machine—came into use about 1910.

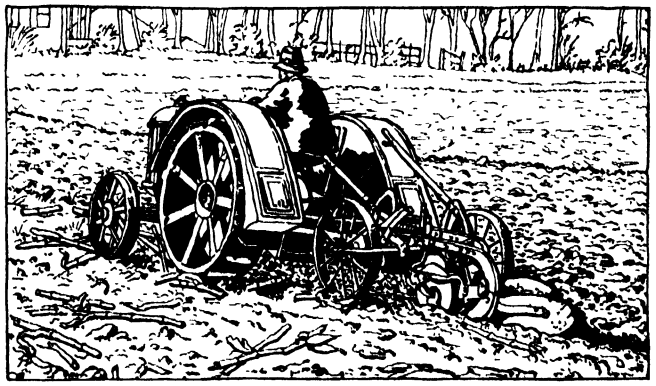
Among the early attempts to adapt the internal combustion engine to farm work no efforts stand out more prominently than those of Hart and Parr, two young men who developed very satisfactory, stationary, gasoline (petrol) engines as early as 1896. A little later they conceived the idea of mounting a gasoline engine on a truck, and gearing the two together so that the combined unit would propel itself. In 1902 these men built such a machine and proved that the gasoline engine could be used for haulage purposes. A new industry—the great modern tractor industry—was born. Manufacture began almost immediately by several companies, and within nine years a large number of tractors were ploughing, harrowing, seeding and threshing in those regions of the United States and Canada where the farms and fields were large. These early tractors were large, heavy and somewhat crude. Being able to develop 30, 40 and sometimes 50 horse power at the draw bar, they pulled six, eight, ten and twelve-bottom ploughs, or large combinations of soil preparation and seeding implements. One single ploughing outfit, consisting of three large tractors pulling a 50-bottom plough, once demonstrated its ability to plough an acre of ground in 4½ minutes. The advent of the large tractor called for ploughs of size not known before, but manufacturers were quick to respond with the big, multiple-bottom gang ploughs of the independent lift type in which each bottom or each pair of bottoms raised and lowered independently of those adjacent. Larger, heavier disc harrows, and wider grain drills also were developed for the new "brute."

The tractor had demonstrated its ability to get work done quickly with a minimum of human labour, and, in farming, getting work done when weather, crop or soil is right is a decided advantage The old heavy tractors, however, required considerable outlay in cash, and they were too unwieldy for practical use except in large fields. About 1910 the power farming idea had so thoroughly gripped agriculture that suddenly a demand for small tractors developed from farmers on smaller tracts, and many of the old manufacturers, together with a great number of new tractor concerns, began bringing out smaller tractors This tendency to cut the size, power, weight and price continued until the light tractor of 8–16 and 10–20 horse power came onto the market about 1916 and brought with it the light, two-wheeled tractor plough which was quite an innovation in plough design. The light tractor and light plough, selling at prices which made their use economical on small farms, introduced power farming onto thousands of farms in both the United States and Canada which could not have enjoyed its advantages had not smaller, cheaper units been made available. Likewise, small sizes of grain threshers, of ensilage cutters and of feed grinders became popular because the presence of the small tractor on the farm enabled the farmer to perform these respective operations himself instead of having to depend upon the custom outfit which previously had passed from farm to farm doing belt work for hire.

Another major development in the current period of agriculture is the mechanical corn picker. Such a machine was talked of in 1851; some were built and successfully operated about 1910, but not until about 1920 did it really start to take its place in the corn belt. Likewise, rotary hoes, for rapid corn cultivation, were in 1928 just beginning to become popular, although they had been on the market for 20 years. A new machine of importance to the sugar cane industry is the mechanical harvester which cuts, strips and bunches the cane in one operation. This is a big, expensive machine, but, when finally perfected, it will be a great labour saver.

Present Position.—Inasmuch as we are now in the midst of tendencies and developments in agricultural machinery which promise far reaching effects, it is well to consider the period since 1925 separately. Thus far the farm tractor has functioned well for ploughing, harrowing, seeding small grains and for belt work. The conventional type of tractor, however, has not been so well adapted to mowing and raking hay, or to planting and cultivating row crops. In such work not so much power is required; quick guiding and short turning are necessary, and the implement elements which perform the work must be so placed that the operator can readily see their action and easily manipulate them. What agriculture needed was a light tractor, perhaps of special form, which, in addition to ploughing, harrowing and doing belt work, could serve as a base for the quick attachment and detachment of such implement elements as an eight-foot cutter bar for mowing, a rake, hoppers for planting four rows of seed at once and cultivator rigs for cultivating those rows Since 1925, general-purpose tractors of this type have proved successful and are becoming very popular. They are bound to have considerable influence in several kinds of farming and probably will cause rather marked changes in implement design. Another tractor development of importance is the power take-off, a device and system by which the tractor can drive directly the working parts of the grain binder, corn picker or combination harvester-thresher.

To-day the farmer of 200 acres can have his 15–30 horsepower, conventional type tractor for the heavy field and belt work; then he can resort to his general-purpose tractor for the lighter field and row crop jobs The farmer of a tract too small to support two tractors can use his general purpose tractor for all tractor jobs. Either of these farmers can have a motor truck to haul



BY COURTESY OF THE J I CASE THRESHING MACHINE COMPANY

THE MODERN TWO BOTTOM TRACTOR-PLOUGH, FOR USE BY SMALL FARMERS, DEVELOPED FROM THE BULKY 8 AND 12 BOTTOM TRACTOR-PLOUGHS THAT REVOLUTIONIZED THE FARMING INDUSTRY IN 1902

his produce to market, and both are sure to have an automobile. Thus, except in the poorer agricultural regions and in extremely hilly country, the slower methods by horses have received a severe setback.

The old process of loading manure by hand may give way soon to the mechanical manure loader now being developed. Mechanical shockers are on the market; they promise relief in the back-breaking task of shocking grain after the grain binder. Another development, however, threatens the grain binder. Since 1925 it has been found that combination harvester-threshers can be used successfully for small grain and soy-beans grown in humid regions, and several of these machines have been sold in the north central states, in western Canada, and even to a few large farms in the

eastern states. The appearance of this great labour saver in the smaller wheat fields of the upper Mississippi valley has been somewhat of a sensation. There, of course, smaller machines are used, the ten and twelve foot size now being most popular. The use of the "combine" means a saving of approximately 20 cents a bushel in the cost of raising wheat. The combination harvester-thresher is introducing another machine, the windrow-harvester, as an accompaniment to the "combine" in territories where uncertain weather, uneven ripening or the presence of a heavy growth of weeds require that the cut grain lay in the windrow a few days previous to threshing. The windrow-harvester, tractor drawn and tractor driven, cuts a wide swath of grain high, and lays it in a windrow on top of the stubble. After the material has cured, the "combine" is used to pick up and thresh the windrows.

From the standpoint of cost of production, a mechanical means of picking cotton has been needed and sought for many years. Not until quite recently, however, have efforts to produce a practical device been successful enough to promise early relief. One type of cotton picker consists of a number of revolving spindles which pluck the cotton by wrapping it about them as they turn; the spindles then recede to a cleaning chamber where the cotton is removed ingeniously, and the spindles automatically return to come in contact again with the plant. The action is continuous as the machine straddles the row. Such pickers, although they are not quite to the manufacturing stage, seem very promising for territories where uneven ripening necessitates several pickings. Where killing frosts occur before picking time, as in north-western Texas, manufacturers are now marketing cotton strippers. These strip the cotton from the plant, and are much simpler and cheaper than the typical, mechanical picker. This method of harvesting has become practical only since improvements in ginning machinery have made it possible for the ginner to handle the great amount of trash and bolls which the stripper gathers. Since 1925, renewed attention has also been given to the application of electricity to agriculture. For this *see* ELECTRICAL POWER IN AGRICULTURE. As to the farm home, one need only liken the application of electricity there to that in the most modern city dwelling.

From this brief historical sketch we see that through the introduction of agricultural machinery and implements the muscular exertion of farm work was slowly shifted from man to beasts of burden. These in turn have been displaced by mechanical power units and by more machinery until to-day, comparatively speaking, agriculture seems well mechanized. The same is true in all industry; but the benefits of the transition in farming are especially significant because in agriculture there is more primary horsepower involved than in all manufacturing and mining combined. With the cheap fertile lands of the United States and Canada largely utilized, with fertility being depleted, with the population increasing rapidly, more intensive agriculture that will increase production per acre seems sure to come. But, again, this involves machinery in no small way if increased production is to be had without marked increase in costs If the farmer is to maintain his standard of living, and at the same time successfully meet competition in the world's markets, he must pay increasing attention to the many phases of agricultural machinery and implements.

Manufacturing.—As indicated in the following table, taken from United States census reports, the value of machinery and implements on farms has increased rapidly until to-day it aggregates a large investment. It is to be noted, too, that capital used in the manufacture of agricultural machinery indicates an extensive industry.

Between 1900 and 1910, several large combinations of manufacturers were effected in order to pool interests, to secure "full lines" of merchandise, and to lessen the expense of development and sales work. This introduced a new era in the manufacture and sale of farm equipment. The manufacturer's problem today is not one of new developments alone. The merchandising of farm machinery and simplification of types are also vexing problems, and in these the manufacturer is handicapped by the farmer himself Developing and introducing a new device calls for peculiar talent and is often a greater task than simply patenting the idea. In addition to commending the thousands of inventors who contributed to the development of agricultural machinery, much credit is due also to such men as McCormick, Deering, Osborne, Wood, Deere, Parlin, Emmerson, Noyes, Brown, Adams, Steward, Oliver and a score of others, the pioneers in manufacture It was to the vision, persistence, and the business, organizing and manufacturing ability of such men that the industry owed its foundation.

Census year	Value of machinery and implements on farms in the United States	Manufacture of Agricultural Machinery		
		Number of establishments engaged in	Capital invested in	Value of manufactured products including goods exported
1850	$ 151,587,638	1333	$ 3,564,202	$ 6,842,611
1860	246,118,141	2116	11,477,239	17,487,960
1870	336,878,429	2076	34,834,600	52,066,875
1880	406,520,055	1943	62,109,668	68,640,486
1890	494,247,467	910	145,313,997	81,271,651
1900	761,261,550	715	157,708,265	101,207,428
1909 } 1910 }	1,265,149,783	604	256,281,000	146,329,268
1920*	3,594,772,928*	583	366,962,052*	536,945,000*
1925	2,691,703,629	303	Not available	265,086,000

*Values affected by inflations due to war-time conditions.

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AGRICULTURAL ORGANIZATION. In most countries a growing realization of the weakness of the isolated farmer as a marketing unit and, again, of the dominance of industrial and commercial interests in modern legislation has prompted the formation of farmers' organizations, in order to secure more adequate consideration of the position and needs of agriculture. The conditions of food scarcity brought about by the World War stimulated this movement. (*See* AGRICULTURE.) Governments were obliged to deal collectively with the primary food producers, who on their side were forced into combinations to secure that the necessary regulations neither impeded production nor imposed an impossible burden on the farmers. Combinations for marketing are dealt with elsewhere (*see* AGRICULTURAL CO-OPERATION); the organizations here to be considered aim at uniting the farming community in order to influence legislation.

Further, since it has become clear that the status of the food producer can with difficulty be determined within the nation itself, considerable effort has been given to the formation of international associations which might be able to secure common action in the interests of agriculture. It is recognized that as regards the great staple articles of food, wheat and the other cereals, meat and dairy products, a common world price tends to be set, determined by the incidence of the exportable surpluses from the countries producing more than they consume, upon the chief open markets, *e.g.*, Great Britain. For example, the United States produces a certain excess of wheat beyond its requirements, which has to be exported chiefly to Europe. The price the American farmer will receive will be forced down by competition to the price obtainable in Europe less freight and commission. This is, to take an analogy, the pressure generated by internal competition to sell, at which the safety-valve blows off. The coincidence of other surpluses upon the European market or weakness in purchasing power there tends to lower the price; conversely the growth of a new demand, as from China and Japan, will enhance the price.

The tendency of commerce is generally to bring the run of prices of agricultural products, the output of which fluctuates from causes beyond control, continually down to the level caused by a surplus anywhere, a level which is on the average undesirably close to or even below the cost of production. Hence a general depression of the agricultural interest all over the world and an increasing tendency on the part of farmers to seek more remunerative occupation in industry or commerce. This is the justification for the attempts to create some international organization of farmers, however remote and impracticable common action may seem.

National Organization.—Examples of the type of national organization which aims at influencing legislation are the National Farmers' Union of Great Britain, the Farm Bureaus Federation and The Grange in the United States, and the Union Suisse des Paysans, but parallel organizations exist now in most countries.

The National Farmers' Union was only founded in 1908 and grew comparatively slowly until 1917, when it became necessary for agriculturists to have one organization to deal with the Government on behalf of the farmers engaged in the campaign for the increase of food production. It is organized on a basis of county branches, each of which makes an allotted contribution to the central body; only men actually engaged in farming are accepted as members. By 1927 the membership had reached 130,000, farming an area of some 12,500,000 acres. A similar Society exists in Scotland.

One of the most notable organizations in Europe from the point of view of the influence it has been able to exert is the Union Suisse des Paysans of which Dr. E. Laur is the director. Its membership includes nearly all the farmers in Switzerland, though the only figure available, 402,000, is the sum of the membership of all the affiliated societies, and the same individual may be a member of several of these simultaneously. It enjoys a subscription income of upwards of 100,000 francs a year The oldest of the organizations in the United States is The Grange, or Patrons of Husbandry, which was founded in 1868 for educational and social purposes. Later it became active in political life and in organizing marketing agencies.

More recently the Federation of Farm Bureaus grew up among the Farm Bureaus which were initiated for educational purposes by the County Agricultural Agents. It is now a widespread and active organization, exercising considerable influence both as regards marketing and legislation.

International Organization.—The International Institute of Agriculture, the original conception of which was due to the late David Lubin, though it took shape on the initiation of the present king of Italy, began operations in 1910. Its constitution is determined by treaty between the contributing States, and it is governed by a president and a permanent committee acting as the executive authority to carry out the instructions given by an assembly representative of the constituent States, sitting every two years in Rome, where the Institute has its permanent home. The representatives at the assembly and on the permanent committee are nominated by the respective governments; thus the Institute is essentially a governmental organization, in which agricultural associations as such have no part. The work of the Institute has always been of a technical character. It prepares an annual summary of the agricultural statistics of all countries and a digest of agricultural legislation; it also issues bulletins at regular intervals which abstract the papers appearing in the technical publications of the world on economic and scientific subjects connected with agriculture The Institute also convenes from time to time international conferences on particular questions. In order to obtain an expression of international agricultural opinion that shall be independent of governments the Institute has formed an association of representatives of agricultural associations of all countries, and the first meeting of this body was held in Nov. 1927. The associations to be invited to send representatives are, however, nominated by the governments of the respective countries. It has been urged that the international body which is to express the considered opinion of agriculturists must be independent of all governmental control or direction, especially as regards the nomination of representatives or associations to be represented.

To this end the Commission Internationale d'Agriculture, a body founded in 1891, of which the chief task was the organization of the successive International Congresses of Agriculture, has been reconstituted to consist of representatives of agricultural associations (not exceeding six for each country) and of co-opted members of distinction in agriculture, which latter may take part in the discussions but not vote. While the Commission meets twice a year in Paris, the resolutions that are to be communicated to governments are reserved for discussion at a conference to be held every second year in connection with the International Congress of Agriculture, of which conference only the elected representatives of the associations are members.

On the formation of this Commission, which held its first meeting in Rome in 1927, various other proposals for the establishment of an international association of agriculturists, *e.g.*, that initiated by Dr. Laur of Switzerland, were dropped. Eighty associations from 22 different countries including all the European States except Great Britain and Italy, have adhered, and the Commission has entered into relations with the League of Nations and the International Institute of Agriculture at Rome. The Commission may be regarded as possessing the best title to express the considered opinion of the agriculturists of the world, and it may be hoped that it will also be accepted as the Conference of Associations working with the International Institute at Rome. (A. D. H.)

AGRICULTURAL PRICES. In the early stages of English agriculture the mass of producers were content to satisfy

their own wants and were practically indifferent to outside trade. Later, however, the need arose for some machinery for bringing buyers and sellers into touch, and this was met by the institution of fairs and markets held at fixed places and periods. These in the first instance no doubt arose spontaneously, but it speedily became apparent that the holding of a fair or market in a town could be made a source of profit to the burgesses, or if there were no sufficiently powerful organized community, to the lord of the manor. Thus arose a system of tolls on goods exposed for sale in the market. The Crown, exercising its authority as overlord, saw at once an opportunity of revenue and claimed and exercised the right to forbid the holding of a fair or market except under royal charter, which was granted on terms. Tolls and regulations of the market would tend to raise the price level, but the effect could only have been slight.

A more serious effect on agricultural prices was caused by legislation against the practices of badgering, forestalling, engrossing and regrating, which was passed in the early part of the 16th century and did not disappear from the statute book until late in the 18th century The purpose of this legislation in restraint of trade was to protect the consumer from trade practices which were presumed to raise artificially the price of food. A "badger" was a dealer in food who bought in one place and sold in another. He was licensed for a year and was under recognisances against forestalling, engrossing and regrating. "Forestalling" was purchasing food on the way to market with intent to sell it at a higher price; "engrossing" was attempting to control—in modern phraseology to "corner"—the market by buying up all the food for the purpose of exacting higher prices; "regrating" was the resale of food previously bought in the same market.

The State for many centuries intervened directly in the regulation of the price of wheat and bread From the Norman conquest to the reign of Henry VI. the exportation of wheat was prohibited, although in earlier times it had been common. Importation was unchecked, although there is no record of it until the 14th century. In 1436 an act was passed authorizing the exportation of wheat whenever the price did not exceed 6s. 8d. per quarter and in 1463 the exportation of corn was forbidden until the price exceeded that at which exportation ceased Thereafter a succession of enactments were passed some giving a bounty on exports, others imposing a duty on imports, or adopting both methods under limitations of prices. In 1774 an act was passed permitting imports at a nominal duty of 6d. per quarter when the price reached 48s. and forbidding exports unless the price was below 44s. when a bounty of 5s. per quarter was given on exports in British ships.

Up to this time legislation had for its main object the interests of consumers while attempting also to have regard to the interests of producers, and also to encourage shipping. In 1791 the first of a series of acts was passed which, with increasing stringency, aimed mainly at protecting the interests of home wheat-growers, which continued until the repeal of the Corn Laws in 1846.

In the 13th century the Assize of Bread was established, by which the duty was imposed on justices of the peace of adjusting the weight, quality and price of bread to the current prices of wheat. The system was modified in detail from time to time, but continued in force until 1822 in London and until 1836 in the provinces

Modern Methods.—In later times the establishment of great markets in the large centres of population did much to fix prices on the basis of general and not of local supplies Many of the markets developed from local to national importance by reason largely of their position in relation to means of communication. Covent Garden is a notable instance. It was originally a place where growers of fruit and vegetables in the vicinity of London could dispose of their produce direct to retailers and consumers. The convergence in the metropolis of the main lines of railway made it a national distributing centre, serving, through various channels, all parts of Great Britain, and "Covent Garden prices" became the standard of values throughout the country.

The organization of commercial price-fixing on a national basis had, however, scarcely been completed when a new factor was interposed which speedily changed the basis on which price-levels of some of the principal foodstuffs rested. Imported wheat, meat, cheese, butter and other kinds of agricultural produce were sent to the British markets in ever-increasing quantities. As they increased in bulk and improved in quality their influence became so great that prices in the wholesale markets were fixed on an international rather than on a national basis.

The most prominent instance of this modern development is to be found in the wheat trade, where imported grain, forming as it does about four-fifths of the whole supply, dominates British prices and determines the value at any given time, of British wheat.

Price-fixing arrangements in the wheat trade are highly organized. World's prices are practically settled at four great markets, viz, Chicago, Winnipeg, Liverpool and London, and so well adjusted and sensitive is the mechanism that fluctuations in one are immediately reflected in the others.

The question of the effect on prices of the system under which the world's wheat trade is carried on is debatable and has been, in fact, hotly debated. It has been contended that speculation in "futures" depresses the level of prices and thus injures farmers, and, on the other hand, that it raises the level and thus injures consumers. The subject has been investigated closely, and it appears, by comparison with the price records of other commodities, that, on the whole, the organized "futures" market tends to maintain a more stable level of prices, notwithstanding occasional fluctuations caused by gambling operators

The "stabilization" of agricultural prices is advocated in some quarters, but no intelligible scheme has been produced which does not imply State control and an acceptance by the taxpayers of the risks of State trading

Yearly, or seasonal, fluctuations of agricultural prices are, as already indicated, occasioned mainly by variations in the weather, but there are also cyclical changes which are the result of monetary causes. Periods of low prices react not only on agricultural products but on all other commodities, and a consideration of them requires a wider outlook than that presented by one branch of production

Price Records.—Of the price of British wheat there are consecutive and fairly comparable records for nearly 300 years.

The average prices per quarter for each decennium since 1647 are as follow.—

	s.	d.		s.	d.
1647–56	52	8	1787–96	54	4
1657–66	51	4	1797–1806	76	9
1667–76	42	4	1807–16	91	0
1677–86	42	2	1817–26	67	0
1687–96	43	2	1827–36	56	1
1697–1706	40	1	1837–46	58	7
1707–16	47	7	1847–56	55	4
1717–26	36	3	1857–66	48	6
1727–36	35	8	1867–76	54	3
1737–46	32	10	1877–86	42	3
1747–56	34	9	1887–96	29	2
1757–66	40	9	1897–1906	28	5
1767–76	49	9	1907–16	37	6
1777–86	44	5	1917–26	61	10

The highest price for any single cereal year was 126s 6d in 1812, and the lowest 22s 10d in 1894. The highest price in the last decennium was 80s. 10d. in 1920, and the lowest 42s. 2d. in 1923

Systematic records of food prices were begun by Sauerbeck in 1846 and the series is continued in the *Statist*. Similar records have since been started by the *Economist* and the Board of Trade In 1904 the British Board (now the Ministry) of Agriculture began to collect and publish weekly a market report which includes prices of all agricultural products.

By the method of index numbers these records enable the changes in the prices of agricultural products to be compared with those in the prices of commodities generally. There was a fall in prices generally between the periods 1871–75 and 1894–98 which averaged 40%. In the period from 1894–98 to 1910–14 there was an average rise in the prices of all commodities of 33%. The changes in the prices of British agricultural products in these two periods are indicated in the table given overleaf:

	1871–75 to 1894–98	1894–98 to 1910–14
	Fall per cent.	Rise per cent.
Wheat	51	22
Barley	39	13
Oats	38	19
Potatoes	39	10
Pork	23	23
Beef	29	26
Bacon	25	29
Mutton	25	20
Butter	25	25

After 1914 prices of agricultural products, as of other commodities, rose rapidly under war conditions. Taking the period 1911–13 as the base, the average percentage rise in each year is shown below, the rise in the price of feeding stuffs and fertilizers being also given:

Year	Agricultural products	Feeding stuffs	Fertilizers
1915	27	37	15
1916	60	87	56
1917	101	174	96
1918	132	187	111
1919	158	168	115
1920	192	173	150
1921	119	81	120
1922	69	46	47
1923	57	36	23
1924	61	54	19
1925	50	52	14
1926	51	25	13

(R. H. R.)

United States.—The great rise in commodity prices caused by the World War and the consequent post-war decline had grave economic consequences throughout the world. One of the distinguishing features of that international price upheaval is that during the period of rising prices, agricultural prices advanced more, whereas during the period of falling prices they declined more than did other prices. The nature of this post-war price disparity can be well illustrated with the price changes that took place in the United States, where the effect of agricultural price depression was not limited to the business depression of 1921 and 1922 but continued as a political factor for several years thereafter.

According to the indexes of the U.S. Bureau of Labor Statistics, commodity prices reached a peak in 1920. In that year, they were, in general, on the average about 130% higher than during the pre-war five-year period, 1910–14. Agricultural prices were about 121% higher and non-agricultural or industrial prices about 141% higher.

Prices received by farmers at their local farm markets had also advanced in line with the advance in agricultural prices at the central markets. Then came the great price decline of 1920–21. The unequal effect of that price decline can be seen in the indexes for 1921. All wholesale prices taken together dropped 80 points, non-agricultural prices dropped 74, but agricultural prices dropped 88 points and prices received by farmers 89 points. Because of this greater decline in agricultural prices, the general depression of 1920–21 became an agricultural depression of longer duration.

The sudden deflation in the value of the farmers' products affected all sections of the agricultural industry. Land values were high, many had purchased farms at high prices, burdened themselves with heavy mortgages and expected the high prices of 1920 to continue. On practically all farm-land taxes had more than doubled, and other expenses of production, such as wages and machinery, had also risen. When in 1921 prices crumpled to half or less of those prevailing in 1920, the necessity of meeting the fixed high interest and rent charges, as well as the high production costs, left very little, if anything, of income available for living expenses. Furthermore, the higher prices of goods bought by farmers (as shown by the index of non-agricultural prices) reduced the buying power of the farmer still more. The low and inadequate farm incomes of 1921 and 1922 naturally also hurt those undertakings dependent on agriculture, such as country banks, country stores, fertilizer and implement agencies. As a result of many causes, partly domestic, partly foreign, agricultural prices did not recover materially in 1922. Since then, first one farm commodity, then another, has, usually as a result of reduced production, recovered temporarily, but in the main agricultural prices have remained nearer the pre-war prices than did the non-agricultural prices throughout the period 1921–27. About this agricultural and non-agricultural price disparity has centred much of the discussion of farm relief. The removal of that disparity by raising the level of agricultural prices to that of industrial prices and creating a greater degree of stability in agricultural prices has been the object of practically all proposals for farm relief, particularly the McNary-Haugen plan which has been before the U.S. Congress in several modifications for four years; twice passed by both Houses and twice vetoed by the President.

Briefly described, the McNary-Haugen plan of farm relief provided for the establishment of a Federal Farm Board with power so to buy and sell surplus farm products of the United States as to raise the domestic prices received by producers. The cost of operating the plan and any losses sustained in the sale abroad at prices lower than in the United States would be met by a fee known as an "equalization fee" collected at the central markets from mills, packers, etc., on all units of a commodity that entered commerce. In that way all producers would contribute alike to the cost of the plan, and all would share alike in the benefits of the difference between the advance in domestic prices and the fee collected, the advantage arising from the fact that far more would be sold in the domestic markets at higher prices than would be sold at lower prices abroad.

In its early form, as voted down by Congress in 1924, the McNary-Haugen plan aimed to equalize agricultural and other prices by setting up a Federal agency to handle the surplus production of crops which were held to be responsible for maintaining agricultural prices on a low level. The general level of all commodity prices, which was then approximately about 150% of the pre-war level, was to be used as a standard. The operations in Government buying and selling were to aim toward raising individual farm commodity prices to the general wholesale level of all other commodities. This price-ratio scheme was dropped in favour of a plan to make the tariff effective, the emphasis of the latter growing out of the belief among farm leaders that the stability of non-agricultural prices was the result of protective measures enjoyed by other groups, such as existing tariffs on non-farm products, immigration-restriction law, aiming among other things to maintain high wage standards, and the Federal Reserve system aiming toward stability in finance and commerce.

The emphasis on "making the tariff effective for agriculture" was not maintained in the later forms of the McNary-Haugen plan because a tariff could protect only those farm products of which the domestic production was below domestic requirements. In the case of commodities such as cotton and tobacco, the major part of which the United States exports, tariff protection could not raise prices to a higher level or prevent annual fluctuations.

Originally the McNary-Haugen proposal found most of its support in the west central farm sections of the United States where grain and livestock prices remained low until the summer of 1924. Other sections of the country, such as the dairying and the southern cotton producing areas, gave it little support. Prices for their products were either not particularly low or were actually high, as was the case with cotton. But in 1926 a record cotton crop created a cotton-price depression as serious as that of 1921, which had the effect of bringing southern farm leaders to the support of the McNary-Haugen plan. This wider support, which may be said to have grown out of the low grain and hog prices up to 1924 and out of low cotton prices of 1926–1927, resulted in the passage of the McNary-Haugen bill in the spring

of 1927. Vetoed by the President, it was again passed by both Houses of Congress in 1928, and again vetoed on the grounds of impracticability, unconstitutionality and class legislation.

(L. H. B.)

AGRICULTURAL PRODUCTION: *see* AGRICULTURE, CENSUS OF, and the various products, WHEAT, BEEF, etc.

AGRICULTURAL RESEARCH. In its modern aspects agricultural research began with the series of field experiments started by Jean Baptiste Joseph Dieudonne Boussingault about 1834 on his farm at Bechelbronn, in Alsace. He had already made a name as an adventurous traveller in South America, but at the age of 32 he settled down to field experiments which he carried on until Alsace passed into the hands of the Germans. Unfortunately the farm was not preserved, and in consequence this first experimental station has long ceased to exist.

The scientific foundations had already been laid by the de Saussures, Jean Senebier, and other plant physiologists of the Geneva school and elsewhere, and considerable information had been gained by Sir Humphry Davy; but these results could not be interpreted in field terms without field experiments. Boussingault used quantitative methods; he weighed and analysed the manures applied and the crops obtained and at the end of the rotation drew up a balance sheet showing how far the manures had satisfied the needs of the crops, and how far other sources of supply, air, rain, and soil, had been drawn upon. This method, patiently and carefully applied, solved the problem of the feeding of crops, and it remains the basis of all modern field work. The facts gathered by this and other methods were reduced to order by Justus von Liebig in 1840 and subsequent years in his brilliant generalizations on plant nutrition and crop production.

In 1843 J. B. Lawes and J. H. Gilbert started their experiments at Rothamsted, which are still carried on, so that Rothamsted remains the oldest agricultural station in the world. These experiments led almost immediately to the discovery of artificial fertilizers, the effects of which on the soils of Britain were so striking that similar experiments were soon made in most countries where conditions were sufficiently settled. Although the results were not always as clear and definite as in Great Britain, the experiments opened the way to new knowledge of soils, crops, and animals; in the United States, where water supply is often the limiting factor in crop production, they led to important developments in soil physics; in France, to George Villes' important contributions on the use of fertilizers; in Russia, to far-reaching studies of soil morphology.

Soil bacteriology (*q.v.*) began in France as the result of an investigation by J. T. Schloessing and C. A. Müntz; further fields were opened up by M. P. E. Berthelot. Striking advances were made by Sergei Winogradsky, who introduced new conceptions and more precise methods, raising the subject to the rank of a science. Animal nutrition was studied first by Lawes and Gilbert at Rothamsted and then considerably developed in Germany. Right up to the time of the World War there was continuous expansion; agricultural colleges and experiment stations were founded in almost every civilized country, and notable contributions to agricultural science were being made not only in the larger but in the smaller countries, Holland, Denmark, Switzerland, Sweden and others.

Since the War there have been many and striking developments. Although impoverished, the European countries have maintained and even extended their organizations for agricultural research, and in every country except one or two in south-eastern Europe there are experiment stations owned and financed by the State; frequently also others financed by agricultural societies. Indeed, the belief of the modern farmer in agricultural education and research is one of the most hopeful features of the times.

The British Empire.—For many years the great self-governing Dominions have had their own agricultural research stations which have made notable contributions to agricultural science. The Canadian workers have achieved much in the production of new varieties of wheat, the farming of dry lands, and the development of agricultural machinery.

The Guelph Agricultural college had been founded in 1873 but it grew only slowly and in 1883 it had only nine graduates. Then came the awakening of Canada to the need of agricultural research. In 1884 a select committee was appointed by the Canadian parliament to study agricultural conditions and this committee recommended the establishment of an experimental farm. In 1887 this was done, and the farm was started near Ottawa under the direction of William Saunders. It has since grown out of all recognition and has now become one of the foremost agricultural experiment stations in the world. Branch farms were established in different parts of the Dominion, some of which, such as Indian Head (Sask.) and Lethbridge (Alta.), have by reason of their special conditions been able to carry out researches which could only with difficulty have been achieved elsewhere. The present director of the Ottawa station is E. S. Archibald, who succeeded J. H. Grisdale, the second director, in 1916.

Australia has, in Farrar's wheats and many field experiments, done much for arable farming and the solving of pastoral problems; still more recently the setting up, at Adelaide, of the Waite Agricultural Research Institute in 1923 under Dr. Richardson, and of the Department of Scientific and Industrial Research under Dr. Julius, have opened up great possibilities of future development. In New Zealand the Cawthron Institute was established at Nelson in 1915: South Africa has probably the largest and best veterinary research station in the world at Onderspoort under Dr. P. J. Du Toit. In India the large experiment station at Pusa was started in 1903 by the aid of a generous gift by Mr Phipps, an American. In other tropical regions there have been very great developments. The Imperial College of Tropical Agriculture was founded in 1924 at Trinidad to give the training which could not be provided at home. The research institute originally founded by the Germans at Amani in Tanganyika has been restarted since the World War under the directorship of Dr. Nowell The Wellcome Tropical Research Laboratories at Khartum are maintaining and extending their studies of soils and micro-organisms, important in tropical conditions, and each of the African territories has its own agricultural officers. Perhaps even more significant, the growers are organizing and financing their own experiment stations on broad and generous lines that augur well for the future: the Rubber Research Institute of Malaya, inaugurated in 1926; the Tea Research Institute of Ceylon, inaugurated somewhat earlier, are examples. Altogether the progress of agricultural research in the empire in the post-War period has exceeded the most sanguine expectations.

Until recently, each of the separate parts of the empire conducted its own researches independently of the rest In Oct. 1927, however, an imperial agricultural research conference was called for the first time and the first steps were taken towards co-operation and co-ordination so far as this might be possible. It was decided to set up bureaux in Great Britain, for soil at Rothamsted, animal nutrition at the Rowett Research Institute, Aberdeen, and animal health in London; also correspondence centres for plant genetics at Cambridge and Aberystwyth, fruit at East Malling, animal genetics at Edinburgh and agricultural parasitology in London; these are in addition to the already established bureaux for entomology and mycology; while a further object that they have is to keep in touch with all agricultural research workers in the empire, provide information, and generally give any further help in their power.

Great Britain.—In 1909, parliament set up the development fund at the instance of Mr. Lloyd George and assigned a capital sum of £2,000,000 for rural development, including agricultural education and research. The commissioners adopted a novel method of organization of research which has fully justified itself. Instead of setting up one or two large stations to deal with the whole body of agricultural science they made grants to certain existing institutions, each of which was to become responsible for one or more sections of agriculture. Of these institutions the chief are:—

Soils, plant nutrition, and plant pathology.	Rothamsted experimental station. Cambridge university.
Animal nutrition.	Rowett Research Institute, Aberdeen.

Plant physiology.	Imperial College of Science and Technology, London.
Plant breeding.	Cambridge university. University college, Aberystwyth. Scottish plant breeding station, Edinburgh.
Fruit.	Long Ashton, Bristol. East Malling, Kent.
Glasshouse industry.	Cheshunt, Herts.
Animal breeding.	Edinburgh university.
Dairying.	Reading university.
Animal pathology.	Cambridge university. Royal Veterinary college, London Scottish Animal Diseases Research Association.
Agricultural parasitology.	London School of Hygiene and Tropical Medicine.
Agricultural economics.	Oxford university.
Agricultural engineering.	Oxford university.

The amounts expended on agricultural research in Great Britain have increased continuously since 1909, the original development fund having been substantially increased when the Corn Production Act was repealed and the State commitments were commuted by the grant of £1,000,000 which, at the request of the farmers themselves, was devoted to agricultural research and education. In 1926 the grants amounted to £329,705, including £60,000 advisory, £9,231 rural industry, and £23,700 Scottish grants. The total research grant for England and Wales was therefore £236,774. Besides the State funds, grants are periodically made to institutions by the agricultural societies.

The United States.—Agricultural research began early in the United States. On Feb 26, 1791, there was held at the senate chamber, New York, "a meeting of a respectable number of citizens" which established a society for "the investigation of agriculture, manufacture, and arts, with such subjects of enquiry as may tend to explain or elucidate their principles." In 1842 a successor, the New York State Agricultural Society, began the publication of a series of reports, some of which, dealing with the design of the plough, are among the best that have yet been written on the subject. Faith in agricultural education in the United States was so great that even during the anxious days of the Civil War Senator Justin S. Morrill, of Vermont, was able to persuade the legislature to adopt the Act which bears his name, and which was signed by Abraham Lincoln on July 2, 1862; this established in each State a college of agriculture and mechanical arts that often developed in conjunction with a State university. Information regarding the agricultural colleges in the United States and their work will be found in the article AGRICULTURE IN THE U.S.A.: *Experiment Stations.*

The Federal Department of Agriculture, created by an Act of Congress and signed by President Lincoln in 1862, is the most extensive agricultural research agency ever established, its work covering every field of agriculture and rural life affairs. Through its Office of Experiment Stations it has general supervision of the State Experiment Stations, with which it carries on a large number of co-operative investigations. Its great research bureaus expend over ten million dollars a year in fundamental investigations in addition to about the same amount expended by the Experiment Stations, making a total annual expenditure for research of over twenty million dollars. Recent estimates of financial returns for these expenditures published by the United States Department of Agriculture show that each dollar thus expended yields an annual return of over five hundred dollars. This explains in part the increasing support given to this type of work. There are also a certain number of private establishments. Some of these have become merged in the State institutions, such as the experiment station at Storrs, Conn., which, founded as an agricultural school, became a college and then, through the activity of one of its most distinguished members, Atwater, an important centre of research. Of the newer institutions which still retain their individuality perhaps the most notable is the Boyce-Thompson, founded in 1924.

Enormous sums of public money are expended in the United States on agricultural research. In 1925 and 1926 the amounts included:

	1925	1926
Federal Funds	$10,000,000.	$10,300,000.
Hatch, Adams and (in 1926) Purnell Acts	1,440,000.	2,400,000.
State appropriations	5,827,871.	6,000,000.
	$17,267,871.	$18,700,000.

In 1927 the total spent was $21,000,000.

Some of the experiment stations are in receipt of large total incomes: in 1925 Ohio received $736,164 and California $665,861. But great as these sums are, they represent only six cents per acre per annum of the cultivated land in the United States and thus they are relatively not much greater than the expenditure in Great Britain, which represents four cents per acre; per $1,000 of farm produce obtained each year the United States spends on research $2.50 while Great Britain spends $1 40.

France.—To France, as already described, belongs the honour of having begun the first field experiments. The college of agriculture at Grignon, founded in 1827, continues its activities. George Villes' experiments from 1848 to 1863 were made at Vincennes; Grandeau's at the Station Agronomique de l'Est founded at Nancy in 1871 and still associated with soil investigations. The experiment station at Montpellier is associated with vine investigations and with the soil studies of Delage and Lagatu. The chief organization in Paris is the Institut Agronomique; but the Institut Pasteur, although not an agricultural body, carries on researches in plant physiology and microbiology of great importance to agriculture, supplemented by the work at its substation at Brie-Comte Robert. It is hoped at an early date to develop a great national institute for agricultural science near Paris.

Germany.—Although the agricultural college of Hohenheim was founded as far back as 1817, there was no experiment station till 1851, when one was started at Möchern in Saxony under Emil Wolff. Others were set up later; at Munich in 1857, where much work was done on soils, and at Popplesdorf, where there had been an agricultural high school since 1847. There was a rapid expansion after the federation of the German States in 1871; in 1861 there had been only nine stations, but by 1881 there were at least 53. Most of these were attached to universities and under close Government control; they were also charged with certain responsibilities in regard to control of fertilizers, feeding stuffs, seeds, etc. Some, however, were under the agricultural societies. In 1888 the association of experiment stations was formed for the purpose of securing uniformity in methods of investigation and inspection of these various articles.

By 1914 the German experiment stations had much further increased, both in number and in size, and had attained great repute all over the world. There has, however, been some change in subject matter; much more attention is now devoted to fertilizers in consequence of the enormous strides in the output of synthetic nitrogenous compounds Among the larger State institutions are those at Halle for animal nutrition, agricultural chemistry and microbiology; at Königsberg i. Pr., Bonn-Popplesdorf; Landsberg (Warthe) for soils, plant nutrition, animal husbandry, and plant pathology; at Bremen and Landsberg for moor culture; at Breslau, Hohenheim and Gottingen for agricultural chemistry and bacteriology; at Berlin and Leipzig (Möckern) for many branches of agricultural science. In addition to these, there are great private institutions owned respectively by the nitrogen syndicate, the potash syndicate and the superphosphate manufacturers' association

Russia.—The Russian experiment stations have been completely reorganized since the revolution. Those best known to the outside world devote much of their time to soils; those deserving mention are.

Perm	University biological Station
Voronezh	Agricultural institute
Gorki (White Russia)	Agricultural academy

Leningrad.	Dokuchaiev Institute of Soil Science. State Institute of Experimental Agronomy.
Moscow.	Scientific Institute of Fertilisers.
Kazan.	Forestry and Agricultural Institute.
Saratov.	Institut für Landwirtschaft und Melioration.
Ukraine.	
Kiev	Forestry and Agricultural Institute.
Odessa.	Agricultural Institute.

Holland.—Of the smaller countries Holland deserves special mention because of the admirable research work carried out in Dutch East Indies at Buitenzorg in Java, the experimental gardens and station of which are models of efficiency and activity. The results are published in *The Bulletin of the Botanical Garden.* In Holland itself there are several well-known stations, the largest of which is at Wageningen, known, among many other things, for the work of Quanjer on plant pathology, Hissink on soil, and others.

Italy.—Italy possesses agricultural stations at Rome, Pisa, Turin, Portici, and elsewhere: the scientific results are published in *Le Stazione sperimentali agrarie Italiana.*

Denmark.—Serious agricultural research began in Denmark after the termination, in 1864, of the war with Germany. The Danes sought, in the words of one of their distinguished statesmen, "to gain within their borders what they had lost without," and they proceeded to intensify their agriculture, developing a system which has become the admiration of Europe. One of the first stations to be set up was the veterinary and agricultural high school in Copenhagen, which from 1860 onwards published a series of admirable reports on the feeding of farm animals. As it expanded it covered other subjects of agricultural importance. Since the war agricultural research has developed considerably in Denmark. The method has been to set up a number of stations, each dealing with specific subjects; at the same time to establish field experiment stations in various parts of the country, all these being directly under the State. The veterinary college remains the centre for animal husbandry, forestry, and horticulture; it is, however, primarily a teaching institution. The more important of the newer research stations, which may be regarded as offshoots from Copenhagen, are at Lyngby and Hillerod, North Seeland.

Practical Results of Research.—The chief characteristic of the work of the experiment stations in recent years has been the tendency to joint investigation. Not only have stations in the same country combined to carry out a programme of work, but even stations of different countries. In the western United States and Canada there is a combined programme of investigation on wheat rust. In Europe the chief soil investigators have cooperated with those of Great Britain in devising uniform methods of soil examination and soil mapping, under the aegis of the International Society of Soil Science The International Institute of Agriculture at Rome has brought together the investigators concerned with fertilizers, with the view of drawing up uniform methods of studying the action of these substances on the plant and on the soil.

Much of the knowledge recently gained at the experiment stations can be appreciated only in relation to the whole subject with which it is concerned, and is therefore dealt with under the proper headings. Some of the outstanding results are, however, referred to here. In the study of soils the most important advance has been in the knowledge of the changes taking place when salts are added to the soil. In principle the changes are simple, being merely the usual exchange of bases and acids; the consequences of these changes, however, are often far-reaching and they have been found to explain many of the phenomena of acidity and alkalinity, and also the deterioration of irrigated land. These phenomena were always taken to be quite independent, but now they seem to be closely related. With fuller knowledge of the causes the possibility is opened up of designing effective methods of treatment. A better knowledge of soil biology is opening up a new chapter in the field of soil formation and fertility.

Great progress is being made in the field of soil amendments and fertilizers, especially as regards the use of concentrated fertilizers.

Another striking development has been the recognition of the Russian work, which has been slowly developing during the last 40 or 50 years. This had been published in Russian and only briefly summarized in western languages, so that it remained inaccessible to western European and American students. In 1909 Dr. Glinka expounded some of this work to the European soil investigators assembled at the soil conference in Hungary, and in 1922 Dr. Waksman, at the request of the United States department of agriculture, translated many of the Russian papers into English. Soil workers then found a great mass of knowledge in regard to classification of soils, which was new to them. The basis of the Russian classification is that the soil type is largely determined by the environmental conditions; indeed it can be predicted once these are known. The recognition of this dependence has revealed the close relationship between climatic and orographical factors with soil type, which knowledge promises greatly to simplify the work of the soil surveyor

Great advances are being made in the study of diseases of animals and plants, especially those carried by insects and mites, such as the tick fever, discovered by Theobold Smith of the U S. Department of Agriculture, and the mosaic or virus diseases carried by plant lice and leaf hoppers.

In plant breeding efforts have been directed largely to the production of disease-resistant varieties, disease playing an increasingly important part in limiting crop production. Rust in wheat still baffles the investigators, and, worse still, new diseases brought into the different countries sometimes spread with considerable rapidity and do much damage before resistant varieties can be found. The problem of immunity has been much studied but no satisfactory explanation is yet found, while the cause of the virus diseases remains as elusive as ever. In Canada a search is continually being made for new varieties of wheat with short growing periods more suitable to the short seasons of the northern parts. There has been a steady pushing up of the northern boundary of the wheat growing area, and no one now would venture to set definite limits to it. In crop production the most striking development has been the manufacture of synthetic nitrogen fertilizers, which is now so firmly established along broad lines as finally to remove the fear of world starvation expressed in Sir W. Crook's famous address to the British Association in 1898.

In animal husbandry there have been steady developments in the prevention of animal disease, the subject now being regarded as in a great part a matter of hygiene and nutrition. The discovery of vitamins is opening up new fields of nutrition in relation to growth and health of men and animals. Great attention has been paid to the mineral nutrients, lack of which has been found responsible for serious diseases in Africa and elsewhere. Deficiency of phosphorus is one of the most serious, but deficiency of calcium and possibly of iodine is also responsible for animal disease. Fortunately, the remedy can be found as soon as the causes can be diagnosed. Considerable progress has been made in the treatment of diseases by various sera. In dairying, great strides have been made in the production of clean milk.

In every country in the civilized world the economic situation in agriculture has been profoundly altered by the great advances made in our knowledge of the effect of temperature on agricultural produce. Research laboratories have been set up particularly for studying the effects of low temperatures, and refrigeration is steadily being reduced to an exact science. In the United States, particularly in the U.S. Department of Agriculture and the State Experiment Stations, much attention is now being given to economic and sociological research in reference to agriculture and rural life. (E. J. R.)

AGRICULTURAL REVOLUTION, THE, a term indicating that period in history which witnessed the transition of English methods of farming from mediaeval to modern conditions. During the 18th century increasing knowledge and new inventions revolutionized both agriculture and stockbreeding. At the same

time the rapid growth of enclosures vastly improved the conditions under which farming was carried on. But it increased the resources of the great landowner to the extinction of the yeoman farmer, and thus an essentially progressive movement in agriculture brought much misery in its train. The expenses incurred by the enclosure movement, the subsequent rise in the value of land, reductions in agricultural establishments, the protective system of the corn laws, and the supplementing of wages from the rates (Speenhamland system [*q.v.*] 1795) raised prices, lowered wages and depressed a large section of the agricultural population to the level of paupers. (*Cf.* INDUSTRIAL REVOLUTION.) *See* also AGRICULTURE; ENCLOSURES; CORN LAWS.

AGRICULTURAL SOCIETIES AND SHOWS. In British agricultural history there is no parallel to the enthusiasm which spread through the country during the last quarter of the 18th century. It spread downwards from George III., "Farmer George," who himself contributed to Young's monthly publication, *Annals of Agriculture,* started in 1784. The politicians, including Fox and Burke, the great landowners, such as the duke of Bedford and "Coke of Norfolk," all shared in the zeal and were excited by farming topics and busy with farming experiments. One of the results was the founding of the Board of Agriculture by Pitt in 1793. But the board was preceded by the birth of a number of local associations in different parts of the country. Among the earliest and more important were the Bath and West of England Society, founded in 1777; the Highland Society in 1784, and the Smithfield Club in 1798; and before the end of the century very many of the counties had founded organizations of one sort or another for the promotion of the art and craft of agriculture

The chief activity of the greater societies was the holding of an annual agricultural show; and the annals of many such shows begin in the year of the society's foundation. But in this respect the board did not at once follow the example of the societies, and its popularity waned as agriculture became depressed It was indeed dissolved in 1822, but in the year before its temporary extinction it held, at Aldridge's repository, the first national agricultural show It was modelled on the many local shows, of which the oldest had already a history of 44 years. But the agricultural show, such as we know it to-day, may be dated from the formation of the Royal Agricultural Society at a later date

The Royal Agricultural Society.—This society was founded in 1838 and received its charter in 1840, the year from which most critics date the rise of modern scientific farming, as fostered by the researches of Liebig and his British successors Gilbert and Lawes The first show under its auspices was held at Oxford under the presidency of Lord Spencer. It was various in range and of considerable extent, though small in comparison with the shows of to-day. There were six classes only for cattle, three for sheep, one for horses, and one for pigs. The section for implements was considerable, and prizes were also given for essays on agricultural subjects, for skill in ploughing, and for the best farm in Oxfordshire. Since that day the scope of this show, as that of most others, has increased; and its form has been closely imitated in the British empire overseas and in foreign countries Few contrasts in Britain surprise foreign visitors more than the magnitude and excellence of its agricultural shows, which are celebrated in a country that is regarded as overwhelmingly industrial, and are indeed superior to any in the world.

The great additions to the scope of agricultural shows in the 20th century were made, not only with the idea of promoting agricultural science, but also to increase the spectacular attractions, and so provide funds for the proper objects of the society. The modern royal show, which continues for five days, may occupy as much as 100 acres of land, and the machinery, much of it seen "in motion," is alone a great feature. Besides classes for almost all breeds of stock and of poultry, and in addition to forestry, educational and scientific sections, it contains pavilions or tents for the display of rural crafts, and for the work of the women's institutes. A flower show, usually both large and elaborate, is housed in a series of great marquees. A working dairy is seen in action several times a day. Lectures and demonstrations of many sorts are given at intervals, and every afternoon, except on the opening day when the bulk of the judging is done, horse jumping and harness competitions are held in a spacious ring and draw large crowds

The royal show has always been peripatetic, except for the years 1903, 1904, 1905, when it was brought to Park Royal, on the north of London, with disastrous results to its finances The prevailing principle in the selection of sites is to visit populous districts more or less alternately with purely agricultural centres; and except when the weather has been unfavourable, it has generally been found that the money made at the crowded centres enables the society to bear the losses sustained in more strictly agricultural areas.

Several local shows are comparable with the royal, though rather smaller and of shorter duration. But similar variety of exhibit is seen in the shows of the Highland Society, of the Bath and West of England, the Welsh national show, the "Royal Counties," the "Three Counties" and indeed many of the larger county shows, notably in Lancashire, Yorkshire, Cornwall, Oxford, and Suffolk Many of these, as well as the royal, attract large numbers of foreign buyers, especially from South America.

The history of most of these shows and societies was a history of progress, with some oscillations, till the years of depression in agriculture following the great prosperity of 1918 and 1919 It began to appear at this time that the shows were too many, and perhaps too elaborate. Though many societies remained abundantly prosperous—and such shows as those of the Suffolk, Lincolnshire, and Cornish societies were never better than in 1927, the year of the 150th anniversary of the earliest, a movement for the amalgamation of local and county shows now began as a result of the unsatisfactory agricultural conditions and a shrinking of many farmers and landowners from the expense of exhibiting Though some contraction may be inevitable, yet the breed societies, more in Britain than in other countries, show no sign of degeneration, and are the backbone of the agricultural show. Elsewhere two of the largest agricultural shows in the world are held annually at Buenos Aires and in Sydney, New South Wales Both have a generic likeness to the English shows and enjoy the same popularity.

Although as already recounted, the Royal Agricultural Society of England was nearly ruined by the experiment of holding its show in London, the great fat-stock shows, held in November and December, and the dairy show, held in London in October, have flourished progressively under urban conditions. Especially since dairying took the lead over corn-growing as the chief department of British farming following the World War, the annual dairy show has become a remarkable epitome of the science of dairying as of the quality of the dairy breeds of cattle. Of the winter fat stock shows the three that attract the best fat stock are held at Norwich, Birmingham, and the Agricultural Hall at Islington in North London. The Smithfield Club, which is responsible for the London show, was founded as the Smithfield Cattle and Sheep Society as early as 1798, and has always emphasized at its shows its original object to promote the supply and breeding of the best meat. (W. B T.)

IN THE UNITED STATES

Agricultural Societies.—Educational advancement in agriculture has been marked by undertakings common to many localities. Agricultural societies came into being in the late 18th and early 19th centuries The New York Society for the promotion of useful arts, though not confined to agriculture, was founded in 1766. The New Jersey society for promoting agriculture, commerce and arts was in existence in 1781 The Philadelphia society for promoting agriculture was established in 1785 In the following years the number of local, county and State agricultural societies increased rapidly and played an important part in initiating systematic instruction in agriculture. In 1792 the New York society published a volume of its transactions, and the Massachusetts society issued bulletins on agricultural topics. The holding of fairs in Cambridge was suggested to the Massachusetts society in 1801. In 1807, Elkanah Watson exhibited two merino sheep in the public square of Pittsfield, Massachusetts This may well

mark the beginning of cattle shows, enterprises of no mean educational value.

The South Carolina agricultural society, organized in 1785, bought, in that year, a tract of land on which experiments were to be conducted In 1792 the New York agricultural society provided funds to the trustees of Columbia college for the endowment of a professorship in natural history, chemistry and agriculture. The Philadelphia society received, in 1794, recommendations from one of its committees that the legislature of the State be requested to support agricultural education in schools and colleges. A grant of $500 was made by the Massachusetts society in 1801 for the establishment of a professorship of natural history at Harvard college

The Columbian agricultural society was founded at Washington in 1809. It was the forerunner of the U S. Agricultural society, organized in 1852 at a convention of delegates from 12 State agricultural societies. During 1817–25 the allotment of State funds to county and local societies encouraged their extension. In 1819, State aid was provided in New York and Massachusetts. The latter State offered $200 annually to every society raising and investing a fund of $1,000. For larger investments the subventions reached a maximum of $600. In the same year the legislature of New York appropriated $10,000 a year for four years "for the promotion of agriculture and family domestic manufactures." The climax of rural organization was reached in 1820–25. Most of the country agricultural societies disintegrated in the following 25 years, largely as a result of the withdrawal of State aid. On the other hand, the State agricultural societies continued to flourish. By means of meetings, conventions, farmers' institutes, fairs, exhibits, demonstrations, bulletins and reports they exerted a profound influence on farm practices and served as important educational agencies. Later, many of them became State boards of agriculture and, later still, State departments of agriculture. As a national group they have developed common policies that directly affect educational and regulatory activities in the several States. (X)

Agricultural Shows.—Fairs and exhibitions have been an integral part of American country life for more than a century and have played an important part in the progress of agriculture In the early colonial days it was the practice of the farmers at the close of the harvest season to take their farm products and fattened live stock to the village and display them there on the commons, primarily for sale or trade; but often such exhibitions were also motivated by a sense of pride and a desire to show the neighbours what had been accomplished in the way of producing a particularly fine specimen of animal or farm product. These occasions naturally developed into gala days for the community because of the opportunity they afforded rural people from widely separated districts to meet for recreation and social contact, and because the finish of the harvest found the people in a festival mood. From post-harvest sales and gala days of early times it was a natural step to the fair as it is known to-day, with its exhibits of fruits, vegetables, grain and live stock competing for prizes and ribbons, and the horse races, ball games, fireworks and other amusement features added to help carry the expense of the event.

The first permanent fair association in the United States grew out of a cattle show inaugurated in Pittsfield, Mass., in 1810. By 1860 the agricultural fair was an established institution, practically every State and county of agricultural importance holding an exhibition in the autumn after harvest. Then came a time, about 1900, when amusement features, such as horse racing, outweighed the agricultural exhibits in importance, and the time of holding the fairs was determined more by the convenience of the racing circuit than by the agricultural factors. Fairs as agricultural institutions suffered and many counties abandoned them. More recently, however, there has been a revival of the business of exhibiting agricultural products, and the county fair is once more assuming its original object. State fairs are now permanently established and in general well-managed and prosperous institutions, giving sufficient attention alike to education, recreation and entertainment features to insure a well-balanced programme and continued success. To-day there are county fairs, district fairs, State fairs, regional fairs including two or more States and national and international expositions of world-wide fame.

The first great show of more than local importance, known as the American Fat-Stock show, was established in 1878 by the Illinois State board of agriculture and was held annually in Chicago from that time until 1897. It was the outgrowth of the desire of a number of cattle breeders and feeders, as well as men interested in horses and swine, to stage a show in keeping with the progress of the purebred live stock industry. The show was patterned after the famous Smithfield Club show in England and flourished for many years until political influence and inadequate support caused its failure in 1897. Three years later, the present International Live Stock Exposition was organized. It held its first show in Dec. 1900, at the Union Stock Yards in Chicago. It was founded largely through the efforts of a group of admirers of purebred animals which included such famous live stock men as Robert B. Ogilvie, Mortimer Levering, William E. Skinner, Alvin H. Sanders, John Clay and John Spoor. Profiting by the experience of the old Fat-Stock show, the new organization laid plans for a great educational institution free from political favoritism Following closely the ideals of the founders, succeeding directors have made the International the leading exponent of a great movement for the improvement of live stock and crops in America. The International has been held annually in Chicago ever since its organization, except in 1914 and 1915, when it was omitted on account of the presence of foot-and-mouth disease in the United States. Staged usually during the last week in November and the first few days in December, a time when all other fairs and shows have been completed, the International draws the year's prize-winning draft horses, beef-cattle, swine, grain and hay exhibits and numerous other farm products from all over the United States and Canada. The organization owns its own grounds, covering 500 paved acres. Joined to the many barns and other buildings housing the show stock is the amphitheatre, seating 5,000 visitors and enclosing a tan-bark arena 600ft. long. Here the finest live stock in America have paraded annually for a quarter of a century before the eyes of leading judges of North and South America and Great Britain. Standards have been set by this show. Year by year this institution has continued to expand until every phase of American agriculture is now embraced within its scope. While the display of breeding and fat live stock is still the cornerstone of the exposition, many educational and entertainment features have been added from time to time. The evening horse shows, including ponies, hunters and jumpers, saddle and light harness horses, have won world fame for the quality of the entries. The various State colleges have long been exhibitors of some of the finest live stock in all classes and the annual live stock judging contest for agricultural college students is of far-reaching importance as an educational feature. Within the last decade 1,000 or more farm boys and girls have attended the International annually as a reward for achievement in club-work in agriculture and homemaking. Classes for baby beeves raised and fitted for show by these young farmers have formed one of the new and important attractions, and the live stock judging contest, open to champion junior judging teams from every State, is another innovation. Interest in feeding, fitting and showing live stock is encouraged by a large class of awards for herdsmen, caretakers and other helpers.

While the International is the live stock classic of the year, there are other shows of great importance to the regions in which they are held. The exhibits at such shows are often on a par with those at the International, although they draw from a much more limited territory. Such shows as the American Royal Live Stock Show held annually at Kansas City, Mo., the Pacific International Live Stock Exposition at Portland, Ore., the Southwest Exposition and Fat Stock show at Ft. Worth, Tex., and the National Western Stock show at Denver, Colo., are important shows held prior to the International. From these it draws many of the winning animals. The great show of the East is the Eastern States Exposition held annually at Springfield, Mass., since its organization in 1916. Dairy cattle are the big feature of this show, although

there are always excellent classes of all breeds of beef-cattle, sheep, swine, light horses, hunters, jumpers and ponies.

The National Dairy Show is primarily a show for the advancement of the dairy industry, although some classes are held for horses. Its live stock exhibit consists of 1,000 or more of the finest dairy cattle of all breeds in America. It is by no means limited to the live stock end of the industry. Machinery and equipment for the creamery, the distributing plant and every other phase of dairy manufacture, form a large part of the attraction and add to the educational value of the show The show was first held in 1906 in the Chicago Coliseum. The success of this first venture resulted in the organization of the National Dairy Association and the continued success of the show ever since. It is a much travelled show, having been held in Chicago, Ill ; Columbus, O.; Springfield, Mass.; Milwaukee, Wis.; Detroit, Mich ; Indianapolis, Ind ; St. Paul, Minn. and Memphis, Tenn. Another important dairy show is the Dairy Cattle Congress held annually at Waterloo, Ia. The National Swine Show is the leading show in the world of breeding swine and is devoted exclusively to this branch of the live stock industry. While in point of numbers it is often exceeded by some of the larger State fairs, no other swine show draws so many champions of the various breeds from all parts of the continent. It was organized by the National Swine Growers' Association primarily as a breed-promotion institution, holding its first show in 1916 at Omaha, Neb. It has also travelled, having at different times been held in Cedar Rapids, Ia , and Des Moines, Ia In 1921 it moved to Peoria, Ill , where the association now owns its buildings and grounds.

Poultry shows have been held in the United States for more than 50 years. Thousands of shows of varying sizes are held annually, small towns and communities having their local shows and many State fairs having poultry exhibits also. Large State shows are held later in the season and are followed by regional or international shows. The leading poultry show is the Madison Square Garden Poultry Show at New York city, where it has been a regular event since 1870. Thousands of birds are exhibited in individual cages designed to show them to advantage. Pigeons, bantams, and every other variety and breed of feathered domestic fowl are included. The Boston Show was the first large poultry show in the United States, having been started in 1865 It is well balanced and in some respects is better than the Madison Square Garden show Other poultry shows of nation wide interest are held in Chicago and Kansas City.

There is scarcely a branch of the agricultural industry that does not have some show of more or less national scope Special shows are held by rabbit breeders and fanciers, by kennel clubs and by organizations interested in bees and in song birds. There are shows exclusively for horses of certain breeds, for fruits and vegetables and for flowers. The Society of American Florists and Ornamental Horticulturists holds the National Flower Show at a different place each year. The International Flower Show is held annually in the Grand Central Palace, New York city. The American Orchid Society holds a large show, usually every other year, at Madison Square Garden Countless other flower societies exhibit their new products in various local and regional shows Obviously all these exhibits are of immense value to specialists as well as amateur breeders and growers in making progress in their profession.

Canada.—Approximately 500 fairs are held annually in Canada, most of them provincial or local The most important is the Canadian National Exhibition at Toronto, Ont. Held usually in September, this show includes exhibits from practically every branch of agriculture and allied industries and emphasizes educational features. Of the 2,368 fairs held in 1927 in North America, with a total attendance of 39,468,000, none exceeded the Canadian National with its 1,870,000 visitors. No other North American fair owns buildings and grounds of greater value; its valuation is $13,500,000, while that of its nearest competitor, the Ohio State Fair at Columbus, O., is $5,000,000.

Another fair of note is the Royal Agricultural Winter Fair, patterned after the Royal Agricultural Show in England. It was first held in 1922 in the new coliseum on the grounds of the Canadian National and has since grown rapidly. It is held annually in Toronto, usually in December, and limits its exhibits to live stock, grain and hay and other farm products. It draws its entries from the best herds and flocks and fields of Canada, the United States and other countries. Dominion honours for live stock are awarded here.

Other agricultural fairs of note are the Central Canada Exhibition, held annually at Ottawa, Ont ; the Calgary Exhibition and Stampede at Calgary, Alta.; the Old Winter Fair at Guelph, Ont.; the Provincial Exhibition, New Westminster, B C.; the Quebec Provincial Exposition, Quebec, P Q ; the Provincial Exhibition, Regina, Sask ; and the Great Eastern Exhibition, Sherbrooke, Province of Quebec.

South America holds many local or regional fairs and expositions every autumn, but the principal one is the Argentinian *Exposición Nacional de Ganadería,* usually called the Palermo show. This exposition ranks with the leading live stock shows of the world. It was inaugurated in 1875, with but 18 head of horned cattle by the Argentine Rural society (founded in 1866). Its early progress was irregular and in some years no shows were held because of financial and other difficulties. With the growth of the live stock industry in Argentina and other South American countries it finally became established and is now held annually in the autumn at Buenos Aires, where the society owns grounds and buildings near the fashionable Palermo suburb The Palermo show is principally a beef-cattle show There are often from 1,000 to 1,800 head of Shorthorn bulls in the show rings. The Shorthorn classification is perhaps the most elaborate show-ring exhibit to be found in any live stock show in the world, there being as many as 29 classes, in which the animals range from junior yearlings to 3-year-olds. The great number of classes is due to the separation of the animals into groups differing in age by from 15 to 30 days, whereas in other countries most show classes are from 4 to 8 months apart in age. Another unique feature is the compulsory auction of practically all animals exhibited, the purchaser paying a selling commission of 6%. The commission rate is doubled if the owner buys back his own exhibit. The auctioning of the grand champion bull is the outstanding attraction and has become an event in the social season. A week or ten days is often required to complete the auction after the closing of the show. Besides shorthorns, other breeds are shown in great numbers and in good quality, as are horses of both light and draft breeds, sheep, swine, poultry and other agricultural exhibits Dairy cattle are also an important feature of interest. The exhibition grounds are beautiful and in perfect condition and the buildings are elaborately designed and well arranged around the show rings to permit all judging to be done in the open

Two other important live stock shows in South America, both of which are held in Uruguay, are the National Live Stock and Poultry Exposition at Montevideo, and the Live Stock and Poultry Exposition at Salto The exposition at Montevideo is under the management of the Rural Society of Uruguay and is largely a cattle show, but there are usually good classes of sheep, swine, dairy cattle and horses. The Salto show is principally a cattle show, the Hereford breed predominating. Many ranchmen from southern Brazil go to this show to buy their breeding stock

(L. S. R)

AGRICULTURAL STATISTICS. The collection of statistics relating to the use and output of agricultural land is a comparatively modern institution. It is only within the last half century that the duty of a government to obtain such information has been generally recognized. During that period, thanks largely to the influence of the International Statistical Institute, and of the International Agricultural Institute, the systematic collection of agricultural statistics has been undertaken in most countries, although there are still some which lag behind

In England it might be claimed that the first agricultural statistics were those collected in the 11th century in Domesday Book, which included a record of the use of all land then under cultivation. But it was not until the 19th century that the State undertook, as an ordinary function of administration, the annual collection of statistical information about agriculture. Attempts

were previously made by private enterprise to ascertain facts, the most famous being that of Gregory King in 1688. He estimated the total area of England and Wales at 39,000,000 acres, which proved to be somewhat exaggerated when actual measurements became available. He further estimated the area of arable land at 9,000,000 acres, of pastures and meadows at 12,000,000 acres. In 1827 another estimate was submitted to a select committee of the House of Commons by W. Couling, who based his calculations on personal investigations made between 1796 and 1816, and again in 1824–27, in the course of which he claimed to have travelled 50,000 miles His estimates covered the whole of the British Isles, in which he reckoned there were 19,000,000 acres of arable land and 27,000,000 acres of pasture and meadow. In England and Wales he estimated the arable area at 11,000,000 acres and pasture and meadow at 17,000,000 acres. Spasmodic attempts were made from time to time in different parts of the country to collect agricultural statistics. In 1831 the magistrates of Norfolk instituted an enquiry for that county, and a little later the Board of Trade endeavoured to obtain, experimentally, particulars of the agriculture of Bedfordshire. In 1854 the Highland and Agricultural Society of Scotland established a system of agricultural statistics for Scotland, the cost being borne by the Government. This continued for three years; it was discontinued then in consequence of the withdrawal by the Treasury of financial support. In 1855 a committee of the House of Lords reported in favour of uniform and compulsory returns and in 1864 a resolution was passed by the House of Commons demanding the immediate establishment of a national system of agricultural statistics. No legislation was passed but the Board of Trade gave effect to the wish of Parliament and established a system of annual returns from every occupier of agricultural land of the acreage of crops and number of live stock on each holding. The returns were first obtained in 1866, and in 1884 they were supplemented by the collection of estimates of the year's yield of the principal crops. The responsibility for the collection of all agricultural statistics was transferred from the Board of Trade to the Board of Agriculture soon after its establishment in 1889.

The most systematic attempt to provide agricultural statistics by private enterprise was that made by Lawes and Gilbert in their calculations of the production and consumption of wheat in the British Isles. These were started in 1852 and continued annually until official estimates of the yield of wheat and other crops were begun 32 years later The method they adopted was to ascertain the average yield per acre of five experimental plots at Rothamsted on which wheat was (and is) grown continuously year after year. Each of the plots was very differently manured and one was always unmanured. The yields, of course, varied widely and it was assumed that these variations would on the whole represent the differences in the produce of crops grown under widely differing conditions throughout the country. In the absence of any satisfactory system these estimates were generally accepted as fairly trustworthy for a series of years, and for comparing the results of one harvest with another

Systems of Collection.—Much discussion has taken place among statisticians and economists as to the best system of collecting agricultural statistics In practice the question is settled in most countries mainly on administrative and financial grounds without much regard to a theoretical ideal. For ascertaining the area of every agricultural holding and of the crops grown thereon, and for enumerating the farm live stock the distribution to every occupier of a schedule, analogous to a census schedule, is generally agreed to be desirable. This was the system adopted for the British Isles in 1866, and is still in force, although the schedule of enquiry has been gradually made more elaborate and comprehensive. The schedules are distributed by post through the local crop reporters who are also responsible for their collection. The returns are made on June 4 in each year. In some countries, where a similar system is adopted, the returns are collected at longer intervals. In Denmark, for example, the enquiry is made quinquennially and in the United States decennially, annual variations being estimated. Returns of the yield of crops are obtained by other methods. In England and Wales the Ministry of Agriculture has a staff of 320 specially appointed crop reporters, each of whom is responsible for estimating the average yield of crops in every parish of his district. In Belgium the administration of each commune is responsible for obtaining estimates of produce. In France the duty is also placed upon the communal authorities, who call into consultation a limited number of representative farmers. Similar systems are adopted in other continental countries.

Statistics of World Agriculture.—The total land area of the world, omitting the Polar regions as unsuited for agriculture, is 50 million square miles. Of the four continents, Asia and America are almost equal in extent and together comprise 63% of the total area. Africa comes next with 23%, and Europe has less than 8%, the remainder being scattered in "Oceania" which accounts for 6½% of the total surface. Statistics of agriculture are only partially available for this vast area, although they are gradually becoming more comprehensive. The alteration of territorial boundaries, and the establishment of new States, which followed the World War, have necessarily involved the re-adjustment of administrative arrangements in Europe for the collection of agricultural statistics, and disturbed the sequence of comparative figures. But the International Agricultural Institute obtains returns for all the principal European countries on more or less uniform lines as well as for North America, Argentina, Chile, India, Australia and New Zealand. Returns for Russia, after a prolonged period of uncertainty, are again becoming available but are not yet included in the general summaries issued by the institute. Taking the area of land under arable cultivation as representing the area of crop-production, India has about one-third of the total, the United States coming next with 28%, which is nearly equal to the whole arable area of Europe, excluding Russia.

The average production of the chief cereal crops in those countries for which returns are available is returned as follows, the figures representing millions of bushels —

	Wheat	Rye.	Barley	Oats.
Europe	1,179	766	592	1,494
Canada, U.S.A. and Mexico	1,189	89	269	1,828
Asia .	387		120	.
Africa	99		,93	23
Argentina . .	204	3	10	59
Australia . .	129			
	3,187	858	1,093	3,404

Maize, for which returns are available for ten European countries, the United States, Canada and Africa, has a greater production than any other cereal crop except oats, the total being returned as 3,352 million bushels. The potato crop, although less widely grown than wheat, exceeds it in total production, the returns accounting for an average of 4,343 million bushels.

Statistics of farm live stock are less complete than those of crops and are in many countries collected infrequently at irregular intervals. The following table shows approximately the world's totals of each kind of animal and their relation to the human population and to area:—

	Number.	Per 1,000 inhabitants.	Per 1,000 hectares.
	Millions.	*Head.*	*Head.*
Horses . .	99·8	58·7	9·4
Cattle .	510·9	295·7	46·2
Sheep . .	532 2	325 9	49·3
Goats . .	116·8	114·9	14·0
Pigs	209·7	155·9	19·6

Unfortunately no statistics of any reliability are available for China (pre-eminently an agricultural country). The annual value of pigs reared in China must be enormous and cattle and horses are everywhere in evidence; but the unsettled state of the country since the Revolution has made records difficult to obtain.

The distribution of the animals and their relative importance as indicated by their density are shown in the following table.—

	No. per 1,000 hectares.				
	Horses.	Cattle.	Sheep.	Goats.	Pigs.
Europe	39·3	124·0	155 7	27·4	64·3
North & Central America	11·1	38·8	19·6	4 4	28·5
S. America	10 1	41·6	45·8	8·9	12·6
Asia	4·7	53·3	29·7	23 3	19 4
Africa	0·9	16·5	34 4	14·9	1 4
Oceania	3·3	18 8	116 4	0·3	1·3

(A precise date for the statistics of the foregoing three tables cannot be given; they represent an average for a series of recent years, a ten-year average being aimed at up to 1928)

The International Agricultural Institute has formulated a scheme for a world agricultural census in 1930 in which it is hoped all the chief countries will co-operate. If this can be generally carried out on uniform and systematic lines, statistics of the world's agriculture will be more complete.

Statistics of British Agriculture.—The continuity and in some degree the comparability of agricultural statistics for the British Isles have been affected by political and administrative changes For many years they were collected by the Board of Agriculture for Great Britain and by the Department of Agriculture for Ireland. In 1912 the Board of Agriculture for Scotland was established and took over the collection of statistics in that country. When Ireland was divided separate agricultural departments were set up for Northern Ireland and the Irish Free State respectively, so that there are now four departments responsible for the agricultural statistics of the British Isles.

The total area of land under crops or grass (in other words the "farmed" area) in Great Britain is nearly 30½ million acres, of which 13¾ millions are under arable cultivation and a little over 16½ millions in permanent pasture. The acreage of each of the chief crops in 1926 was as follows.—

	Acres
Wheat	1,646,000
Barley	1,270,000
Oats	2,804,000
Beans	218,000
Peas	120,000
Potatoes	641,000
Turnips and swedes	1,158,000
Mangold	340,000
Clover and rotation grasses	3,987,000
Small fruit	77,000
Hops	26,000
Sugar beet	229,000

The number of farm live stock in Great Britain in 1926 was as follows.—

	No.
Horses	1,307,491
Cows and heifers	3,206,732
Other cattle	4,244,181
Total cattle	7,450,913
Breeding ewes	9,870,107
Other sheep	14,191,712
Total sheep	24,061,819
Pigs	2,345,431

The average total production and yield per acre in the ten years 1916–25 of those crops for which estimates are obtained annually are shown in the following table:—

	Total produce.	Yield per acre.
	Tons.	*Cwt*
Wheat	1,717,000	17 3
Barley	1,185,000	15 0
Oats	2,230,000	13 8
Beans	187,000	15·7
Peas	75,000	13·7
		Tons
Potatoes	4,133,000	6·2
Turnips and swedes	18,009,000	13·7
Mangolds	7,472,000	19 1
Hay:—		*Cwt.*
Clover and rotation grasses	3,032,000	29 1
Permanent grass	4,905,000	21·4

Particulars of other crops, and statistics relating to agricultural output which are not included in the annual returns are obtained from time to time in connection with the census of production (*see* AGRICULTURE, CENSUS OF). (R. H. R.)

AGRICULTURAL WAGES. The origin of wages in agriculture was the disappearance of the serf. So long as slave labour was available no question of remuneration arose. In England serfdom, speaking generally, was a product of the Norman Conquest, when the organization was established on a system of "villeinage." (*See* VILLENAGE and MANOR.) The gradual emancipation of the villeins and their development into tenant farmers was accompanied by the emergence of a class of men who occupied no land, or not sufficient for subsistence, and were therefore compelled to seek a living by selling their labour to others.

In the middle of the 14th century the relations of employers and employed were violently changed by the catastrophe of the Black Death, or plague. In the rural districts large areas were left derelict by the death of the occupiers and the owners were unable to keep them in cultivation for lack of labour. An urgent demand for labour followed, and wages rose suddenly in consequence of the restricted supply.

State Regulation.—In these circumstances the State, first by Royal Proclamation and subsequently by statute, intervened. The famous Statute of Labourers enacted that "Every man or woman, of whatsoever condition, free or bound, able in body, and within the age of three score years . . . and not having of his own whereof he may live, nor land of his own about the tillage of which he may occupy himself, and not serving any other, shall be bound to serve the employer who shall require him to do so, and shall take only the wages which were accustomed to be taken in the neighbourhood where he is bound to serve." The "accustomed" wages were those paid in the year before the plague appeared. Those who attempted to get higher wages were liable to imprisonment, while those who either paid or received more than the authorized wages were fined three times the amount of the excess. Justices were sworn to enforce the Act and to fix the actual rates of wages in each district. (*See* LABOUR LEGISLATION)

The Statute of Labourers was frequently amended and its provisions and penalties made more stringent, but nevertheless it is evident that it failed to prevent a substantial rise in the agricultural wages. Thorold Rogers in *Six Centuries of Work and Wages* declares that the 15th century and the first quarter of the 16th were "the golden age of the English labourer if we are to interpret the wages which he earned by the cost of the necessities of life. At no time were wages, relatively speaking, so high, and at no time was food so cheap." Attempts were constantly made to reduce wages by enforcing the Statute of Labourers, but ineffectively. Wages kept at a high level, gradually became customary and were ultimately recognized, tacitly if not explicitly, by parliament.

Under the vigorous rule which followed the accession of Elizabeth more effective measures were taken to regulate wages The Justices in Quarter Sessions were empowered to fix rates of wages in husbandry and they exercised their powers assiduously and rigorously. Thereafter wages conformed to the assessments of Quarter Sessions and were reduced notwithstanding the continual increase of the cost of living. The establishment of a system of Poor Law Relief tended to depress the level of wages. Magistrates were encouraged to reduce wages knowing that if the wage-earner became destitute the responsibility for his maintenance would be a charge on the whole community while farmers, and ultimately landowners, would benefit by the lowness of the wage.

At the end of the 18th century a momentous step was taken which had the effect of still further depressing the level of agricultural wages and completing the pauperisation of the wage-earners. It affords a curious instance of the perversion of good intentions by misguided policy. At the Berkshire quarter sessions in April, 1795 the chairman, Mr. Charles Dundas, M P., afterwards Lord Amesbury, expatiated on the necessity of increasing the wages of agricultural labourers instead of leaving them to apply for poor relief for the support of their families, which was impossible on a wage of one shilling a day. It was resolved to

convene a meeting to consider the question. The notice of the meeting referred to "the great inequality of labourers' wages and the insufficiency of the same for the necessary support of an industrious man and his family," and proposed that the meeting should "limit, direct and appoint the wages of day labourers." The meeting was duly held and at the outset unanimously agreed that "the present state of the poor does require further assistance than has been generally given them." A proposal to enforce the payment of wages in proportion to the price of bread (in other words the institution of a minimum wage) was discussed and rejected, but it was resolved "very earnestly to recommend" to farmers that they should "increase the pay of their labourers in proportion to the present price of provisions." The magistrates attending the meeting pledged themselves, each in his district, to ensure that every "poor and industrious man" should have either from wages or from the poor rates 3s. weekly when the gallon loaf cost 1s. and for his wife and each child 1s. 6d The man received 3d. and each of his family 1d more or less for every penny that the price of the loaf rose or fell. (*See* ASSIZE)

This system and scale were generally adopted throughout the country, the only two counties in which it did not, sooner or later, come into operation being Durham and Northumberland The effect was as might have been foreseen. Farmers so far from adopting the earnest recommendation of the Speenhamland magistrates tended more and more to reduce wages and to throw the balance required for subsistence on the rates. There were local differences, arising from various causes, and in 1824 a House of Commons Committee on Agricultural Wages reported that whereas in the northern counties, which the Speenhamland system had not reached, wages were from 12s to 15s. per week, in other counties they varied from 8s. or 9s to 3s. for a single man and 4s. 6d for a married man.

In 1830 there was a serious revolt of agricultural labourers originating, as others had done, in Kent but rapidly spreading to Sussex, Surrey, Berkshire, Hampshire and Wiltshire. There is no doubt that it arose from a feeling of general desperation. Among the immediate causes were the brutality of the game laws, the introduction of threshing machines, and the ruthless administration of poor relief by parish officers, but the lowness of wages was the general grievance which united all. The demand put forward was for a wage of 2s 6d per day. The rising was suppressed, not without bloodshed, and the punishments which followed were based on the theory, then commonly accepted, that extreme severity was the only deterrent to crime. When in 1835 the old Poor Law system and the anomalies and abuses with which it was encrusted were abolished, State regulation of agricultural wages was abandoned, having existed in various forms for nearly 500 years.

Wages Machinery.—After about 80 years of *laissez faire* the State in 1917 again intervened to regulate the wages of agricultural labourers. In doing so it adopted a new principle, the object in view being to secure that wages did not fall below a fair level. This policy was embodied in the Corn Production Act, 1917, which was passed to stimulate the production of food and to authorize the compulsory cultivation of land. Prior to 1917, with the exception of a few areas where trade unions had successfully overcome the inherent difficulties of organizing agricultural workers, no system of collective bargaining existed for the fixing of agricultural wages. When, under the Corn Production Act, 1917, farmers were given a State guarantee for corn prices there was coupled with it a system of wage-fixing machinery for agriculture on the lines of the Trade Boards already in operation for several other industries, and the first Agricultural Wages Board was established, together with County Wages Committees.

The Corn Production act was a war measure, its duration being limited to six years But after the war the Government re-enacted its main provisions in the Agriculture act 1920, which embodied what was heralded as a permanent agricultural policy. The wage-fixing machinery was continued in the same form, *i.e.*, an agricultural wages board, with local committees, entrusted with absolute power to settle minimum rates of wages. This act was repealed in the following year and the Agricultural Wages Board was abolished. The Corn Production (Repeal) act 1921 set up local conciliation committees charged with the duty of agreeing upon minimum wages for their districts but without the power of enforcing their decisions. Three years later however the legally enforceable minimum wage was re-established by the Agricultural Wages (Regulation) act 1924. This set up, in form, the same wage-fixing machinery as before, but with the important difference that the responsibility for fixing rates was placed on the district committees, the Central Wages Board merely embodying their decisions in statutory form. The enforcement of the orders was entrusted to the Ministry of Agriculture, instead of to the wages board as under the acts of 1917 and 1920.

Under this Act England and Wales are divided into areas on a county basis, each having an autonomous Agricultural Wages Committee composed of equal numbers of representatives of employers (nominated by the National Farmers' Union), and workers (nominated by the National Union of Agricultural Workers and the Workers' Union), together with two impartial members appointed by the Minister of Agriculture and an outside chairman selected by the committee itself. The Central Agricultural Wages Board is similarly composed of equal numbers of members representing the organisations of employers and workers, together with a panel of five independent members (including the chairman), appointed by the Minister of Agriculture.

Rates of Wages.—By the Corn Production act the Agricultural Wages Board was given discretion to fix minimum rates of wages, subject to the proviso that no amount less than 25s per week for able-bodied men should be fixed. This limitation, in fact, never became operative. When the Agricultural Wages Board began operations in 1918 current rates of wages everywhere were higher than that figure. Under the act the board could not fix a minimum wage until it had received and considered a recommendation from the district committee concerned The Norfolk committee sent up the first recommendation which was to fix 30s. This was adopted by the board, and subsequently the average for the whole of England and Wales worked out at 30s 6d. There were four subsequent revisions of the rates, in May 1919 when the average was 37s. 10d., in April 1920, 43s., in August 1920, 46s. 10d , and in Sept. 1921, 42s 3d

During this period prices of commodities including farm products were abnormally high, but in 1921 they began to fall rapidly, a fact which was recognized by the Agricultural Wages Board in the reduction by over 4s. of the minimum wage just before its abolition. Under the Conciliation Committee system the reduction proceeded rapidly and in less than a year the average had fallen to 28s Under the Act of 1924 minimum rates again became legally enforceable and the District Committees steadily raised them so that the average of 28s at the beginning of 1925 had risen to 31s 8d at the end of 1926.

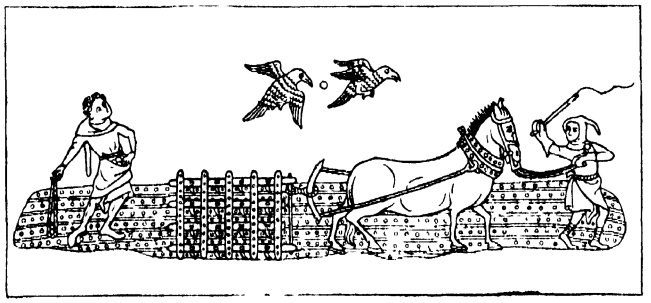
When the minimum wage was first introduced the Agricultural Wages Board was criticized for fixing hours of work as well as wages This criticism was founded on a misapprehension. It was evident that merely to fix the amount of the weekly wage and leave employers the right to demand an unlimited amount of work for it would enable any unscrupulous employer to defeat the object of the act. The board laid down the number of hours to be worked for the minimum wage and fixed the payment, at a higher rate per hour, for overtime. The board also fixed special rates for those classes of farm workers, such as shepherds, stockmen and horsemen, whose normal occupation necessitated longer hours of work

Agricultural wages had been from time immemorial, paid partly in kind The custom was so well established that when the Truck act was passed prohibiting payment of wages generally in kind, agriculture was expressly exempted from its provisions. The most common form of payment of agricultural labourers in kind was board and lodging, the "living-in" system being very common in Scotland, the north of England and parts of Wales. (*See* AGRICULTURAL LABOURER) In all parts of the country the provision of a cottage, either rent-free or at a nominal rent, was general, and other forms of part-payment in kind were the supply of fuel, milk, and potatoes. The Agricultural Wages Board expressed the

opinion that the abolition of all such allowances and perquisites was desirable, but after careful examination they decided unanimously that this was not then practicable. They therefore defined those allowances which might be given in part-payment of the minimum wage and drew up a scale of the amount which could be deducted from the cash wage in each case. Minimum rates of wages were also fixed for female workers and for boys.

The conciliation committees under the act of 1921 and the district wages committees under the act of 1924 adopted the principles and followed the lines laid down by the first Agricultural Wages Board, the only important variation being the raising of the age at which the rate for male adults applies from 18 (at which it was fixed in 1918, mainly on the ground that military service was compulsory at that age) to 21. In all other material respects the system of agricultural wages now prevailing is that established under the Act of 1917. (R. H. R.; R. E. S.)

AGRICULTURE: A GENERAL SURVEY. Agriculture is so primitive and fundamental an art, the beginnings of which so far precede any documents, that any attempt to write its earliest history becomes a matter of surmise and unverifiable conclusions from general principles. It is reasonable to suppose that prehistoric hunter man began by learning to tame the young of certain species, which proved to be fertile in captivity and could be attached to his wanderings. At probably a later stage tribes that gathered certain grains of food value began to make provision for future years by scattering a portion of the seed and effecting some rough clearance of the soil. They took the desirable grains with them in their wanderings and by sowing them they learned to become independent of return to the original centres of growth. When any remains of the early settlements emerge, they reveal evidence of animals and cultivated plants For example, predynastic tombs in Egypt, an early Sumerian house in Mesopotamia (3500 B.C.), and lake dwellings in Switzerland and Italy associated with neolithic man, have yielded grains of wheat of a comparatively advanced type, which must have been preceded by long ages of culture. Flax and barley were also grown. It is significant, however, that no wild species can be assigned as the origin of any of our widely cultivated plants and the same complexity and uncertainty gathers round the sources of the domesticated horses, sheep, oxen and pigs With the exception of maize and barley, the cultivated plants are polyploids, *i.e.*, the number of chromosomes in the cells is a multiple of the diploid number which characterizes the normal species. This



MEDIAEVAL METHODS OF AGRICULTURE
Soaring birds and harrowing. From the Louterell Psalter, an illuminated manuscript of the early part of the 14th century. ("Vetusta Monumenta," vol. 6, Pl. XXII., fig. 7)

points to a probable hybrid source; but whatever the origin, the polyploidy provides material susceptible of the variation on which selection can work, even when it is not attended by giantism or an excess of vigour which would naturally draw the attention of the early cultivator. Though no wild species can be fixed upon as a starting point of our cereals, Vaviloff has argued that the existing distribution of varieties points to certain centres as the original fountain of the cultivated races, these being regions which are to-day characterized by a concentration of varieties in the cultivated fields, where a host of forms occur not yet segregated into distinct races and shade off into weed forms which equally inhabit the uncultivated land. Vaviloff thus indicates the highlands of south-western Asia, particularly Afghanistan, as the probable centre of the soft and club wheats; northern Africa as the home of *durum* wheats, while *einkorn*, a primitive wheat cultivated in prehistoric times, may have had its origin in Asia Minor. Still another race, *emmer*, perhaps the most ancient of cereals, is found in patches all over the old world and only among isolated and backward peoples.

But if we can arrive at some conclusions respecting the earliest forms of our cultivated plants and animals, the history of the growth of husbandry must ever remain a blank. When agriculture does emerge in written history in the time of the Greeks and Romans (*see* GEOPONICI), it is already a highly developed art, which had behind it long centuries of empiric progress, the fruit of observation and of trial and error Cato, Varro, Virgil, Columella, the elder Pliny, describe an elaborate system of farming, embodying many principles, such as the value of leguminous crops as a preparation for wheat, for which modern science has only recently found an explanation. The methods of growing corn, vines and olives then prevailing had not been substantially altered down to the middle of the 19th century, and the sculptured representation of a sacrificial bull, lamb and boar on the *plutei* of Trajan in the Roman Forum bear witness to an advanced state of stock breeding. Roman agriculture is indeed the foundation of modern farming, and though over the greater part of Europe it became submerged with the irruption of the barbarians, its traditions probably never died out in the favoured regions, but shaped and were resumed in modern systems of farming.

Mediaeval Farming.—The course of farming in England that we find in early days is in many respects common to all the invading Northern peoples who drifted across Europe; it finds its parallels in all countries north of the Alps, in Russia and in India It is not uniform, for on the western sides of the islands, in Wales and in Ireland, we find evidence of an earlier system, which is reflected to-day in the grouping of the houses into scattered hamlets instead of into the larger villages characteristic of the more purely arable districts of the Midlands and Eastern England. Whether the organization derives from an original communal ownership of the land and even of its produce is still a matter of dispute, but when records begin the system had passed out of this stage and to some extent had been shaped by feudal theory (*see* ENGLISH HISTORY)

The Manor.—The unit of land holding and cultivation was the Manor (*q.v.*), of which there might be one or more within the parish The land was held at one or more removes from the king by the lord of the manor, from whom the tenants held in return for various services and with varying degrees of freedom. The cultivated land lay in three, or some multiple of three, open arable fields, divided into strips of one or one half acre, separated by baulks of rough grass and terminating in still wider baulks, the headlands on which the cumbrous ox team and plough could turn On heavy land the strips were steeply ridged to throw off the water and this ridge and furrow still persists in many parts of the Midlands which have long been laid down to grass In some places the old strips still defy cultivation, because of the labour that would be required to throw down the ridges and the infertility of the subsoil that would be bared in their crowns.

The three fields were cropped on a fixed rotation of winter corn (wheat or rye), spring corn (barley, oats, peas or beans, or mixed corn) and bare fallow. In each field the tenants held a certain number of scattered strips, the original intention being probably to give to every man a share of the good land and the bad, and mingled with them were the strips held by the lord and constituting his demesne. Each tenant farmed his own strips but was required to give a stated number of days' service to cultivate the demesne strips, services which gradually became commuted into payments in money or in kind. At a certain date after harvest the arable land was thrown open to the cattle to wander over, and this of itself prevented any growth of fodder crops. On the lower land by the river would exist an area of meadow land to be laid up for hay and again divided in proportion with the arable land The tenure of the particular strips for the year was often balloted for, a practice which still endures in

places, as at Yarnton near Oxford. After hay harvest or Lammas the meadows were thrown open for common pasturage, hence the name of "Lammas fields" which still obtains Besides the arable and the meadows the manor embraced a certain amount of "waste," the origin of what to-day are known as "commons" (*q.v*). On this the tenants had right of pasturage and in suitable districts of *turbary*, that is, the right to cut turf or peat for fuel It also provided fern for litter, reeds or heather for thatching, furze and brushwood for firing, rushes for the floors and other purposes, rough timber for fencing and building, stone, gravel and sand.

Production.—The farming that prevailed under these conditions was necessarily inefficient. Some manure appears to have been made by strewing roughage, marl or clay in the folds and in the "garsons," the little enclosures by the village into which the stock were driven at night; but the crops must have mainly depended upon the inherent fertility of the soil The sheep were folded upon the fallow by night, though tenants were often obliged to put them upon the lord's land only In the west where the area of unoccupied land was greater, there is evidence of a practice of moving the arable fields continually, whereby some fertility would be accumulated while the land lay in rough pasture. Of extraneous fertilizers there were none; in areas on the chalk the practice of sinking pits into the chalk and spreading it on the land may have endured, for it is mentioned by Pliny in his account of Britain, and the traces of the old pits that remain in certain districts indicate a long continuance of the process of chalking and marling. The level of production was exceedingly low Walter of Henley, who wrote early in the 13th century the standard treatise on the management of an estate, advised the sowing of two bushels of wheat per acre, which ought to yield threefold From the context this would be a minimum, and the contemporary author of "Hosbonderie" says that barley might yield eightfold, wheat fivefold, rye sevenfold, peas and beans sixfold, and oats fourfold From other sources we shall be justified in estimating the level of production of open field land in mediaeval times at a yield of about 10 bushels of wheat to the acre.

If the conditions of cropping were bad the live stock were in a worse state The stock of all the tenants and of the lord herded together and were driven afield and tended by the village cowherd, shepherd and swineherd respectively Which class of stock prevailed depended to some extent upon the class of land, in the open down and heath country sheep were a feature, the acorns and mast of the woodlands finished off the swine before the winter Pannage (*q v.*) for so many hogs is a common entry in Domesday as an appanage of a particular holding But with this mixture of everybody's stock little in the nature of selective breeding could be practised Walter of Henley insists on the value of good boars, but in general the bull and the boar were common to the manor—the result was a "haphazard union of nobody's son with everybody's daughter." Whatever disease came along ran riot through the whole herd or flock. Oxen were chiefly kept for work, and Walter of Henley considered an ox at work should consume half a sheaf of oats a day. Though the greater speed of the horse was recognized, it required more care, cost more to feed and was "carrion" instead of meat when worn out. Cows were kept for milk and the milk was mainly converted into butter and cheese In the early summer they grazed on the "waste" and marshes or were tethered on the grass baulks; later they had the aftermath of the meadows and the stubbles With the advent of winter the worn out oxen and the old cows were killed off and salted down.—"For Easter at Martinmas hang up the beef." During winter the cattle subsisted in the yards on hay, pea and bean haulm and straw. Rarely were cattle stall-fattened and the open field farmers sold most of their calves for slaughter Sheep were from the earliest times an important element in English farming because of the value of their wool. The ewes were often milked, the toothless "crones" being killed for meat. During the open weather they lived on the downs or the waste by day and were folded on the fallow by night, in the depth of winter they were housed or folded and fed upon whatever roughage was available. Swine afforded the chief meat of the community; they scavenged for a living in spring or summer and fattened upon the "pannage" of the woods. A few were specially fattened upon tail corn and the brewers' grains, for the barley that was grown was very largely turned into ale. The manor aimed at being self-supporting both for food and clothing. Rarely had even the lord any margin of corn for sale; the chief money revenue was derived from the live stock, wool, skins, and dairy produce.

Enclosures.—But the strict manorial system early began to be broken into The lords had often retained meadows and made enclosed fields which they either farmed themselves or let. Little holdings grew up by sufferance on the waste, occupied by "tradesmen" in the villages or other cottagers who also shared in the common grazing. The rising value of wool in the late mediaeval times tempted lords to aim at enclosures of the arable, and recurring dearths and epidemics, of which the Black Death is the most notable, deprived the land of its labourers and facilitated the putting together of larger units of cultivation From the earliest times the substantial independent farmer, represented by Chaucer's Franklyn, was a feature of English country life Not only were the old feudal services commuted into rents, but by new intakes from the wastes or by fencing off portions of the open fields the tenants began to enjoy land in severalty In Tudor times the process of enclosure was in full swing, though the legislature was opposed to, and public opinion was loud in denunciation of, a movement which appeared to diminish corn growing and the rural population But the driving force was the growing commerce of the nation Not only did both landlords and tenants want something to sell and looked upon the land as the basis of a business rather than a subsistence, but the small holders who had been barely able to exist upon their little parcels of cultivation found other and more attractive outlets in the growing commerce and industries

The New Farming.—It was towards the close of the Tudor times and in the early seventeenth century that the new farming began Increasing intercourse with the Continent and particularly with Flanders, where some of the old Roman tradition had persisted, brought new crops and stock and new methods into England Sir Richard Weston (1591–1652) who farmed in Surrey in Charles I's time, is credited with the introduction of turnips, clover and other sown grasses, and these crops providing winter keep were the foundation of the improved system of agriculture. With them cattle could be fattened and maintained during the winter; at the same time farmyard manure was made in quantity sufficient, with the help of the clover which enriches the soil in nitrogen, to raise enormously the whole level of production The new farming could, however, only be practised on enclosed farms; on the open fields clover and turnips would be every man's property as soon as the common stock were turned on to them

Turnips and clover were not the only introductions from the Low Countries; most of the commoner garden vegetables, as cabbages and cauliflowers, carrots and parsnips are owing to the same source. Fruit trees too were "fetched out of Flanders." Richard Harrys, fruiterer to King Henry VIII, bought "105 good acres in Teynham which he divided into 10 parcels, and brought plants beyond the seas and furnished the ground with them," which land "hath been the chief mother of all other orchards for these kindes of fruites." Hop growing also had a similar origin.

Doubtless the same thing happened with live stock, but here the evidence is more meagre because the descriptions of the early writers are so imperfect. But it would seem probable that the large long-woolled white-faced sheep were originally of Roman origin, and the Kents or Romney Marsh, the Lincolns and Leicesters, all on the eastern side of England, may well have been derived from a very similar sheep which is still found in Flanders. The importations may, indeed, have been earlier, for the English long wool was famous in mediaeval times and was among the first of the staple articles of export, its importance being still commemorated in the "woolsack" on which the Lord Chancellor sits. The earlier long wool chiefly came from the Cotswold country, the home of the other white-faced long-wooled race of sheep, and

this possibly may be a remainder from Roman occupation. The black and white cattle which have always been about the Eastern counties were certainly of Low Country origin—the modern Frisian, Holstein or Dutch Cattle. We may even surmise that some white race of Roman origin (either directly or at second hand from the Rhine provinces) went to the making up of the Shorthorn race, whose hybrid origin is betrayed by the mixed white and red in the coat colour of the roans

Enclosure Laws.—The progress of enclosures which has been described grew apace in the 18th century. Whereas in early days it was opposed by Parliament, in the 17th century it became possible to obtain sanction for agreements from the Court of Chancery, and from the time of Anne a strictly legal procedure by private Act was made available (*see* COMMONS) Commissioners were appointed to make the award and apportion the several holdings to the tenants of the open arable fields, but a private Act remained necessary until the General Enclosure Act of 1845. Under the acts the commissioners could proceed to an award although a minority of the parties interested, one-eighth or even one-third, refused to agree. In certain counties—Suffolk, Sussex, Kent, Essex, Somerset, Devon and Cornwall, the marches of Wales, Cheshire, Lancashire and the four northern counties—enclosures were early and were but rarely effected by Act. Possibly from the nature of the land the rigorous common field arable had never been usual in them It was in the great corn growing areas of the Midlands, Yorkshire, Lincolnshire and Norfolk, that so much enclosure by Act took place in the 18th and early 19th centuries. After 1760 the process was much accelerated by the growth of industry and population even before the Napoleonic wars created so great a call for good production. Valuable, indeed necessary, as enclosures were to the nation from the point of view of production, so great a change in the economy of the country-side could not be effected without much serious, if temporary, dislocation of labour and some permanent change for the worse in the condition of the poorer classes. Often the lord and the larger tenants took the opportunity of enclosure to put the land down to grass, so that a single shepherd would take the place of a dozen men who had formerly worked on the village land The enclosures themselves may have been fair enough in their apportionments, though it would always have been easy for the lord and the bigger farmers to over-weigh their poorer neighbours, but many cottagers who had no arable and therefore no title in the award found their customary rights of grazing swept away with the commons There were those who held that the commons encouraged an idle race of casual labourers and poachers, but the other side of the picture, the destruction of a thrifty peasantry, was the theme of many writers in the 17th and 18th centuries.

Arthur Young, himself an unceasing advocate of enclosure, deplored the evils that had resulted therefrom "By nineteen Enclosure Acts out of twenty, the poor are injured, in some grossly injured . . . The poor in these parishes may say, and with truth, *Parliament may be tender of property; all I know is that I had a cow, and an Act of Parliament has taken it from me*"

The Agricultural Labourer.—With enclosure at any rate began the creation in rural Britain of a race of landless men, dependent for employment upon the larger holders of land; and though the darkest days of this class did not come until the close of the 18th and the first third of the 19th century, when the pauperization caused by the old Poor Law became universal, the lot of the agricultural labourer, still the worst paid and worst housed section of the community, was established Thomas Mozley writes of his parish in Northants in 1829, "There were many farmers, several yeomen, very many small freeholders, as many tradesmen as the place could find work or customers for, and not one single labourer, in the sense of an independent workman offering his labour for wages, but a multitude of paupers" The labourer class was also recruited from those yeomen proper who obtained small farms after enclosure but were unable to hold on to them. It requires neither fraud nor force to displace the small proprietor; the mere pressure of economic change is sufficient. A run of bad seasons, the constant temptation to mortgage, the inheritance by a widow, and the neighbouring proprietor who wants to add land to land finds his opportunity, especially where, as in England, land has also for so long possessed a non-economic social value Special opportunities were also offering to active men in industries and commerce, and since many of the old yeomen farms could produce but the barest living for their occupier, they were sold and merged in larger holdings because the owner was no longer content with the income derivable from them. In other countries peasant farming has subsisted largely because there were no alternative occupations with a higher standard of living within reach and because the layout of the land on the open field system persisted and did not permit of putting together large units of farming. The open field system nevertheless persisted into the 19th century; and even in 1927 a non-enclosed parish farmed on the old English plan can be seen at Laxton in Northamptonshire, while the parishes of Epworth and Haxey in the Isle of Axholme remain in strips, though the owners crop them as they please

The Norfolk System.—The improvement in method of farming possible on the enclosed land soon took effect Early in the 18th century we find in operation what afterwards came to be called the "Norfolk" or four-course rotation In consequence England became a corn exporting country during the first half of the 18th century, until the growth of population manifested itself with the development of industries This epoch of British farming which became systematized in the early 18th century and endured until 1840, may be described as that of the conservation of the resources of the soil. The land was usually cultivated on a four course system of two corn crops, alternating with turnips and a leguminous crop—clover or beans The leguminous crop gathered nitrogen from the air and maintained the stock of this indispensable element of fertility at a comparatively constant level, despite the wastages that were going on The turnips and the hay and straw provided for the making of farmyard manure, whereby there was returned to the soil the greater part of the valuable materials that the crops had taken out Nothing left the farm except the nitrogen, phosphoric acid and potash sold away in the wheat and barley, the meat, milk and wool Strict covenants prevented such wasting of the soil capital as would occur from the sale of hay or straw or roots, or the too frequent growth of salable corn crops Under this system the average production became more than double that of the mediaeval farms. Arthur Young speaks of 24 bushels of wheat as the average yield per acre, John Bennet Lawes, writing of Hertfordshire as he knew it when he began his experiments at Rothamsted about 1835, sets the yield at 20 bushels, and the lower estimate is probably nearer the mark for the whole country. This level of production, which we may compare with the six to ten bushels of mediaeval open field farming, could be maintained indefinitely. The limiting factor was generally the supply of nitrogen, and this depended upon the recuperative actions of the leguminous crop in the rotation and of bacteria in the soil which make use of the organic matter supplied by the roots, the stubble and the straw, as against the removals in salable produce and the wastages that occur in the making of farmyard manure and in the soil itself under particular conditions, as washing out and waterlogging The balance that was established was sufficient to maintain the yield at the level of 20 bushels per acre of wheat

Live-stock and Other Improvements.—Other improvements in agriculture were simultaneously in progress, great areas of waste land were being added to cultivation, especially on the heaths and light soils which before turnips and clover were introduced became immediately exhausted. Small's plough, the horse hoe, the drill, the threshing machine, were all inventions which took practical shape in the 18th century and did much to add to the effectiveness of the farming operations Drainage and the systematic amelioration of the land which had been impracticable on the open field system were now taken up vigorously, though the wide extension of field drainage had to wait until the invention of drain tiles in the next century.

Moreover, with the prevalence of enclosed fields, the improvement of live stock could be taken up with some prospect of rapid

achievement. Robert Bakewell (*q.v.*) was the pioneer, and though he was unfortunate in selecting the Longhorn cattle to work upon, his creation of the Leicester breed of sheep persisted and led to rapid amelioration of all the long-wooled sheep. His methods were taken up by other men; Charles Colling (*q v*) made the Shorthorn breed, and John Ellman (1753–1832) the Southdown sheep which has been the progenitor of all the other "down" breeds. England developed a race of breeders who combined the instincts of the fancier with certain definite principles. They began by selecting their breeding stock for conformity to an ideal type in which the meat was laid on in the most valuable places; by close line-breeding, even by inbreeding, the type was fixed and the "pedigree" sires became capable of stamping their own type in a few generations upon the common country-bred stock. Early maturity, the capacity to grow rapidly on good food, proved to be equally obtainable by selection, and the result was that in the 19th century Britain was possessed of a number of definite breeds of cattle, sheep and pigs that were doubly or trebly more efficient than were the old unimproved stocks Their value may be gauged from the way the flocks and herds of the new countries of the world have been populated with stock of British origin. Shorthorns, Herefords and Devons are the great meat producers of the Americas, Australia and New Zealand; the only non-British breeds that have achieved any world-wide extension are the Merino sheep because of their wool and adaptability to arid climates, and the Friesian cattle because of their unrivalled milk yield.

Capitalist Farming and the Great Landlords.—The new agriculture which had grown up in response to the rapid increase of population under the beginnings of industrialism and had been overstimulated by the excessive prices that prevailed during the Napoleonic wars, fell upon evil days with the break in prices and the restoration of a gold standard that followed the final peace in 1818. But it had accomplished its purpose of providing food for the nation from its own land, and it had completed the conversion of British agriculture from a system of peasant cultivation into one of capitalist business, small indeed in the main, but characterized by the employment of labour In no other country has this development proceeded so far. Prior to the disturbances arising out of the late World War most countries in Europe other than France, Switzerland and Belgium, could show vast estates farmed as single units and owned by the territorial nobility, but there was little or nothing of a middle farming class between the domain owners and the peasants, carrying on farming as a business on land rented from the large proprietor. In Great Britain the political, social and sporting privileges attaching to the possession of land early led to the building up of great estates, but the owner found the best use of his property in letting it again to tenants, who on their side took advantage of the opportunity for employing their limited capital in the business, by which they could derive a bigger income from it than if the greater portion were locked up in ownership of the land.

Thus in England the great landowners were the leaders of agriculture along its path of progress in the 18th century, even though most of the actual improvements, especially in stock breeding, were the work of tenant farmers like Bakewell, Colling and Ellman. A few large proprietors led the way; they created the atmosphere of enterprise and confidence in the industry, and they rendered better farming possible by their expenditure on reclamations and buildings They introduced the improved live stock to their tenants and they enforced sound methods of cropping by the covenants inserted in the conditions of tenancy Prominent among them were the 2nd Viscount Townshend (*q v*) Pope's "Turnip Townshend," who devoted himself to the improvement of his estate in Norfolk on a basis of turnip growing, with the use of the drill and the horse hoe He is generally credited with the Norfolk four-course rotation, but it had been evolved before his time and he only gave to it a wider extension. The ideas that Townshend put into practice were chiefly derived from Jethro Tull (*q v*) of Berkshire, the greatest original thinker about farming processes that England had then produced. His "*Horse-Hoeing Husbandry*," published in 1731, was the basis of all improvements in the operations of cultivation during the 18th and early 19th centuries. A little later Townshend's neighbour, "Coke of Norfolk," 1st Earl of Leicester (*q.v.*) made a productive estate at Holkham of what had been little more than a rabbit warren, and became famous for his annual gatherings, the Holkham sheep shearings, where all the improving landlords and farmers of the day met and exchanged their experiences. There, too, the improved live stock of the time could be seen and judged. The duke of Bedford was equally active and held similar meetings at Woburn. A little later we may single out the earl of Egremont in Sussex, and in Scotland Hope of Rankeillor and Sir John Sinclair of Caithness, first president of the newly formed National Board of Agriculture.

Arthur Young.—But the most active promulgator of the new methods was Arthur Young (*q v*). The younger son of a parson with a small property, Young began by farming, but with constant ill success. He soon found his proper *métier* in writing, and from 1767 to 1795 he published those vivid accounts of the farming, the men and manners of England, Ireland and France, which have become classics of observation and shrewd judgment. In 1784 he began the publication of the "Annals of Agriculture," which embodied contributions from all the men of the time interested in agriculture, even the King himself. When a board of agriculture was established in 1793 Young became its secretary and was responsible for a series of county surveys of the state of farming in England which, if unequal and in some respects inferior to Marshall's *General Survey of the Rural Economy of England*, remains our most trustworthy source of information Young was pre-eminently a diffuser of knowledge; he had a sound knowledge of the general trend of agriculture, witness his unceasing advocacy of enclosures, and a quick eye for improvements of method. If his zeal sometimes outran his judgment in his commendation of innovations, his lively style always exacted interest and made him for 40 years a most effective stimulus towards the reform of farming Rarely can a farmer be instructed in the method he is to follow, but he can be excited to think out a novel adaptation to his own conditions

Period of Scientific Progress.—We may take the accession of Victoria as the beginning of a new era in British farming The occupiers of land had slowly adjusted themselves to the new conditions, after the shock caused by the break in prices at the end of the Napoleonic wars. Confidence in agriculture was returning and a new race of landlords was growing up imbued with the idea that the rapid development of science then in progress could be applied to the operations of the farm. In 1838 some of the leaders, among whom perhaps the most active was Philip Pusey, founded the Royal Agricultural Society (*see* AGRICULTURAL SOCIETIES AND SHOWS), which gave a powerful stimulus to the improvement of stock, to experiments in cultivation and manuring, and to the introduction of machinery. Another small landowner, John Bennet Lawes (*q v*) of Rothamsted, Herts, was beginning that fundamental series of field experiments which took formal shape in 1843 when Lawes secured the association of a young chemist, Joseph Henry Gilbert. At Rothamsted was laid the foundations of our knowledge of the use of fertilizers and the nutrition of animals. This period is indeed marked by the introduction of artificial fertilizers. Previously there had been some empiric knowledge of the fertilizing value of such waste materials as woollen rags, soot, and bones, but the supplies were limited and the employment only local. The first consignments of Peruvian guano and of nitrate of soda arrived in 1835; in 1843 Lawes began the manufacture of superphosphate, and his early experiments showed the value of the ammonia salts which could be made from the by-products of gas-making, then becoming general. Other sources of phosphates than bones were rapidly discovered and about 1860 the great deposits of potash near Stassfurth began to be exploited.

At the same time the science of agricultural chemistry was being explored and the theory of the nutrition of the plant—what it draws from the soil, the water and the air—a theory of which Justus von Liebig (*q.v.*) had given a brilliant preliminary sketch in his British Association address, provided a rational basis for

manuring. By 1850 the manufacture of artificial fertilizers was in full swing and though all too many farmers lagged behind in their application, their use, together with the employment of foreign feeding stuffs like linseed and cotton cake, the fertilizing ingredients of which found their way to the land through the farmyard manure made by their consumption, had by 1870 raised the general level of production from British land from 20 to 30 bushels of wheat per acre. As already described, up to 1840 an average of about 20 bushels per acre was all that the land could yield when the farm was strictly self-contained; it was the extraneous sources of fertility which made the higher yields possible. Fertilizers and feeding stuffs were indeed not the only factors at work, though the other improvements influence perhaps more the extension of the cultivated area than its increased yield Field drainage was applied to great areas of heavy land under the influence of James Smith (1789–1850), of Deanston in Scotland, and of Josiah Parkes (1793–1871) whose demonstrations of the value of drainage (*q v.*) became easy of application with Scragg's invention in 1845 of a machine for moulding cylindrical tiles. Smith drained shallow, 30 inches; Parkes put his drains in at 4ft., and much of his work has been in consequence wasted. Only since the great controversy between the two schools has it become clear that Smith's is the way to deal with ordinary heavy land which suffers because it cannot get rid of the rainfall, whereas Parkes's is the best method to cut off underground water rising from below The improvements in cultivating machinery continued and in 1853 Croskill put an efficient reaper at the farmers' service. The steam plough was designed and ever since has had a valuable if limited field of action. Pedigree stock made rapid progress; one by one the existing breeds of cattle, sheep and pigs became differentiated; breed societies and flock and herd books grew up. Improvements in crops also followed; Shirreff, Chevallier, Le Couteur and Hallet introduced the idea of "pedigree" into cereals.

In these years from 1850 to 1874 farming was a prosperous business and money was poured into the land, British farming may then be said to have reached its high water mark of technical excellence. Of some farmers it was reported that they offered a reward to anyone who could find a weed on their cultivated land; no other country could show such yields of corn and roots; men came from all over the world to buy British live stock with which to improve their native races.

The Great Depression.—All this prosperity culminated in the high prices occasioned by the Franco-German war; in 1874 a turn in the tide was manifest A trade depression set in which limited the purchasing power of consumers; a run of bad seasons, culminating in the disastrous wet and cold year of 1879, brought ruin to many farmers. Other major causes beyond the control of farmers were at work to reduce prices The growth of railways and the development of steamship traffic opened up the international traffic in agricultural produce, and the wholesale settlement of the new countries, particularly of the middle west of North America, gathered way The area of cultivated land in the world with wheat as the staple crop grew apace, faster even than the population; wheat prices fell year by year until 1894. The average *Gazette* price of English wheat was 54s. 3d for the decade 1865–74, 46s in the next decade, and continued to fall to 22s. 10d in 1894. Within the 20 years 1875–1894, 124 million acres of land were added to the cultivated area of the United States alone, and the corresponding increases in Canada, S. America, Australia and New Zealand were considerable

The other great factor was the appreciation of gold which began when Germany started to form a gold reserve after the war of 1870 and was accentuated by the falling yields from what had been the chief gold-producing centres of California and Australia. The situation was not rectified until the Transvaal became a big producer in the nineties of the last century. The prices of all commodities fell, wheat more than the rest [Sauerbeck's index, *i.e.*, all commodities fell 40%, wheat 51%], and some economists have considered that to this cause alone was due the fall in agricultural prices and the resulting depression. But the vast increase of production must have also had its effect or the demand from the rapidly growing population would have counter-balanced it. During this period there was always a surplus of wheat and it was being grown at less than the cost of production, indeed it has been said that the only profit the pioneering American farmer made out of all the plenty lay in the eventual appreciation in value of the land he had settled.

Whatever the ultimate causes of the break in prices it had a disastrous effect upon British farming. Neither farmers nor landlords realized how continuous the fall was going to be, or how completely indifferent would the price remain to the occurrence of a short crop at home; farmers could not readjust their methods and in many cases landowners did not reduce their rents in time to avoid a crash. Much of the old perfection of British farming had to go because of its expensiveness in labour, for during the whole of the period wages were tending to rise rather than to fall Farm after farm was thrown upon the owners' hands; in Essex great areas of clay land became for a time derelict or were let to Scotsmen who would undertake to pay tithes and rates. In some cases the landowners had to farm themselves on an extensive scale, in others farmers who had acquired an art of cheap management had farm after farm thrust upon them until they were operating areas of 4,000 to 10,000ac. These big businesses which grew up towards the close of the century are not reflected in the statistics, for the separate farms were still returned in the rate books as units. Indeed they were farmed as units, each with a bailiff but on the common system which the farmers had found to work; the buying and selling only were centralized. Though prices did turn slightly after 1895 it was not until the close of the century that the conditions began to appear at all stabilized. By that time men had learned to cheapen their methods in the purely arable districts and in others the growing demand for milk had afforded an outlet. The Essex clay lands came back into use, if not under the plough, with a new race of Scotch and Devonshire milk producers. Prices of meat and wool had fallen though not to the same extent as with cereals, and the distress in the west and north of England had never been so great as in the purely arable countries. In some districts special crops solved the farmers' difficulties; a great potato industry developed in the Fen country, where energetic men with intensive methods built up large holdings out of the bankrupt small farms: but the price of potatoes, like that of milk, was made at home, foreign competition being negligible here, while the demand was growing with a larger and more prosperous population The growth of vegetables, fruit and flowers provided also an expanding industry, and the demand for such things increased with the rise in the standard of living.



MEDIAEVAL HUSBANDRY
Feeding chickens. From the Louterell Psalter, an illuminated ms of the early 14th century. ("Vetusta Monumenta")

Loss of Arable Land.—But such commodities provided the exceptions; in the main the farming community had to meet the depression by reducing expenditure, despite the resulting fall in production. The acreage only under wheat in England, 3,337,000 in 1872, had shrunk to 1,745,000 in 1900; yet there was no accompanying increase in the yield per acre such as should have attended the abandonment of the poorer land, without taking into consideration the improvements in the varieties grown and in the supply of fertilizers. The chief resort of the English farmer in order to meet the situation was to lay his land away to grass. Thereby he shifted his production towards the more remunerative live stock and at the same time reduced the labour bill, because on grassland one man may suffice for 200 or 300ac , whereas on the arable land about four men per 100 ac. were then employed. Only when dairying on grassland is a staff required comparable with that employed on the ploughland. Between 1872 and 1900 the area of land under the plough in England was reduced by over 2½ million ac., or nearly 20% of the amount in 1872. There were some notorious examples of these changes; in one case on the Berkshire Downs some 4,000 ac. of ploughland were converted into a sheep ranch tenanted only by a few shepherds, the old farmhouses and

hamlets perishing away in desolation. In England and Wales the agricultural population diminished between 1871 and 1901 from 1,269,371 to 951,674, that is, by nearly one quarter. In Scotland the reduction in arable land was not appreciable, but a similar saving was effected by lengthening the duration of the leys in the rotation; the four-course shift became a five- or a six-course, with two or three years of temporary grass instead of one.

For all the reduction of cultivation and the lower standard of farming the period was not entirely one of retrogression. Improvements in the quality of live stock, especially in the direction of early maturity, in the production of milk, and in the special branches of potato growing, market gardening and fruit growing continued. The self-acting reaper and binder began to be imported in 1873 and proved the great labour-saving implement of the period, though at the outset it only intensified the pressure of competition, since it was worth more to the wheat grower in new countries short of labour than it was to the British farmer. This distressed state of agriculture became the subject of more than one royal commission and parliamentary enquiry, none of which, with protection ruled out as contrary to national policy, could suggest any substantial alleviation. The one legislative action of importance was the creation in 1889 as a special department of State of the Board of Agriculture whereby the importance of agriculture in the national economy was recognized, no other industry having this kind of representation in the machinery of government. The new Board took over certain existing services such as the collection of statistics, the control of scheduled animal diseases, the administration of tithes, enclosures, and university and college estates, and was also charged with one function of a constructive character, the allocation of £5,000 a year for the assistance of agricultural and dairy schools.

Agricultural Instruction.—From about 1890 onwards began the first systematic attempt at agricultural education and in its train followed some new beginnings in research. The great start made at Rothamsted had been left solitary and unaided, though other countries were copying its methods and extending them into all the fields of science which bear on agriculture. The movement was too young to have any effect on the industry before the close of the century; it had to overcome the intellectual inertia of a class which had always been indifferently educated and had no opinion of book farming, while the new scientific teachers had to learn what was good in the practical man's outfit and to recover from their own mistakes. One new fertilizer had been added to the list available for the farmer, namely, basic slag, a phosphatic by-product of the steel industry which was to do much to improve the growing area of grass land. But owing to his poverty the British farmer was not using fertilizers as much as he might have done, and the greater part of the British production of sulphate of ammonia was being exported.

The period from the beginning of the century to the outbreak of the World War was one of steady recovery and quiet progress under the favouring wind of slowly rising prices Knowledge was growing, both from the example of successful practitioners under the new conditions, and from the technical instruction that was becoming more generally diffused. Statistically the industry continued to decline; the arable land of England diminished by a further million acres between 1900 and 1914, nor was there any compensating increase in the numbers of live stock, though the output was improving as better methods of feeding and breeding brought the animals earlier to market. All over the country examples could be found of progressive and prosperous farmers who were taking advantage of the resources science was increasingly putting at their disposal. But many were still set in old ways; mindful of the bad times that were not far off they sought the path of safety first and were distrustful of all enterprise that might cost money. In the use of lime, fertilizers and other ameliorations of the soil our farmers were falling behind their competitors in Holland, Denmark and Germany, just as in the applications of machinery they could not rival the farmers of America and Australia. Labour was still too cheap in the agricultural counties of England; farmers still clung to the traditions that had answered when wages were 7s. a week and wheat over 6s. a bushel

Marketing.—Above all the weakness of the British farmer as an economic unit was being exposed. The rapidly growing population was to an increasing extent being fed from overseas; in the five years preceding 1914 the United Kingdom only produced 42% of the food it consumed as measured in calories, in particular it only grew 20% of the wheat it needed. Great Britain was the one open market for the agricultural surpluses of the whole world, for the one or two small countries that also persevered in a free trade policy were themselves exporters of agricultural produce. In consequence great commercial interests grew up to exploit this import trade, interests that could impose upon the aspirants for a place in the British market those conditions of uniformity of produce, standardization of output, and attractiveness of packing, which made for ready sale Our competitors by the mere fact of dependence upon an export trade were marshalled into co-operative societies, and through this discipline the peasant farmers of other countries secured all the advantages of marketing which might have been expected to belong only to the big businesses The typical British farmer, who in his day had been a not inefficient unit for the sale of his staple produce and could look down upon the exploitation of the peasant, was loath to forgo his individuality and slow to recognize his weakness in the world's markets. The lack of leadership and organization was all a part of the want of public confidence in an industry which had become somewhat remote from modern life. The great landowners no longer regarded agriculture as a money-making business; they maintained home farms because of the traditional association of the English gentleman with the countryside and because the exhibition of pedigree stock was a recognized form of social competition; but the lawyers, the bankers and the capitalists remembered the past and had no belief in the earning capacity of the land. No joint stock enterprise to produce food at home could hope to obtain public support, however much money might be forthcoming to exploit wheat or wool, tea or rubber or copra abroad. The farmers who were making money said little about it and trusted to obtain whatever capital was needed for their businesses, many of them extensive, from their friends or trade connections. Politically the farming interest did not count; in Parliament there could be no agrarian party, hardly even an agrarian member, because even in a purely rural constituency the more numerous labourers were not likely to vote with the farmers. Nor was there any policy upon which the agriculturists were united, although most farmers were still protectionists, such a measure was taboo to all parties so far as concerns food and even with the agricultural labourer the dread of higher prices outweighed the hope of better employment.

The one political measure of outstanding importance was the Small Holdings Act of 1908 which empowered County Councils to acquire land and equip it for small holdings and allotments (*see* ALLOTMENTS and SMALL HOLDINGS). This Act may be taken as one of the signs of a growing public interest in agriculture, of the feeling among thinking people that the urbanization of Great Britain was proceeding too fast and that some measures should be sought to check the drift of men away from the land. The triumphal march of industrialism from factory to factory had lost some of its attractiveness; statesmen no longer regarded the simple theory of Great Britain wholly given up to manufacturing, and exchanging its goods for food, as desirable or even safe. So the Small Holdings Act was an attempt to recreate the peasantry that had always been dying out in Britain, and to provide an access to the land for men whom circumstances had driven into the towns but who still felt a call to the soil. The growth of small holdings could do little towards reducing the volume of imports; the impulse was social rather than economic, but a small holding might give a jumping-off point for the energetic man who would move into larger and larger farms, and new blood was needed in the farming community. The statutory small holders rarely failed to establish themselves, but their numbers barely sufficed to keep pace with the wastage that was elsewhere going on (*see* also *post* section on *Small Holdings*).

The Development Fund.—Another measure of perhaps more far-reaching consequences was Lloyd George's Development Act of 1909, by which was set up a commission endowed with ample

funds, the function of which was to promote research and education in agriculture and to carry out other experimental work in rural industries which might help to restore prosperity to the countryside. Thanks to this fund British agriculture began to be provided with an adequate establishment for research and investigation, such as the United States, Germany and other progressive countries already enjoyed. Some results from research were already accruing. The plant breeder's improvements were quickly recognized by farmers, and Rowland Biffen of the Cambridge school of agriculture and Beaven of Warminster, working independently, had applied the principles which Mendel had been the first to bring to light, to the breeding of new varieties of cereals. Some of Biffen's wheats and Beaven's barleys were already being widely grown by farmers in the progressive districts and their success did more than anything else to convert farmers to a belief in the value of research.

One other technical advance may be noted. Towards the close of the period the tractor plough, driven by an internal combustion engine, began to appear in our fields. The new tool could be operated on a farm of ordinary British size, whereas the steam plough was only economic on an extraordinary acreage and had become an emergency implement only hired for special work Imperfect as the motor implement was and still is, it offers potentialities of speeding up and economizing manual labour which have not as yet been fully realized

THE WAR PERIOD

The war struck across all these projects of quiet development, and its first effect was to sweep the agricultural colleges and research institutes of all their students and younger staff for service in the new troops For the first two years of the war farmers were told to get on with their business as usual but that they had no special part to play or contribution to make Prices rose steadily but not abnormally, though here and there a special shortage would declare itself. It was towards the close of 1916, when the submarine menace began to assume threatening dimensions and harvests both at home and in America were deficient, that the new government called upon the farmers to assume a share in the fight

The Food Production Department.—The Board of Agriculture, of which the new president was Rowland Prothero (since raised to the peerage as Lord Ernle), set up early in 1917 a Food Production department directed by Sir Arthur Lee (later Lord Lee of Fareham) and county committees were constituted with certain powers of directing the crops to be grown by farmers. Little could be done to enlarge the area under crop in 1917, but rapid surveys were made of land and to each county was assigned an area of land to be put under the plough, as far as practicable in corn and potatoes. Power was also taken to enter upon land that was being inadequately cultivated; services were organized to provide and distribute steam and tractor ploughs, horses and implements; labour was recruited from every possible source, including interned persons and prisoners of war, and the women joined in large numbers and rendered devoted service, training centres being set up to make them and other unskilled labour serviceable on the land The supply of seeds, fertilizers, feeding stuffs, and other necessities like binder twine was organized, and the necessary transport (now under control) and credits for purchases overseas were arranged. Late as came the effort it was prosecuted with great energy, and even in 1917 the area under the plough was increased by a quarter of a million acres, in addition to 720,000 ac. of arable grassland sown to crops An increase of 60,000 ac. of wheat, 150,000 ac. of barley, 620,000 ac of oats and 260,000 ac. of potatoes was obtained in 1917 as compared with 1916.

Another section of the Food Production department promoted the cultivation in allotments of all the spare ground that could be found round the cities and towns, and saw to the supplies of seeds and tools. This movement (*see* ALLOTMENTS and SMALL HOLDINGS) was of no small value in mitigating the shortages of food which set in later; it had a further result in awakening a desire among many of the urban dwellers for a plot of land to cultivate. The Allotment movement thus stimulated is still active to-day, difficult as it is to retain land near towns from the spread of building

The Corn Production Act.—To assure the farmers of a return for the task imposed upon them the Corn Production Act (1917) was passed, which gave certain guarantees for the price of cereals for a term of six years. In effect these guarantees never were required, so rapidly did prices rise within a few months of the passing of the Act to a level then not contemplated. But other provisions of the Act touched the industry more closely. A minimum wage for agricultural labourers was fixed, and a machinery of Wages Boards was set up to determine what the minimum should be from year to year in each district Again the stated minimum was nugatory, so rapidly did the situation develop, and the Wages Boards became organizations to fix the actual wage rate, not the minimum. Landowners were debarred from raising rents in so far as such increases could be ascribed to the guaranteed prices; indeed the whole Act was framed as a permanent policy of assisting agriculture as well as to meet the existing emergency. The farmer was to receive a certain guarantee of price that would encourage him to produce; the State assumed this burden because it was the general interest of the community to ensure production from and employment upon the land If the farmer was thus secured the labourer in his turn must be assured of a living wage; the expenditure of the State was not to go wholly into the farmer's pocket. The landowner again was not to divert the benefit intended for the producers, as he might otherwise do on the fundamental economic basis that rent represents the difference between the earning power of that land and of land on the margin of cultivation The Act was directed to maintain and extend the area of cultivation, and whatever its defects, defects that are inherent in all such schemes of bounties or protection (namely, that they cannot ensure a responsive effort on the part of the farmers nor avoid an unearned increment on land that was already profitable) it was the first coherent scheme that recognized the needs of all classes interested in the land

Price Fixing.—The immediate interests of the farmers were, however, far more concerned with the course of prices Early in 1917 definite shortages began to be manifest, attended by rapid upward rushes of price and speculation among dealers The newly formed Ministry of Food was therefore forced to embark upon a course first of price fixing and then of rationing all the major articles of food. Such measures involved a very complete control of the whole machinery of distribution; prices had to be fixed for both consumer and producer, the middleman's allowances were determined, and the supplies had to be artificially directed to meet the requirements of each district As far as farmers were concerned, two main difficulties had to be met by the Food Controller. He had to effect a compromise between the high prices necessary to stimulate production and the low prices required by the consumer, opposites that proved almost irreconcilable with regard to milk in the later years of Food Control. The fundamental problem of rationing was solved by leaving the consumption of bread uncontrolled and keeping its price down by a subsidy. Thus even the poorest could secure their main food supply, after which high prices might be allowed to check consumption of the supplementary articles of diet. The second difficulty lay in fixing the prices of much of the produce of the farmer on a reasonable parity, so that he would not be tempted to concentrate on the production of the most profitable. For example any cereal can be converted into milk or meat or eggs; butter or cheese might be more profitable than the raw milk. A shortage in cattle food was soon disclosed since so much of it had come from overseas while the carefully rationed ships' tonnage had to be reserved for essential human foodstuffs, soldiers and munition materials. Also the normal home production of cattle food was itself reduced because wheat was milled more deeply so as to produce 5 or 6% of poor offals instead of the 30% before the war; hence the situation had to be faced when it might be necessary to reduce greatly the animal stock. Actually the milk herd of the country was not appreciably reduced, but sheep declined by one and a half millions between 1916 and 1918, and the pig herd, nearly two and a half millions in 1914, had fallen to 1,700,000 in 1918.

It cannot be said that the numerous regulations imposed by the Food Ministry and the Board of Agriculture in the critical years 1917–19 were wholeheartedly observed Many of them ran counter to the traditions of the farmer, who apart from any question of profit could always see his own reason for following his accustomed routine. Thus the campaign for ploughing up grassland, which was the main item in the Board of Agriculture's programme, met with much obstruction and a somewhat grudging performance. All the instincts of the farmer were against breaking up a good pasture which was producing some food when undisturbed, whereas the crop he would get from it was problematical. The argument that even a bad corn crop could do far more to feed the people than the meat or milk which could be derived from the grass, carried little weight with the farmer who was uncertain of his labour supply, who feared wireworm and weeds, who thought of the time when he would have to put the land back to grass. Few farmers again would withhold grain from stock when stock were so profitable and little or none of their accustomed feeding stuffs were to be had.

Increased Production.—During the latter part of 1917 and early 1918 the energy of the Food Production Department and its county committees found a real response, with the result that in 1918 as compared with 1916 the total arable land of the United Kingdom had been increased by 1,720,000 ac. and the land under crops by nearly three million acres, the increase in wheat being three-quarters of a million acres, in oats over one and a half million acres, and in potatoes nearly 400,000 acres. But the withdrawal of more men from the land for active service in the spring of 1918 and the disastrous harvest conditions that were unfortunately experienced, so intensified the opposition to compulsory ploughing that no further progress could be made, indeed there were nearly half a million acres less grain in 1919 than in 1918. Happily the war had come to an end in November, 1918, or the consequences of this revolt against the ploughing up of grassland might have been a food shortage of the sternest kind.

TABLE I.
CROPS AND STOCK IN ENGLAND AND WALES (000 omitted)

	1914.	1916.	1917	1918.	1919	1924	1927.
	Acres	Acres	Acres	Acres	Acres	Acres.	Acres
Arable land	10,998	11,051	11,246	12,399	12,309	10,929	10,310
Wheat	1,807	1,912	1,918	2,557	2,221	1,545	1,636
Barley	1,505	1,332	1,460	1,501	1,510	1,314	1,051
Oats	1,930	2,085	2,259	2,780	2,564	2,037	1,748
Turnips and Swedes	1,045	932	969	909	981	831	716
	No	No.	No.	No.	No.	No.	No.
Cows and heifers	2,484	2,430	2,465	2,578	2,553	2,663	2,791
Other Cattle	3,394	3,786	3,762	3,623	3,641	3,231	3,484
Sheep (total)	17,260	17,951	17,170	16,475	15,124	14,843	17,070
Pigs (total)	2,481	2,168	1,919	1,697	1,798	3,228	2,687

At this stage, when the actual fighting was over but the crisis of food supplies still persisted, the temper of the farmers turned very strongly against control. They had become organized and by iteration of individual inconveniences every regulation became a general grievance. It is the evil of all price fixing that the producers are almost perforce driven to base their case upon the performance of their weakest members; hence follows either inordinate profits for the more efficient or restriction of supplies

Effect of the War upon Farming.—The consequence of the war, which from the farmers' point of view may be regarded as persisting until near the end of 1920, for there was little relaxation in the operations of the food controller until then, was a great temporary prosperity for the farmers. Even though, checked by the regulations of the food controller, the British farmer always had to sell his wheat at less than the world price, that is, at less than foreign corn was being bought for distribution in the United Kingdom, and though the cost of labour and prices had risen to a high level and commodities rose also, rent had not varied and the balance was strongly in his favour. He had also enjoyed the benefit of the lag which affects all farming operations—that much of the expenditure incurred in preparing a crop antedates the sale by many months; hence on a rising market some at least of the costs are incurred on a lower scale than the realization, this being particularly true of labour. While the largest sums of money were earned on farms growing potatoes and vegetables, probably the highest rate of profit was on the purely grazing farms selling sheep and wool, young stock and milk, and employing little labour. But the only men who really kept their profits were those who gave up their farms and sold their stock before the end of 1920

The most immediate effect of these profits was a sharp rise in land values. During the period 1918–21 there were immense sales of agricultural land amounting on a conservative estimate to three million ac in England and Wales About one-eighth of the farming area of the country changed hands in these years at greatly enhanced values Landowners were not able to raise rents though their disbursements for tithe, repairs and taxation had increased; farms being in demand, it was evident that they could treble or even quadruple their net incomes from land by selling it and investing the proceeds in Government Stocks. Tenants were anxious to retain their holdings but had to buy in order to do so. Consequently these years saw the creation on a fairly large scale of an owner-occupier class of farmer Some of these men had already made money enough to pay for their farms or were able to do so while prices were high, they were comparatively safe when the crash in values came in 1921. The men who then found themselves in difficulties were those who had bought their farms on borrowed money and still carried the mortgage, still more those who had entered and stocked their farms in the period of high prices.

Considering the production of the country we have already seen that the advance in the arable and particularly in the corn area attained in 1918 was not maintained even in the years of high prices that persisted until 1921. All powers of dictating cultivation were abandoned at the close of the war As regards live stock the size of the milk herd was maintained, though the beef herd suffered a small decline. The sheep flock of Great Britain, of England in particular, was greatly diminished; in England and Wales it stood at about seventeen and a half million at the beginning of the war, had fallen to sixteen and a half million in 1918 and reached its lowest point, 13,383,000 head in 1921, while analysis of the returns shows that the loss had fallen almost entirely upon the sheep of the arable counties Arable sheep farming had always been a special British feature characteristic of the open country upon the chalk and the sands. There half the arable land used to be farmed with fodder crops—rye, winter barley, tares, rape, kale, turnips and swedes, which were sown so as to afford a succession of green crops upon which the sheep were closely penned in folds that were moved day by day on to fresh ground In addition to their green food the sheep and lambs received a little hay and corn and cake to force them on for market at an early stage; the land received the benefit of the manure made from the food and the treading of the sheep. This system, the sheet anchor of the older light land farming, was unsuited to war and post-war conditions. The labour required, both for the fold and the growing of the fodder crops, was too expensive at the new rates of wage, the supplementary feeding stuffs were unobtainable, and prices tempted the farmer to sell all his flock and put the land into corn Again fixed prices ignore quality; the arable sheep farmer could no longer realize the extra price he had been accustomed to obtain for his quickly-grown lambs. Consequently the great arable sheep areas in Hants, Wilts and similar counties lost up to 50% of their sheep and though numbers have been reviving of late years the restocking has been with grass breeds like the Cheviot-Border, Leicester half-breeds, Exmoors, Kerry Hills, etc , to the permanent loss of the Down breeds, like Hampshires, Oxford Downs and Southdowns.

The stock of pigs suffered great reductions with the shortage of feeding stuffs in 1917, 1918 and 1919. The herd which in England and Wales had remained for many years at about two million fell to 1,700,000 in 1918, but has since recovered rapidly to more than its previous level, reaching indeed three and a quarter million in

1923. The numbers of poultry followed much the same course as that of pigs and from the same causes, but the post-war development has been more marked with the rapid extension of the knowledge of skilled poultry management.

THE POST-WAR DEPRESSION

The course of agriculture after the war will be best appreciated by a study of prices. The following table shows the average prices of some of the chief items of agricultural produce for the cereal years (Sept.–Aug.) 1913–14 to 1926–27.

TABLE II.
AVERAGE PRICES FOR THE CEREAL YEARS (SEPT.–AUG.) 1914–15 TO 1926–27

Year.	Wheat per qr. of 480 lb.	Beef (*) per cwt.	Milk (†) per gal.	Wool (**) per lb.	Potatoes‡ per ton.
	s.	s.	d.	d.	s.
1914–15	49·8	72·5	9·8	18·5	77·0
1915–16	53·0	84·5	12·8	17·0	110 0
1916–17	74·3	110 0	15·3	18·9	207 5
1917–18	72 3	114 0	19·0	20 3	139·0
1918–19	72 8	124·5	24 0	35·8	164·5
1919–20	75·6	140 0	27·5	41·0	241 0
1920–21	84 7	148 5	25·0	9·8	199·5
1921–22	50 7	96·0	17 3	13·3	174 0
1922–23	42 5	88 0	15 5	10 8	71·5
1923–24	45 0	88 0	14 9	22·4	185·5
1924–25	53·6	88 0	15 0	15·9	187 0
1925–26	52·5	84·0	14 9	14 0	108·5
1926–27	51·1	76·0	14·3	15·9	143·0
Nov. 27§	45 0	65 0	16 0	18 5	120·0

*Average of 1st and 2nd quality English.
†Contracts.
**Average of country sales.
‡Average of King Edward and Arran Chief.
§Approximate prices.

War prices were maintained until the spring of 1921, then they dropped by about one-third by the close of the year. The prime cause was the deflation of money in Great Britain and America which was then effected; the secondary causes were the abundant harvests in the vastly expanded area of cereals in the Americas, particularly in Canada, and the lack of purchasing power among the war-ruined population of Europe Prices in Britain continued to fall until 1923, then tended to recover a little until the long-continued coal strike of 1926 produced a new fall which specially hit the class of farmers who had so far suffered least, namely, the producers of milk and meat The situation has been aggravated by a succession of bad seasons since 1918, which of themselves would have hurt the position of farmers even in normal times. Bad growing seasons, wet harvests, foot and mouth disease, have been serious contributory factors in the ruinous condition in which British farming now finds itself Deflation alone wrote off nearly half the capital farmers estimated they possessed in 1921, and though this did not really alter the position of men who had been farming continuously from before the war, it fell heavily upon those who had entered farming during the years of high prices or had mortgages out from the purchase of their farms.

Post-war Legislation.—The state of agriculture has not been without consideration and legislative action during the post-war period. War experiences had persuaded both Parliament and the general public that the maintenance of a prosperous agriculture was of some moment in the national policy. Even during the war a reconstruction committee under Lord Selborne had examined the question and drawn up a series of recommendations on which the Corn Production Act of 1917 had to some extent been based But that Act, as already seen, had immediately become nugatory as far as guarantee of prices was concerned. As the outcome of a Royal Commission which sat in 1919 an Agriculture Act was passed in 1920, which accepted the main principles of the old Act by charging the State with the payment of subsidies on the acreage of wheat and oats grown, whenever the prices fell below the assessed costs of production. The county agricultural committees became statutory bodies endowed with powers to determine tenancies in case of persistent bad cultivation or neglect, and even to enter upon the land and act themselves in cases of default. Wages boards were continued and tenants were given greater security of tenure by provisions which compelled the landlord to give compensation for disturbance equivalent to a year's or even up to four years' rent, unless the county agricultural committee would certify that the notice to quit was justified by the bad cultivation of the tenant. The Agriculture Act had, however, but a brief existence. It antedated by only a few months the break in prices of 1921, and it soon became evident that under the guarantees the State would be called upon to pay a very large sum



MEDIAEVAL METHODS OF AGRICULTURE
Reaping corn. From the Louterell Psalter, an illuminated manuscript of the early part of the 14th century. ("Vetusta Monumenta" vol. 6, pl. XXIII., fig. 3)

upon the acreage of wheat and oats grown. The basal figure had in fact been set much too high for oats, a crop which is mostly consumed upon the farm and which therefore does not greatly affect the income of the farmer. But no attempt was made to remedy this defect; the public cry for economy was so insistent that the Act itself was repealed in 1921 within 10 months of its passing, in spite of all the promises set out in the Act that four years' notice would be given before the guarantees were withdrawn The repeal coincided with the very situation the Act was designed to obviate, a wholesale break in prices brought about by causes beyond the control of the farmer, brought about indeed in this case by the deliberate deflation policy of the Government With the guarantees the wages board disappeared and though conciliation committees were set up in most counties, the average weekly wage dropped from 42s in September, 1921, to less than 28s before the end of 1922 The repeal of the Agriculture Act put an end to all ideas for a national constructive policy for agriculture, the industry must henceforward sink or swim by its own powers and be guided by its own lights The action was part of the pessimism of the time, of the war weariness that shirks any sustained effort and doubts the value of any planning for the future. Bitterly as it was resented by the farmers, who thereby lost all confidence not only in governments but in agriculture itself, it was angrily acquiesced in, because they got rid of their two greatest bugbears—the shadow of control of farming and wages boards. The resentment generated by ploughing-up orders given in 1918 and other interferences consequent upon the orders of the food controller, had been worked up to an intensity out of all proportion to the actual hardship that had been inflicted, and farmers generally were prepared to purchase freedom at any cost. A very large proportion of them indeed grew little wheat or oats and were anxious to grow less in the difficult state of arable farming. So the farmers' representatives, while protesting, accepted the situation; they saved those sections of the Act that gave them compensation from disturbance (provisions which have injured the land-owners and are in many respects a hindrance to the improvement of farming) and they obtained as a slight recognition of the sacrifice imposed upon them the allocation of a million pounds to the extension of agricultural research and education.

Since that period the National Farmers' Union, in which is concentrated the political opinion of the farming community, has been averse to any further interference of the State with agriculture The distressed state of the industry gave rise to a further enquiry in 1923—the Agricultural Tribunal, consisting of three economists not directly connected with agriculture, who produced an illuminating survey of the subject early in 1924. The main

recommendation of this report, a subsidy upon arable land with further assistance to the growth of wheat, received little support from the farmers' organizations and was never adopted by the government of the day. It also recommended the re-establishment of the wages boards and this was given effect to in 1924. The only other legislative measures calling for some comment were an Act in 1922 which disposed of a long-standing controversy by permitting the admission of Canadian store cattle into Great Britain, and the Agricultural Credit Act of 1923 which gave some relief in the shape of cheap mortgages to farmers who had purchased their holdings during the operation of the Corn Production and Agriculture Acts. Again the British Sugar (Subsidy) Act of 1925 provided a very ample scale of subsidies on sugar produced in Britain, for a period of 10 years, in order to encourage the establishment of a sugar beet industry in this country.

Wages and Prices.—The difficulties of agriculture at the end of 1927, enhanced by the bad harvest of the year, may be apprehended from a study of the course of prices, the cost of living and the weekly rate of wages from the beginning of the war down to the present time The cost of living, being based on the general cost of commodities, is some index of the cost of the farmer's necessary purchases; the rate of wages measures the largest item in his expenditure, or from one-quarter to one-third of the total

TABLE III.

INDEX NUMBER OF AGRICULTURAL WAGES, PRICES AND COST OF LIVING

	Average weekly wages	Percentage increase on 1914			
		Wages	Prices of agricultural produce.	Cost of living.	
	s. d.				
1914	18				
Aug., 1917	25	39	97	80	
July, 1918–May, 1919	30 6	69	141	114	First wages board period
May, 1919–Apr., 1920	37 10	110	169	120	
Ap., 1920–Aug., 1920	43	139	186	144	
Aug., 1920–Aug., 1921	46 10	160	160	140	
Sept., 1921.	42 3	135	116	120	
Jan., 1922	33 6	86	75	92	
Dec., 1922	27 10	55	59	80	
1923	28	56	57	74	
1924	28	56	61	75	
1925	31	72	50	77	Second wages board
1926	31 8	76	50	73	
Oct., 1927	31 8	76	40	67	

costs of production on arable land. The fundamental disproportion is seen—that while in October, 1927, the price of farming products only stands at 40% above the pre-war index, commodities are 67% higher and labour, the largest item of the farmer's expenditure, is 76% higher.

The low agricultural prices are not due to over-production, for as far as can be estimated the gross output from the land of the world, actually lower in some items, has not kept pace with the growth of population since 1914 (*see* later, section *World Agriculture*). That this shortage has not resulted in higher prices is due to the destruction of the purchasing power of so many of the countries of the world, through war and revolution and the depression in industries The efforts that so many states are making towards a deflation of their currency is regarded by many economists as the immediately operative factor, depressing prices for all producers and destroying the confidence upon which industrial activity depends.

The other element in the equation—the relatively high cost of labour—cannot be met in England by a reduction in the wage rate, which in agriculture is already below that prevailing in other industries Indeed, bad as is the state of trade, men are leaving farming for any other occupation that offers; many farmers are complaining of the shortage of labour, and in certain cases where profits are assured, as in sugar-beet growing, labour from Ireland is being imported. Any local call for men immediately draws agricultural labourers from their following and when any general revival of industry takes place the land is likely to lose most of its active and able-bodied men Thus if no other change supervenes, farming, except for those special businesses that can command a sheltered or a luxury market, will be reduced to a species of ranching with a minimum of labour. There is one alternative—a sustained effort to make labour more effective, on the one hand by better organization, by the use of machinery and the elimination of wasted effort, and on the other by careful training to increase the skill of the individual Much of what was called "good" farming before the war was still dealing with labour on a mid-19th century basis of wages, and though operations had been cheapened after the fall of prices of the eighties and the nineties, there has been no radical reconsideration of methods such as is called for by the modern relation of wages to the prices of agricultural produce. This is the big problem before British agriculture—the revision of all its traditions of husbandry, and it requires the co-operation of the investigators, both scientific and economic, with the study by individual farmers of the conditions imposed by their own farm and particular business The investigators may supply stimulus and guidance, but the main effort will have to be exerted by the farmers themselves, for the problem is one of management and practice, demanding a consideration of the technique of farming and the arts of leadership and management that has not been forthcoming for the last two generations. Some encouragement, some renewal of confidence may come from increasing prices, for the withdrawal of men from the land because of the superior rewards in other occupations is not confined to Britain but is common to all countries It is affecting the peasant as well as the wage-earning labourer, it is manifest in the United States as in France Its effect upon output must become manifest, and as the world's population still continues to grow, scarcities will be declared, and whether by compulsion or by choice, farmers will have to intensify their production from the land

AGRICULTURAL CO-OPERATION

The obvious advantages that can be obtained by buying and selling on a wholesale scale and the great success attending co-operative effort among farmers abroad, particularly in Denmark, has for many years caused agricultural co-operation (*see* CO-OPERATION) to be pressed upon the British farmer The work of propaganda and advice was undertaken by the Agricultural Organization Society, which was founded on the model of the successful Irish Society initiated by Sir Horace Plunkett. The A O S. was a voluntary organization supported by subscriptions from its affiliated societies, but it enjoyed a considerable amount of subvention from the Development Fund from 1910 to its demise in 1924. The earlier efforts at co-operation chiefly aimed at the formation of purchase societies to supply the farmers' requirements for fertilizers, feeding stuffs and other materials. Though many of these ventures had but a brief existence some have become strong trading corporations, such as the Eastern Counties Farmers' Co-operative Society at Ipswich. A wholesale society, launched during the war with the object of bulking the purchases of individual societies, came to disaster. Little progress was made with societies for the sale of farmers' produce, though a number of egg-collecting depôts were and still are flourishing. Dairy societies had a somewhat chequered existence; in some cases as soon as they attained local success they attracted the attention of one of the big dairy firms and after a period of fierce competition either succumbed or were bought out. Eventually the Agricultural Organization Society, despite all the devoted work given to it and the subventions it had enjoyed, found it necessary to dissolve. It had never received any wide measure of support from farmers, and as the National Farmers' Union had become the representative organization of the farmers of England and Wales and was prepared to take over the care of co-operative action amongst its members, the old society gave way to the National Farmers' Union At the same time the Government under the Agricultural Credits Act made provision for loans to Agricultural Co-operative Societies on the basis of a loan of 20s. for each 20s. share taken up by members, of which

no more than 5s need be initially called up. The history of these latter ventures has not been altogether encouraging At the same time there was a movement for the setting up of co-operative bacon factories on Scandinavian models. Seven such societies were started, of which only four are working to-day Two active wool-selling agencies have been established, one in the south-east and one in the northern counties, both of which are steadily progressing In 1925 on the termination of the hop control, a wartime organization, a new voluntary organization was formed to continue the collective sale of hops and has succeeded in enlisting some 90% of the hop-growers of the country. While other examples could also be named, speaking generally, agricultural co-operation has made but little progress among the farmers of England

The reasons are not far to seek. In the first place the larger English farmers make their purchases on a big enough scale to secure terms comparable with those offered by the co-operative society. When such men joined a purchasing society they were apt to use it merely to beat down the terms offered by their merchants. The smaller farmers followed the lead of the big men or were unable to forgo the credit they obtained from the merchants Again the firms dealing in agricultural necessaries were very firmly entrenched in Great Britain; many of them were bigger and more efficient than a newly-started co-operative society could be, and having capital behind them did not shrink from competition. They had the great advantage too of being able to offer credit, and their agents being generally drawn from the farmer class had friends and connections among the men with whom they wanted to do business

Societies for the sale of farmers' produce have an even more difficult task Trade rivalry is equally strong; the customary markets are close at hand and farmers are loath to forgo their individuality or renounce the chance of a temporary rise of prices Co-operative selling involves working to contract and the production and regular delivery of a standardized article The bacon factories failed largely because they could not ensure a regular supply, the farmers diverting their pigs to other channels when prices rose Firm contracts to deliver regularly were refused by the producers or could not be enforced. Milk societies would be compelled by their members to give a price too high for successful working because a competing trader with a long view would offer prices above the economic parity. Certain ventures failed also from embarking upon a manufacturing process, like bacon curing, which requires a considerable degree of technical skill, and the inability of the society to pay a competent manager or else to find one before its resources went

The existence of a near-by market is the great obstacle to agricultural co-operation for the sale of produce. Nearly all the examples that are so freely quoted of the success of farmers' organizations—the bacon factories of Denmark or the fruit selling associations of California—rest upon the fact that only an export trade is available and that farmers cannot engage individually in such a trade. They are driven to organize because the alternative is the control of a wholesale trader who cuts the producers' returns to the minimum that will keep them in business For these and other reasons the true co-operative spirit has been lacking, and British farmers have not shown that loyalty to the principle of combination which would induce members to stick to their society even at the cost of some loss to themselves. When there is an old-established market at hand it is almost impossible for a co-operative business to give the farmer better returns at once. Psychologically, too, defaulters and men who stand outside a combine have a powerful disintegrating influence upon it They share in all the benefits if the combine succeeds in raising the general level of price, they take no risks and get paid at once, while members may be waiting for a portion of their returns because the society has only succeeded in raising prices by withholding part of the crop from the market. The "outsiders" would not be human if they did not boast about their advantages, and English farmers are as yet too easy-going and too much merged in the general community to counter with a social boycott. Similar occurrences in certain of the British Dominions have resulted in legislation to force recalcitrants into any combination which has secured the adhesion of three-quarters or four-fifths of the producers; but such procedure is quite alien to the English farmers' declared policy of "No Control." Yet the acceptance of voluntary control is the essence of co-operative organization, and by virtually compelling farmers to produce the article wanted by the market, rather than that which they fancy, exerts a powerful educational influence On the other hand if he does not accept the voluntary control of his own organizations the British farmer is likely to drift into subjection to the much less sympathetic control of big businesses which will make of him a tied producer.

Thus the prospects of agricultural co-operation do not appear bright, though the situation is not without hope; a sense of the necessity for combination is growing. Nothing can be gained by preaching co-operation at large, but little by little particular instances are making good, especially where the association only attempts to sell and not to manufacture the raw material provided by the farmer. An alliance may be possible with the great co-operative organizations among consumers, which indeed have hitherto been spending their efforts in organizing foreign rather than home producers. But it is only by combination of some sort, from within or from without, that British farmers can hope to retain a remunerative share of the best of all agricultural markets —that of Great Britain. *See* AGRICULTURAL CO-OPERATION.

BRITISH FARMING SYSTEMS

British farming is characteristically an affair of small capitalist businesses employing paid labour The following table (Table IV) of the holdings in England and Wales shows the apportionment of such holdings with respect to their size.

TABLE IV.

NUMBER OF HOLDINGS BY SIZE, ENGLAND AND WALES, 1924

(Excluding holdings of less than 5ac)

Area in acres.	Number of holdings	Total acreage.	
5– 20	111,934	1,264,217	252,252 farms, comprising
20 50	79,537	2,691,131	8,369,843ac. of less
50 100	60,781	4,414,495	than 100-ac. units.
100 150	31,930	3,924,450	80,272 farms, comprising
150 300	35,485	7,420,533	17,266,059ac , of more
300	12,857	5,921,076	than 100-ac. units.

Characteristically, too, the farms are tenancies held under yearly agreements, though the tenant is largely protected from disturbance by the Agricultural Act. The landowner provides the permanent equipment of the farm-buildings, gates and fencing, water supply, drainage. The landowner also is responsible for repairs to the fabric, but minor improvements of which he will remain possessed are generally carried out on the basis of the landowner finding materials—timber for fencing, bricks, stone, gates, drain tiles, seeds for permanent pasture, etc , and the tenant finding the labour. The landowner's capital has been estimated to amount on the average to £31 per acre, the tenants to £12–£15 per acre, and the average rent to 31s. per acre Under such a system the entry upon and leaving of a farm, at whatever date, necessitates a considerable adjustment of account between landlord and tenant, since the farm must be left as a going concern These adjustments were formerly regulated entirely by custom and though they are now governed by the various Agricultural Holdings Acts (consolidated in 1923), custom is recognized and still plays a large part. The basis of the Act is that the outgoing tenant is entitled to compensation from the landowner for all improvements he has effected, the amount of compensation being determined by the value of the improvement to the incoming tenant For certain types of permanent improvement, *e g.*, buildings, plantations of fruit trees, the tenant is not entitled to compensation unless the consent of the landlord has previously been obtained The purpose of this exclusion is to prevent the tenant from committing the landowner to payment for an improvement which the latter might not be able to realize. For example the

improvement effected by planting land with fruit or hops might be valued as high as £100 an acre, with embarrassment to the landowner if he had to pay out this sum on the determination of the tenancy without any assurance of being able to find a tenant willing to pay an adequate rent for it. An exception is made in the case of holdings let as market gardens Here general legislative sanction has been given to what was known as the "Evesham custom." The tenant possesses the right of free sale of the improvements he has made, *e g.*, beds of asparagus, fruit plantations, etc., but must find the purchaser, the landowner being obliged to accept the tenant proposed by the outgoing tenant, who has made his own bargain for the improvement with the new tenant.

In ordinary cases the negotiations with regard to improvements proceed between the outgoing and the incoming tenant, in whose agreement with the landowner is a clause that he shall pay whatever compensation is due to the outgoer. Each tenant appoints a valuer who between them prepare an agreed valuation of the tenant right, there being provision for an arbitrator in cases of dispute. The account includes the cost of cultivations carried out before leaving the tenancy standing crops and manurial residues whether of fertilizers applied or purchased feeding stuffs consumed during the latter years of the tenancy. But as farms are vacated at different dates in different parts of the country, though most commonly at Michaelmas or Lady Day, custom still plays a large part in determining both what things are the subjects of compensation and the basis of assessment.

Tenancy.—The British tenancy system possesses many advantages The handicap that farming is under as compared with other industries lies in the large amount of fixed capital involved in comparison with turnover and in the lag that exists between expenditure and returns. For the farmer who has to own his farm this implies a considerable degree of credit, and in foreign countries it has generally been found necessary to give some State support to landbanks or other long term credit organizations which will take the burden of the capital outlay on land and buildings The short term credits required for the conduct of the business proper are supplied by co-operative associations or the banks Otherwise mortgages rule and mortgages have universally proved destructive to the farmers whenever a run of bad seasons occurs. In Britain the landowner has supplied the cheap capital the industry requires for its permanent equipment, and the banking system so far pervades the community that it can furnish a not unreasonable proportion of the working capital the farmer should have Even so the farmer would have to work upon a much smaller proportion of borrowed capital than prevails in other business, and in practice in Britain the farmer resorts to a dangerous extent to the tradespeople with whom he deals. The merchants who sell to him his requirements in manures and cakes and buy from him his corn and hay, and the auctioneers through whose hands pass the store cattle he buys and the finished cattle and sheep he has to sell, provide to a very large extent the financial backing of the industry. This custom obviously limits the power of the farmer to buy and sell in the best market, and it has been proposed by legalizing the creation of chattel mortgages to enable the banks to accord greater credit facilities. The farmer could then assign his livestock or his standing crops as security for advances.

The tenancy system undoubtedly assisted in the development of British farming in the 19th century, though it produced a certain number of cases of oppression when the power of the landowner to turn out a tenant for causes unconnected with farming remained unrestricted. The condition, however, of success in a tenancy system is the possession by the owner of a real knowledge of, and interest in, the conditions of farming. He (or, in the case of large estates or other interests, his agent) must have considerable technical knowledge, if he is to be a working element of the system, the adviser and leader of his tenants. The declining interest of landowners in agriculture and the inadequate training of so many of the agents employed by them have been a main cause of the weakness that the tenancy system has latterly displayed and its hampering effect upon enterprise and innovation among the farmers. Many people, therefore, aiming at a return to a system of occupying ownerships plead the necessity of freedom for the cultivator and the stimulus of the "magic of property"; though it will be within the experience of those who have had occasion to survey the countryside in detail that even if some of the best, so also many of the worst, managed farms are the property of their occupiers. Further in a modern state no ownership system persists; minors, females or men with other interests inherit, and the new owners prefer to let rather than to sell. For these reasons it has been argued that the welfare of the industry demands the state ownership of all agricultural land and a stricter exercise of the continuing owner's interest in good farming

Small Holdings.—Other observers who were impressed by the straits of wage-paying farming, even at the low rates for agricultural labour, have sought a solution in a break up of the larger holdings characteristic of British farming and a return to the peasant system of family farms which are customary in most parts of the world. Even in the worst of the depression flourishing colonies of small holders could be found in many parts of the country, and the creation of small holdings has been attended by an increase in the production from the soil. For instance in the Vale of Evesham grass farms on clay land which were indifferently grazed, and yielded but a poor return of milk and store stock, became intensively cultivated for asparagus, plums and other vegetables and fruit; where there had been perhaps one man employed per hundred acres, the small holders would make a thrifty living on fifteen acres of the new cultivation. Consideration of such cases led to the Small Holdings Act of 1908 (see *ante, British Farming Systems*) and to a widespread demand for a general policy of dividing up the land. It is doubtful, however, whether the admitted success of small holdings is a sufficient basis to justify their general application to British conditions. The success of small holdings depends upon two factors The small holder, being his own master, works harder and more intelligently and for longer hours than the paid labourer; he also throws in the work of his family, often of considerable amount Large farmers would agree that if they could get from their labourers the quality of work put in by the small holder they could pay wages even higher than the returns obtained by the small holder. Small holders, therefore, are concerned with the production of those things in which manual labour bulks largely, but also they must engage in a branch of the industry that has a rising market, and preferably one that is naturally protected. With their ears to the ground they have been quick to seize upon small things that the large farmer neglects. Milk, potatoes, vegetables, fruit and poultry, and occasionally pigs, have been the produce upon which the small holders have depended. They rarely touch the main lines of farming—corn, beef, or sheep and even with milk they often make their profit by combining retailing with production. Thus the opportunities for small holding are limited and the markets they cater for are easily overstocked although as regards milk and vegetables they have reaped the advantage of a demand that has been steadily rising for years. As a rule small holders require good land and can make little use of the great areas of the chalk and clay soils

While it is generally agreed that small holdings are unsuited to the production of corn or cattle and sheep breeding it is argued that even these branches of agriculture could be pursued if they were organized for the co-operative use of machinery, pedigree sires, etc. But this is only equivalent to saying that small holding farming could be successful if imperfectly and by agreement it adopted the methods of large farming. Co-operative farming has not been realized and the mark of the small holder is his independence; as a rule he has only become united with co-operative selling societies when he has been under the necessity of working for an export market. Nor is there necessarily any greater production from land under small holdings; in the instance quoted above the increases are due to a change in system introduced by the small holder. But the large-scale fruit grower or market gardener or milk farmer will produce more per acre and that of better quality than the small holder working single-handed Organization and the command of capital in the large businesses tell even against the individual attention which is the asset of the

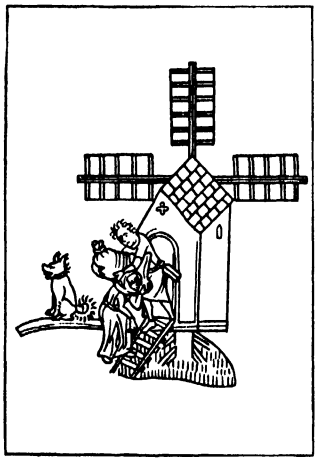
small holder; spraying is more suitably undertaken on an extensive scale, clean milk more often comes from the large herds. The greater production per acre of the small holder is often a consequence of the more intensive farming which he is forced to adopt but which would be uneconomic if the labour had to be paid for. There are thus two cardinal difficulties attending upon a revival of a peasant system of farming in Britain, one economic, the other social. The economic drawback is the higher capital outlay involved; the creation of a colony of small holdings necessitating expenditure on buildings, roads, fencing, water supply, etc., that is much greater than would be required on a farm of equal area and engaged in the same type of farming But it is not germane to quote the excessive cost of the small holdings set up after the war, which reached £2,000 and upwards per holding, because at that time no farm, large or small, could have been equipped on bare land so as to produce an economic rent The old peasant holdings inherit in their buildings and equipment, the results of the gradual unpaid labour of many generations, and when the holding is sold this accumulated capital is counted cheap, because the price is based upon the farm's earning capacity, not upon what it would cost to reproduce it: hence the prime economic difficulty of building up small holdings *de novo* The second question is whether small holdings can persist on any large scale under modern conditions Depending on the basis of the occupier giving his labour cheaply as measured in terms of hours and wage rates, the total cash returns from a small holding are often little or no better than the wages of the agricultural labourer and still less than those of the industrial worker A certain number of men are always prepared to give this price for their independence and for the chance of getting on, and upon this fact depends the social value, even the necessity, of small holdings. But it cannot be expected that a whole class of the community will permanently consent to lower wages and longer hours Looking back at the history of British farming the merger of the smaller into the larger farms has always been going on In other countries peasant farming has persisted longer because of the slower development of the industries, though even in France to-day the peasant is being attracted from the land, and in America the younger generation looks askance at continuing the family farm. It is in China, Japan and India that the sheer pressure of population maintains the one man farmer at a standard of living barely above the starvation level Some small holdings are a necessity as a social safety valve; but a general return to small holdings would not solve the problem of increased food production. Farming is an industry like any other and a return to small holdings would be as much a retrograde step as would be a return to hand weaving Nor is the argument valid that the State would gain by having more men employed upon the land. If extra men are employed on the land because the production has been intensified there is a gain, but if the extra labour has only to make up for an inefficient method there is loss. To prohibit machinery and return to spade labour would ensure the greatest number of men upon the land but the community would lose thereby. That community is the richer which employs the smaller proportion of persons in the production of its necessary food, leaving thereby a greater number free for the production of clothes, houses, etc , and other elements constituting wealth.

Industrialized Farming.—It is obvious that on the large farm very considerable economies of working can be effected, especially from the use of machinery. The cheapening of costs of production depends upon making manual labour more effective. Modern power cultivators are likely to be large in order to secure that speed and depth of working proper to their work; they therefore require large fields to save turning about and only broad acres defray their heavy overhead cost. Farming is no exception to other industries in that large scale working by its powers of organization and concentration of effort can obtain better work done at a lower cost. The improvement of live stock by breeding and selection is only possible with numbers upon which to work. Buying and selling is better done on a large scale, however much the small holder may be able to obviate his weakness by co-operation. Large scale enterprise can employ those methods of costing and recording upon which good management is based In his technical methods the small holder must work by tradition; he cannot afford to experiment and is therefore slower to accept new ideas. Furthermore the land still requires considerable capital expenditure if it is to be put to its best use; and drainage, the straightening of boundaries, and similar wholesale improvements are not practicable except on a large tract of land. It seems inevitable that as intensified production becomes imperative to provide food for a growing population it can only be obtained by large scale industrialized working. Two conditions, however, must be fulfilled before large scale farming can be attempted with confidence First of all a new art of management must be evolved, based upon systematic cost accounting and a critical knowledge of average standard costs Good farming has hitherto been very much a personal affair depending upon the experience, intuition and determination of the individual Industrialized farming will always require the qualities of the old farmer—his eye and energy, but it also calls for more calculated management even though farming cannot be standardized like other industries. The other condition of success is the formation of a corps of workers trained for their job and rewarded accordingly. The old type of agricultural labourer was a highly skilled man; much of the work of farming is now being done by men who have been prevented by some defect from entering other walks of life, or by youths who have been left to learn their craft haphazard. Efficiency demands efficient men, for however much machinery may be employed a farm cannot be supervised like a factory. But if the future of agricultural production lies with industrial farming, a bigger unit will be required than the present average British holding. Successful as was the farm of 200–500ac. as a first step towards intensive production, it has become an uneconomic unit to-day; it is too small to take full advantage of machinery, is still retail in its buying and selling and demands too large a proportion of its turnover for management With an average ratio of six labourers to one farmer on English farms, the business is insufficient adequately to pay one man solely engaged in management, and even units of 500ac are not large enough The proper unit is probably something of the order of 5,000ac , with some hierarchy of managers and under managers into which young men who have been trained for the work could enter in subordinate positions. But it is also one of the handicaps of the present system of British farming that its management is too rarely recruited from school or college as other businesses are. The possession of capital is more often the condition of entry and too often is regarded as dispensing with the need for any technical training; but the industry would be the gainer from a greater leaven of men who began on a more educated plane

World Agriculture.—The depression under which agriculture is now labouring would seem, however, to offer little chance of a reorganization of the industry along industrial lines, there being nothing to tempt the large capitalists to take up food production. This depression is felt in all countries and, as the Economic Conference at Geneva in 1927 indicated, it is the outcome of the deficient purchasing power of Europe and of China due to industrial depression It was perhaps initiated by the deflation policy of the leading States, because it is evident that the low prices are not due to overproduction in the usual sense of the word.

If we exclude from consideration Asia and tropical Africa, as being both self-contained in the matter of food, the population of the rest of the world, constituting roughly the countries inhabited by the white races of mankind, increased between 1913 and 1926 by approximately 50 millions, or 7½%. The corresponding increase in the area of cultivated land is susceptible of even less accurate estimation, but according to the best figures available is about 36 million hectares. Meantime, however, agriculture had not been intensified, rather the reverse, and on the basis of current farming one hectare of land (2¼ac) is required to produce the food and other agricultural materials consumed by one unit of population. On this showing the increased food production since 1913 has not kept pace with the growth of population. Considering again the countries making returns to the International Institute of Agriculture, the wheat

acreage has increased in the same period from 109 to 119 million hectares, the production from 1,029 to 1,139 million quintals, *i.e.*, nearly 11%. But part of this increase in wheat has been purchased at the cost of other crops. In the countries other than Asia and Africa the four chief cereals for human consumption, wheat, rye, barley and maize, taken together, have only increased in area by 4% and in production by 5%. Food animals have increased, cattle by 12%, sheep by 2%, while pigs have declined by 4%, from which an increase of 8% in the meat production may be estimated. These figures lead to the conclusion that latterly the expansion of world food production has not been keeping pace with the growth of world population, even taking account of the relative checks imposed by the war and by its consequences. The low prices result from the deficient purchasing power of the larger population and from the fact that the greater part of the food production of the world is carried on by peasant farmers. This method of farming can neither alter its production in response to a lower demand nor combine to maintain prices The men who are engaged in it accept the bad times because in the main no alternative is open to them, and by their capacity to endure hardships and yet persist in production at the low prices prevailing, they ruin the capitalist farmers who have to pay wages. But there are signs that the indifferent returns of peasant farming as compared with wage earning in the industries is beginning to tell in the withdrawal of men from the land. It is clearly happening in the United States and in France, where may be seen in progress the movement that characterized England in the latter part of the 18th century. Peasant farming does not persist when industry and commerce come near and display their openings to the farmer Moreover the opportunities for creating new peasant communities of farmers have become smaller; great stretches of unoccupied fertile land in temperate climates, such as were settled in the 19th century and provided food for the then unprecedented growth of population, have diminished. The demand for food and other raw materials produced from the land must soon be felt by the still growing population, and any return of industrial prosperity is likely to be followed by a sudden upward rush of prices because there is no margin of overproduction and accumulated stocks behind the present low prices. Production adequate to meet the real needs of the existing population cannot be met by extending the cultivated area but will require an intensification of farming on the land now available. Intensification will only be prompted by better prices and will then best be realized by large scale farming on industrial lines.



MEDIAEVAL HUSBANDRY
Going to the mill. From the Louterell Psalter, an illuminated ms. of the early 14th century. ("Vetusta Monumenta")

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(A. D. H.)

IN THE UNITED STATES

Canada and the United States are one agricultural unit. They produce more than one-fourth of the world's wheat supply, nearly three-fourths of the corn and more than one-third of the oats They produce nearly one-third of the total grain supply, including rice. The United States is the most important food-producing area under one government. There are no trade barriers within the area. The population is fairly homogeneous and highly prosperous. This combination of circumstances provides the basis for a highly developed agriculture. It produces one-half of the world's cotton, two-thirds of the corn, one-fourth of the oats, one-fifth of the wheat crop and has about one-fourth of the hogs and one-tenth of the cattle.

Population.—According to estimates of the bureau of the census, over one-half of the white population of the United States came from the British Isles and seven-eighths from northwestern Europe (Table I) It is often stated that the American population

TABLE I *Estimated Population in the United States in 1920, by Country of Origin**

	Number
Great Britain and Northern Ireland	39,200,000
Germany	14,800,000
Irish Free State	10,400,000
Scandinavian countries	4,500,000
France	2,000,000
Netherlands	1,800,000
Czechoslovakia	1,600,000
Other western and northern European countries	3,000,000
Poland	3,600,000
Italy	3,600,000
Other southern and eastern European countries	2,500,000
All other white population	5,700,000
Total white population	94,800,000
Negro	10,500,000
Indian	200,000
Asiatic	1,200,000
Total	105,700,000

**Message from the President of the United States*, 70th Congress, 1st session, Senate Document No. 65, p. 11, Feb. 27, 1928.

is a mixture of many races, but the population is as homogeneous racially as most of the countries of north-western Europe The immigrants from southern and eastern Europe have tended to remain in cities, so that the farm population is practically all from north-western Europe, except the negroes in the cotton belt. The white population increasingly uses power and machinery in farming In 1880, 44 4% of the population was engaged in agri-

TABLE II. *Persons 10 Years of Age or Over, Gainfully Employed in the United States, 1880–1920**

Date	Employed in agriculture	All other occupations	Percent engaged in agriculture
1880	7,713,875	9,678,224	44 4
1890	9,148,448	14,169,735	39·2
1900	10,381,765	18,691,468	35·7
1910	12,659,082	25,508,254	33·2
1920	10,953,158	30,661,090	26·3

*Data for 1880–1900 were taken from the *Thirteenth Census of the United States*, 1910, vol. iv., p. 41; and for 1910 and 1920, from the *Fourteenth Census of the United States*, 1920, vol. iv., p. 34.

culture, and 40 years later, 26·3% (Table II.). The production per worker is so large that great quantities of cotton, grain and meat are available for export. In France, about 41% of the population is engaged in agriculture, but only a small quantity of agricultural products is available for export.

Settlement of the United States.—The public domain of the United States was acquired by cession, purchase and conquest The first acquisition took place in 1781 and the last in 1853. From 1781 to 1802, the various States ceded to the United States 268,000,000ac. (Table III.). New York State was the first to part with its lands and Georgia the last. The Louisiana purchase,

in 1803, whereby the United States obtained legal possession of 433,000,000ac. for $27,000,000, was the greatest acquisition that the country has ever made. From this area most of the country's surplus food is produced By the purchase of Florida in 1819, the nation obtained control of 32,000,000ac, at a cost of $6,000,000. The annexation of Texas added 71,000,000ac, at a cost of $15,000,000. The Oregon territory comprising 166,000,000ac. was added in 1846. For the Mexican territory of 325,000,000ac, the United States paid to Mexico $15,000,000 In 1853, Mexico ceded to the United States 15,000,000ac. costing $10,000,000 This was known as the Gadsden purchase.

TABLE III. *Acquisition of the Public Domain, Continental United States, Exclusive of Alaska and Insular Possessions**

Acquisitions	Date	Acres added	Price
Thirteen colonies	1781-1802	268,000,000	
Louisiana purchase	1803	433,000,000	$27,000,000
Florida purchase	1819	32,000,000	6,000,000
Texas	1845-50	71,000,000	15,000,000
Oregon	1846	166,000,000	
Mexican territory	1848	325,000,000	15,000,000
Gadsden purchase	1853	15,000,000	10,000,000
Total		1,310,000,000	73,000,000

*B. H. Hibbard, *A History of the Public Land Policies*, p. 31, 1924

TABLE IV. *Disposition of the Public Domain**

	Acres
Homesteads, timber culture	256,000,000
Military bounty land	68,000,000
Sales	220,000,000
Swamp land grants	64,000,000
Timber sales	35,000,000
Railroads, roads and canals	137,000,000
Educational institutions	99,000,000
Miscellaneous grant	79,000,000
Held for parks, and forest reserves	170,000,000
Mineral and power reserves	48,000,000
Indian reservations	35,000,000
Remaining public domain	186,000,000
Total	1,397,000,000

*B. H. Hibbard, *A History of the Public Land Policies*, 1924, p. 570

When the national Government was formed, it was heavily in debt and public lands were sold in order to derive necessary revenue. Later the land policy was primarily concerned with settlement. More land was disposed of through homestead and timber claims than by any other single means Cash sales were second in importance Large areas were given to the railroads in order to encourage the development of the country; also to public schools and other educational institutions. The area still remaining in the public domain is mostly forests or arid grazing land.

TABLE V. *Disposition of the Public Domain**

Date	Acres	Value
Prior to opening of land office	1,281,860	$ 1,050,085
1800-09	3,302,191	6,802,232
1810-19	14,323,192	38,429,123
1820-29	8,669,918	12,243,273
1830-39	62,316,123	79,123,381
1840-49	17,736,951	20,705,156
1850-59	49,791,624	44,819,870
1860-69	11,112,396	12,824,930
1870-79	11,213,998	18,128,384
1880-89	45,577,320	71,827,991
1890-99	11,598,751	24,761,471
1900-09	26,725,816	61,334,693
1910-19	18,571,206	32,513,627
1920-23	2,806,701	5,049,521
Total	285,028,047	429,673,737

*B. H. Hibbard, *A History of the Public Land Policies*, pp. 100, 103, 106, 113-115, 1924.

The data in Table V. indicate that there were five distinct periods of settlement, the first one between 1810-19. The period of depression following the War of 1812 checked settlement. Another wave of active settlement occurred between 1830-39. More land was settled in this decade than in any other decade Another active period occurred between 1850-59. This carried settlement into eastern Kansas The next period of striking activity was between 1880-89 In this period, settlement occurred over most of the remaining territory, but much of the poorer land was left in Government ownership The land disposed of between 1900-19 was mostly arid land that previously had been considered of little value.

Number and Size of Farms.—Since the first settlement, there had been a steady increase in the number of farms until 1920. The severe agricultural depression which began in that year resulted in a decrease in the number of farms (Table VI). The number of farms of each size is shown in Table VII. The number of small farms and farm homes of less than 50ac. is increasing. These farms increased from 29% in 1880 to 38% in 1925 There has been a corresponding decrease in the percentage of larger farms. While 38% of the farms were less than 50ac., these farms included only 6% of the total land in farms Only 3·3% of the farms had 500ac. or more, but these farms included 34% of the total land. Many of these farms were in arid regions or in regions where the land is not adapted to intensive farming; therefore these large farms included only 17% of the area of improved farm-land. The average size of farms in 1925 was 145 acres. Most of the country was settled under a policy of developing family farms. The data on the size of farms indicate the success of

TABLE VI *Number, Acreage of Land, and Size of Farms in the United States**

Date	Number of farms	Land in farms, acres†	Improved land in farms, acres	Average acreage per farm
1850	1,449,073	293,560,614	113,032,614	202 6
1860	2,044,077	407,212,538	163,110,720	199 2
1870	2,659,985	407,735,041	188,921,099	153·3
1880	4,008,907	536,081,835	284,771,042	133·7
1890	4,564,641	623,218,619	357,616,755	136·5
1900	5,737,372	838,591,774	414,498,487	146·2
1910	6,361,502	878,798,325	478,451,750	138·1
1920	6,448,343	955,883,715	503,073,007	148·2
1925	6,371,640	924,319,352	505,027,400†	145·1

**Fourteenth Census of the United States*, 1920, vol. v., p. 32. *United States Census of Agriculture*, 1925, part 2 p. 4.
†Total crop land and ploughable pasture.

TABLE VII. *Percentage Distribution of the Number of Farms of Different Sizes in the United States**

	1880	1890	1900	1910	1920	1925
Under 20ac.	9 9	9·1	11 8	13 2	12·4	15 1
20-49ac.	19 5	19 8	21 9	22 2	23·3	22 8
50-99 ,,	25 8	24 6	23 8	22 6	22 9	22·3
100-174ac.	42 3	44 0	24 8	23 8	22 5	21 7
175-499 ,,			15 1	15 4	15 6	14 8
500ac. and over	2 6	2 5	2 6	2 8	3 3	3·3
Total	100	100	100	100	100	100

**Fourteenth Census of the United States*, 1920, vol. v, p. 66.

TABLE VIII. *Distribution of Land in the United States, 1920**

Size	All land in farms acres	Improved land in farms acres	Per cent all land in farms	Per cent improved land in farms
Under 3ac	34,625	32,220	0 0	0·0
3-9 ,,	1,567,333	1,418,167	0 2	0 3
10-19 ,,	7,086,941	6,353,374	0 7	1·3
20-49 ,,	48,464,330	38,507,730	5 1	7 7
50-99 ,,	105,630,796	72,621,719	11·1	14·4
100-174 ,,	194,681,260	128,200,972	20·4	25·5
175-499 ,,	276,806,995	170,074,735	29·0	33·8
500-999 ,,	100,975,916	48,134,952	10·6	9·6
1000-ac. and over	220,035,519	37,729,138	23·1	7·5
Total	955,883,715	503,073,007	100	100

**Fourteenth Census of the United States*, 1920, vol v, p. 65.

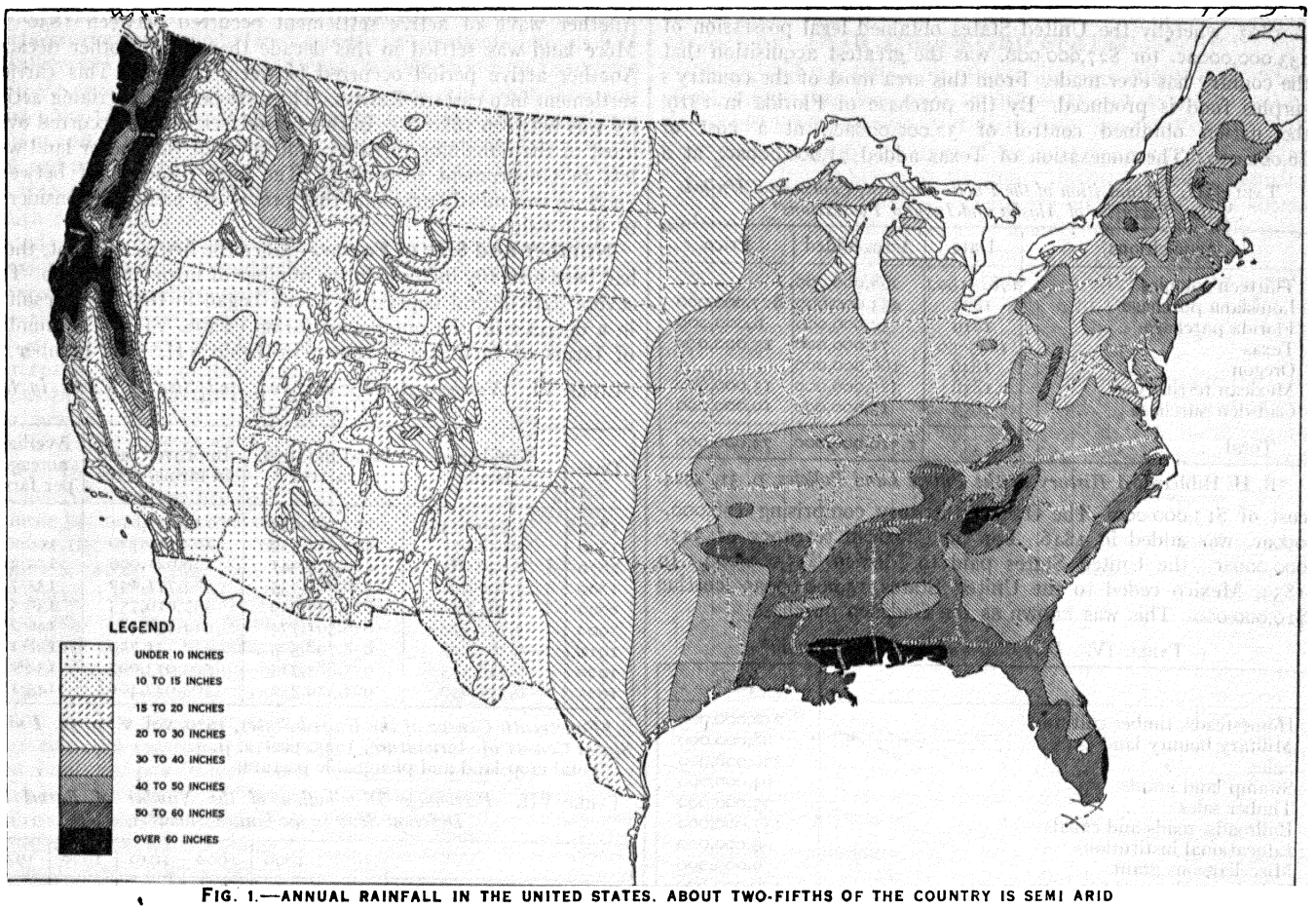


FIG. 1.—ANNUAL RAINFALL IN THE UNITED STATES. ABOUT TWO-FIFTHS OF THE COUNTRY IS SEMI ARID

this policy. There are very few farms that are too large to be handled by the farm family with a small amount of hired labour.

Uses of Land.—19% of the land area of the United States is in harvested crops; 12% in humid pasture; 12% in forests and cut-over land, a part of which is pastured; and 31% in arid pasture. The original forest area has been estimated at 822,000,000 acres. Nearly 60% of this is still in forests or cut-over land. Of the land in farms other than farm wood-lots, somewhat less than one-half was once in forests and over half was natural grass land. Additional crop land will be obtained by clearing forest lands and by use of pasture lands. The pasture land is the most available source

TABLE IX. *Utilization of the Land Area of the United States, 1919**

	Acres
Crops harvested	365,000,000
Humid pasture	231,000,000
Arid pasture	587,000,000
Forest, including cut-over and burned-over land, pastured	237,000,000
Forest, including cut-over and burned-over land, not pastured	246,000,000
Farm land not in harvested crops, pasture or forest	115,000,000
Urban, desert, marsh, roads and railroads	122,000,000
Total land area	1,903,000,000

*U.S. Department of Agriculture *Yearbook*, 1923, p. 416.

of additional crop land. The largest area of readily available good crop land was the natural grass land of the Middle West, extending to about the 100th meridian. West of this there are large areas of arid and semi-arid land, much of which has now come into use, but which requires economical methods of farming and particular care in the conservation of moisture.

The period of rapid settlement following the Civil War resulted in the occupation of most of the good land as far west as the 100th meridian. This land was so easily prepared for crops that a remarkable increase in production occurred between 1880–1900.

Topography.—The topography of the United States is shown in fig. 2. There are three mountainous areas: one in the east, one in the west and the Ozark mountains in the south-central part. About one-half of the area is mountainous. Much of this is covered with forests. The primary agricultural area is the central basin. Most of it is less than 1,500ft. in elevation. Along the

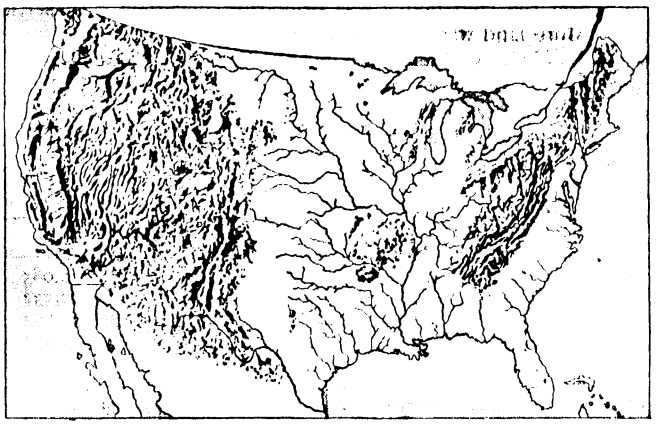


FIG. 2.—TOPOGRAPHY OF THE UNITED STATES
There are three mountain areas, one on each coast and one in the South Central part. Most of the crops are grown in the level areas and in the mountain valleys

coasts and between the mountains, there are many smaller areas that are highly developed agriculturally.

Rainfall.—The rainfall of the United States is shown in fig. 1. The western mountain range causes heavy precipitation along the coast, but makes most of the western two-fifths of the country arid. The rainfall of the central basin comes largely from the Gulf of Mexico. It decreases northward from the gulf. Rainfall is carried a short distance west from the Gulf of Mexico, but decreases rapidly in that direction. The boundary line between the

humid and semi-arid areas is only a short distance west of the Gulf of Mexico. The percentage of the total area that received various amounts of rainfall is shown in Table X. Thirty-nine % of the United States receives less than 20in. of rainfall, 11% receives over 50in.; one-half of the area receives from 20 to 50in.

TABLE X. *Average Annual Precipitation in the United States**

Precipitation	Land area	Per cent of total
inches	acres	
Under 10	154,000,000	8·1
10 to 20	589,000,000	30·9
20 „ 30	314,000,000	16·5
30 „ 40	320,000,000	16·8
40 „ 50	325,000,000	17·1
50 „ 60	160,000,000	8·4
60 „ 80	29,000,000	1·5
80 „ 100	9,000,000	0·5
Over 100	3,000,000	0·2
Total	1,903,000,000	100

*U.S. Department of Agriculture *Yearbook*, 1921, p. 418.

Length of Growing Season.—The average number of days between frosts is shown in fig. 3. The area with over 240 days between frosts is sub-tropical. Citrus fruits and early vegetables are produced in the most favourable parts of this area. Most of the cotton is raised in the area with a growing season of from 200 to 240 days. The only important exception is a considerable area of cotton in the portion of Texas which has a growing season of over 240 days. Most of the winter wheat is grown in regions with a growing season of from 160 to 200 days. Most of the corn is

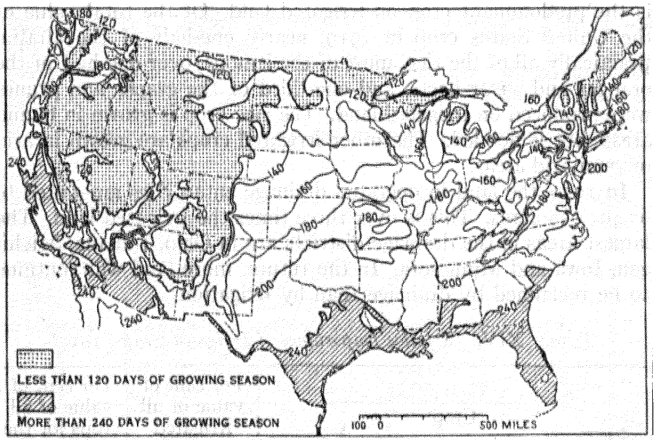


FIG. 3.—LENGTH OF GROWING SEASON
Of the land area of the United States 11% has a growing season of over 240 days, while 26% has a growing season of under 120 days

grown in regions with a growing season of 140 to 180 days. Spring wheat is primarily grown in regions with less than 140 days of growing season.

TABLE XI. *Normal Monthly Temperature in Berlin, Germany, and Des Moines, Iowa**

Date	Berlin	Des Moines
January	31·3	20·1
February	32·5	23·7
March	37·0	35·9
April	45·9	50·1
May	54·9	61·3
June	62·1	70·6
July	64·6	75·4
August	63·3	73·1
September	57·0	65·6
October	48·2	53·4
November	38·1	38·4
December	32·7	26·0
Average	47·3	49·5

*The normal monthly temperature at Des Moines, Ia., is based on a 30-year period. U.S. Department of Agriculture *Yearbook*, 1926, pp. 1,268 69; and at Berlin, Germany, is based on the 50-year period 1841-90. J. Hann, *Handbuch der Klimatologie*, p. 218, 1911.

Temperature.—The temperatures in Berlin, Germany, and Des Moines, Ia., are given in Table XI. The July temperature averaged 65° F in Berlin and 10° higher in Des Moines. The contrast shows the difference between a potato and a corn climate. A temperature that is high enough for the best yields of corn is too high for the best yields of potatoes. It is very easy for Germany to produce higher yields of potatoes than the United States and equally easy for the United States to produce higher yields of corn.

Value of Crops.—The value of all harvested crops in the United States is shown in fig. 4. This figure shows the combined

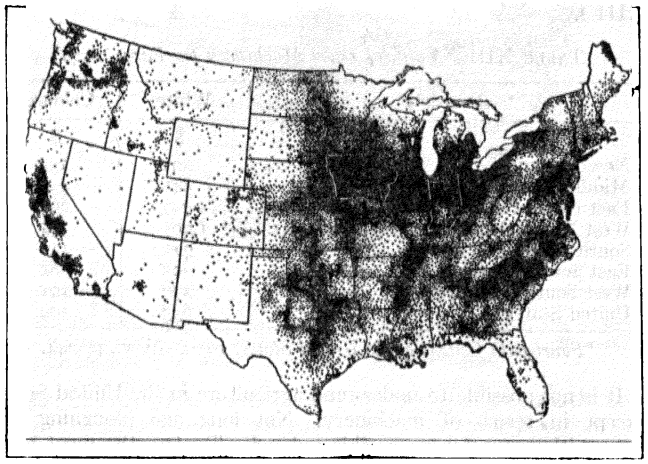


FIG. 4.—VALUE OF HARVESTED CROPS IN THE UNITED STATES, 1919
Most of the crops are grown in about one fourth of the area in regions where rainfall, soil and topography are favourable. Each dot represents $1,000,000

effect of topography, rainfall and soil on the crop production. The areas that produce only a small amount of crops for sale are mountainous, arid or sandy. The highly productive sections of the country occupy about one-fourth of the total land area. The largest area that is highly productive is in the north-central part of the country extending from Ohio to Nebraska. There is a highly productive area south of this along the Mississippi river. A region of high crop values in Texas is caused by an area where good soils overlap on sufficient rainfall. Most of the coastal plain area from Texas to Maine and a considerable area around the Great Lakes are too sandy for most crops. Between the coastal plain area and the mountains there is a productive area extending from Alabama to Virginia. Philadelphia is in the centre of another highly productive area. Long Island, the Connecticut river valley and Aroostook county, Me., are small areas with high production. In western New York, south of Lake Ontario, is an area with level productive land. In the western half of the United States, there are many small areas of irrigated land. A number of these are indicated in fig. 4. Along the Pacific coast there are several highly productive areas.

Machinery.—This subject is also dealt with under AGRICULTURAL MACHINERY AND IMPLEMENTS.

Most of the food of the world is produced by a small number of farmers who use machinery. The millions of farmers in Asia, and other countries where machinery is not used, produce a small

TABLE XII. *Value of Farm Machinery**

Year	Per acre	Per farm	Per acre of improved land
	$	$	$
1850	0·52	105	1·34
1860	0·60	120	1·51
1870	0·66	102	1·43
1880	0·76	101	1·43
1890	0·79	108	1·38
1900	0·89	131	1·81
1910	1·44	199	2·64
1920	3·76	557	7·15
1925	2·91	423	5·33

**Fourteenth Census of the United States*, 1920, vol. v., p. 32.

percentage of the world's food supply. In one region in China,[1] the farmers had $8 82 worth of machinery per farm compared with $423 in the United States. The value of machinery per farm increased from $108, in 1890, to $423, in 1925 (Table XII.) A relatively small amount of machinery is used in the southern States. The average value of machinery on farms operated by white persons in the east south central States, in 1920, was $203, but was $1,065 in the west north central States (Table XIII) Coloured farmers use relatively little farm machinery regardless of the section of the country in which they are located. The average value of machinery on farms operated by coloured persons was $109, but was $605 on farms operated by whites (Table XIII).

TABLE XIII. *Value of Farm Machinery per Farm*, 1920*

Division	White	Coloured
	$	$
New England	591	253
Middle Atlantic	846	450
East North Central	727	264
West North Central	1,065	352
South Atlantic	312	110
East South Central	203	81
West South Central	376	101
United States	635	109

**Fourteenth Census of the United States*, 1920, vol v , p 244.

It is not possible to understand agriculture in the United States except in terms of machinery Not long ago ploughing was done with a one-furrow walking-plough To-day, the most common practice is to use a two-furrow plough drawn by horses or by tractors A large amount of work is done with ploughs that turn three furrows or more. Harrowing, disking and other operations in fitting the soil were commonly done with two horses, but to-day four or more horses or the tractor are commonly used. About 50 years ago grain-binders and threshing machines were in common use. The harvester was later developed into the twine-binder, which dropped the bundles into piles for shocking. At that time, it was necessary to cut the bands and feed the threshing machine by hand The grain was measured and lifted into the wagon. The straw was elevated by a carrier and several persons were needed to keep it out of the way. Horses were often used for power. If a steam-engine was used, one man and a horse were required to haul the water. To-day bundles are quite commonly pitched into a pen-rack, so that no loader is required, and then pitched into the self-feeder of the threshing machine. The grain is weighed and delivered into the wagon or truck. The straw-blower takes care of the straw. The only hand labour involved in raising a grain crop is in shocking the grain, pitching the grain onto the wagon and from the wagon to the threshing machine. For a number of years, the combined harvester and thresher has been used in the Pacific coast States. When this is used, no hand labour is involved in grain production. Recently, combines are being introduced into all the States and a large percentage of the wheat is handled in this way. The use of the tractor and the combined harvester is making it possible to farm large areas of semi-arid land on which the yields were not high enough to pay before labour-saving methods were introduced For some time the planting of corn has been done with the corn-planter, which rows the corn in both directions, two rows at once. A considerable number of farmers are now using two-row cultivators. Most of the husking is still done by hand, but power husking machines are beginning to be used. The ears of corn were formerly shovelled from the wagon to the crib. Many farmers now have elevators to do this work Power shellers have been in universal use for some years, but recently have been improved. The only hand labour in raising corn is husking and shovelling the ears into the sheller. Not many years ago, hay was cut with a mowing machine about 4ft wide, and raked with a horse-rake It was then pitched on to the wagon, then to the mow or stack. Most of the hay produced is now loaded with a hay-loader or pushed from the field to the stack on a sweep-rake. It is elevated to the stack by horse-power. In the eastern States, hay is usually loaded with a hay-loader and unloaded with a horse-fork. In either case, the only hand labour is that of making the stack or mowing away the hay. Until recently, potatoes were planted, dug and dusted or sprayed by hand to control the potato beetle. To-day, most of the commercial crop of potatoes is planted with a potato-planter, dug with machinery and sprayed with a power sprayer. The only hand labour involved is in cutting the seed, picking up the potatoes and placing them on the wagon or truck. Under some conditions, digging machines are used to pick up the potatoes. Although the majority of cows in the United States are milked by hand, about one-half of them, in intensive dairy sections, are milked with machines. Records obtained from 422 farms in New York in 1922 showed that 46% of the farmers used milking machines.

Irrigation and Drainage.—Approximately two-fifths of the United States is too dry for crop production unless irrigated or farmed with particular reference to the conservation of moisture A part of this area is summer-fallowed. By fallowing, enough moisture is conserved so that one crop may be grown every two years. In other regions, crops are planted every year, but with the expectation that many crop failures will occur. The total rainfall in the arid area is sufficient to irrigate only a very small percentage of it. In 1919, the area under irrigation amounted to 19,191,716 acres. The systems available at that time could have irrigated 26,000,000 acres It is estimated that this is about one-half of the land that it is possible to irrigate Alfalfa (lucerne) is the predominant crop on irrigated land Of the total value of the United States crop in 1919, nearly one-half of the alfalfa, practically all of the rice, most of the lemons, over one-half of the oranges and sugar beets, and one-third of the grapes and prunes were produced on irrigated land. The rice crop is grown in humid areas, but is flooded. The other irrigated crops are grown in arid or semi-arid areas.

In 1920, the land in operated drainage enterprises amounted to 65,495,038 acres This is over three times the irrigated land The largest areas in the drainage districts are in Ohio, Indiana, Michigan, Iowa and Minnesota In the future, more land will continue to be reclaimed by drainage than by irrigation.

TABLE XIV *Relative Importance of Irrigated Crops*, 1919*

Crop	Per cent of value of all irrigated crops	Per cent of value of all crops for the United States
Alfalfa	22·8	44·9
Rough rice	11 8	99·1
Oranges	7 1	53·0
Potatoes	6 2	8·0
Sugar beets	4 7	62·6
Wheat	6 4	8 9
Grapes	4·4	38 0
Cotton	3 7	1·3
Apples	3 0	10 1
Peaches	3 0	25 8
Wild hay	2·2	7·9
Lemons	2 0	87·7
Prunes	1·9	37·1
All crops		5·6

*R. P. Teele, *Economics of Land Reclamation*, p. 37, 1927.

Forests.—Originally, nearly one-half of the land in the United States was covered with forests. The estimated original quantity of timber was 5,200 billion board feet, of which about 2,200 billion board feet remain. The present cutting is about four times the annual rate of growth. The United States now uses nearly one-half of the timber and over one-half of the paper of the world. It is evident that this rate of consumption cannot continue unless provision is made for growing the crop more rapidly. The majority of the States now furnish forest trees for planting

[1] J. L. Buck, "An Economic and Social Survey of 150 Farms," Yenshan county, Chihli province, China, University of Nanking, *Bul. 13*, p. 30, June 1926.

at a very small charge. Thus far, the acreage planted per year has been very small. In 1926, about 53,000ac. were planted. Farmers planted more than any other agency, followed by the Federal and State Governments. Corporations planted a relatively small percentage of the total. Farmers and other private agencies are the chief owners of forest land, but the area of national, State and municipal forests is increasing.

TABLE XV. *Area of Forest Land*

Ownership	Acres
National forest	89,100,000
State	8,700,000
Municipal	450,000
Farm woodlots	150,398,000
Other private forests	220,852,000
Total	469,500,000

Corn.—Corn is the most important crop in the United States. It is grown by more farmers, occupies more acres and has a greater total value than any other crop. About two-thirds of the farmers grew corn in 1925. No other crop, except hay, was grown by much more than one-third of the farmers. Less than 10% of the corn crop is used directly for human food. About 40% is fed to hogs, 15% to cattle, 20% to horses and 5% to poultry. Corn furnished over one-half of the feed, other than pasture, for live stock. While only a limited amount is used directly for food, corn is indirectly the most important single source of human food in the United States. Although a very large number of farmers grow corn, the chief centre of production is in the strip of land, 200m. wide and 800m. long, extending from Ohio to Nebraska. This region is known as the corn belt. It produces most of the corn of the world (fig. 5).

After corn is husked, cattle and horses are turned into the fields for pasture. In the dairy regions, a considerable amount of corn is placed in the silo for winter feed. About 4% of the total crop is cut for silage and 7% is cut for fodder. About 5% of the corn is harvested by turning the hogs into the field.

Thus far, corn has been singularly free from devastating pests. The European corn-borer is now appearing in the eastern edge of the corn belt. As this spreads, it may cause serious reduction in yields. Usually when a serious pest appears, it causes much more loss in the earlier years than later. When the natural enemies of the pest become more numerous and methods of control are better developed, the ravages are less serious.

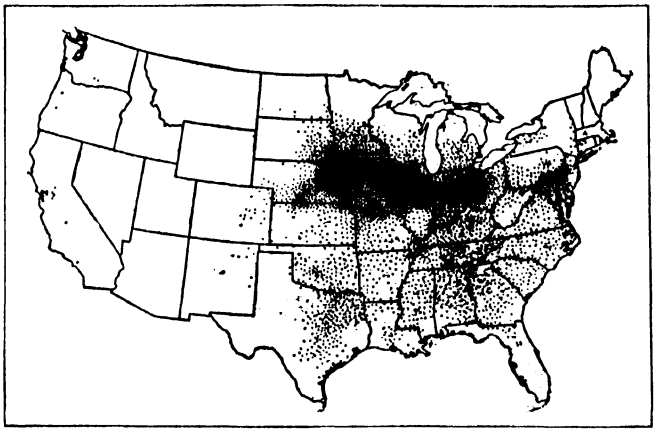


FIG. 5.—CORN PRODUCTION IN THE UNITED STATES
Corn is the most important crop in the country. Two-thirds of the farmers raise it. The region of highest production, extending from Ohio to Nebraska, is called the corn belt. Each dot represents 300,000 bushels

Cotton.—Cotton is the most important cash crop grown in the United States, second only to corn in total value. Cotton is limited to the southern States. It is grown throughout the South, but there

TABLE XVI. *Acreage and Production of Crops in the United States (Cotton in Bales of 500 Pounds. Other Crops in Bushels)**

	Corn	Wheat	Oats	Barley	Rye	Buckwheat	Rice	Potatoes	Sweet potatoes	Cotton
Acreage										
1879	62,368,504	35,430,333	16,144,593	1,907,727	1,842,233	848,389	174,173	..	..	14,480,019
1889	72,087,752	33,579,514	28,320,677	3,220,834	2,171,604	837,164	161,312	2,600,750	524,588	20,175,270
1899	94,913,673	52,588,574	29,539,698	4,470,196	2,054,292	807,060	342,214	2,938,778	537,312	24,275,101
1909	98,382,665	44,262,592	35,150,441	7,698,706	2,105,561	878,048	610,175	3,608,855	641,255	32,043,838
1919	87,771,600	73,099,421	37,991,002	6,472,888	7,679,005	742,627	911,272	3,251,703	803,430	33,740,106
1924	82,328,843	50,862,230	37,650,155	6,766,980	3,743,562	716,588	744,033	2,910,786	466,832	39,204,319
Production										
1879	1,754,591,676	459,483,137	407,858,999	43,997,495	19,831,595	11,817,327	3,961,560	169,458,539	33,378,693	5,755,359
1889	2,122,327,547	468,373,968	809,250,666	78,332,976	28,421,398	12,110,349	4,625,573	217,546,362	43,950,261	7,472,511
1899	2,666,324,370	658,534,252	943,380,375	110,634,877	25,568,625	11,233,515	9,002,886	273,318,107	42,517,412	9,534,707
1909	2,552,189,630	683,379,259	1,007,142,980	173,344,212	29,520,457	14,849,332	21,838,580	389,194,065	59,232,070	10,649,268
1919	2,345,832,507	945,403,215	1,055,182,798	122,024,773	75,992,223	12,690,384	35,330,012	290,427,580	78,091,913	11,376,130
1924	1,823,880,173	800,876,659	1,304,599,083	159,139,124	55,673,814	12,003,699	29,525,543	352,462,200	37,443,870	13,682,699

**Fourteenth Census of the United States*, 1920, vol. v., pp. 732, 813, 817, 839.
U.S. Census of Agriculture, 1925, vol. i, pp. 3, 38.

TABLE XVII. *Relative Importance of Crops in the United States, 1925*

Per cent of farms reporting		Acres		Total value		Value sold	
Crop	Per cent	Crop	Number (000 omitted)	Crop	Amount (000,000 omitted)	Crop	Estimated amount (000,000 omitted)
					$		$
Corn	65·9	Corn	82,329	Corn	1,926	Cotton	1,505
Hay	56·3	Hay	74,096	Cotton	1,505	Wheat	1,003
Potatoes	36·5	Wheat	50,862	Wheat	1,130	Corn	379
Oats	34·1	Cotton	39,204	Hay	1,122	Oats	193
Cotton	30·3	Oats	37,650	Oats	660	Hay	163
Wheat	20·4	Barley	6,767	Tobacco	229	Potatoes	132
Sweet potatoes	10·8	Rye	3,744	Potatoes	226	Barley	45
Tobacco	6·2	Flaxseed	3,435	Barley	121	Sweet potatoes	30
Barley	5·6	Potatoes	2,911	Flaxseed	67	Rye	23
Rye	3·6	Tobacco	1,538	Rye	63	Flaxseed	22

are three centres of intensive production. One area extends across Georgia and the Carolinas, another along the Mississippi river from the northern border of Tennessee to that of Louisiana. The third intensive area is in Texas and Oklahoma. The centres of intensive production are in the northern and western portions of the cotton belt. This is due in part to the smaller injury from the boll weevil in the regions that have light rainfall or cold winters. Cotton is the most important farm product exported from the United States. About one-half of the crop is exported.

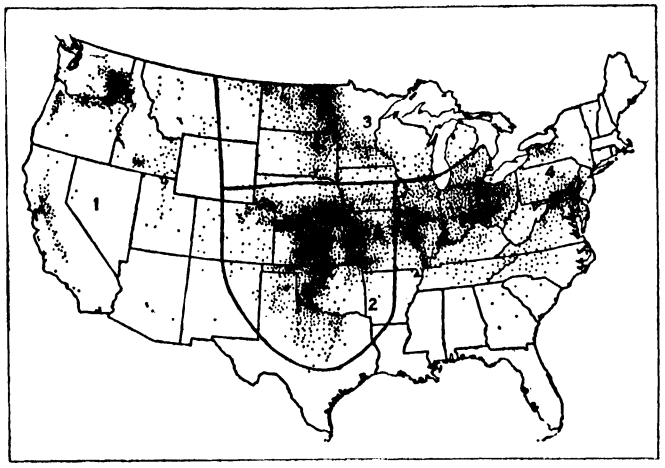


FIG. 6.—WHEAT PRODUCTION IN THE UNITED STATES
1. Soft wheat and spring wheat. 2. Hard winter wheat. 3. Hard spring wheat. 4. Soft winter wheat. Each dot represents 200,000 bushels

Wheat.—Wheat is the third crop in importance in the United States. There are four fairly distinct wheat areas. The most important one is the hard winter wheat region, of which Kansas is the centre. North of this is the hard spring wheat region. This same geographical area includes most of the wheat of Canada. East of these regions soft winter wheats are grown, although the hard wheats are encroaching on the western edge of the area. Various types of wheat are grown in the mountain and Pacific coast States, but the most important are the soft wheats grown in Oregon and Washington (fig. 6).

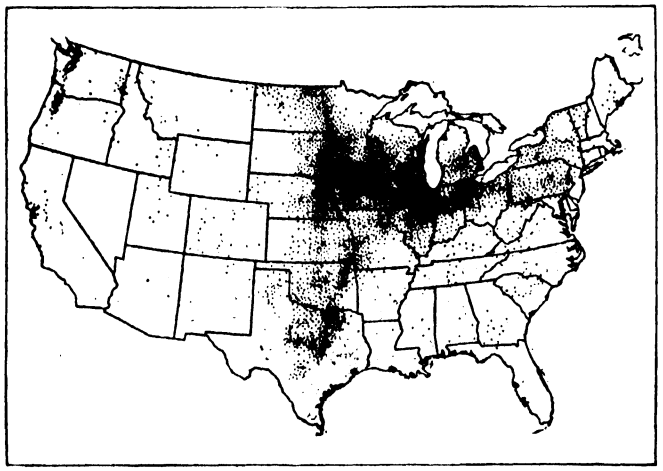


FIG. 7.—OAT ACREAGE IN THE UNITED STATES
Most of the oats are produced in the North Central parts of the country. Each dot represents 10,000 acres

Oats.—Oats are produced in many States, but the greatest production is in the corn belt. In this area they are usually grown after corn, without ploughing the ground. Oats do not give a high return per acre, but require less work (fig. 7).

Hay.—There are three more or less distinct hay areas in the United States. In the western half of the country alfalfa is the major hay crop. East of the alfalfa area and north of the cotton belt, timothy and clover are the major hay crops. South of this area, annual crops, such as cow peas, soy beans and the like, are the primary forage crops (fig. 8). Timothy, red and alsike clover make 46% of the hay acreage. Alfalfa furnishes 14% of the hay acreage, but the yields per acre are about twice as high as the average for other hay (fig. 9).

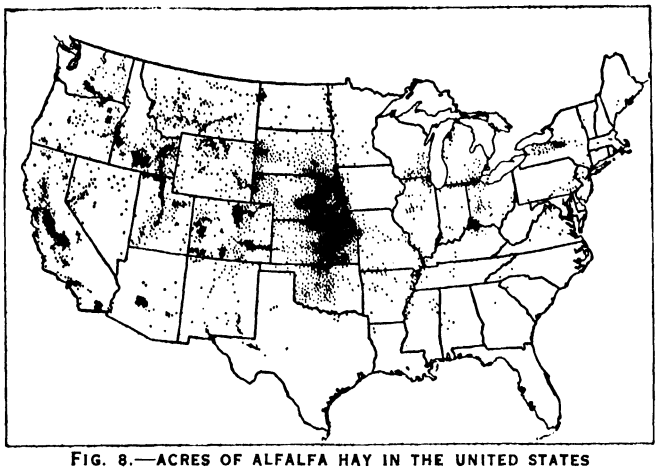


FIG. 8.—ACRES OF ALFALFA HAY IN THE UNITED STATES
Most of the alfalfa is produced in the western half of the country. Each dot represents 2,000 acres

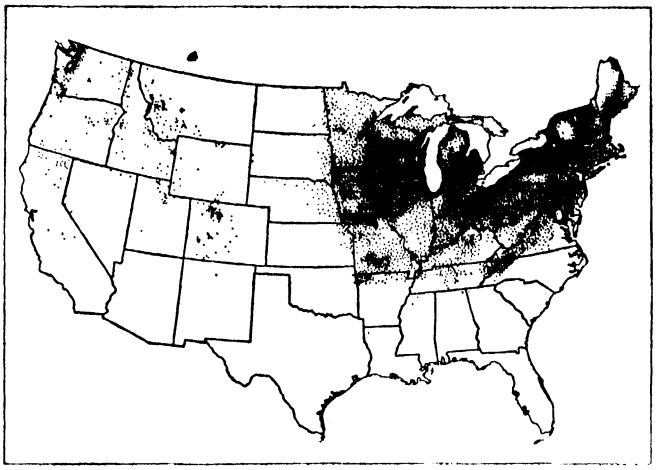


FIG. 9.—ACRES OF TIMOTHY AND CLOVER MIXED HAY IN THE UNITED STATES
Most of the clover and timothy hay is produced in the north-eastern quarter of the country. Each dot represents 2,000 acres

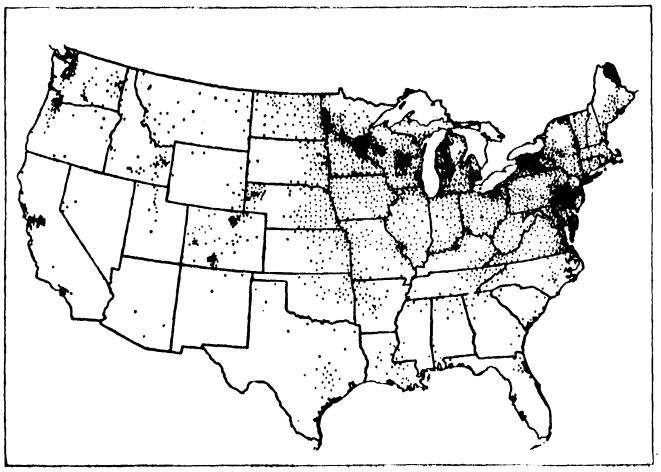


FIG. 10.—ACREAGE OF POTATOES IN THE UNITED STATES
Although potatoes are grown in most parts of the country, commercial production is limited to various areas in the Northern States and along the Atlantic coast. Each dot represents 1,000 acres

Potatoes.—Potato production is rapidly being concentrated in certain areas that have sandy soils and a cool climate. Most of the potatoes are grown in the northern tier of States or along the Atlantic coast. Formerly, potatoes were grown in small acreages

TABLE XVIII. *Production of Grain in the United States**
(Pounds of corn, oats, wheat, barley, rye and buckwheat†)

Year	Acres (000 omitted)	Pounds (000,000 omitted)	Pounds per acre	Pounds per capita	Year	Acres (000 omitted)	Pounds (000,000 omitted)	Pounds per acre	Pounds per capita
1866	61,682	69,110	1,120	1,948	1897	169,591	189,699	1,119	2,650
1867	64,972	68,249	1,050	1,885	1898	175,199	207,208	1,183	2,841
1868	66,715	75,679	1,134	2,047	1899	213,374	213,157	1,156	2,868
1869	69,458	77,271	1,112	2,047	1900	184,101	212,298	1,153	2,794
1870	69,254	85,945	1,241	2,229	1901	184,630	170,634	924	2,199
1871	64,999	80,116	1,233	2,025	1902	183,777	233,884	1,273	2,952
1872	68,280	87,401	1,280	2,153	1903	181,671	207,615	1,143	2,568
1873	74,112	80,496	1,086	1,931	1904	181,391	219,516	1,210	2,662
1874	80,052	76,573	957	1,789	1905	184,265	242,362	1,315	2,882
1875	86,864	106,004	1,221	2,414	1906	184,577	252,737	1,369	2,949
1876	93,920	102,987	1,097	2,282	1907	183,674	215,647	1,174	2,470
1877	93,205	113,424	1,217	2,447	1908	185,901	219,975	1,183	2,473
1878	100,956	120,245	1,191	2,526	1909	188,577	242,536	1,286	2,680
1879	118,632	150,898	1,272	3,088	1910	198,052	248,844	1,256	2,692
1880	120,927	143,706	1,188	2,865	1911	203,718	218,946	1,075	2,333
1881	123,389	106,830	866	2,082	1912	201,302	277,853	1,380	2,917
1882	126,569	140,985	1,114	2,686	1913	205,264	230,265	1,122	2,371
1883	130,634	134,753	1,032	2,510	1914	206,316	252,216	1,222	2,548
1884	136,203	155,067	1,138	2,824	1915	218,708	293,560	1,342	2,924
1885	135,875	154,619	1,138	2,754	1916	211,893	234,033	1,104	2,299
1886	141,859	145,464	1,025	2,534	1917	219,546	275,278	1,254	2,667
1887	141,822	134,439	948	2,291	1918	225,155	262,864	1,167	2,518
1888	146,281	163,960	1,121	2,734	1919	226,950	265,404	1,169	2,527
1889	140,219	169,563	1,209	2,767	1920	218,043	290,650	1,333	2,731
1890	138,903	128,386	924	2,040	1921	225,553	266,814	1,183	2,462
1891	146,732	184,072	1,254	2,883	1922	220,706	268,925	1,218	2,451
1892	147,227	156,557	1,063	2,405	1923	218,709	274,323	1,254	2,461
1893	147,726	149,150	1,010	2,248	1924	207,328	242,297	1,169	2,136
1894	144,216	134,972	936	1,996	1925	211,295	265,205	1,255	2,305
1895	163,052	199,984	1,227	2,901	1926	212,469	252,294	1,187	2,168
1896	167,272	204,973	1,225	2,918	1927	213,718	263,378	1,232	2,242

*G. F. Warren, "Prices of Farm Products in the United States." United States Department of Agriculture, *Bulletin* 999, p. 6, Aug. 26, 1921.
†Grain as reported by the Bureau of Crop Estimates, converted to pounds by multiplying corn and rye by 56, wheat by 60, oats by 32, barley and buckwheat by 48.

on heavier soils, but commercial production requires machinery, which works best on light soils. Fertilizers make it possible to obtain large yields of good quality on soils that were not strong enough for continued use before fertilizers were used (fig. 10).

Grain.—The total grain produced in the United States increased from 69 billion pounds in 1866 to nearly 294 billion in 1915. Since 1920, the general tendency of production has been downward. The production per capita was highest in the 20 years from 1895 to 1915. Since that time it has been declining. The yields per acre are considerably higher than formerly.

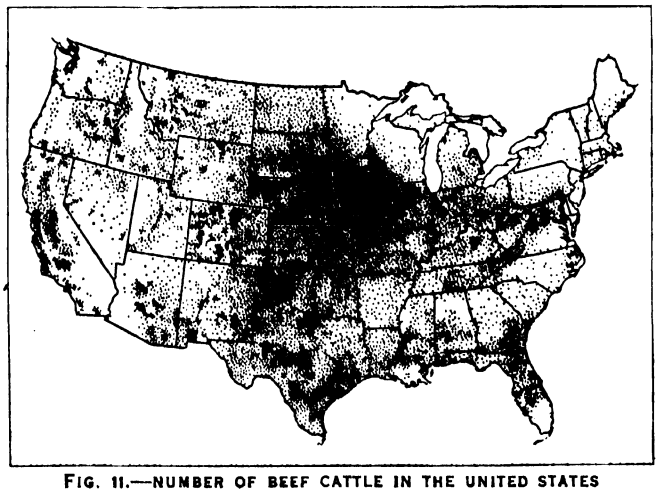


FIG. 11.—NUMBER OF BEEF CATTLE IN THE UNITED STATES
Beef cattle constitute over one half of the total number of cattle in the country. Each dot represents 2,000 head

Cattle.—The value of cattle and calves slaughtered represents 37% of the total value of all slaughtered animals. There are two major areas of cattle production: the timothy and clover areas where cattle are produced on pasture and hay, and the southern and western areas, where a greater dependence is placed on the range. Many of the beef cattle are grown on the range and fattened in the corn belt (fig. 11).

The northern States from Minnesota to Massachusetts are the most important centres of dairy production, but dairy cows for

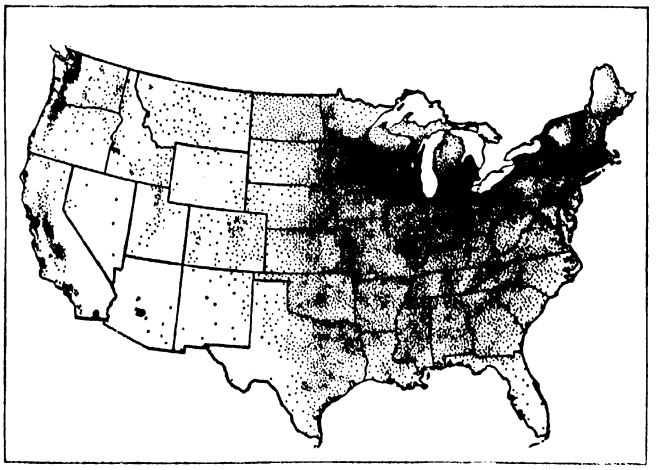


FIG. 12.—NUMBER OF DAIRY CATTLE IN THE UNITED STATES
Dairy cattle are found in all parts of the country, but most of them are raised in the north eastern quarter of the country. Each dot represents 2,000 head

milk supply are scattered wherever there are people (fig. 12). An abundance of pasture is the chief factor in economical cattle production. Some of the most favoured areas are on the Pacific coast, where good pastures are available most of the year. In most of the United States, conditions are less favourable for dairying than in England, Ireland and Holland, because the pasture season in these countries is longer. The milk production in Denmark averages about 6,300lb. per cow. The production in a number of dairy regions in the United States averages about 5,500lb. per cow. In many regions of New York State, the production aver-

ages 5,700. The dairy regions shipping milk to New York city average 6,200 pounds. Comparisons are often made between the United States and Denmark or Holland. If a significant comparison is to be made with these countries, it must be made with intensive dairy districts in the United States, because in the latter a large percentage of the cows that are milked are beef cattle.

TABLE XIX. *Number of Animals on Farms in the United States**

Date	Total cattle	Dairy cows	Hogs	Sheep	Chickens
1850 June 1	17,778,907	6,385,094	30,354,213	21,723,220	..
1860 „ 1	25,620,019	8,585,735	33,512,867	22,471,275	..
1870 „ 1	23,820,608	8,935,332	25,134,569	28,477,951	..
1880 „ 1	39,675,533	12,443,120	49,772,670	42,192,074	..
1890 „ 1	57,648,792	16,511,950	57,426,859	40,876,312	258,871,125
1900 „ 1	67,719,410	17,135,633	62,868,041	61,503,713	233,566,021
1910 April 15	61,803,866	20,625,432	58,185,676	52,447,861	280,340,959
1920 Jan. 1	66,652,559	19,675,297	59,346,400	35,033,516	359,537,127
1925 „ 1	60,760,366	17,644,867	50,853,526	35,590,159	409,290,849

**Fourteenth Census of the United States*, 1920, vol. v., pp. 553, 575, 588, 599. *U.S. Census of Agriculture*, 1925, pt. 3, p. 28.

Hogs are reared on three-fourths of the farms in the United States, but the chief centre of production is in the corn belt. Hogs eat about 40% of the corn crop. A bushel of corn produces a little more than 10lb. of live hog, or from 7 to 8lb. of pork. Pork is produced in the United States in sufficient quantities to supply home demand and forms a chief export (fig. 13).

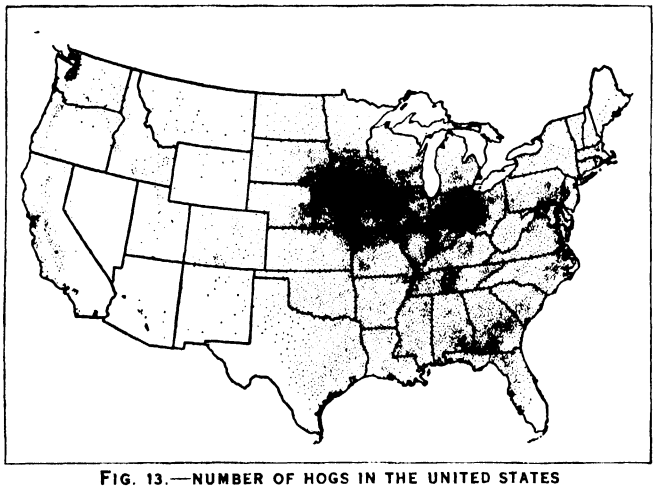


FIG. 13.—NUMBER OF HOGS IN THE UNITED STATES
Although hog production is almost as widely scattered over the country as population, the corn belt is the chief centre of intensive pork production. Each dot represents 5,000 head

Pure-bred Live-stock.—In 1920, the U.S. census reported 1,981,514 registered pure-bred cattle and 2,049,900 registered hogs in the United States. This is a small percentage of the total pure-bred animals, as many are not registered. The registrations probably indicate the relative numbers of the different breeds and the blood characteristics of the grade animals. Shorthorn and Hereford cattle are the most important beef breeds in the United States (Table XX.). Nearly all of the steers that go to market are typical Shorthorn, Hereford or Angus cattle. The majority of the dairy cattle are Holstein-Friesian or Jersey, although Guernsey are rapidly increasing. In the southern States, the majority of the cattle are of the Jersey type; in the northern States, the majority are of the Holstein-Friesian type, but the Jersey, Guernsey and Ayrshire types are quite numerous.

Pure-bred hogs in the United States are predominantly Duroc-Jersey and Poland China. The three most important breeds of hogs as well as many of the important breeds of poultry are of American origin, but the important breeds of cattle, sheep and horses are European.

In the eastern half of the United States Shropshire sheep predominate. Rambouillet are grown in all parts of the country, but are very numerous on the ranges of the West.

Percheron horses predominate, but there are considerable numbers of Belgian, Shire and Clydesdale horses.

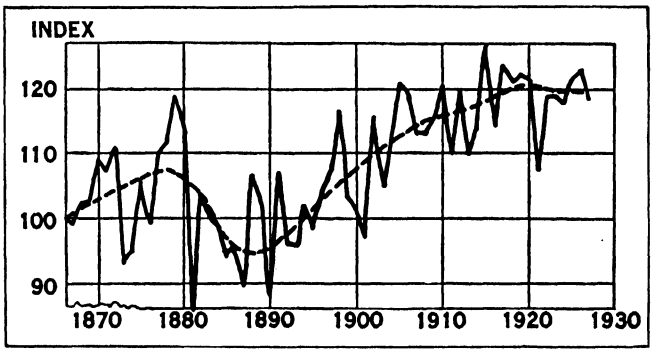


FIG. 14.—CROP YIELDS PER ACRE EAST OF THE MISSISSIPPI RIVER, 1866–1927
Yields declined during the agricultural depression of the '80s and rose rapidly thereafter. The increase was stopped by the agricultural depression following the World War

Crop Yields.—Comparisons of yields of small grains and potatoes in Europe and the United States are often made and erroneous conclusions drawn. This is often assumed to be due to differences in methods of farming. However, they are due primarily to climate. Most parts of the United States are too hot for the best yields of small grains and potatoes. The yields of these crops are much below the European, but corn yields are much higher. Europe obtains 5bu. more wheat and oats per acre than the United States, but produces 8bu. less corn (Table XXI.). The best yields of small grains are obtained in countries too cool to raise corn. The yields of potatoes in Belgium are over twice the yields in France. The small grains yield nearly twice as much as they do in France. France is warm enough to obtain small yields of corn, whereas Belgium raises practically none. The yields of all small grains and potatoes in France are higher than in the United States. Wheat yields are 8bu. higher, but corn yields are 10bu. less. The same comparisons are shown in different parts of the United States. The average yield of potatoes in Maine is higher than that in Germany, England or France, and nearly as high as that of Belgium (fig. 14).

TABLE XXI. *Crop Yields Per Acre, in Bushels, 1921-25**

	Corn	Wheat	Rye	Oats	Barley	Potatoes
United States	27·7	13·8	13·9	30·8	24·8	107
Europe	19·3	18·4	20·5	35·8	23·4	169
Asia	..	11·8	..	..	..	..
Southern hemisphere	21·4	12·3	..	..	13·7	103
Iowa	39·9	19·1	17·6	36·1	28·6	86
Maine	..	24·4	..	38·6	29·0	262
Belgium	..	38·9	36·8	62·6	49·1	266
Germany	..	27·3	23·8	44·1	31·3	188
England and Wales	..	32·9	..	47·4	32·5	231
France	17·8	21·5	18·5	35·3	26·6	125

*U.S. Department of Agriculture *Yearbook*, 1926.

TABLE XX. *Number of Registered Pure-bred Animals on Farms in the United States, 1920**

Beef cattle		Dairy cattle		Sheep		Hogs		Horses	
Shorthorn	416,995	Holstein-Friesian	528,621	Shropshire	124,454	Duroc-Jersey	819,117	Percheron	70,613
Hereford	405,582	Jersey	231,834	Rambouillet	106,849	Poland China	726,504	Belgian	10,838
Aberdeen Angus	108,524	Guernsey	79,446	Merino	59,920	Chester White	191,207	Shire	5,617
Polled Durham	61,764	Ayrshire	30,509	Hampshire Down	51,813	Hampshire	108,782	Clydesdale	4,248

**Fourteenth Census of the United States*, 1920, p. 637 and ff.

The yields of small grains and potatoes in Maine are higher than those in Iowa, but Iowa yields of corn averaged nearly 40bu., while Maine raises very little of this crop. The small-grain yields in Iowa are about the same as those in France, but corn yields are twice as high. The only part of the United States that has a climate approximating that of Europe is in the State of Washington, west of the Cascade mountains. Some of the counties in this region had yields of over 40bu. of wheat per acre in 1925, and 75 to 80bu. of oats. Crop yields are exceedingly variable. The yearly variations and the long-time tendencies are shown in fig. 14. The low prices in the period of the over-expansion from 1880–90 caused yields to decline. Rising prices caused yields to increase. The rapid advance was checked by the agricultural depression following the World War.

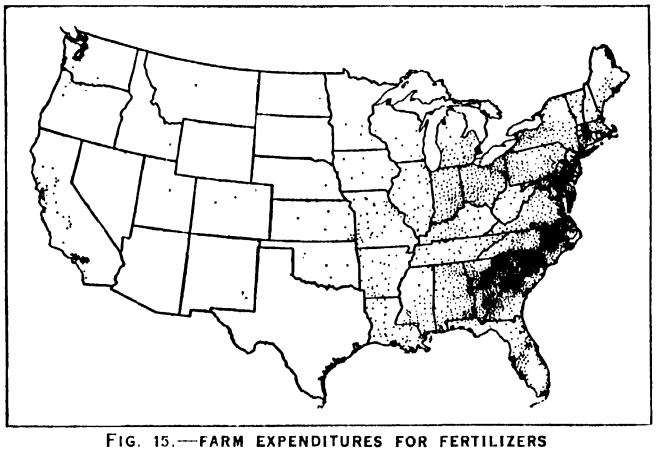


FIG. 15.—FARM EXPENDITURES FOR FERTILIZERS
Most of the fertilizer is used on the cotton, tobacco and garden crops along the Atlantic coast. Each dot represents 100,000 lbs.

Fertilizers.—A very small amount of fertilizer is used on general farm crops. Most of it is used for cotton, tobacco, potatoes and truck-crops on the sandy soils of the Atlantic coast (fig. 15). The quantity of fertilizer used is decidedly variable from year to year, depending primarily upon prices received for cotton and tobacco in the preceding year. About two-thirds of the total fertilizer is acid phosphate. Ground limestone is not listed among the fertilizer materials in Table XXII., but is one of the very important materials needed on American soils.

TABLE XXII. *Relative Importance of Fertilizer Material Used in the United States**

Material	Tons
Phosphorus group:	
Acid phosphate	4,000,000
Raw ground bones	102,000
Ground steamed bones	57,000
Organic nitrogen group:	
Tankage	700,000
Cottonseed-meal	280,000
Fish scrap	260,000
Mineral nitrogen group:	
Nitrate of soda	153,000
Sulphate of ammonia	143,000
Potassium group:	
Kainit	405,000
Muriate of potash	215,000
Manure salts	200,000
Sulphate of potash	41,000

*E. E. Vial, "Prices of Fertilizer Materials and Factors Affecting the Fertilizer Tonnage," Cornell University Agricultural Experiment Station, *Memoir* 119, 1928.

Most of the soils in the eastern half of the United States need limestone for the best growth of clover. In recent years, methods of grinding limestone have been so cheapened that vast quantities will be used as soon as agriculture becomes more profitable.

Cropping Systems.—In most parts of the United States certain principles of cropping are followed, but fixed rotations are not common. In regions where timothy and clover are grown, they are usually seeded with wheat or oats. If corn, oats, wheat, timothy and clover are grown, they are commonly planted in that order. In the better parts of the corn belt, corn may be planted two or more years before it is followed by oats. From southern Pennsylvania to Kansas, there is a region which is too hot for oats. Corn can be harvested early enough to plant winter wheat. The common rotation is corn, wheat and clover. In the northern States, potatoes are commonly grown in a three-year rotation of potatoes, oats and clover. Alfalfa lives so long that it is usually left for an indefinite number of years. Corn follows alfalfa when grown in rotation with it. In the cotton belt considerable land is planted in cotton year after year, but an increasing number of farmers are using cow peas, velvet beans or other legumes in the rotation. In the arid regions, wheat is the pre-eminent crop. Since it pays so much better than most other crops, much of the land is planted to wheat for many years in succession.

Diversity.—When a self-sufficient agriculture was followed, each farmer grew many kinds of crops. This system was very wasteful of time. No region is well adapted to all crops, so that low yields were often obtained. The small acreage required a large amount of time per acre. A large production was not required, because all that was necessary was to supply the farmers' needs. With the introduction of machinery, it became necessary to have an income and sufficient acreage to use machinery effectively. There has been a steady movement to grow the major part of each crop in the region that is best adapted to it. Most farming communities specialize on one or a few products. For instance, 82% of the hens in Sonoma county, Calif., in 1924 were kept in flocks of over 900; 50% in Suffolk county, Long Island, N.Y., were kept in flocks of more than 450. One-half of the cows in New York State are in herds of 20 or more.

In some regions, several products pay about equally well. Such regions are quite diversified. In others, the second-best product yields a very poor return, compared with the best. Such regions are highly specialized. Cotton, peanuts and tobacco have been increasing so rapidly that the percentage of farms reporting them increased in the 25 years ending with 1924 (Table XXIII.). The acreage per farm also increased. For nearly all the other crops, the percentage of farmers growing the crop decreased in the 25-year period. In every case shown in Table XXIII., and for nearly all other crops, the acreage grown per farm increased.

TABLE XXIII. *Per Cent of Farms Growing Each Crop and Acres Grown per Farm*

	Per cent of farms reporting		Acres per farm reporting	
	1899	1924	1899	1924
Corn	81·0	74·7	20·2	20·7
Oats	36·0	34·1	14·0	18·8
Rye	5·1	3·6	7·0	16·3
Potatoes	49·4	36·5	1·0	1·3
Sweet potatoes	17·5	10·8	0·5	0·7
Cotton	24·7	30·3	17·1	20·3
Peanuts	2·3	3·9	3·9	4·4
Tobacco	5·4	6·2	3·6	3·9
Tomatoes	5·3	2·9	0·7	2·3
Cabbage	0·9	1·9	0·4	1·4
Beans, dry	4·3	2·4	1·9	10·9
Onions, dry	4·3	0·9	0·2	1·6

The increases are particularly striking for vegetables and other minor crops. The farmer who grew lettuce in the mountain States produced an average of 5ac. per farm, and on the Pacific coast 9 acres. In the Pacific coast States, those who grew beans raised 38ac. per farm. Those who grew sugar beets in the mountain States grew 18ac. per farm. In the west north central States those who grew corn raised an average of 45ac. Those who grew winter wheat raised an average of 65ac.

The percentage of the farmers growing hogs decreased from 68 to 57 in 15 years, and those keeping dairy cows decreased from 81 to 59%. The percentage keeping poultry decreased only slightly, but the number of chickens kept per farm increased nearly 50%. A considerable part of this is due to the establish-

ment of large commercial flocks of from several hundred to several thousand hens.

TABLE XXIV. *Number of Farms Reporting Each Kind of Live-Stock and Number of Head per Farm*

	Per cent of farms reporting		Number of head per farm	
	1910	1925	1910	1925
Hogs	68	57	13	14
Dairy cows	81	59	4	6
Sheep	10	7	86	83
Chickens	88	86	50	74

Co-operation.—There has been a rapid increase in the amount of business done co-operatively. In 1924, 14% of the farmers marketed their products co-operatively and 6% did some co-operative buying. In some parts of the country co-operative fire

TABLE XXV. *Value of Farm Products Purchased and Sold Co-operatively, 1924**

Division	Amount purchased co-operatively	Amount sold co-operatively
	$	$
New England	5,709,116	20,745,326
Middle Atlantic	7,376,663	50,273,909
East North Central	15,688,188	145,068,090
West North Central	25,740,405	292,354,272
South Atlantic	4,968,028	73,376,620
East South Central	2,691,511	49,827,199
West South Central	2,702,699	75,724,191
Mountain	1,709,581	35,043,394
Pacific	9,384,978	115,871,386
United States	75,971,169	858,284,387

**U. S. Census of Agriculture*, 1925, pt. 2, pp. 16–18.

insurance is practically universal. Large numbers of farmers borrow co-operatively through the Federal land banks. In 1924, the farmers purchased $76,000,000 worth of products co-operatively, and sales amounted to $858,000,000. In Iowa, tenants did almost twice as much co-operative purchasing and selling as did the owners. Grain, dairy products and live-stock were the leading products handled.

Credit.—Co-operative credit is available through the 12 Federal land banks. Although called Federal, the Federal Government owns no share in eight banks, and only 1% of the total stock of the 12 banks; all other stock is owned by the borrowers. In Feb. 1928, there were 461,719 farmers using the system. The total loans outstanding amounted to $1,463,918,114.

The land-bank system is under the general supervision of the Farm Loan board, which is appointed by the President of the United States. Each bank is managed by a board of directors. Three of them are appointed by the Farm Loan board, four are elected by the borrowers, but the seventh is subject to approval by the Farm Loan board. The banks obtain their funds through the sale of bonds to the investing public. They cannot charge the borrower more than 1% above the rate paid on the bonds. The Federal Land Bank bonds sell at a low rate of interest, so that these banks are usually the first to reduce interest rates. All the profits above the amount set up as reserves are returned to the borrowers as dividends on the stock held by the farmers who borrow. Each borrower is required to invest $5 in stock for each $100 borrowed Most of the loans are made for 20 or 36 years. When the banks were first started, the usual method of payment was 1% on the principal the first year and an equal total payment in each successive year. The interest payments steadily declined and the payments on principal steadily increased A form of loan now coming into general use requires payment of the total principal in 20 or 33 years by paying 5 or 3 percent of it each year, in addition to payment of interest. This makes the total payment decrease each year. It allows the farmer to pay more than one instalment on the principal when he has a good year and skip payment in a bad year, provided he had paid in advance in the good year.

The portion of the mortgage business done by the co-operative Federal land banks is rapidly increasing Life insurance companies, private land banks, mortgage companies, banks and individuals also lend money on farm mortgages The Federal Intermediate credit banks owned by the Federal Government, but managed by the land bank officers, lend money to marketing agencies on warehouse receipts and discount notes for banks and credit corporations. Most of the short-time credit used by farmers is furnished by banks or by dealers who sell goods on time. For tenant farms, landlords supply considerable credit. It is expensive for dealers to furnish credit; consequently farmers pay a very high rate of interest. Part is paid as interest, but a large part is covered by charging a high price Mortgage credit is readily available on easy terms, but equally good short-time credit facilities have not been developed.

Roads.—Now that the horse has been so largely supplanted by automobiles and trucks, the road question has become of great importance to farmers. Roads are used even more as interurban thoroughfares than by farmers. Formerly all roads were considered local and practically all support came from the localities.

TABLE XXVI. *Relative Importance of Co-operative Agencies in the Number, Membership and Volume of Business, 1925**

Number of associations		Number of members		Total amount of business		Amount of business per organization		Amount of business per member	
Commodity	Number	Commodity	Number, 000 omitted	Commodity	Amount, 000,000 omitted	Commodity	Amount, 000 omitted	Commodity	Amount
					$		$		$
Grain	3,338	Grain	520	Grain	750	Tobacco	3,750	Fruits and vegetables	1,556
Dairy	2,197	Dairy	460	Dairy	535	Cotton	1,240		
Live-stock	1,770	Live-stock	400	Live-stock	320	Poultry	563	Grain	1,442
Fruit and vegetables	1,237	Cotton	300	Fruit and vegetables	280	Nuts	410	Dairy	1,163
Miscellaneous buying	1,217	Tobacco	300	Cotton	150	Dairy	244	Poultry	800
Miscellaneous selling	698	Miscellaneous buying	247	Miscellaneous buying	135	Fruits and vegetables	226	Nuts	800
Cotton	121	Fruits and vegetables	180	Tobacco	90	Grain	225	Live-stock	800
Wool	91	Miscellaneous selling	173	Miscellaneous selling	74	Live-stock	181	Miscellaneous buying	547
Poultry	71	Wool	50	Poultry	40	Miscellaneous buying	111	Cotton	500
Nuts	30	Poultry	50	Nuts	16	Wool	110	Miscellaneous selling	428
Tobacco	24	Nuts	20	Wool	10	Miscellaneous selling	106	Tobacco	300
								Wool	200
Total or average	10,803		2,700		2,400		222		889

**R. H. Elsworth, "Agricultural Co-operative Associations," United States Department of Agriculture, *Technical Bulletin 40*, pp. 22, 27, 29. Jan. 1928.

Now that roads have become national, farmers are often taxed to build roads for city use. On the primary highways in Pennsylvania, New York and Maine, 5% of the traffic was farm travel, in Georgia, 9%, and in Illinois, 10%. Much more than this percentage of maintenance is usually contributed by farmers. In 1925, 7·5% of the farms were on hard-surfaced roads and 15% on gravelled roads. The percentage on hard-surfaced roads was highest in the Middle Atlantic States, averaging 22%, but the percentage on either hard-surfaced or gravelled roads was highest in the east north central and Pacific States (Table XXVII). From the standpoint of agriculture, the most important problems are the increase in the number of lateral roads and an adjustment in the methods of financing so that the local communities will pay no higher percentage of the cost of construction of these roads than their use is of the total use.

TABLE XXVII *Per Cent of Total Number of Farms on Different Kinds of Roads, 1925*

Division	Concrete	Macadam	Gravel	Improved dirt	Unimproved dirt	All others
New England	1·3	12 0	24 4	22 4	38·1	1 8
Middle Atlantic	6·2	16 0	8 1	15·1	50 0	4 7
East North Central	5 0	9 6	32 3	17 9	32·1	3 1
West North Central	0 8	0 6	10·4	44 6	40 5	3·1
South Atlantic	2 2	2 8	3 9	34 8	53 2	3 1
East South Central	0·6	6 4	15 2	28 0	47 0	2 8
West South Central	0 7	0 8	11 1	40 4	44 4	2 6
Mountain	2 1	0 4	13 3	35 5	43·8	5 0
Pacific	9 0	7·3	29 9	20 7	27 7	5 4
United States	2 5	5 0	14 0	31 4	43 1	3 2

Tenancy.—About two-fifths of the farms in the United States are operated by tenants and the percentage is increasing As the amount of machinery and other capital necessary to start farming increases, a longer time is required for a hired man to accumulate enough property to become an owner.

The percentage of tenancy is highest in the southern States where there are many negro tenants, and in the Middle West, where the capital per farm is high (Table XXVIII). In New England, only 7% of the farms are operated by tenants and in the west south central States 53% are so operated (Table XXIX) The most common form of tenancy is to share the crop for the farm In regions where live-stock is produced in considerable quantities, the live-stock products are also shared About one-fifth of the tenants pay cash rent. When a share of the product is given as rent, the fraction is usually one-third, two-fifths, one-half, etc The difference between two-fifths and one-half may be very large when expressed in dollars. For this reason, a considerable number of share tenants pay some cash in order that the contract may be more closely adjusted to the value of the lease (Table XXX.).

In the cotton belt, two other forms of tenure have been adopted, primarily for negro tenants who require close supervision. One of these is called standing rent, in which the tenant pays a given quantity of cotton or other crop, regardless of the yield All that he raises above this quantity is his own. This is intended to encourage more attention to the crop

TABLE XXVIII. *Number of Farms in the United States Classified by Tenure, 1880–1920**

Year	Number of owners and managers	Number of tenants	Per cent tenants
1880	2,984,306	1,024,601	26
1890	3,269,728	1,294,913	28
1900	3,712,408	2,024,964	35
1910	4,006,826	2,354,676	37
1920	3,993,539	2,454,804	38
1925	3,909,032	2,462,608	39

**Fourteenth Census of the United States*, 1920, vol. v., p. 124.

TABLE XXIX. *Per Cent of All Farms Operated by Tenants 1920**

Division	Per cent
New England	7·4
Middle Atlantic	20 7
East North Central	28 1
West North Central	34 2
South Atlantic	46 8
East South Central	49·7
West South Central	52·9
Mountain	15·4
Pacific	20 1
United States	38 1

**Fourteenth Census of the United States*, 1920, vol v., p 133.

TABLE XXX. *Number of Tenants in the United States, 1920**

	Number
Share tenants	1,117,721
Croppers	561,091
Share-cash	127,822
Cash tenants	480,009
Standing renters	104,996
Unclassified	63,165
Total	2,454,804

**Fourteenth Census of the United States*, 1920, vol. v., p. 148.

The cropper system is also classed as tenant farming, but is, in reality, half way between hired labour and tenancy. The owner of the farm furnishes mules and equipment, feed, fertilizer and living expenses for the worker. The worker receives a share of the crop and agrees to repay money advanced for his living. If the crop is good, payment is made; if not, the landlord may lose the money

Farm Labour.—Before the World War, wages of farm labour were highest in the western States Following the war, competition with nearby cities made farm wages in New York higher than in the West Wages are lowest in the southern States, the average monthly payment in Alabama being less than one-half of those in the North (Table XXXI).

TABLE XXXI *Farm Wages by the Month, with Board*

Year	New York	Pennsylvania	Alabama	Texas	Iowa	North Dakota	Oregon	United States
	$	$	$	$	$	$	$	$
1910–14	24 56	19.75	13 56	18 74	29 34	30 08	31 40	20 41
1910	23 50	18.75	13.00	18 00	28 00	29.00	32 00	19.58
1911	24 00	19.20	13.70	18 40	28 30	28 90	31 00	19.85
1912	24 40	19.80	13 70	19 00	29 60	30 30	31.00	20.46
1913	25 50	20.60	14 40	19.20	30 70	31 00	31 00	21 27
1914	25 40	20 40	13 00	19.10	30 10	31 20	32 00	20.90
1915	25 40	21 00	12 50	18 70	31 10	32.00	31.30	21.08
1916	20 40	24 00	12 50	20 40	34 10	33 20	34 50	23.04
1917	35 00	30 00	16 00	25 00	41.00	41 00	44 00	28.64
1918	40 00	34 00	21.20	31.00	50 00	52 00	58 00	35.12
1919	43 30	37.80	25.50	38 80	55 00	56 00	64 00	40.14
1920	54 40	47 00	20 30	42 00	66.35	70 00	68.00	47.24
1921	40 00	35 00	17 00	26 00	39 60	40 00	44 50	30.25
1922	30 70	33 00	17 60	24 00	36 80	38.70	43 50	29.31
1923	45 50	38 00	19.90	28 30	43.30	40.30	52.50	33 09
1924*	47.30	39.24	21.67	29.33	43 82	41.92	45 93	33.34
1925*	48.40	39.42	23 46	27.75	44.58	43 17	45 79	33.88
1926*	49 60	40 03	22 00	28.67	45 79	44.17	49.25	34.85
1927*	49 42	40 21	21 08	26 83	46 92	44 58	49.96	34.93

*The quarterly wages published by the U S. Department of Agriculture were weighted in the following manner to obtain the average yearly wage rate: April 1; July 2; October 2; and the following January 1.

Farm wages are influenced by prices of farm products and by conditions of employment and wages in cities. Near industrial centres, city wages have more effect on farm wages than do prices of farm products. For the United States as a whole, the wages of farm labour are influenced more by prices than by city wages (fig. 16). The average hours worked by farm operators per year are 3,020, but there is great variation from this average in different areas. The negroes take so many holidays that the farm labour

reported for some of the southern States amounts to only 2,034 hours. The total for Wisconsin is 3,421 hours. Since this is a dairy State, a large amount of work is done on Sundays and in all seasons. The Wisconsin farmer works about two-thirds more hours than farmers in some of the southern States and many more than farmers in China Hard work is an important factor in the prosperity of the American farmer. He spends more years in school than does the Asiatic or negro farmer. He works more hours per year and usually is able to retire earlier. He may work fewer hours in his lifetime than the Asiatic farmer. In the regions

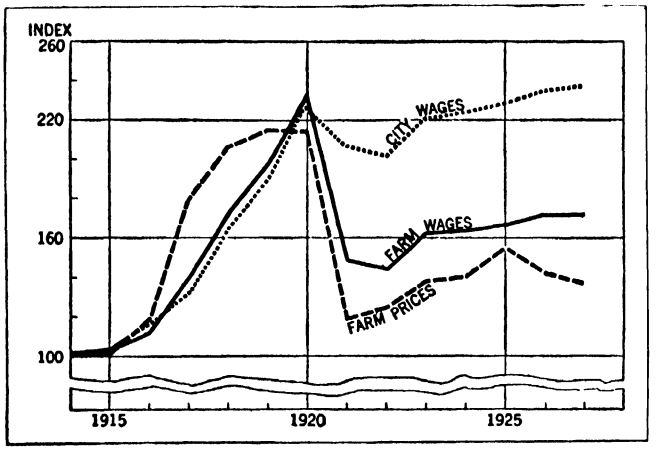


FIG. 16.—PRICES RECEIVED BY FARMERS FOR FARM PRODUCTS, FARM WAGES, CITY WAGES, 1910–1914 = 100 ON GRAPH
When farm prices rose, farm wages rose more rapidly than city wages. When farm prices fell, farm wages fell, but city wages remained high. Farm wages are more affected by farm prices than by city wages

that depend on crops, the amount of work during the summer is much higher than in the winter. Because of the use of machinery and the character of the population, the amount of work done per worker is very great. In China and India, there are 2ac of cropland per worker engaged in agriculture; in England, 9; and in Iowa, 56 When the high yield of corn per acre is considered, this large acreage indicates the very high production per worker in Iowa The production per worker in the southern States is much lower because negroes do so much of the work They accomplish much less per hour because so little machinery is used. There are only 10ac. of crops per person engaged in agriculture in South Carolina. While farms in the United States are large in acreage compared with those of Europe or Asia, they are small if measured in terms of workers. The labour force of the average farm consists of the operator, one hired man for each three farms and one member of the family assisting the operator for each three farms. The average farm, therefore, has less than two workers (Table XXXII.)

TABLE XXXII. *Number of Acres of Crop Land per Person Employed in Agriculture*

Country	Acres of crop land per worker
China	2
India	2
Italy	4
Russia	4
Germany	6
Belgium	6
France	8
England	9
Scotland	17
United States	24
South Carolina	10
New York	24
California	26
Iowa	56
North Dakota	100

Yields per acre in the United States are lower than in western Europe, but crop acres per worker are so much higher that the production per worker is about three times as much as in Europe, and six times as much as in Italy. From 1910–25, the population of the United States increased 23,000,000, but the farm population decreased over 3,000,000, in spite of which, the crop production increased about 10%. In 1925, the farm population was 28,984,221, or one-fourth of the total population

Many more children are born on farms than are needed to do the farm work. Probably about one-half of the farm children go to cities There is a constant movement from farms to cities and a smaller flow from cities to farms. A ten-year study of this question in New York State showed that on the average, about five persons went to cities from the farm for about every two persons that left the cities for the farm. The rate of movement from year to year was primarily dependent on conditions of city employment and profits of farming In 1920, the net movement from New York farms to cities was 24,000 The following year, unemployment in cities was serious and the net movement was only 3,000.

TABLE XXXIII *Domestic Exports from the United States, 1900 26*—000 omitted*

Years ending June 30	Pork and its products, pounds	Beef and its products, pounds	Milk, condensed and evaporated, pounds	Butter, pounds	Eggs, in the shell, dozen	Wheat, including flour, bushels	Tobacco, unmanufactured, pounds	Cotton, including linters, bales	Cotton-seed cake and meal, pounds	Linseed cake and meal, pounds	Cotton-seed oil, crude and refined, gallons	Oleo oil, pounds
1900–04	1,305,217	636,969		15,425	3,125	196,690	328,321	6,669	1,074,720	552,190	38,792	147,626
1905–09	1,248,682	599,332		12,484	5,439	116,181	321,197	8,303	1,173,349	684,450	45,863	188,550
1910–14	913,025	221,513	15,774	4,278	13,170	107,103	392,183	8,840	933,288	661,819	36,192	116,225
1915–21	1,678,917	434,209	383,512	19,519	26,392	257,030	468,037	6,290	706,718	397,783	27,923	78,154
1922–26	1,563,645	188,223	191,475	7,202	30,783	207,237	496,665	6,904	567,863	579,815	8,203	102,130

*U.S Department of Agriculture, *Yearbook*, 1926, pp. 1,177–80.

TABLE XXXIV. *Imports into the United States, 1900–26*—000 omitted*

Years ending June 30	Total hides and skins, except furs, pounds	Wool, unmanufactured, pounds	Coffee, pounds	Sugar, raw and refined, pounds	Coconut meat, broken or copra, shredded or prepared, pounds	Olive oil, edible and inedible, pounds	Molasses, gallons	Tea, pounds	Total tobacco, unmanufactured, pounds
1900–04	309,360	155,394	928,799	3,788,348	.	9,746	13,788	94,342	28,216
1905–09	372,292	209,413	965,058	3,922,704	15,010	32,541	20,221	98,353	38,688
1910–14	530,909	207,584	899,339	4,388,801	45,128	41,736	33,859	95,108	55,790
1915–21	573,359	394,663	1,227,534	5,962,139	252,370	45,472	113,669	105,675	66,695
1922–26	436,741	329,968	1,337,950	8,449,009	358,772	113,967	179,021	96,089	68,470

*U.S. Department of Agriculture, *Yearbook*, 1926, pp. 1,177–80.

Exports and Imports.—The chief agricultural exports are cotton, wheat and pork. Nearly one-half of the cotton crop is exported. For a number of years before the World War, exports of food products declined, but exports of cotton increased. In the war period, there was a great increase in exports of food, but a decline in exports of cotton. After the war, food exports declined rapidly, but exports of cotton increased.

About three-fourths of the pork exported goes to Europe. Considerable pickled pork and pickled beef go to tropical countries. Most of the cotton and wheat go to Europe. Condensed milk, powdered milk, cheese and eggs are exported to tropical countries. As a whole, the major exports go to Europe and the major imports come from the tropics. The chief agricultural imports are sugar, coffee, hides, rubber and wool, all of which have constantly increased (Tables XXXIII., XXXIV., p. 416).

Taxation.—The usual method of farm taxation in the United States is a capital levy. The farms are assessed on the estimated value at market prices. In most States, machinery, live-stock and other personal property are similarly appraised. A certain percentage of this appraisal value is taken for school taxes, another for local and State taxes. A few States do not levy direct taxes for State purposes Farmers contribute very little direct taxes to the Federal Government, as it levies no taxes on property. This system of taxation was fairly satisfactory when conditions were so uniform that the market price of a property represented its income-producing power. Such a method of taxation is unfair to industries with a slow turn-over. The most striking cases are forests and orchards, which give no returns for many years, agriculture as a whole has a very slow turn-over compared with commerce (Table XXXV.).

So much income is now derived from salaries, copyrights, patents, use of mails in advertising, etc., that real estate is no longer a good measure of ability to pay Another difficulty is that railroads and manufacturing plants derive their revenue from large areas, but when taxed as real estate in some political unit, the tax does not go to the regions that contribute the business. With the growth in total taxes, considerable dissatisfaction with this method of taxation is developing A few States are discontinuing direct property taxes and most States are raising an increasing percentage of their income from other sources. However, revenues for schools, roads and local government are based on property. Dissatisfaction with this system is resulting in increased aid for schools and roads from the State and nation.

The changes in taxes on a few farms in New York State indicate the increasing burden of taxation. One hundred years ago, six days of labour at farm wages were required to pay the taxes, but now about 37 days are required. The taxes could have been paid with 3bu. of wheat, but 104bu. are now necessary. In most States, taxes were from two to nearly three times as high after the World War as before. They rose almost directly in proportion to wages. The major portion of the farm taxes are spent for labour and for salaries of school teachers and other public employees. Therefore, they rise as these payments advance.

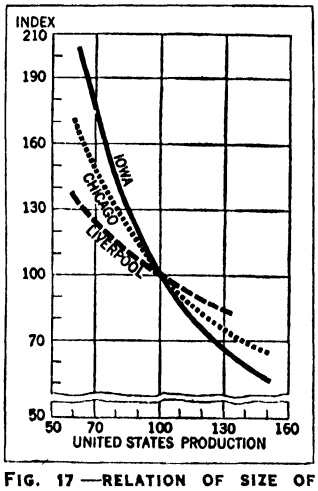


FIG. 17.—RELATION OF SIZE OF THE UNITED STATES CORN CROP TO PRICES
A crop, 20% below normal, increased prices to Iowa farmers 42%, but prices in Liverpool only 15%

Land Values.—The average value per acre of farms in the United States nearly doubled in the 50 years ending with 1900 and doubled in the following 10 years. Prices declined from 1870–80, and from 1890–1900. They rose rapidly from 1910–20 and declined thereafter. The rise in the price of farm-land does not indicate an increase in the value of the same property. Thousands of acres of land were drained. Many new buildings were erected and others improved. Land was cleared, fences were built, orchards were planted. There is no way of telling what portion

TABLE XXXV. *Index Numbers of Farm Taxes*

Year	New York* 1910–14 = 100	Ohio† 1910–14 = 100	Texas** 1914 = 100	Missouri‡ 1910 and 1913 = 100	Kansas§ 1910–14 = 100	North Dakota¶ 1910–14 = 100	United States§§ 1914 = 100
1880		63					
1881		64		57	21		
1882		67			24		
1883		71			25		
1884		73					
1885		73			32		
1886		72					
1887	55	73			41		
1888	56	73					
1889	65	70			48		
1890	64	73					
1891	55	64			45	21	
1892	62	67				21	
1893	63	67		64	47	21	
1894	62	67				21	
1895	63	67			46	21	
1896	62	66			45	32	
1897	60	67			45	21	
1898	58	68			50	32	
1899	63	71			47	32	
1900	59	72		50	48	32	
1901	61	70			50	32	
1902	55	69			51	43	
1903	62	79			60	43	
1904	63	79			57	43	
1905	65	82			64	53	
1906	62	87			66	64	
1907	68	89			73	64	
1908	77	99			75	74	
1909	77	100			84	85	
1910	82	100		93	87	96	
1911	98	91			96	85	
1912	101	97			99	96	
1913	105	105		107	105	106	
1914	113	107	100		110	117	100
1915	122	138			120	128	
1916	123	136			127	149	
1917	143	137		121	146	149	106
1918	146	149			158	181	
1919	166	179	210	164	198	202	130
1920	198	208			242	277	155
1921	191	227			270	287	217
1922	197	221	226	264	247	309	232
1923	219	229	229	286		298	246
1924	220	245		286		287	
1925	231						253
1926	234						250
1927							250

*M. S. Kendrick, "An Index Number of Farm Taxes in New York, and its Relation to Various Other Economic Factors," Cornell University Agricultural Experiment Station *Bulletin* 457, p 3, Dec. 1926.

†O. W. Johnson, "An Index Number of Farm Taxes in Ohio, 1881–1924, inclusive," Ohio Agricultural Experiment Station, the *Bi-monthly Bulletin*, vol. x., No. 9, Whole Number 177, p. 188, Nov.–Dec. 1925.

**F. A. Buechel, "Trend of Taxes on Agricultural Land in Texas and Distribution of the Farmers' Tax Dollar," Agricultural and Mechanical College of Texas *Bulletin* 334, p 9, Sept. 1925.

‡C. O. Brannen and S. D. Gromer, "Taxation of Farms in Missouri," Missouri Agricultural Experiment Station Research *Bulletin* 93, p. 4, Nov. 1926.

§E. Englund, "Tax Revision in Kansas," Kansas Agricultural Experiment Station *Bulletin* 28, p. 11, Dec. 1924. Total tax levy of the State (mostly farm taxes).

¶R. W. Newton and A. H. Benton, "Some Tax Problems of North Dakota Farmers," North Dakota Agricultural Experiment Station *Bulletin* No. 203, p. 13, Oct. 1926. General property taxes, excluding levies by cities and villages in North Dakota.

§§H. C. Wallace, "The Year in Agriculture." The Secretary's Report to the President, *Yearbook* of the Department of Agriculture 1923, p. 8 (1924). Data for 1925–27 from Report on the Agricultural Situation by the Special Committee of the Association of Land Grant colleges and universities, p. 20, Nov. 1927.

TABLE XXXVI. *Value of Farm Lands per Acre*

	1850	1860	1870	1880	1890	1900	1910	1920	1925
	$	$	$	$	$	$	$	$	$
Massachusetts	32.50	36.92	42.64	43.52	42.54	50.21	67.51	99.25	107.53
New York	29.00	38.30	57.36	44.41	44.08	39.21	53.78	69.07	70.95
Iowa	6.09	11.91	25.26	22.92	28.13	43.31	96.00	227.09	148.87
Georgia	4.20	5.89	4.00	4.30	6.30	6.95	17.78	44.74	26.77
Texas	1.44	3.48	3.27	4.70	7.78	5.50	16.39	32.45	27.77
California	0.99	5.58	12.36	15.79	32.53	24.56	51.93	104.67	114.57
United States	11.14	16.32	22.72	19 02	21.31	19.82	39.60	69.38	53.52
Acres of land that a month's labour at farm wages would buy			0 44	0 65	0.62	0.70	0 49	0.68	0 71

of the increase was due to improvements and what portion to rising prices. Prices in typical States are shown in Table XXXVI The corn belt is the region of highest land price and has shown the greatest increase in prices.

The acres of land that could be bought with the cash paid for a month's labour in addition to board, are shown in Table XXXVI. The largest amount of land that could be bought with a month's labour was in 1925 when one-half more land could be purchased than in 1870 or 1910. Some farmers acquire land by gift or inheritance, but the majority acquire it by working as hired men or as tenants. The most common single method is to work as a hired man and later as a tenant.

Prices.—American agriculture is characterized by family farms operated with machinery on a commercial basis. When the chief purpose of the farmer was to raise his own supplies, prices were of minor concern A large crop was an occasion for thanksgiving and was in fact the origin of Thanksgiving Day. With commercial agriculture, a large crop usually brings the American farmers less than a small crop. Formerly, a large crop meant that the farmer would live well. To-day, with commercial agriculture, it means that he lives poorly

The relations of the size of the corn crop to prices paid to farmers in Iowa, and to prices in Chicago and Liverpool, are shown

TABLE XXXVII. *Relation of the Size of United States Crops to Prices**

Crop	Crop 20% below normal	Crop 20% above normal
	Percentage that prices were above normal	Percentage that prices were below normal
Potatoes:		
Minnesota farm price (1895–1915)	50	28
Rhode Island farm price (1895–1915)	22	15
Corn.		
Iowa farm price (1877–1913)	42	25
Chicago wholesale price (1876–1913)	26	17
Liverpool wholesale price (1898–1913)	15	11
Beef cattle:		
Nebraska farm price (1890–1914)	50	28
Chicago wholesale price (1890–1914)	17	12
United States retail price (1890–1914)	15	11

*G F. Warner and F. A. Pearson, "Inter-relationships of Supply and Price," *Cornell University Agricultural Experiment Station Bulletin 466*, Sept. 1927

in fig. 17 and Table XXXVII. A crop 20% below normal ordinarily sells for about 42% above the normal price on Iowa farms, but brings only 15% above the normal price in Liverpool. A crop 20% above normal ordinarily sells for about 25% below normal prices in Iowa, but prices in Liverpool are depressed only about 11%. Retail prices of corn meal are only slightly affected by the size of the corn crop. A crop of potatoes 20% above normal depresses the Minnesota farm price 28%, but reduces the Rhode Island farm price only 15%. The smaller reduction in price in Rhode Island is because farmers there are so near the consumers that the farm price is more like a retail price. Most of the American farm products are so far from consumers, that prices fluctuate with extreme violence. Prices to European farmers usually fluctuate less, not only because farmers are nearer the consumers, but because so large a part of the product is consumed on the farms. Commercial production far from consumers results

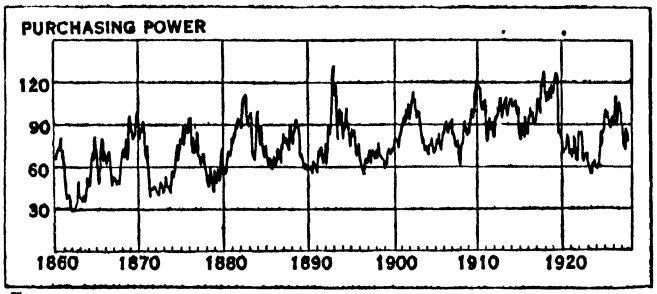


FIG. 18.—PURCHASING POWER OF THE PRICE OF HEAVY HOGS AT CHICAGO, 1860–1927
The centres of the major cycles of low prices are from 5 to 8 years apart. If this cycle is of usual length, hogs may decline in purchasing power

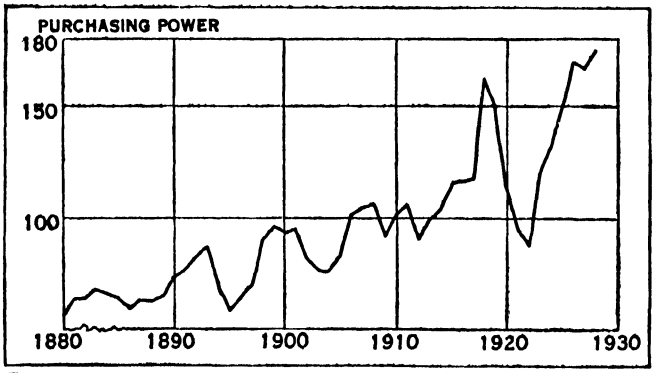


FIG 19.—PURCHASING POWER OF THE PRICE OF SHEEP IN THE UNITED STATES, 1880–1928
Sheep have periods of high and low prices, usually lasting about 4 or 5 years. On Jan. 1, 1928, the purchasing power of sheep was the highest ever known, 175

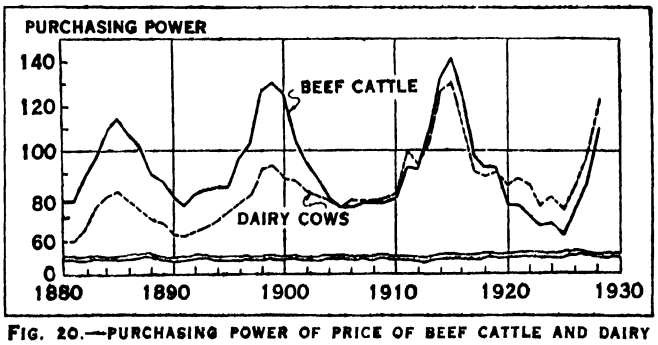


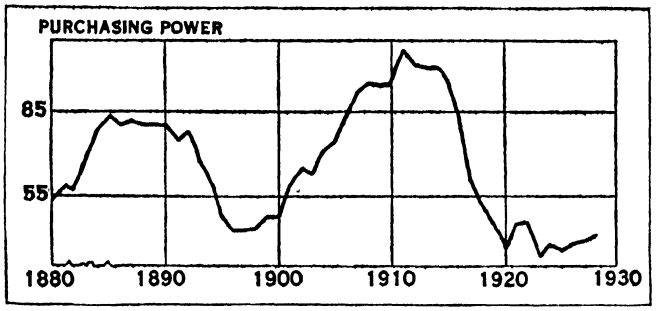
FIG. 20.—PURCHASING POWER OF PRICE OF BEEF CATTLE AND DAIRY COWS IN THE UNITED STATES, 1880–1928
The major centres of high and low prices of dairy cows and beef cattle occur at the same time. The periods of high prices are about 16 years apart. The last high period was in 1915

in violent price fluctuations. In agriculture, this problem is comparable with that of unemployment in cities.

For most industrial products, a year of high prices is one of high production, because it takes such a short time to produce goods. In agriculture, a much longer time is required to produce. High prices result in increased production, but it is from one to many years before the increased product appears on the market. A retail price of round steak, 20% above normal, results in receipts of cattle at Chicago 32% above normal 8 years later. When

prices are low, animals are thrown on the market and production is checked, but it is some years before the shortage occurs. The periods of high prices of hogs are 5–8 years apart; for sheep, 4–5 years; for beef cattle, about 16 years; for horses, 25 years (figs. 18, 19, 20 and 21).

Cost of Distribution.—In 1917, beef sold at retail in the United States for an average of 23.11¢ per pound. Farmers received 8.14¢ per pound for beef cattle. There was a difference of



FROM "FARM ECONOMICS"

FIG. 21.—PURCHASING POWER OF THE PRICE OF HORSES IN THE UNITED STATES, 1880–1928

Periods of high prices usually are about 25 years apart. Apparently the price of horses has begun to advance

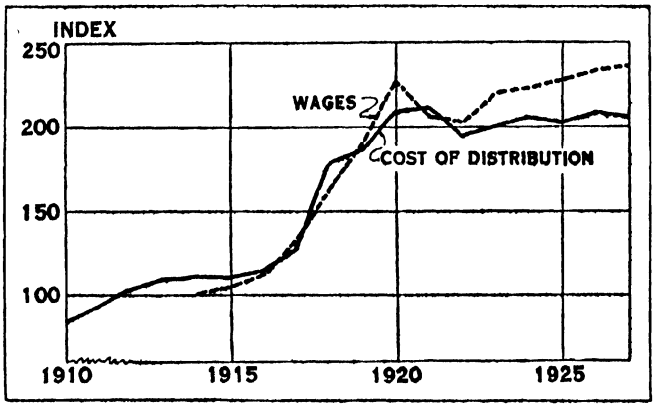


FIG 22.—COMPARISON IN COST OF DISTRIBUTING BEEF WITH EARNINGS OF NEW YORK FACTORY WORKERS

Costs of food distribution follow wages, but because of increases in efficiency have risen less rapidly than wages

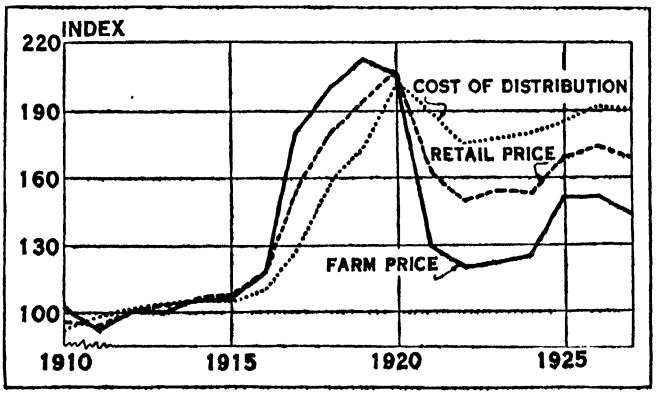


FIG. 23.—INDEX NUMBERS OF THE UNITED STATES FARM PRICE OF FOODS, COST OF DISTRIBUTION AND THE UNITED STATES RETAIL PRICE

From 1916 to 1920, costs of distribution were low and farm prices were relatively high. Since 1920, costs of distribution have been high and farm prices low

14.97¢ between the farmer and the consumer. In 1921, beef cattle retailed at 25.59¢ per pound, but farmers received only 5.53 cents. In 1917, the retail receipts from a 1,000lb. live steer amounted to $143.70. In 1921, they amounted to $159.20. In 1917, it cost $62.30 to distribute the beef and in 1921 it cost $103.92, so that farmers received $81.40 in the first case and $55.30 in the second. Some persons believe that the lower farm price in 1921 was due to over-production, but retail prices were higher than in 1917.

For the five years before the World War, the average cost of distributing the beef from a 1,000lb. steer was $49. Following the World War, it was over twice as much. In each case, the farmer received the balance. The cost of distributing foods is primarily city wages (fig. 22). When financial inflation occurs, wages and the cost of distribution are low, relative to retail prices, and farm prices are very high. When financial deflation occurs, wages and the cost of distribution remain high and farm prices are low compared with retail prices (fig. 23).

(G. F. W.; F. A. PE.)

Agricultural Chemistry.—Agricultural chemical investigations in the United States are conducted in the various bureaux of the Federal Department of Agriculture, in the agricultural experiment stations of the States, in many universities and research institutions and in the laboratories of various industrial establishments

The chemical control of commercial fertilizers and the study of fertilizer action upon the growth of crops engaged at first almost the exclusive attention of agricultural chemists in the United States The study of cattle feeds for regulatory and research purposes was next taken up and finally, with the passage of State and Federal pure food laws, the diet of man began to be investigated—first for the prevention of adulteration and then for the improvement of human nutrition The sequence of plant, animal and man, although apparently illogical as regards importance, was the natural order of research development. The passage of State and Federal laws governing the purity of insecticides made a further increase in the regulatory activities of agricultural chemists in America and the experiment stations began to find their investigational work so seriously disturbed by regulatory interferences that many of these institutions felt obliged to transfer all work of chemical control to State chemists. The policy of separating research and control work has been adopted by most of the State experiment stations. It was put into effect in the U S. Department of Agriculture in 1927, when the execution of the Food and Drugs Act, the Insecticides Act, the Tea Inspection Act and the Naval Stores Act was transferred from the Bureau of Chemistry to the purely regulatory Office of Food, Drug and Insecticide Administration. The agricultural chemical research work of the department upon soils, fertilizers, foods, etc., was consolidated in a new Bureau of Chemistry and Soils.

A survey of the last classified list of projects of the U.S. agricultural experiment stations shows that of a total of 6,610 projects some 1,400, or about 21%, involve various applications of chemistry to agriculture. Of these 412 relate to fertilizers and fertilizer experimentation, 188 to soils and waters, 172 to animal nutrition and 117 to human nutrition. Agricultural chemical investigations as a whole follow the numerical order of plant nutrition, animal nutrition and human nutrition. Individual State experiment stations specialize in particular types of research, lysimeter studies upon percolation in soils, for example, being given the most attention in Tennessee, soil acidity in Rhode Island, alkaline soils in California, vegetable proteins in Connecticut and animal calorimetry in Pennsylvania. The lines of investigation depend naturally upon the predominating agricultural needs of each section, chemical investigations upon dairy products being stressed by New York, Wisconsin and other large milk-producing States, those upon flour by Minnesota and the other wheat-growing States, those upon sugar production by the cane-growing States of the South and the beet-producing States of the West and those upon corn by Iowa and other large corn-growing States of the Middle West. The most active subject of agricultural chemical research in America at the present time is that of vitamins, 23 of the State experiment stations conducting investigations in this field. Other investigations upon vitamins are being carried out in the research laboratories of various universities and in the bureaux of the U S. Department of Agriculture.

In the U S. Department of Agriculture agricultural chemical researches are conducted in the bureaux of chemistry and soils, plant industry, animal industry, dairy industry, forestry, entomology, home economics and agricultural economics. Among the more important chemical projects of these bureaux are investiga-

tions upon soils, fertilizers and nitrogen fixation; foods and food technology; human and animal nutrition; plant constituents; insecticides and fungicides; chemistry and technology of tanning materials, leather, paper, farm fabrics, sugar, starch, oils and fats; meat products, dairy products, forestry products, etc.; storage of fruits, cereals and vegetables; utilization of farm wastes; spontaneous combustion; deterioration of agricultural products; explosions of agricultural dusts; and methods of agricultural chemical analysis. Important agricultural chemical researches are also conducted in the United States in the laboratories of the large packing houses and other industries which utilize agricultural products.

The most important agricultural chemical organization in the United States is the Association of Official Agricultural Chemists (established 1884) which publishes a journal and books of methods upon agricultural chemical analysis. (C. A. B.)

EXPERIMENT STATIONS

In the United States experiments were early conducted by the agricultural colleges, but not until 1875 was the first American experiment station with State support established. This was situated at Middletown, Conn., under Dr. W. O. Atwater, and later removed to New Haven with Dr. S. W. Johnson as director. It still survives as the oldest American station. The University of California next provided funds for a station at Berkeley, under the leadership of Dr. E. W. Hilgard. Other States soon followed, so that by 1887 there were about 18 stations, some with meagre support.

The movement for a nationally supported system of experiment stations culminated in the passage of an act approved on March 2, 1887, and designated the Hatch Act, in honour of its champion, Hon. William H. Hatch. It authorized an annual appropriation of $15,000 for an experiment station in connection with each of the agricultural colleges established under the Land Grant Act of 1862. This gave a marked impetus to the experiment stations, and States which had not previously provided them promptly took advantage of the act. In 1906 the fund was supplemented by the Adams Act, designed especially to promote original scientific investigation of agricultural problems. On its maturity in 1911 this act doubled the annual Federal support. This was again enlarged in 1925 by the Purnell Act, which authorized an increase of $20,000 to each State the first year, with annual additions of $10,000 until $60,000 was reached and also extended the scope of research to include agricultural economics, home economics and rural sociology. In addition to the grants under the two previous acts, each State will thus receive $90,000 in 1930, or an aggregate of $4,320,000. The Federal grants are liberally supplemented by State appropriations, aggregating about three times those from the Federal Government. In Alaska, Hawaii, Porto Rico, Guam and the Virgin islands, experiment stations are maintained with special congressional appropriations under the Federal Department of Agriculture. The first was established in Alaska in 1898. Experimental work in the Philippines is under the insular Government, and receives no financial support from the United States.

The Federal Department of Agriculture aids in promoting the purposes of the stations through a central office of experiment stations, which exercise supervisory control over the Federal appropriations, maintains intimate relations with the stations in all the States, has charge of the insular stations, and issues a journal, the *Experiment Station Record,* begun in 1889, which reviews the publications on agricultural research throughout the world. The office also publishes an annual report on the progress of the stations. There has thus been developed a comprehensive and closely knit system of experiment stations, co-operating with one another and with the Department of Agriculture, and supported jointly by the States and the general Government. Total appropriations for the fiscal year 1927 aggregated $12,733,000, including $233,980 for the insular stations. The stations employed 2,831 persons in administration and research, some of them only part time, in addition to clerks, labourers and temporary help. Many of the States also provide branch stations or sub-stations dealing with special enterprises, such as citrus fruits, sugar, rice, tobacco, or with the special problems of localities.

In addition to the stations receiving the benefits of the Federal Acts, a number of special stations have been provided in the States, such as the poultry and fruit stations in Missouri, the coastal plain station in Georgia, the truck station in Virginia, the institute of animal nutrition in Pennsylvania, and the stations for the sugar and pineapple industries in Hawaii. In this connection, mention should also be made of the privately supported Boyce Thompson Institute for plant research at Yonkers, N.Y., opened in 1924; the Food Research Institute at Stanford university, for studying problems connected with food supply, consumption and distribution; and the Marble Laboratory at Canton, Pa., equipped for study of fruit storage.

The State experiment stations have experimental fields and trial grounds: accommodation for experimental animals; insectariums; creameries and cheese factories; veterinary hospitals; and laboratories for chemical, botanical and bacteriological study (*see* AGRICULTURE IN THE UNITED STATES: *Agricultural Chemistry*)

All the stations publish bulletins, circulars and annual reports dealing with the results of their work, and these are sent through the mails free of postage. Many popular articles are prepared for the Press, while the more technical features of research are published in appropriate scientific journals. The stations are in close contact with the farming public and with extension workers. The results of experiments are thus spread broadcast, often being applicable far beyond the boundaries of the State in which the investigations were carried on. (E. W. A.)

AGRICULTURE, BOARD OF: *see* GOVERNMENT DEPARTMENTS.

AGRICULTURE, CENSUS OF. The term "census" originally was restricted to a periodical enumeration of the population of a country by its Government, but its significance has widened. It is now applied to any systematic statistical enquiry, on a wide scale, into the economic or sociological conditions of the population or a section of it. Special enquiries in connection with agriculture have been made either annually or at less frequent intervals in many countries for a considerable period (*see* AGRICULTURAL STATISTICS), but they were limited in scope. Usually they were confined to statistics of the number of farms or holdings, the acreage and yield of crops and the number of live stock. An agricultural census is more comprehensive. Its object is to obtain a complete return of the production from agricultural land, and of the power—human, animal or mechanical—employed in the production.

GREAT BRITAIN

In Great Britain an agricultural census was first taken in connection with the Census of Production Act, 1906. Under this act compulsory powers were given to the Board of Trade to obtain returns of the output of all industries, but agriculture was expressly excluded, mainly on the ground that much of the information relating to that industry was already obtained annually under a long-established system of voluntary returns from all occupiers of farms. On Nov. 23, 1907, the Board of Trade addressed a communication to the Board (now the Ministry) of Agriculture stating that for the purposes of the census of production schedules issued by them would be required to be filled up by manufacturers and other industrialists, but in the case of the produce of agriculture it was proposed to leave the collection of the necessary information to the agricultural department. The Board of Agriculture acquiesced and proceeded to issue a series of enquiries designed to supplement and complete the information obtained by the annual agricultural returns.

Census of 1908.—The results of the census taken in 1908 were published under the title of "The Agricultural Output of Great Britain," described as a "Report on enquiries made by the Board of Agriculture and Fisheries in connection with the Census of Production Act, 1906, relating to the total output of agricultural land, the number of persons engaged and the motive power employed." The "output" from agricultural land is not the same as the production. It is evident that crops produced and consumed

by live stock would be reckoned twice if their total bulk were added to the beef, mutton and pig-meat produced. Such crops are of the nature of raw materials used in the process of manufacture. The object therefore was to calculate the net production or "output," being, in fact, that part of the gross production which is sold off the farms. The total value of the crops grown in 1908 was calculated (at market prices) at £125,000,000, of which £46,600,000 represented the portion actually sold. The actual value, or, as it is termed, the "consuming value" of the major portion of the crops was thus dependent on their realization in other forms.

The total sales, *i.e.*, the "output" from all the farms, were:

	£
England and Wales	127,650,000
Scotland	23,150,000
Great Britain	150,800,000

The permanent labour employed throughout the year on the farms of Great Britain, excluding the occupiers themselves but including members of their families, was 1,173,000 persons. Consequently the gross output per person employed was £129. On the total area included in the agricultural returns the gross output amounted to £3 3s. 1d. per acre but the range was very wide on different classes of land. Thus the return from woodland was only about 6s. and from rough grazings not more than 10s. or 12s. per acre. On the cultivated area, *i.e.*, the farmed land proper, the average output was £4 10s. per acre. The mechanical motive power used on farms was generated by 34,450 engines of various descriptions with a total horsepower of 213,525.

Census of 1925.—It was intended that an agricultural census should be taken, with the census of production, quinquennially, and in 1913 the Board of Agriculture again made detailed enquiries on similar lines to those made in 1908. But before the returns could be fully tabulated and analysed the outbreak of war interrupted the work and compelled the transfer of the staff engaged upon it to more urgent matters It was not until twelve years later that it became possible to resume the enquiries under the Census of Production Act, and as on the previous occasions the agricultural census was undertaken by the agricultural departments. The establishment, in the interval, of the Board of Agriculture for Scotland left the English department responsible only for England and Wales. The result of their enquiries was published early in 1927 under the title of "The Agricultural Output of England and Wales, 1925" (Cmd. 2815), and described as a "Report on certain Statistical Enquiries made in connection with the Census of Production Act, 1906, relating to the output of all kinds of agricultural produce and to the agricultural industry generally, together with a brief survey of agricultural statistics up to 1925."

The scope of the report was wider than that relating to 1908 not only by the inclusion of serial tables for a number of years where the materials were available, but also by an endeavour to meet a desire expressed in the House of Commons during the years 1925 and 1926 for a complete survey of the agricultural conditions and possibilities of the country. An attempt was made to meet that demand on the statistical side, it being admitted that "there are necessary limitations to the information which can be supplied by agricultural statistics and also to the deductions which can safely be drawn from them."

The value of the total output from all farms in England and Wales in 1925 was £225,330,000. The following table gives the comparative figures for each of the main groups of products in 1908 and 1925 with the percentage increase in each case:

	Thousands of £.		Percentage increase.
	1908	1925	
Live stock	50,800	78,970	55
Dairy produce	25,500	57,600	126
Poultry and eggs	4,350	15,080	247
Wool	2,100	3,000	43
Farm crops and vegetables	40,200	54,450	35
Fruit, flowers, etc.	4,200	16,230	293
Annual Totals	127,150	225,330	77

The average increase of prices in 1925 over 1908 was calculated at 77%, so that it would appear that the output was practically the same in each year although the area of agricultural land had been reduced in the interval.

Of the total output in 1925 live stock and live stock produce represented 68·6%, farm crops 20·5%, and fruit, vegetables, flowers, etc, 10·9%. Sales of fat cattle, sheep and pigs—excluding transactions in store stock between one farmer and another—represented 35%, and sales of dairy produce 25·6% of the total sales. Poultry and eggs, the output of which increased since 1913 to a greater extent than that of any other kind of produce, represented 6·7%, and wool 1·3%. Corn crops accounted for no more than 10·7%, and potatoes for 5·3% of the total. Of the corn sold about one-half in value was wheat.

Strictly speaking the output of farms is meat-animals and not meat itself in its consumable form. But, following the precedent set in the 1908 report, a calculation of the quantity of meat represented by the animals sold annually off the farms was included in the 1925 report. The average number of each kind of meat-animal slaughtered annually was calculated as follows, the numbers being in thousands (000's omitted):

Cattle	*Calves*	*Sheep and lambs*	*Pigs*
1,225	785	5,194	3,518

The average total quantity of meat produced (in thousands of cwt.) was:

Beef	*Veal*	*Mutton and lamb*	*Pig-meat*	Total
6,866	609	2,411	5,026	14,912

There has apparently been a substantial reduction in the production of English meat. If the estimated weight of meat of all kinds is added together the total quantity has decreased since before the war by 15% Taking into account the increase of population the supply per head of English meat fell from 55 lb. to 44 lb., a reduction of 20%. The change in the extent of the home supply varies in each kind of meat. Beef production declined by 17% and mutton and lamb by 38%, but veal increased by 30%, and the production of pig-meat remained about the same.

Of the total quantity of milk produced about four-fifths is consumed in its natural state as liquid milk. Of the remainder about three-fourths is made into butter and one-fourth into cheese. The production and disposal of milk and dairy produce in England and Wales in the year ending June 4, 1925, are shown in the following table:

	Sales off farms		Consumed in farm households		Total	
	Actual	Equivalent in milk	Actual	Equivalent in milk	Actual	Equivalent in milk
	Millions of gallons					
Liquid milk	818	818	70	70	888	888
	Thousands of cwt.		*Thousands of cwt.*		*Thousands of cwt.*	
Butter	454	133	115	33½	569	166½
Cheese	481	54	21	2	502	56
	Thousands of gal.				*Thousands of gal.*	
Cream	650	6½	..	.	650	6½
Total milk		1,011½	..	105½	.	1,117

The cream consumed in farm households is included under liquid milk. A considerable portion of liquid milk is sold by farmers to factories and creameries where much of it is converted into butter or cheese. Consequently the amount of milk actually consumed is less, and that of butter and cheese greater, than is shown in the above table.

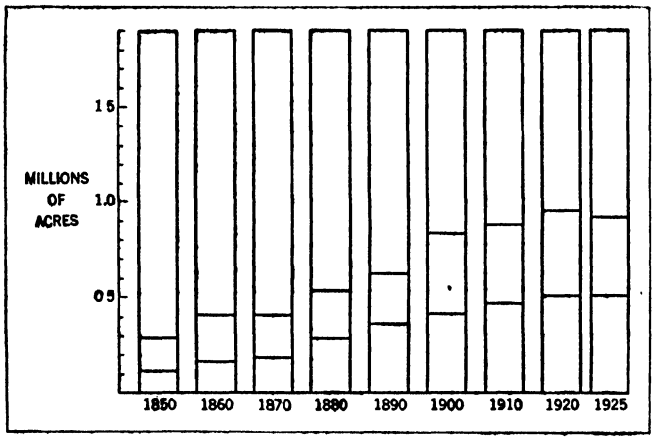
Returns of the motive power used on farms showed a great increase in 1925, as compared with 1908, in the number of oil or petrol engines. In 1908 there were only 6,911, but in 1925 there were 56,744. On the other hand steam engines had been reduced from 8,690 to 3,731. Electric motors increased from 146 to 700. The number of motor tractors, which were not known in 1908, in use on farms in 1925 was 16,681.

Persons Employed.—An exact calculation of the amount of manual labour employed in agriculture is not possible owing to uncertainty as to the number of persons, male and female, who are engaged only on part-time or for certain seasonal occupations (*see* AGRICULTURAL LABOURER). The report suggests that "the total number of persons employed in the agricultural and horticultural industries in 1925 was in the neighbourhood of 800,000 which, with about 300,000 employers or persons working on their own account, gives a total of 1,100,000 engaged in the industry." On the basis of these figures it is calculated that the average output per person employed was £282, while if employers working on their own account are included the average is £205.

No official returns of the rent of agricultural land had previously been collected, but in connection with the agricultural census of 1925 estimates were obtained from the crop reporters of the average rents of holdings of various types. The average for all holdings, omitting those devoted solely to fruit, vegetables or poultry, was 31s. per acre. For arable holdings the average was 26s., for pasture holdings 36s., and for mixed holdings 29s. per acre. Classified according to size-groups, rents averaged 62s per acre for holdings of 1 to 5 acres and 51s. for holdings of 5 to 20 acres, declining progressively to 24s for holdings of 300 to 500 acres and 20s. for holdings of over 500 acres. The gross rental value of all farms was calculated at £43,350,000, and the gross capital value of all agricultural land at £815,000,000. The total amount of tenants' capital, including the value of live and dead stock, the tenant right valuation and other working capital was estimated at £365,000,000. (R. H. R.)

THE UNITED STATES

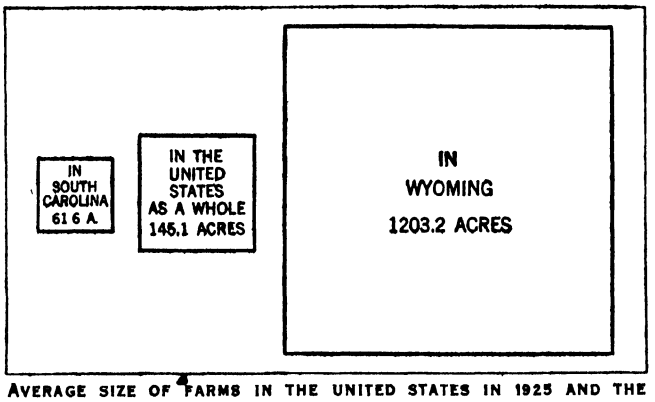
The first satisfactory census of agriculture in the United States was taken in 1850. Beginning with this date, the farm census, covering a gradually increasing number of items, has been taken in



LAND AREA OF THE UNITED STATES AND FARM ACREAGE, 1850-1925
The entire column represents the total land area of the country. The lowest sub-division of each column represents the "improved" land and the division next above, the "unimproved" land

connection with each decennial census of population up to and including 1920. In 1925 was taken the first quinquennial, or inter-decennial, census of agriculture. This census was considerably less extensive in scope than recent decennial censuses have been, and it is intended to maintain this relationship; that is, to take a complete census of agriculture in the decennial year and a census covering only the more important items in the middle of the decade.

In 1850, 1,449,073 farms were enumerated in continental United States; in 1910, 6,361,502; in 1920, 6,448,343; in 1925, 6,371,640, this census showing the first recorded decline. The census of agriculture, like the census of population, is based upon information obtained by a large force of enumerators who visit all the families in the United States, covering most of the territory within one month from the census date. The information for the census of agriculture was obtained in 1920 on a four-page standard schedule containing rather more than 400 questions. In each locality, however, there were questions that did not apply; the farmer in Maine, for example, was not asked to report cotton or oranges; and the average number of questions actually answered by the individual farmer was probably not more than 50.



AVERAGE SIZE OF FARMS IN THE UNITED STATES IN 1925 AND THE AVERAGE SIZE WITH THE SMALLEST AND THE LARGEST AVERAGE ACREAGE PER FARM

The census differs from the various estimates of crop production, live stock, etc , in that it is based upon a direct count of all the items represented, rather than upon a sample or upon calculated probabilities. The returns are carefully checked against the records of the previous census and are subjected to other forms of critical examination, so that ordinarily there is little opportunity for serious error in the count. Nevertheless the task of obtaining and tabulating reports from nearly 6,500,000 farms is one of great magnitude on the mechanical side alone. To expedite the tabulation and to facilitate the classification, the information is taken off the schedules on punched cards, one card being used for each item or group of items. The whole number of cards punched from the schedules in 1920 was 147,091,000, or about 23 cards per farm. Each of these cards went through the sorting and tabulating machines a number of times, the total amount of work of this nature amounting to the equivalent of 1,300,822,000 cards handled one time.

The information obtained in the 1920 farm census may be grouped under seven headings:

(1) Information with Regard to the Farmer.—The personal questions included sex, colour, age, country of birth, farm experience (that is, the number of years spent as farm labourer, farm tenant and farm owner) and number of years on present farm. The question on tenure may be considered as relating either to the farmer or to the farm, according to the point of view. The following tenures were distinguished: full owner; part owner; manager; cash tenant; share-cash tenant; standing renter (Southern States only); share tenant; cropper (Southern States only). The per cent of tenant farms in 1925 was 38·6, as compared with 38·1 in 1920; these figures indicate an almost negligible increase when compared with the rapid increase from 25·6% in 1880 to 38·1% in 1920. Considerable increases in the corn belt States just west of the Mississippi were offset by decreases in other parts of the country, mainly in a group of Eastern States centring in Ohio.

The classification of farmers by age and tenure shows that tenancy is most common in the younger groups and thus gives support to the theory of the "agricultural ladder," according to which the normal course of farm experience is for a young man to start as a farm-hand, perhaps on his father's farm, and then to become successively a farm tenant, an owner subject to mortgage and finally an owner of an unencumbered farm. The replies to a question on the 1925 schedule also indicate that a large proportion of the tenants outside the South rent their farms from close relatives,

the proportion running as high as 40% and even 50% in some counties. The social significance of tenancy under these conditions is, of course, radically different from what it would be if the relation between landlord and tenant were purely a business matter.

(2) Farms and Farm Property.—In addition to the total acreage of land in farms, the decennial censuses have always given the acreage of improved land; and recent censuses have also given separate figures for woodland included in farms. The census of 1925 carried a more detailed classification of farm-land, separating in particular the different types of pasture-land and showing separately crop-land idle during the preceding year and crop failure, as well as the land from which crops were harvested. The total acreage of land in farms, which increased from 293,560,614 in 1850 to 955,883,715 in 1920, declined to 924,319,352 in 1925.

Great social significance attaches to the relation between the acreage of agricultural land and the population. The changes in this relation between 1850 and 1920 are shown in the following table:

Relation between Population and Acreage of Improved Farm-land in the United States, 1850 to 1920

Census year	Population	Improved farm-land (acres)	Population per 1,000 acres of improved farm-land	Acreage of improved farm-land per capita
1920 . .	105,710,620	503,073,007	210	4·76
1910 . .	91,972,266	478,451,750	192	5·20
1900	75,994,575	414,498,487	183	5·45
1890	62,947,714	357,616,755	176	5·68
1880	50,155,783	284,771,042	176	5·68
1870 .	38,558,371	188,921,099	204	4·90
1860 .	31,443,321	163,110,720	193	5·19
1850 .	23,191,876	113,032,614	205	4·87

The improved acreage probably measures the extent of productive farm-land more accurately than does the total acreage, which includes large areas of woodland and of land useful only for grazing. The number of acres of improved land per capita was only a little less in 1920 than in 1850, indicating that the growth of the agricultural area had about kept pace with the growth of the population.

The census of 1925 shows a slight decrease in the farm acreage, but since 1920 several new factors, including the extensive replacement of farm work stock (which was a consumer of farm products) by motor equipment, have tended to keep farm production ahead of the growth in population and even to create a surplus. The value of farm property shown in the census reports includes not only the value of the farm real estate, with separate figures for the value of buildings, but also the value of implements and machinery and of live stock. The aggregate value, after increasing from $20,440,000,000 in 1900 to $77,924,000,000 in 1920, declined to $57,018,000,000 in 1925, mainly by reason of a lower price level. Data as to mortgage debt are secured only for farms operated by their owners, and the figures for the amount of debt are shown only for what are termed full owners; that is, farmers who own all the land that they operate. The reports of the census of 1920 show the rate of interest paid on the farm mortgage debt as well as the amount of debt on farms in different groups classified according to value.

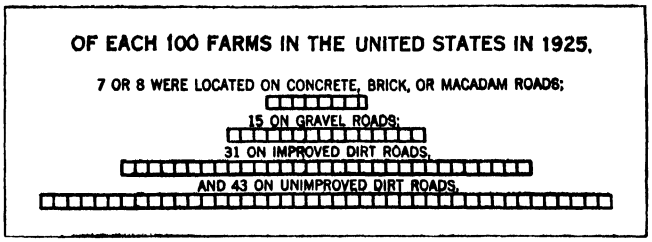
(3) Live Stock.—The live-stock inventory, as obtained at the various decennial censuses, has shown an increasing amount of detail in the classification. It has been found desirable not only to report separately the calves, lambs, colts, etc., as representing a new generation of live stock just coming into existence, but also to make other age classifications, separating, for example, horses and cattle between one and two years old from those two years old and over. Sex classifications are also required. Recent censuses have attempted to separate dairy cattle from beef cattle, though the results so far obtained have not been absolutely satisfactory, mainly because of the difficulty of classifying general-purpose cattle.

(4) Crops.—Perhaps the simplest and most fundamental item in the farm census, after the number and acreage of farms, is the acreage of the more important crops harvested in the year preceding the date of the census enumeration The census schedules call both for the number of acres harvested and for the quantity of the product. Previous to 1920 each farmer was asked to state also the value of his product. Beginning with 1920 the average value per bushel or other unit of measure has been obtained independently for most of the crops, and the value has been computed for the total production of each county.

The cotton crop receives special attention. Its acreage and production are reported along with other crops in the returns of the decennial or quinquennial censuses. In addition reports of production are secured every year from the ginners of cotton. These reports are received (and published) semi-monthly during the major part of the ginning season, and the total production of cotton, as reported by the ginners, is available to the public shortly after the harvest is completed. The cotton-ginning reports probably represent the most accurate statistics of crop production that are available for any crop on a large scale anywhere in the world.

(5) Live-stock Products.—The live-stock products reported in the census comprise wool and mohair, eggs and chickens and dairy products, including the total production of milk, the production and sales of butter, and the sales of milk, cream and butterfat. Some difficulty is experienced in obtaining accurate reports from the farmers as to the total production of milk, except in cases where practically the whole amount is sold The proposal that this question be omitted from the schedule by reason of this difficulty meets with instant objection, however, from those who use the statistics of the dairy industry. In connection with live-stock products, the census bureau makes practically the only estimates —as distinguished from enumerations—which appear in its decennial reports. A considerable number of farmers report the number of sheep which they had on the census date but fail to report the wool production; other farmers likewise report chickens but no eggs, or dairy cows but no milk. For the farms failing to report production, estimates are made on the basis of the average production per unit as shown by the complete reports.

(6) Miscellaneous Items.—Data for farmers' expenditures for feeding stuff, fertilizers and labour have been obtained as a part of the farm census for several decades. In 1920 new items were introduced, including the number of tractors and automobiles on farms, the number of farm houses equipped with running water or with electric or gas lights, and the number of farms having telephones. In 1925 the tractor item was continued, a question as to radio sets was asked, and a query was added as to the kind of road on which the farm was located.



THE NUMBER IN EACH 100 FARMS IN THE UNITED STATES SUB-DIVIDED BY THE CHARACTER OF ROADS UPON WHICH THEY ARE SITUATED

(7) The Farm Population.—The farm population, as distinct from the total rural population, was reported for the first time in the population census of 1920. Farm population figures were also secured in the farm census of 1925. Under the definition employed in 1920, farm labourers not living on a farm but living in strictly rural territory, outside any incorporated place, were included with the farm population. In 1925 the enumeration was necessarily limited to those persons living on farms, since the canvass covered only the farms. Estimating and deducting from the 1920 totals the non-farm-resident farm labourers, it appears that the farm resident population of the United States decreased from about 31,000,000 in 1920 to about 29,000,000 in 1925, or an average an-

nual decrease of 400,000. During the same years the total population of the country was increasing at the rate of about 1,800,000 per year, so that while the farm population was decreasing at the rate indicated, the non-farm population was increasing at the rate of 2,200,000 per year.

The census statistics thus indicate the current trend, not only in such material elements as acres of land, bushels of wheat and thousands of cattle and hogs, but also in the more important element consisting of the people who make their homes on the nearly 6,500,000 farms in the United States and depend for their livelihood mainly on the products of agriculture. (L. E. T.)

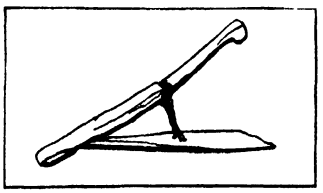
AGRICULTURE, CHAMBERS OF. The Central Chamber of Agriculture in Great Britain was founded in 1866 simultaneously with the formation of local chambers in the country. These were combined into one association, known as the Central and Associated Chambers of Agriculture. The objects of the Association are to promote the interests of agriculture, and with that view to watch over all measures affecting agriculture both in and out of parliament, and to take such action thereon as may seem desirable in its interests. The scope of the association has widened, and it now comprises not only chambers and farmers' clubs, but agricultural societies, unions, federations, dairy associations and other agricultural institutions. Its aim is to form a common centre for all the different sections and groups in the industry. The work of the chamber is governed by a council of twenty-four members chosen by the subscribing members of the central chamber, and about 70 deputies appointed annually by the various federated bodies.

AGRICULTURE, DEPARTMENT OF: *see* GOVERNMENT DEPARTMENTS.

AGRICULTURE, ELECTRICITY IN: *see* ELECTRICAL POWER IN AGRICULTURE.

AGRICULTURE, INTERNATIONAL INSTITUTE OF: *see* INTERNATIONAL INSTITUTE OF AGRICULTURE.

AGRICULTURE, PRIMITIVE. Agriculture (cultivation or tillage of the ground for the production of plants for food) is the basis of civilization, and primitive agriculture marks the transition from the lowest cultural stage, commonly called savagery. When and where, how and why were the first steps taken? No simple answer can be given. As to the date and place, a few hints are given by archaeology, but where primitive agriculture is now established there is rarely even a tradition of its origin. "God Almightie first planted a garden" is the general belief, God being represented by Osiris in Egypt, King Kintu in Uganda, Sidi or Soidi in Torres Strait, Ofanu in Tahiti, Tupan in Brazil, and by all the other local culture-heroes who brought the good gifts to men. As to the how and the why, information must be sought in areas where beginnings are being made. There is as yet no cultivation of the soil or raising of crops in the Arctic regions, in the semi-desert regions of north and south Africa and Arabia, in the prairies of North America, the steppes of Asia, the high plateaux of Tibet and Mongolia, or the whole of central Australia. It is unknown also in certain jungle areas inhabited by groups of pygmy peoples, such as the Negrilloes of the Congo, the Andamanese, the Semang of the Malay peninsula, and there is no record of it among the extinct Tasmanians.

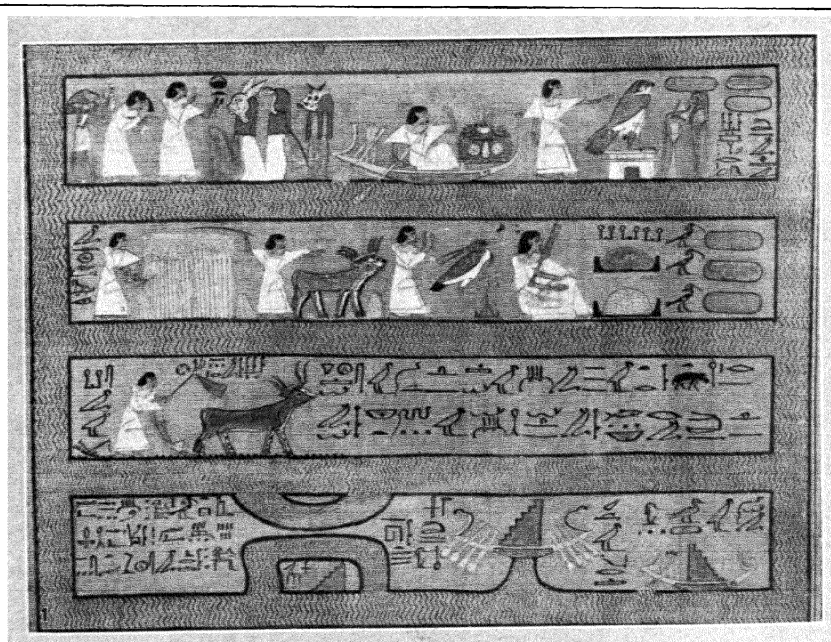


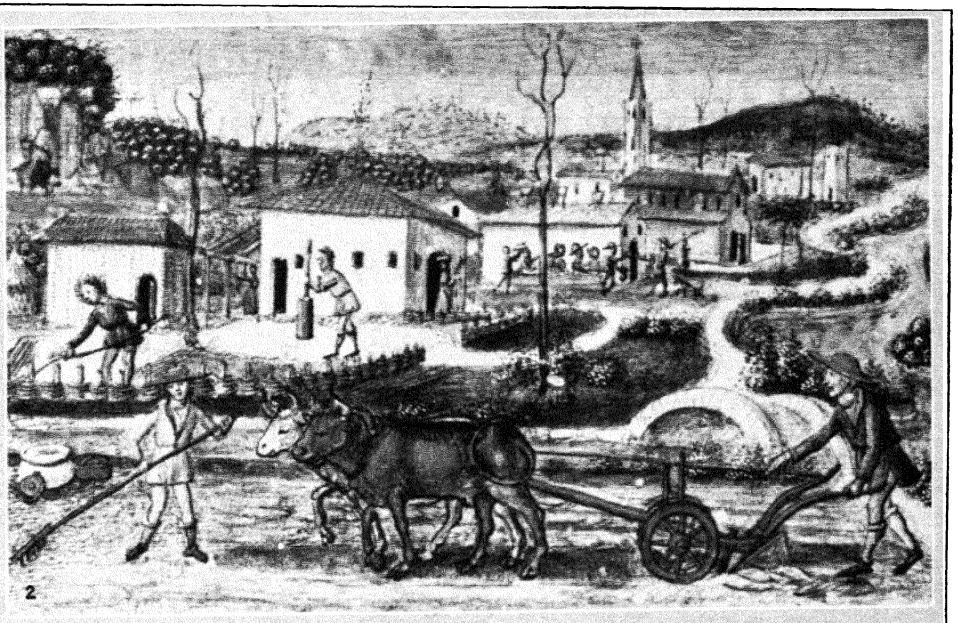
AN EGYPTIAN HOE FOUND AT THEBES USED IN THE NILE VALLEY ABOUT 2,000 B.C.

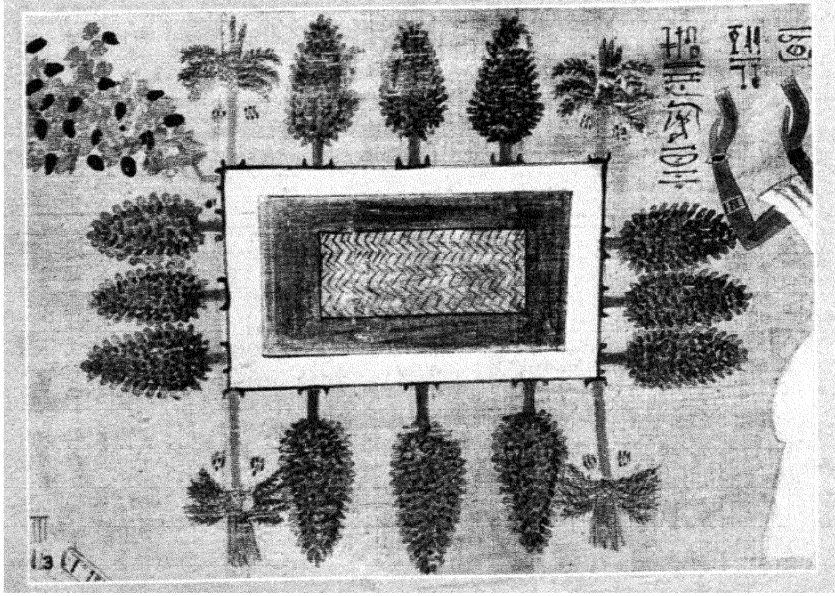
The first steps have been noted in various parts of the world. In Western Australia a species of flag was cultivated to the extent of burning down the crop at the end of the season to improve the next crop. Also, when digging up yams, the natives replaced the heads in the holes. Purslane (*Portulaca*) was also encouraged if not artificially cultivated. The Besisi of the Malay peninsula used to carry fruit they were eating to fresh spots so that the seeds might spread over the country. In Arizona a company of Cocopa, Mohave or Pima women, safely guarded by a number of men, set forth to a rich and favourable spot on the side of a cañon. Each woman has a little bag of gourd seed, and she plants these, one by one, in rich crannies or crevices where the roots can find sustenance, the sun may shine in, and the fruit may later swing down, as from a trellis. The planters go home and take no further notice of their vines until they return in the autumn to collect the gourds. In manioc areas, the natural means of procuring food is still by hunting. Cassava forms a useful alternative, and when game is scarce or hunting unsuccessful, manioc culture increases in importance, yams, beans, peas, pumpkins and maize being added to the crops, while if hunting fails altogether, the group perforce turns to agriculture. Examples are common in the Congo region. Similarly compulsion turns pastors into agriculturalists. In Africa the women have no share in cattle tending and are often mainly occupied in cultivating the crops of maize and vegetables. Should war or disease cause the herds to dwindle, or encroachments diminish the extent of the pasturage, the necessity for agriculture is increased until it absorbs the whole community. Sometimes the stimulus is given by political pressure, as in the case of the Bashkir Tatars, whose pasture lands were encroached upon by Russians to the north and west, and by the Ural Cossacks to the east, so that they could no longer support flocks and herds in sufficient numbers. Sometimes, however, although the first steps are taken, progress goes no farther, as in the wild rice districts of North America in the neighbourhood of the Great Lakes. Most of the Indians who had access to the rice fields collected the rice, ate it at every meal until it was finished, and then turned to other sources of food. There was a common belief that if any seed were sown no more would ever grow wild, and while food was plentiful and space and game were abundant, no further steps were taken.

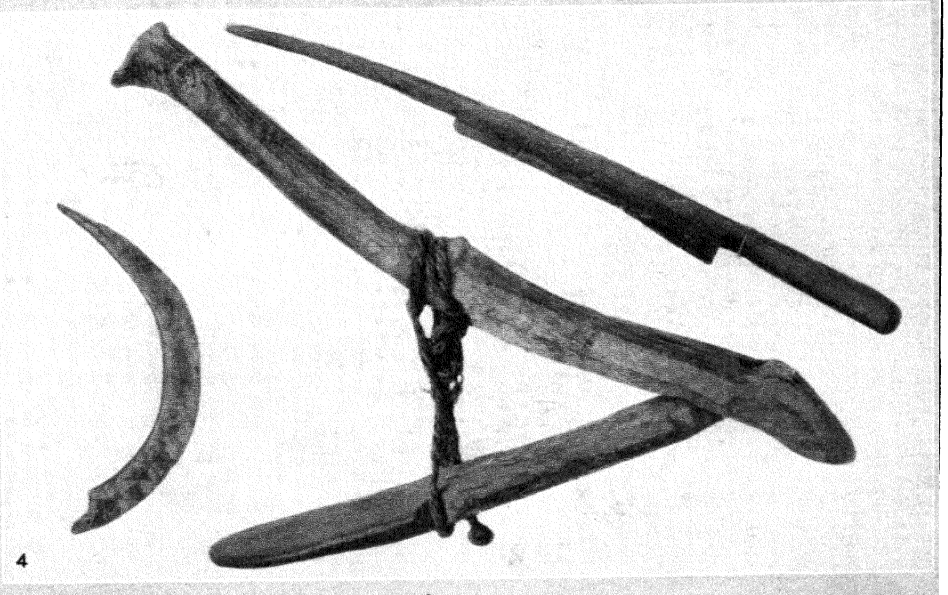
Assartage.—In tropical or semi-tropical countries the common method of agriculture is assartage or essartage (from Lat. *exsartare*, to grub up trees and bushes from forest land to make it arable). For example, in South America a tract of specially productive forest land is chosen as a site for a maize field, smaller trees and undergrowth are cut down at the end of the rainy season, except those of greater size or of very hard wood, and the fallen masses, dried by sun and air for a few weeks, are then fired. On this charred surface, among half-burnt branches and blackened trunks, the maize is planted in holes a few feet apart, and when it reaches the surface the Indian clears and stirs the ground with the hoe. Immediately after harvest the ground is prepared for a fresh crop, which, however, yields much less, and the clearing is then abandoned for several years. It soon becomes overgrown with weeds and undergrowth, and after a time, if no virgin land can be had, these will be burnt down and the land replanted as before; but the crops are poor, the soil is exhausted, the ashes of the undergrowth have not sufficient fertilizing value, and the clearing is finally abandoned. The burning of the felled trees enriches the land, and the same clearing can be used two, three or more times, but is less and less productive each season, so that new land is prepared and the cropped piece left fallow. The system is practised wherever space permits.

In Torres Strait each family has its patch of garden land marked out within the tribal area by definite boundaries. The limit may be marked by standing trees but more commonly the boundary is a ridge of earth, formed by the weeds and refuse thrown on the edge in the process of clearing the land. Every year a man clears a new piece of land and lets another portion lie fallow. The men cut down the larger trees, formerly with shell axes, while the women attack the undergrowth. There is no regular rotation of crops; usually the same plants (yams, bananas, sweet potatoes or sugar-cane) are planted in the same patch; only, as the crops deteriorate after one, two or three years, the land is allowed to lie fallow until the undergrowth is four or five years old, when it is cleared again. There are special names for gardens of successive ages. A newly cleared patch is *kerkar gedub* (new garden), next year it is *keas gedub*, and after two years *gazag gedub*. *Keas* and *gazag* gardens are not replanted, though sugar-cane and bananas continue to bear. (Torres Strait Reports, iv. 145–151.) Extensive agriculture (clearing a fresh patch every season) may go on as long as there is sufficient land, either virgin land still uncleared or overgrown fallow worth clearing; but where, owing to limitations of land or increase of population or









BY COURTESY OF THE TRUSTEES OF THE BRITISH MUSEUM

AGRICULTURAL IMPLEMENTS AND FRUIT CULTIVATION OF MEDIEVAL AND ANCIENT TIMES

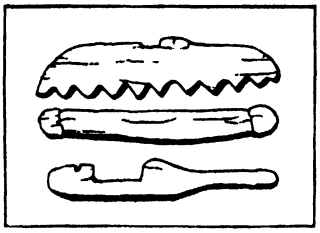
1. Agricultural pursuits, 15th century B.C., from an Egyptian papyrus
2. Farm scene about A.D. 1500 from a North Italian manuscript
3. Fruit cultivation, 14th century B.C., from an Egyptian papyrus
4. Egyptian hoe and sickles used from B.C. 3000 to B.C. 1500

other economic influences, more crops or better crops are required and the exhausted land cannot restore itself, artificial restoration must be applied. Extensive agriculture becomes intensive.

Agriculture is everywhere associated with magic and religious ceremonies to ensure fertility, but artificial fertilization of a more practical nature is not unknown to primitive gardeners. Mariner describes it in Tonga in 1827; powdered pumice was used in the Gilbert isles; human manure was a marketable commodity in Mexico, as in China. In America artificial manuring was found from Nova Scotia to Chile. Fish was commonly planted in the mounds with the maize seed and guano was carefully collected. In Peru extensive cultivation was impossible from lack of space, and crops were restricted to the pockets (*bolson*) of rich soil, consisting of detritus washed down by the mountain torrents, enriched with mineral deposits from volcanic rocks. These natural plots were enlarged by irrigation streams which were also fertilizing. The guano beds of Peru were highly valued; they were the property of the different provinces, and the breeding places of the birds were protected by law.

Irrigation.—Leading an artificial stream on to a patch of land, to provide water for a crop varies from the hollowed tree-fern trunk which the Fijian lays down to supply his taro bed, to the imposing engineering works of the primitive agriculturalists of Peru, or the miles of aqueducts of ancient Ceylon. The sources of water may be natural rivers or lakes, artificial canals, reservoirs or underground supplies, and there are many contrivances for directing it over the land to be watered. Water from a higher level is led off in narrow mud-banked channels which can be stopped or diverted merely by blocking up or breaking down a channel wall here and there. If the water has to be raised, a man may sit by the side of a stream with a half gourd or coco-nut (now-a-days often a kerosene tin) fixed to a stick, ladling out the water and pouring it on to his crop. In deep water a bucket is lowered by means of a rope and drawn up to the surface. The *shaduf*, characteristic of Egypt, and widely distributed from West Africa to the East Indies, consists of a forked pole stuck in the ground, with a long pole balancing on the fork, its heavier end on the bank, and the lighter end, with a bucket attached, over the water. The bucket is lowered into the water, and, when full, the heavy end of the pole helps to raise it. Water can thus be raised 10 or 15ft., and a succession of *shadufs* can raise it to any height required. When there is running water, a water-wheel with buckets on an endless chain is common in the Old World, or the wheel may be turned by animals or men. Where the underground supply of water is very deep, as in parts of India or in the Sahara, a pit is dug, walled in with masonry, and a skin bag lowered over a pulley by long ropes to a depth of 100 or 200ft. The ends of the ropes are attached to bullocks, mules, donkeys, camels, women or slaves, who walk down a slope equal to the depth of the wall. Neither the *shaduf*, the water-wheel or the pulley was used in the New World, but there are extensive irrigation works in the drier Pueblo region, especially Arizona, where 150 miles of ancient irrigation ditches may be traced. In Mexico and Peru extensive engineering works prove the care given to irrigation. Channels were carried round the sides of mountains and even tunnelled through them; so that the waters of the higher valleys where the supply was abundant were made available for the cultivation of others where it was deficient; and these channels were made to irrigate not only the cultivated fields but the llama pastures on the mountain sides.

Terrace Cultivation.—In clearing the land for planting, the trees are felled, the stones are collected or undergrowth and weeds heaped up all along the edges of the space to be planted, and ridges and terraces are thus formed. The discovery of their value for preserving moisture and preventing erosion on slopes would easily lead to the artificial terracing so widely distributed throughout the Old and New Worlds. Terrace cultivation is imposed on agriculture by political, geographical, climatic or economic influences. An agricultural group is by its nature exposed to attacks which, by its nature, it is unable to resist except by retreat to a naturally fortified or easily defended position; and this is provided by the hills, where every patch must be carefully preserved and augmented. Artificial banks are therefore raised to prevent further erosion, and, if necessary, loads of earth are retrieved from the valleys. Such is the precarious agriculture of the Man Tze, or "untameable worms," as the aboriginal inhabitants are called by their Mongol conquerors who forced them to retreat into the mountain fastnesses of the Yangtse valley, where, at a height of about 10,000ft. above sea-level, they perch their villages on the steep cliffs. The back of the house is burrowed out of the rock face; the front is supported on a platform, resting on beams; the approach is by steps made of bolts driven into the rock, and small children are tethered to the door-posts to prevent them from falling over the edge. Here in little patches between the rocks every inch of soil is carefully tilled and crops are raised though the only access to the terrace may be by a rope (I. B. Bishop, *The Yangtse Valley and Beyond*, 1900). Both archaeology and history show evidence of early terracing round the Mediterranean and in Britain during the Bronze Age.

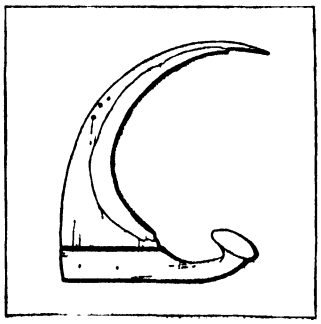


BY COURTESY OF THE METROPOLITAN MUSEUM OF ART
A PRIMITIVE EGYPTIAN RAKE OF THE XXth DYNASTY FOUND AT LISHT

In hilly and mountainous districts where the rainfall is insufficient or irregular, terrace cultivation and irrigation go hand in hand. The water from a mountain stream is easily directed down the slope, and the embankments of the terraces preserve the moisture, so this method is universal on the drier slopes throughout the world. The Arabs in Yemen give the best example. Here the mountains are terraced from their base up to sometimes as high as 6,000ft., with terrace walls from 5ft. to 15ft. high. Reservoirs filled in the two rainy seasons supply the streams for the irrigation channels. When, in the 10th century, the Arabs reached Spain, they converted every mountain slope into a succession of green terraces. In the mountain areas of India, in Ceylon, in Tibet and in China, terrace cultivation can be seen on a large scale. The Chinese, farmers of 40 centuries, carry terracing to a fine art. In densely populated neighbourhoods every inch of soil is of value; it is collected in baskets in the valleys, carried up the barren hill slopes, and embanked, forming astonishingly productive gardens. Examples are rare in the New World, but in Peru the same necessities were met by the same device, and hundreds of terraces one above the other rose from the valleys to the utmost cultivable limit. These were extended year by year by communal labour, and produced the finest crops of potatoes and maize, eliciting the astonished admiration of Cortes: "There was not a span that was not cultivated." Increase of population and of civilized wants, with the growing importance of food-crops or drink-crops, lead to the intensive cultivation seen in the mountain zone of Europe; in Switzerland, for example, or the Moselle and Rhine valleys, in the Vosges and Black Forest, in the Suabian Jura, in Italy, up the slopes of the Apennines or the Ligurian Alps, and in the "desperate agriculture" of Teneriffe, where camels laden with earth bring soil for the gardens almost daily into the town of Santa Cruz.

Implements.—The primitive implement is everywhere the digging stick, usually merely a strong stick, with one end pointed or flattened (a rudimentary spade) and often hardened in the fire. This is used for digging up roots by people who do not cultivate the soil, such as the Australians or the Bushmen of South Africa. The Bushmen weight their digging sticks with a heavy perforated stone whorl which acts as a lever. The digging stick or *ô* in use in Tahiti nearly a century ago was originally a stick sharpened at the point and hardened by charring at the end; but when iron was obtainable, a narrow sharp piece like a chisel was fixed at the end, and as much of the ground was stony, this was found very convenient. No use was made of the foot in thrusting the spade into the soil, but the digger assumed a crouching attitude, piercing the ground and breaking up the earth by the strength of hands and arms (Ellis, *Polynesian Researches*, p. 137–138). In Fiji the grass, reeds and undergrowth were broken down by a sharp-edged club. The digging sticks (poles with one end flattened) are used by three or four men encircling a large clod which they lever up. The women, fol-

lowing on their knees, pulverize this with their hands. A hoe, made of turtle shell or an oyster valve, was used for weeding. A knife has now replaced the club, but as a spade is painful to bare feet, the digging stick holds its place, though its power is now increased by an iron blade. In New Zealand the Maori lashed on a foot-piece at right angles to the digging stick; in Peru a foot-rest is bound on with leathern thongs, and, higher up, another rest is attached in the same way; this is for the left hand, which assists the foot in applying the weight of the body to the thrust. Similar types are found from New Mexico to Chile. The *caschrom*, still used in the stony patches of the Shetlands and the Hebrides, is a larger and more elaborate digging stick, with its end shod in iron and a foot-rest attached. The hoe is really a pick, with the digging end flattened. The simplest form is a piece of wood, with a natural angle, usually part of the trunk and a projecting branch, or two pieces of wood fastened together. The former is illustrated in Europe in the Swedish "hack" and the latter was characteristic of ancient Egypt. In North America a bent piece of wood, the shoulder blade of elk or bison, or a piece of tortoise shell is fastened to a handle, but the hoe was rare in America except in the eastern maize area. The African hoes are of iron, often set at an acute angle to the shaft, this and the shortness of the handle necessitating a crouching position when hoeing. The size and shape of the hoes in Nigeria reflect the variation of soil, a gradation being traced from the sandy soils of the north to the heavier land of the south.



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART
A STONE SICKLE OF THE TYPE USED IN EGYPT 4,000 YEARS AGO RECONSTRUCTED FROM FRAGMENTS DISCOVERED AT THEBES

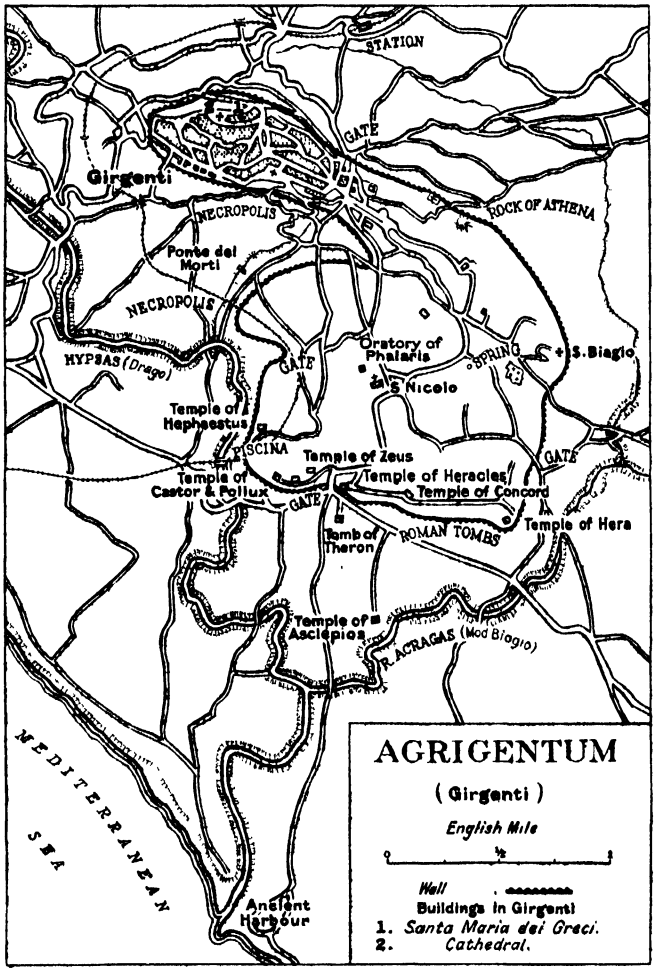
There can be little doubt that women were the earliest agriculturalists. Even when the harder labour of clearing the ground is done by men, planting, sowing, tending and collecting are still women's work. "When the women plant maize," say the Indians, "the stalk produces two or three ears. Why? Because women know how to produce children. They only know how to plant corn to ensure its germinating. Then let them plant it. They know more than we do." (Payne, *History of the New World*, ii. 7.) It is therefore easy to guess that the cultivation of plants was one of women's contributions to the development of civilization; and it is quite in harmony with this conjecture that the cereal deities are usually female, both in the Old World and in the New.

See O. T. Mason, *The Origins of Invention* (1895); E. J Payne, *History of the New World called America* (1895); E. C. Semple, *Influence of Geographical Environment* (1911). (A. H. Q.)

AGRICULTURE, TROPICAL: *see* TROPICAL AGRICULTURE.

AGRI DECUMATES, "tithe lands" given by the Romans to Gallic settlers, and also to Roman veterans on the payment of a rent of a tenth (*decuma*) of the produce, on the east of the Rhine. (*See* LIMES GERMANICUS.)

AGRIGENTUM (Gr. Ἀκράγας, mod. AGRIGENTO), ancient city, south coast of Sicily, 2½m. from the sea Founded by Greek colonists from Gela as late as 582 B.C., its favourable site for cultivation and trade with Carthage made it second only to Syracuse. Pindar calls it καλλίστα βροτεᾶν πολίων (fairest of mortal cities). Ruled at first by tyrants, in 472 a democracy was established. In the struggle between Syracuse and Athens (415–413) the city remained neutral. Its prosperity continued to increase (its population is given at over 200,000) until in 405 B.C. it was captured and plundered by the Carthaginians, a blow from which it never entirely recovered. It was colonized by Timoleon in 338 B.C. with settlers from Velia in Lucania, and in the time of the tyrant Phintias (289–279) it had regained some of its power. In the first Punic War, however, it was sacked by the Romans (261) and the Carthaginians (255), and finally in the second Punic War by the Romans (210). Still in the Roman period, it exported agricultural products, textile fabrics and sulphur. In the local museum are tiles used for stamping cakes of sulphur, which show that the mines, at any rate from the 3rd century A.D., were imperial property leased to contractors. The site is unusual and beautiful with a lofty ridge with two summits to the north. On the western summit is the modern town (985ft.), the eastern summit slightly higher, bears the name of Rock of Athena, owing to its identification by some scholars with the acropolis of Acragas as described by Polybius, who places upon it the temple of Zeus Atabyrius (said to have been erected by the half-mythical Phalaris) and that of Athena. The available space about 70 x 20 yds.) on the eastern summit is, however, too small. In the modern town, on the other hand, the remains of one temple are to be seen in the church of Sta. Maria dei Greci, while the other is generally supposed to have occupied the site of the cathedral. On the north both summits are defended by cliffs; on the south the ground slopes away somewhat abruptly from the eastern summit towards the plateau on which the town stood, while the western summit is separated from this plateau by a valley traversed by a branch of the Hypsas (mod. *Drago*), the deep ravine of which forms the western boundary and defence of the city. On the east is the valley of the Acragas (Fiume S. Biagio). The church of S. Biagio, above it, is built into the temple of Demeter which was preceded by a sanctuary into the cliffs. The Acragas defends the approach from the east and the deeper Hypsas that from the south-west. They unite south of the town and flow out in the small abandoned harbour. A row of important Doric temples crowns the southern slopes; they are built of the local porous stone, which is of a warm red brown colour, full of fossil shells and easily corroded when exposed to the air Of all these temples the oldest is probably that of Heracles (eight columns of which have recently been re-erected),



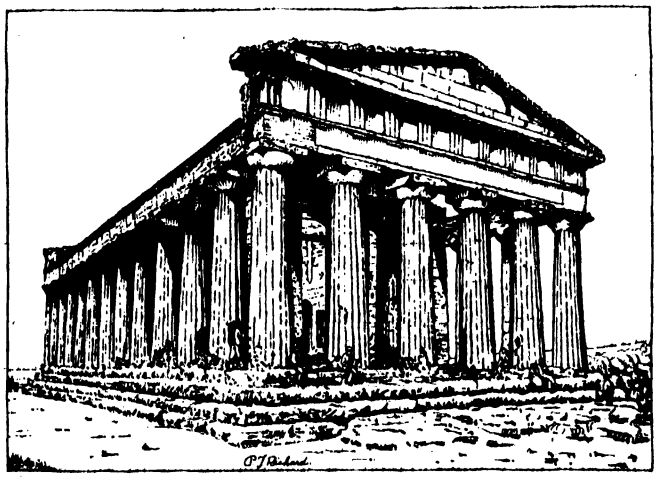
DIMENSIONS OF TEMPLES AT AGRIGENTUM

	Demeter.	Hera Lacinia (so called).	Concordia (so called).	Heracles.	Zeus.	Castor and Pollux (so called).	Unnamed near Castor and Pollux.	Hephaestus (so called).	Asclepius.	Athena (so called).
Length excluding steps*	99	125	129½	220	361	..	..	..	..	..
Breadth	43½	55½	55½	85	173½	..	67½	51½	30½	45
Length of cella	65	93	96½	156	332	91	..	..	..	..
Breadth of cella	43½	32½	31½	45¾	144¼	33	..	..	..	..
Height of columns with capitals	..	21	22	33	62½?	19½	..	..	..	..
Diameter of columns at bottom	..	4½	4½	6¾	14	4	..	5	3½	4⅔
Original number of columns	..	34	34	38	38	34	..	..	..	..
Class	In antis.	Peripteros hexastylos.	Peripteros hexastylos.	Peripteros hexastylos.	Pseudo-peripteros hepta-stylos.	Peripteros hexastylos.	..	Peripteros hexastylos.	Prostylos pseudo-peripteros.	Peripteros
Approximate date	500 B.C.	460 B.C.	440 B.C.	510 B.C.	450 B.C.	338–210 B.C.		After 338 B.C.	Before 210 B.C.	488–472 B.C.

*Dimensions in English feet.

while the best preserved are those wrongly attributed to Hera and Concordia, which are very similar in dimensions; the latter, indeed, lacks nothing but its roof, owing its preservation to its conversion into the cathedral in 597 by Gregory II., bishop of Girgenti. These temples are among the finest in existence. In front of the former, as in front of those of Heracles and Zeus, stood a huge altar for burnt offerings, as long as the façade of the temple itself. The *cella* of the temple of Heracles was modified in Roman times, and a statue of Asclepius seems to show change of cult.

In the colossal temple of Zeus the huge Atlantes (figures of Atlas), 25ft. in height, are noticeable. They seem to have stood in the inter-columniations half-way up the outside wall and to have supported the epistyle. The collapse both of this temple and of that of Heracles must be attributed to an earthquake; many fallen blocks of the former were removed in 1756 for the construction of the harbour of Porto Empedocle. The four columns



THE TEMPLE HERE SHOWN WITH ALL ITS COLUMNS STILL IN SITU, WHICH HAS BEEN WRONGLY ATTRIBUTED TO CONCORDIA, IS THE BEST PRESERVED OF THE NUMEROUS AND SPLENDID RUINS STILL TO BE FOUND ON THE SITE OF THE CITY OF AGRIGENTUM. IT OWES ITS PRESERVATION TO GREGORY II. BISHOP OF GIRGENTI

erected on the site of the temple of Castor and Pollux are a modern (and incorrect) restoration in which portions of two buildings have been used. Of that of Hephaestus only two columns remain, while that of Asclepius, a mile to the south of the town, an anta and two pillars are preserved. Other remains are unimportant. Near the picturesque church of S. Nicolo is the so-called oratory of Phalaris, a tomb of the 1st century B.C., 27¼ft. by 23½ft., and not far off on the east are two private houses of the Roman period. The fishpond (circumference said by Diodorus to be 7 stadia) is an enormous excavation south-west of the city, with drains in its sides; the bottom is now an orange garden.

The wall line can be traced, but actual remains are small except in the valley below the temple of Demeter (S. Biagio). East and west ravines gave protection, so a massive wall was unnecessary, while near the south-east angle a breastwork was formed by the excavation of the natural rock, in later times honeycombed with tombs. Close to this temple on the west is the site of the gate known in later times as the *Porta Aurea*, through which the modern road passes.

Tombs of the Greek period have been found mainly on the west of the town, outside the probable line of the walls, between the Hypsas and a small tributary, the latter having been spanned by a bridge, now called *Ponte dei Morti*, of which one massive pier, 45ft. in width, still exists. Just inside the south wall is a Christian catacomb, and outside it a tomb in two storeys, a mixture of Doric and Ionic architecture, belonging probably to the 2nd century B.C. A village of the Byzantine period has been explored at Balatizzo, immediately to the south of the modern town. The walls of the dwellings are entirely cut out of the natural rock.

The modern town, known as Girgenti till 1928 but now reverting to an older form of its name, is the capital of the province of Agrigento, and an episcopal see, 58 m. S. by E. of Palermo direct and 84½ m. by rail. Pop. (1921) 23,712 (town), 29,823 (commune). The cathedral occupies the highest point in the town; it was founded in the 13th century and there are other remains of architecture of this period. The museum contains fine vases, terra cottas, sculptures, etc. Porto Empedocle (pop. 1921, 11,743) 5½ m. S. by rail, is connected with Castelvetrano, on the line from Palermo to Trapani. It is the principal port for the shipment of sulphur, the mining district beginning just north of Agrigento.

See J. Schubring, *Historische Topographic von Akragas* (1870).

(T. A.)

AGRIMONY, a slender perennial herb (botanical name, *Agrimonia Eupatoria*, family Rosaceae), 1½ to 3ft. high growing in hedge-banks, copses and borders of fields. The leafy stem ends in spikes of small yellow flowers. The flower-stalk becomes recurved in the fruiting stage, and the fruit bears a number of hooks which enable it to cling to rough objects, such as the coat of an animal, thus ensuring distribution of the seed. The plant is common in Britain and widely spread through the north temperate region. The underground woody stem is astringent and yields a yellow dye.

The name has been unsystematically given to several other plants; for instance: bastard, Dutch, hemp or water agrimony (*Eupatorium cannabinum*); noble or three-leaved agrimony (*Anemone hepatica*); water agrimony (*Bidens*); and wild agrimony (*Potentilla anserina*).

AGRIOLOGY is the science of the prehistoric human practices and ways of living, especially those pertaining to the key-factors of existence, food, shelter and clothing.

AGRIONIA, an ancient Greek festival, celebrated annually at Orchomenus in Boeotia and elsewhere, in honour of Dionysus Agrionius ("the wild") by women and priests at night. The tradition is that the daughters of Minyas, king of Orchomenus, having despised the rites of the god, were seized with frenzy and ate the flesh of one of their children. At this festival it was originally the custom for the priest of the god to pursue a woman of the Minyan family with a drawn sword and kill her. (Plutarch, *Quaest. Rom.* cii., *Quaest. Graecae,* xxxviii.)

AGRIPPA, a sceptical philosopher, whose date cannot be accurately determined. He must have lived later than Aenesidemus. To him are ascribed the five tropes (*πέντε τρόποι*) which, according to Sextus Empiricus, summarize the attitude of the later ancient sceptics. (1) Since some thinkers hold that nothing is known but the sensible; others that nothing is known but the intelligible, it follows that the only wise course is neither to affirm nor to deny. (2) The proof of one so-called fact depends on another fact which itself needs demonstration, and so on *ad infinitum.* (3) The data of sense are relative to the sentient being, those of reason to the intelligent mind; that in different conditions things themselves are seen or thought to be different. Where, then, is the absolute criterion? (4) All knowledge depends on certain hypotheses, or facts taken for granted. Such knowledge is hypothetical. (5) The fifth trope points out the impossibility of proving the sensible by the intelligible inasmuch as it remains to establish the intelligible in its turn by the sensible. Such a process is a vicious circle and has no logical validity. A comparison of these tropes with the ten tropes enumerated in the article AENESIDEMUS shows that scepticism has made an advance into the more abstruse questions of metaphysics. The first and the third include all the ideas expressed in the ten tropes, and the other three systematize the more profound difficulties which new thinkers had developed.

See Diogenes Laertius x. 88, and Zeller's *Greek Philosophy.* Also the articles SCEPTICISM; AENESIDEMUS.

AGRIPPA, HEROD I. (*c.* 10 B.C.–A.D. 44), king of Judaea, the son of Aristobulus and Berenice, and grandson of Herod the Great, was born about 10 B.C. His original name was Marcus Iulius Agrippa. Josephus informs us that, after the murder of his father, Herod the Great sent him to Rome to the court of Tiberius, whose son Drusus became his friend. On the death of Drusus, Agrippa, who had been recklessly extravagant, was obliged to leave Rome overwhelmed with debt. After a brief seclusion, Herod the Tetrarch, his uncle, who had married Agrippa's sister Herodias, made him *Agoranomos* (Overseer of Markets) of Tiberias, and presented him with a large sum of money; but his uncle being unwilling to continue his support, Agrippa left Judaea for Antioch and soon after returned to Rome, where he was welcomed by Tiberius and became constant companion to the emperor Gaius (Caligula), then a popular favourite. Agrippa, overheard by his freedman Eutyches to express a wish for Tiberius' death and the advancement of Gaius, was betrayed to the emperor and cast into prison In A.D. 37 Caligula, having ascended the throne, heaped wealth and favours upon Agrippa and gave him the tetrarchy of Batanaea and Trachonitis. To this he added that held by Lysanias; and Agrippa journeyed into Judaea to take possession of his new kingdom. In A.D. 39 he returned to Rome and brought about the banishment of Herod Antipas, to whose tetrarchy he succeeded. On the assassination of Caligula (A.D. 41) Agrippa supported the emperor Claudius, who gave him the government of Judaea, while the kingdom of Chalcis in Lebanon was, at his request, given to his brother Herod. Thus Agrippa became one of the greatest princes of the east, the territory he possessed equalling in extent that held by Herod the Great. He returned to Judaea and governed it to the great satisfaction of the Jews. His zeal, private and public, for Judaism is celebrated by Josephus and the rabbis; and the narrative of Acts xii, telling of his persecution of the Apostles James and Peter, gives a typical example of it. Both the Acts of the Apostles and Josephus give an account of his sudden death after an exhibition of games at Caesarea. A third account says that Agrippa was assassinated by the Romans, who objected to his growing power. He had shown too independent a spirit in his attempt to strengthen the walls of Jerusalem and to summon a meeting of other client princes and after his death the emperor appointed no more kings of Judaea, but ruled the province by means of procurators.

See articles Josephus, J.A. 18 and 19 in *Ency. Bibl.* (W. J. Woodhouse), *Jewish Ency.* (M. Brann), with further references; N. S. Libowitz, *Herod and Agrippa* (2nd ed., 1898); Grätz, *Geschichte d. Juden,* iii. 318–361.

AGRIPPA, HEROD II. (27–100), son of Agrippa, Herod I., and like him originally Marcus Julius Agrippa, was born about A.D. 27, and received from Claudius the tetrarchy of Chalcis and the oversight of the Temple on the death of his uncle, Herod, A.D. 48. In A.D. 53 he was deprived of that kingdom and given other provinces instead. He tried to prevent the Jews from rebelling, and when war broke out sent auxiliaries to help the Romans. He died in Rome in A.D. 100. He was the seventh and last king of the family of Herod the Great. It was before him and his sister Berenice (*q.v.* B 2) that St. Paul pleaded his cause at Caesarea (Acts xxvi.). He supplied Josephus with information for his history.

AGRIPPA, MARCUS VIPSANIUS (63–12 B.C.), Roman statesman and general, son-in-law and minister of the emperor Augustus, was of humble origin. He was of the same age as Octavian (as the emperor was then called), and was studying with him at Apollonia when news of Julius Caesar's assassination (44 B.C) arrived. By his advice Octavian at once set out for Rome. Agrippa played a conspicuous part in the war against Lucius, brother of Mark Antony, which ended in the capture of Perusia (40). Two years later he put down a rising of the Aquitanians in Gaul, and crossed the Rhine to punish the aggressions of the Germans. On his return he refused a triumph but accepted the consulship (37). At this time Sextus Pompeius, with whom war was imminent, had command of the sea on the coasts of Italy. Agrippa's first care was to provide a safe harbour for his ships, which he accomplished by cutting through the strips of land which separated the Lacus Lucrinus from the sea, thus forming an outer harbour; an inner one was also made by joining the lake Avernus to the Lucrinus (Dio Cassius xlviii. 49; Pliny, *Nat. Hist.* xxxvi. 24). About this time Agrippa married Pomponia, daughter of Cicero's friend Pomponius Atticus. Having been appointed naval commander-in-chief he put his crews through a course of training, until he felt in a position to meet the fleet of Pompeius. In 36 he was victorious at Mylae and Naulochus, and received the honour of a naval crown for his services. In 33 he was chosen aedile and signalized his tenure of office by effecting great improvements in the city of Rome, restoring and building aqueducts, enlarging and cleansing the sewers, and constructing baths and porticos, and laying out gardens. He also first encouraged the public exhibition of works of art. The emperor's boast that he had found the city of brick but left it of marble ("marmoream se relinquere, quan latericiam accepisset," Suet. Aug. 29), might with greater propriety have been uttered by Agrippa. He was again called away to take command of the fleet when the war with Antony broke out. The victory at Actium (31), which gave the mastery of the world to Octavian, was mainly due to Agrippa. As a token of signal regard Octavian bestowed upon him the hand of his niece Marcella (28). We must suppose that his wife Pomponia was either dead or divorced. In 27 Agrippa was consul for the third time, and in the following year the senate bestowed upon Octavian the imperial title of Augustus. Probably in commemoration of the battle of Actium, Agrippa built and dedicated the Pantheum still in existence as *La Rotonda.* The inscription on the portico states that it was erected by him during his third consulship. His friendship with Augustus seems to have been clouded by the jealousy of his brother-in-law Marcellus, which was probably fomented by the intrigues of Livia, the second wife of Augustus, who feared his influence with her husband. In 23 B.C., Agrippa went as governor to the East, ruling by means of legates, while he himself remained at Lesbos. But the death of Marcellus, which took place in the same year, obliged the emperor to look

to Agrippa as his successor. He was recalled to Rome, and to strengthen the tie between him and Augustus was made to divorce Marcella and marry the emperor's daughter Julia (21), the widow of Marcellus. In 19 he was employed in putting down a rising of the Cantabrians in Spain. In 18 B.C. he received the Tribunician power for five years, and in the following year a renewal of his command in the East, where his just and prudent administration won him the goodwill of the provincials, especially the Hebrew population. His last public service was the bloodless suppression of an insurrection in Pannonia (13). He died at Campania in March of the year following his 51st year. Augustus honoured his memory by a magnificent funeral.

Agrippa was also known as a writer, especially on geography. Under his supervision Julius Caesar's design of having a complete survey of the empire made was carried out. Amongst his writings an autobiography, now lost, is referred to. Agrippa left several children; by Pomponia, a daughter Vipsania, who became the wife of the emperor Tiberius; by Julia three sons, Gaius and Lucius Caesar (adopted by Augustus as his successors) and Agrippa Postumus, and two daughters, Agrippina the elder, afterwards the wife of Germanicus, and Julia, who married Lucius Aemilius Paullus.

See Dio Cassius xlix.–liv.; Suetonius, *Augustus;* Velleius Paterculus ii.; Josephus, *Antiq. Jud.* xv. 10, xvi. 2; Turnbull, *Three Dissertations,* one of the characters of Horace, Augustus and Agrippa (1740); Frandsen, *Marcus Vipsanius Agrippa* (1836); Motte, *Étude sur Marcus Agrippa* (1872), Nispi-Landi, *Marcus Agrippa e i suoi tempi* (1901); D. Detlefsen, *Ursprung, Einrichtung und Bedeutung der Erdkarte Agrippas* (1906); V. Gardthausen, *Augustus und seine Zeit.* Vol. i. 762 foll., ii. 432 foll.

AGRIPPA VON NETTESHEIM, HENRY CORNELIUS (1486–1535), German writer, soldier, physician and by common reputation a magician. Agrippa was for many years in the service of Maximilian I, the German king, who sent him in 1510 on a diplomatic mission to England, where he was the guest of Dean Colet. From 1511 to 1518 he was in Italy in the service of William VI. of Monferrato and of Charles III. of Savoy. His interest in the occult sciences had brought him into conflict with the church at Dôle in 1509 when he lectured on John Reuchlin's *De verbo mirifico;* again at Pavia in 1515 when he lectured at the university on the *Pimander* of Hermes Trismegistus; and again at Metz in 1518, where he was town orator, for his defence of a woman accused of witchcraft. He then practised medicine in Cologne, Geneva, Freiburg and Lyons for short periods until Margaret, duchess of Savoy and regent of the Netherlands, appointed him archivist and historiographer to the emperor. Margaret's death in 1530 weakened his position, but after suffering a short imprisonment for debt at Brussels he lived at Cologne and Bonn, under the protection of Hermann of Wied, archbishop of Cologne. He then went to France, where he was arrested by order of Francis I. for some disparaging words about the queen-mother; but he was soon released, and on Feb. 18 1535, died at Grenoble. He was thrice married and had a large family. Agrippa's work, *De occulta philosophia,* which brought him into antagonism with the Inquisition, was written about 1510, partly under the influence of the author's friend, John Trithemius, abbot of Wurzburg, but its publication was delayed until 1531, when it appeared at Antwerp. It is a defence of magic, by means of which men may come to a knowledge of nature and of God, and contains Agrippa's idea of the universe with its three worlds or spheres. His other principal work, *De incertitudine et vanitate scientiarum et artium atque excellentia Verbi Dei declamatio,* was written about 1527 and published at Antwerp in 1531. In it Agrippa denounces the accretions which had grown up around the simple doctrines of Christianity, and wishes for a return to the primitive belief of the early Christian church. He also wrote *De nobilitate et praecellentia feminei sexus,* dedicated to Margaret of Burgundy, *De matrimonii sacramento* and other smaller works. An edition of his works was published at Leyden in 1550 and they have been republished several times.

See H. Morley, *Life of H. C. Agrippa* (London, 1856); A. Prost, *Les sciences et les arts occultes au XVI. siècle: Corneille Agrippa, sa vie et ses oeuvres* (Paris, 1881); A Daguet, *Cornelius Agrippa* (Paris, 1856); J. Orsier, *H. C. Agrippa, sa Vie et son Oeuvre* (1911).

AGRIPPINA, the "elder," daughter of Marcus Vipsanius Agrippa (*q.v.*) by his third wife Julia, was the granddaughter of Augustus and the wife of Germanicus. She accompanied her husband to Germany, when the legions on the Rhine revolted after the death of Augustus (A.D. 14). Three years later she was in the East with Germanicus (*q.v.*), who died at Antioch in 19, poisoned, it was said, by order of Cn. Calpurnius Piso, governor of Syria. Eager to avenge his death, she returned to Rome and boldly accused Piso of the murder of Germanicus. To avoid public infamy Piso committed suicide. Tiberius and his favourite Sejanus feared that her ambition might lead her to attempt to secure the throne for her children, and she was banished to the island of Pandataria off the coast of Campania, where she died on Oct. 18, 33, starved to death by herself, or, according to some, by order of Tiberius. Two of her sons, Nero and Drusus, had already fallen victims to the machinations of Sejanus. Agrippina had a large family by Germanicus, several of whom died young, while only two are of importance—Agrippina the "younger" and Gaius Caesar, who succeeded Tiberius under the name of Caligula. There is a portrait of Agrippina in the Capitoline Museum at Rome and a bronze medal in the British Museum, representing the bringing back of her ashes to Rome by order of Caligula.

See Tac. *Ann.* i.–vi.; Suetonius *Tiberius,* 53; Dio Cassius lvii. 6, lviii. 22, lix. 3, Elizabeth Hamilton, *Memoirs of the Life of Agrippina* (1804); Stahr, *Römische Kaiserfrauen* (1880).

AGRIPPINA, the "younger" (A.D. 16–59), daughter of Germanicus and Agrippina the elder, sister of Caligula and mother of Nero, was born at Oppidum Ubiorum on the Rhine, afterwards named in her honour Colonia Agrippinae (mod. Cologne). By her first husband, Gnaeus Domitius Ahenobarbus, she was the mother of the emperor Nero; her second husband was Passienus Crispus, whom she was accused of poisoning, in 49. After the death of Messalina, she married the emperor Claudius, her uncle, and induced him to adopt the future Nero as heir to the throne in place of his own son (Britannicus). In 54 she poisoned Claudius and secured the throne for her son. Being alarmed at the influence of the freedwoman Acte over Nero, she threatened to support the claims of the rightful heir Britannicus. Nero thereupon murdered the young prince and decided to get rid of his mother. Pretending a reconciliation, he invited her to Baiae, where an unsuccessful attempt was made to drown her on a vessel especially constructed to founder. Eventually he had her put to death at her country house. Agrippina wrote memoirs of her times, referred to by Tacitus (*Ann.* iv 53).

See Tac. *Ann.* xii., xiii., xiv.; Dio Cassius lix.–lxi.; Suetonius, *Nero,* 34; Stahr, *Agrippina, die Mutter Neros* (1880); Raffay, *Die Memoiren der Kaiserin Agrippina* (1884); B. W. Henderson, *The Life and Principate of the Emperor Nero* (1903); J. MacCabe, *Empresses of Rome,* ch. v. (1911); also article NERO.

AGRONOMY, the theory and practice of land management and husbandry; in the United States more specifically used of the production of farm crops and plant culture, *e g*, the agronomy department attached to the agricultural experiment stations.

AGROTERAS THUSIA, an annual festival held at Agrae, near Athens, in honour of Artemis Agrotera, in fulfilment of a vow made by the city, before the battle of Marathon, to offer in sacrifice a number of goats equal to that of the Persians slain in the conflict. The number being so great, it was decided to offer 500 goats yearly.

See Plutarch, *De Malignitate Herodoti,* 26; Xenophon, *Anab.* iii., 2. 12; Aelian, *Var. Hist.* ii., 25; Schol. on Aristophanes, *Equites,* 660.

AGUADILLA, the largest and most important town in the north-western section of Porto Rico. The population by the 1920 census of the town itself was 8,035 (1928, 8,679), while the population of the municipal district in 1920 was 24,287.

Aguadilla is situated on the west coast of Porto Rico, on the Mona channel which connects the Atlantic ocean with the Caribbean sea. It is a seaport, but at present has little shipping. It is situated on the belt-line railroad which follows the coastal plains around the island and also has connection by well-built highways with the principal cities of the island. It has several industries and its business houses are well established. Its schools are superior, and an old church is of especial interest.

According to tradition, Columbus's fleet of discovery in 1493 refilled its water-casks at the fountain which still flows in the centre of the town. It is certain that Columbus's landing was near Aguadilla. A tract of land south of the town and within a short distance has been secured for a Columbus park, which will be improved and a creditable monument erected to the discoverer. There is no other place under the U.S. flag on which Columbus landed except Porto Rico. (H. M. T.)

AGUASCALIENTES, an inland State of Mexico, bounded north, east and west by the State of Zacatecas, and south by Jalisco. Pop. (1910) 120,511; (1921) 107,581. Area, 2,499sq. miles. The State occupies a part of the plateau of central Mexico about 6,000ft. above sea level, extending from two spurs of the Sierra Madre, called the Sierra Fria and Sierra de Laurel, eastward to the rolling fertile plains of its eastern and south-eastern districts. It is well watered by numerous small streams and one large river, the Aguascalientes or Rio Grande, and has a mild healthy climate with a light rainfall. The fertile valleys of the north and west are devoted to agriculture and the plains to stock-raising. Indian corn, flour, cattle, horses, mules and hides are exported to the neighbouring States. Mining industries are still undeveloped, but considerable progress has been made in manufactures, especially of textile fabrics. The State has good railway communications and a prosperous trade. The capital, Aguascalientes, named from the medicinal hot springs near it, is a flourishing commercial and manufacturing city. Pop. (1910) 45,198, (1921) 48,141. It has cotton factories, smelting works, railway shops, potteries, tanneries, distilleries and wagon and tobacco factories. It is a station on the Mexican Central railway, 364m. N.W. of the city of Mexico, and is connected by rail with Tampico on the Gulf of Mexico. The city is well built, has many fine churches and good public buildings, street cars and electric lights. Other towns of the State are Rincón de Romos, Asientos de Ibarra and Calvillo, each having less than 5,000 inhabitants.



CATHEDRAL AT AGUASCALIENTES
Aguascalientes, capital of the inland Mexican State of the same name, is an industrial centre for the agricultural plateau surrounding it

AGUE, the common name given to a form or stage of malarial disease; the ague fit is the cold, shivering stage, and hence the word is also loosely used for any such paroxysm. (*See* MALARIA.) For "brow-ague" *see* NEURALGIA.

AGUESSEAU, HENRI FRANCOIS D' (1668–1751), chancellor of France, was born at Limoges Nov. 27 1668, the son of Henri d'Aguesseau, who held many important posts in the Government. He studied law under Jean Domat and was one of the first masters of forensic eloquence in France. He was procurator general from 1700 to 1717, and defended the rights of the Gallican Church against Rome in the controversy which led to the promulgation of the bull *Unigenitus*.

In 1717 he was made chancellor by the Regent Orleans, but was dismissed next year because of his steady opposition to the financial projects of John Law which had been adopted by the regent. He was recalled in 1720. He then assented to the truce which Dubois made with Rome because he feared the outbreak of civil war. Popular opinion unjustly ascribed his attitude to base compliance with Dubois; but he opposed other measures of Dubois and was dismissed when the favourite became chief minister. After five years of retirement spent in study, he was recalled by Cardinal Fleury, and again became chancellor. He attempted, in vain, the codification of French law, but he executed a body of reform which placed him in the same rank with L'Hôpital and Lamoignon.

His grandson, HENRI CARDIN JEAN BAPTISTE, MARQUIS D' AGUESSEAU (1746–1826), was advocate general in the parlement of Paris and deputy in the Estates-General. Under the Consulate he became president of the court of appeal and later minister at Copenhagen. He was elected to the French Academy in 1787.

Of H. F. d'Aguesseau's works the most complete edition is that of Jean Marie Pardessus, published in 16 vol. (1818–20); his letters were edited separately by Rives (1823); a selection of his works, *Oeuvres choisies*, was issued, with a biographical notice, by E. Falconnet in 2 vol. (Paris, 1865). His works include a treatise on money; a life of his father, which is interesting from the account which it gives of his own education; and *Metaphysical Meditations*.

See Charles Butler, *Mem. of Life of H. F. d'Aguesseau*, etc. (1830); Boullée, *Histoire de la vie et des ouvrages du chancelier d'Aguesseau* (Paris, 1835); Fr. Monnier, *Le Chancelier d'Aguesseau* (Paris, 1860; 2nd ed., 1863).

AGUILAR, GRACE (1816–47), English writer, the daughter of a Jewish merchant in London, was born in June 1816. Her works consist chiefly of religious fiction, such as *The Vale of Cedars* (1850) and *Home Influence* (1847). She also wrote, in defence of her faith and its professors, *The Spirit of Judaism* (1842) and other works. She died at Frankfurt-on-Main on Sept. 16, 1847.

AGUILAR, or AGUILAR DE LA FRONTERA, a town of southern Spain, in the province of Cordova. Pop. (1920) 14,864. Aguilar "of the Frontier" was so named in the middle ages from its position on the border of the Moorish territories. Situated in the south of the fertile *Campiña de Córdoba*, its olives and white wine are celebrated; the wine is known as Amontillado, from the adjacent town of Montilla.

ÁGUILAS, seaport and railway terminus, south-east Spain, province of Murcia. Pop. (1920) 17,078. Águilas is built on the landward side of a small peninsula, between two bays and has a good harbour. It is the chief outlet for the Spanish trade in esparto grass, and exports also iron ore and other mineral products of the neighbourhood.

AGUINALDO, EMILIO (*c.* 1869–), Filipino insurrectionary leader, was born near Cavite, Luzon, of Chinese and Tagalog parentage. He was educated in his native town and in the University of St. Thomas, conducted by Dominican friars in Manila. At the outbreak of the insurrection in Aug. 1896, he was mayor of Cavite Viejo. During this uprising Aguinaldo took a prominent part, displaying marked capacity for leadership and assuming dictatorial powers. But in Jan. 1898 he left the Philippines for Hongkong, agreeing to remain permanently in exile on condition of a substantial financial reward from Spain. Immediately after the battle of Manila, May 1, 1898, he returned to the Philippines with the express purpose, it is said, of assisting the United States in the war with Spain. Obtaining the consent of the U S. authorities, he established a native government, of which he became the head, and organized an army. On Feb. 4, 1899, he began hostilities against the United States by making an unsuccessful attack on Manila. During 1899 there were several severe engagements, but in the end the native troops became so hard pressed that Aguinaldo, after repeatedly changing his capital, was forced to take refuge in the mountains. Here the struggle was protracted until March 23, 1901, when he was captured by Gen. Frederick Funston at Palawan, Luzon. On April 19, 1901, Aguinaldo took the oath of allegiance to the United States and retired to peaceful private life.

AGUIRRE, LOPE DE (1508–1561), Spanish adventurer. In 1559 he joined Pedro de Ursua's expedition to the Upper Amazon, in search of El Dorado, and took part in the murder of Ursua and his lieutenant in 1561, after which Guzman was elected captain by the crew, with Aguirre as his master of the camp. The murderers declared themselves rebels, and sailed down the Amazon, plundering and putting to the sword whole villages of Indians. Aguirre established a reign of terror on board ship, which culminated in the murder of Guzman, and his own self-appointment to the position of captain. In July of 1561 the party reached Margarita Island, where they murdered the governor, robbed the royal treasury and proceeded to make incursions into the mainland of Venezuela. About this time Aguirre wrote and despatched an amazing letter to the king of Spain, accusing him of ingratitude toward himself, Aguirre, and his followers, and giving a full account of his own villainous exploits on the voyage.

Soon after, his men began to desert him and just when an attack was expected from Spanish troops, he was shot by his own fellow-rebels, in Oct. 1561.

See R. Southey, *Expedition of Orsua, and the Crimes of Aguirre* (1821); and P. Simon, *The Expedition of Pedro de Ursua and Lope de Aguirre in search of El Dorado and Omagua* (1861).

AGUJARI, LUCREZIA (1743–1783), an Italian operatic singer, possessed of one of the most extraordinary voices, in respect of its almost incredible compass, ever known. Mozart, who heard her at Parma in 1770, noted down some of the passages which she sang, showing her range to have extended from middle C to C in altissimo, or more than an octave above the B flat which is about the limit of the average soprano. At the same time she was a brilliant executant. Known (and advertised) as *La Bastardella,* on account of the circumstances of her birth, as the natural daughter of a man of rank, she paid many visits to London where she received as much as £100 a night.

AHA, of Shabha, an 8th-century Talmudist. He was author of *Quaestiones* (*Sheiltoth*), a collection of homilies (at once learned and popular) on Jewish law and ethics. This is recorded as the first work written by a Jewish scholar after the completion of the Talmud.

AHAB, son of Omri, king of Israel from *c.* 875 to *c.* 852 B.C. (I Kings xvi. 29–xxii. 40). The more important aspects of his reign, which in some respects marks the high water mark of the success of the northern kingdom, may be summarized as follows: (1) *Foreign relations.*—In the reigns of Omri and Ahab the northern kingdom for the first time took an important part in international politics. Omri left to his son an empire which comprised not only territory to the east of Jordan, in Gilead and probably Bashan, but also the land of Moab, whose king was tributary, while Judah (and probably Edom also) if not actually subject to Omri, was certainly a subordinate ally. Ahab's marriage with Jezebel, daughter of Ethbaal of Sidon, revived an alliance which had been in abeyance since the time of Solomon But throughout the reign of Ahab a fierce border war was waged with Damascus, in which Israel, in spite of occasional victory, proved the weaker, while Mesha, king of Moab, successfully revolted and occupied the southern portions of the territory of Gad. Yet the forces of Israel retained strength enough to contribute the second largest contingent of soldiers (the largest force of chariots) to the combined armies which, under the leadership of Benhadad of Damascus, checked the westward movement of Shalmaneser III of Assyria at Karkar in 853 B.C. After the Assyrian repulse, however, the alliance broke up, and Ahab met his death fighting the Syrians in a vain attempt to recover Ramoth Gilead (2) *Domestic affairs.*—Contact with a wider world, and especially the alliance with Phoenicia, had far-reaching results for the kingdom of Israel itself. Jezebel attempted to introduce into religion and government elements which were common enough elsewhere in the ancient world but strange in Israel. She endeavoured to set up the worship of the Tyrian Baal in Samaria, and to maintain the familiar oriental principle of the absolute despotic power and authority of the sovereign. This roused the bitter hostility of that conservative party which clung to the sole worship of the national God, Yahweh, and at the same time held to those democratic conceptions of society which the Hebrews had brought with them from the wilderness and had consistently maintained through their history. The spirit of this party found expression in the prophet Elijah (*q.v.*), who protested alike against the establishment of the Baal priests and the judicial murder of Naboth. He and those who came after him seem to have been successful in eliminating the foreign worship, though in the end their purpose was only achieved by a bloody revolution; but they were powerless to stem the tide of social and moral deterioration. (*See* Amos.) It is to the reign of Ahab that we may trace the beginning of that sapping of the national life which led to the condemnations of the 8th century prophets and to the downfall of Samaria.

(T. H. R.)

AHAGGAR, general name for a large plateau region of the north centre of the Sahara, culminating about 900m. due S. of Algiers and 1,200m. due N. of the mouth of the Niger. The highest peaks do not greatly exceed 8,000ft. above sea-level. (*See* also Sahara.)

AHASUERUS, a royal Persian name occurring in Ezra iv. 6, Dan. ix. 1, and throughout the book of Esther, but its occurrence in Tobit xiv. 15, in some Greek mss., is due to a copyist's blunder. It is the Latinized form of the Hebrew *Aḥašwērōš* (LXX. Ἀσσοήρος). In Ezra iv. 6 Ahasuerus is mentioned as a king of Persia, to whom the enemies of the Jews sent representations opposing the rebuilding of the temple at Jerusalem. He here occupies a place in a chronological series of those Persian rulers who were directly concerned with events of Jewish history. (*See* Ezra and Nehemiah.) Immediately preceding Artaxerxes I. Longimanus, he is evidently to be identified with Xerxes. This conclusion is supported by the resemblance of the Hebrew form of the name to the Babylonian *Aḫšiyarš(u)*, the Egyptian-Aramaic transliterations, etc. The old Persian form, found in inscriptions, is *Khšayāršā.*

In the book of Esther the king, at whose court the scene is laid, bears the same Hebrew name, rendered *Assuerus* in the Latin version and Ahasuerus in the English Bible (but in LXX. "Artaxerxes" throughout). Most modern scholars are agreed that here also Xerxes is the king intended. (*See* Esther.)

In Dan. ix. 1 "Ahasuerus" (*Aḥašwērōš*) is the father of "Darius the Mede," who is said to have become king over Babylonia upon the death of Belshazzar. (*See* also v. 30, vi. 1, 29) The name seems impossible here, however, and is probably due to some accident in the literary transmission (Josephus, *Ant.* x. 11, 4, has "Astyages"). It was perhaps originally a Hebrew form of *Huwaḫšatara* (Cyaxares). No other name resembling Ahasuerus, nor any name like Darius, is to be found in the list of Median kings. We know, moreover, from the Cyrus cylinder, as well as from the Greek historians, that the immediate successor of Nabonidus and Belshazzar as ruler of Babylonia was Cyrus (he is represented in Dan. x. 1, xi. 1, as successor of this Darius). Comparison with the list of Persian kings in the book of Ezra (see above) seems to show that in the Jewish tradition Darius I. Hystaspis was placed before Cyrus as "Darius the Mede."

See articles "Ahasuerus" in the *Encyclopaedia Biblica,* Hastings' *Dictionary,* the *Jewish Encyclopaedia;* Driver, *Introd. to the Lit. of the Old Test.;* Torrey, *Ezra Studies,* pp. 38 *seq.,* 135 *seq.,* 141.

(C. C. T.)

AHAZ, king of Judah. After the death of Menahem, Pekah, king of Israel, and Rezin (rather Raṣun), king of Syria, allied against Assyria and invaded Judah. At the same time the Edomites recovered Elath on the Gulf of Akabah and Judah was isolated. Notwithstanding the counsel of Isaiah, Ahaz called in the aid of Tiglath-pileser I, who, after attacking the Philistines, destroyed the power of Syria, and exacted heavy tribute from Judah It was as a vassal that Ahaz presented himself to the Assyrian king at Damascus, and brought back religious innovations, on the nature of which *see* W. R. Smith, *Relig. of Semites,* pp. 485 sqq. and commentaries on II. Kings xvi. 17.

AHAZIAH, the name of two kings in the Bible. (1) Ahaziah, 8th king of Israel, was the son and successor of Ahab, and reigned for less than two years. On his accession the Moabites refused any longer to pay tribute. Ahaziah lost his life through a fall from the lattice of an upper room in his palace (2 Kings i. 2–17). (2) Ahaziah, 6th king of Judah, son of Jehoram and Ahab's daughter Athaliah, reigned one year. He, together with Joram, king of Israel, was slain by Jehu, son of Nimshi. He is variously called Jehoahaz and Azariah (2 Kings viii. 25–ix.28).

AHENOBARBUS [Lat. "brazen-bearded"], the name of a very extensive plebeian Roman family of the *gens Domitia.* The name was derived from the red beard and hair by which many of the family were distinguished. Amongst its members the following may be mentioned:—

Gnaeus Domitius Ahenobarbus, tribune of the people 104 B.C., brought forward a law (*lex Domitia de Sacerdotiis*) by which the priests of the superior colleges were to be elected by the people in the *comitia tributa* instead of by co-optation; the law was repealed by Sulla, revived by Julius Caesar and (perhaps) again repealed by Marcus Antonius, the triumvir (Cicero, *De*

Lege Agraria, ii. 7; Suetonius, *Nero*, 2). Ahenobarbus was elected pontifex maximus in 103, consul in 96 and censor in 92 with Lucius Licinius Crassus the orator, with whom he was frequently at variance. They took joint action, however, in suppressing the recently established Latin rhetorical schools, which they regarded as injurious to public morals (Aulus Gellius xv. 11).

LUCIUS DOMITIUS AHENOBARBUS, son of the above, and husband of Porcia the sister of Cato Uticensis. Being a convinced aristocrat he opposed Pompey and Caesar while they were united, and when their friendship cooled, attached himself to Pompey. He was consul in 54 B.C., and in 49 B.C. he was appointed by the senate to succeed Caesar as governor of Gaul. After the outbreak of the civil war he commanded the Pompeian troops at Corfinium, but was obliged to surrender. Although treated with great generosity by Caesar, he stirred up Massilia (Marseille) to an unsuccessful resistance against him. After its surrender, he joined Pompey in Greece and was slain in the flight after the battle of Pharsalus (Caesar, *Bellum Civile*, i., ii., iii.; Dio Cassius xxxix., xli.; Appian, B.C. ii. 82).

GNAEUS DOMITIUS AHENOBARBUS, son of the above, accompanied by his father at Corfinium and Pharsalus, and, having been pardoned by Caesar, returned to Rome in 46 B.C. After Caesar's assassination he attached himself to Brutus and Cassius, and in 43 B.C. was condemned by the *lex Pedia* as having been implicated in the plot. He obtained considerable naval successes in the Ionian Sea against the triumvirate, both before and after Philippi, but in 40 B.C. became reconciled to Antony, who made him governor of Bithynia. He took part in Antony's Parthian campaigns, and was consul in 32 B.C. When war broke out between Antony and Octavian, he at first supported Antony, but, disgusted with his intrigue with Cleopatra, went over to Octavian shortly before the battle of Actium (31 B.C.). He died soon afterwards (Dio Cassius xlviii.–l.; Appian, *Bell. Civ.*, iv., v.). His son was married to Antonia, daughter of Antony, and became the grandfather of the emperor Nero.

See Drumann, *Geschichte Rom.*, 2nd ed. by Groebe, vol. iii. pp. 14 ff.

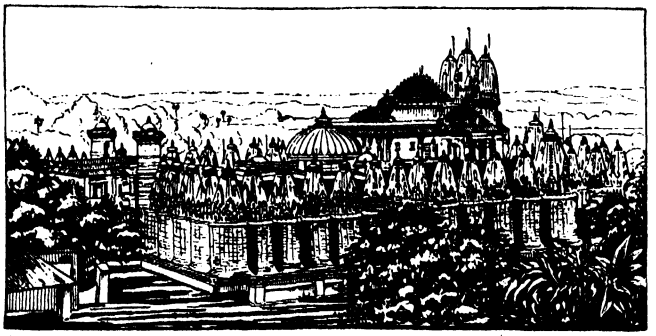
AHITHOPHEL, one of David's most trusted advisers, whose counsel was "as though one inquired of the word of God." He took a leading part in Absalom's revolt, and his defection was a severe blow to the king, who prayed that God would bring his counsel to "foolishness." At Ahithophel's advice Absalom first took the precaution of asserting his claim to the throne by seizing his father's concubines. The immediate pursuit of David was then suggested but Hushai recommended waiting till the levies of all Israel could be called up. This advice was adopted, and David had time to escape across the Jordan. Finding that his policy was neglected, and forseeing the disaster which actually occurred, Ahithophel went home and hanged himself. (2 Sam.xv.31–37; xvi.20–xvii.14, 23.)

AHLEN, a town in the south-east of the district of Münster, in the Prussian province of Westphalia. Pop. (1925) 22,244. It produces metal-work, enamelling, die-stamping, galvanizing, etc.

AHMADABAD, a city and district of British India in the northern division of Bombay. The city was once the handsomest and most flourishing in western India, and it still ranks next to Agra and Delhi for the beauty and extent of its architectural remains. It was founded by Ahmad Shah in A.D. 1411 on a site used for earlier Hindu towns, and embellished with fine buildings of marble brought from a distance. The Portuguese Barbosa described it as "very rich and well embellished, with good streets and squares supplied with houses of stone and cement." In Sir Thomas Roe's time, A.D. 1615, "it was a goodly city as large as London." From 1411 to 1511 it grew in size and wealth; from 1512 to 1572 it declined with the decay of the dynasty of Gujarat; from 1572 to 1709 it renewed its greatness under the Moghul emperors; from 1709 to 1809 it dwindled with their decline; and from 1818 onwards it has again increased under British rule.

In consequence of these changes of dynasty, Ahmadabad became the meeting-place of Hindu, Mohammedan and Jain architecture. Ahmad Shah pulled down Hindu temples in order to build his mosques with the material. The Jama Masjid itself, with its 300 pillars fantastically carved, is a Hindu temple converted into a mosque (*see* INDIAN ARCHITECTURE, Plate III., fig. 15). Many of the houses are beautifully carved and there are numerous fine mosques, tombs, etc. One of the finest is the modern Jain temple of Hathi Singh outside the Delhi gate, which was built only in 1848. Two of the windows in Sidi Said's mosque of filigree marble work are marvels of delicacy and grace, and finer than anything of the kind to be found in Agra or Delhi.

The modern city of Ahmadabad is situated on the left bank of the river Sabarmati; Sabarmati, on the opposite bank of the river, is practically part of Ahmadabad. Its population, which has steadily increased, was (in 1921) 274,007. It has a station on the Bombay and Baroda railway, 309m. from Bombay, whence



THE TEMPLE OF HATHI SINGH AT AHMADABAD, BUILT IN 1848 AS THE LOCAL SHRINE OF JAINISM, A RELIGIOUS CULT THAT HAS GIVEN INDIA SOME OF ITS MOST CHARACTERISTIC ARCHITECTURE

branch lines diverge to Delhi, Khed, Brahma and Dolka, and is the largest centre for trade and manufacture in the presidency after Bombay. Its native bankers, shopkeepers and workers are all strongly organized in guilds. It has numerous cotton mills, about one-third of the population being dependent on the cotton industry, and factories for ginning and pressing cotton. Other industries include oil, flour and silk mills, manufactures of soap, matches, glass, tobacco and hosiery, carpet works and tanneries. Ahmadabad is famous for its handicrafts, including brocades and tinsel lace, copper and brass working, jewellery and wood-carving. Filtered water is obtained from wells in the river bed and the main streets are lighted by electricity. The military cantonment, 3m. N. of the native town, is the headquarters of the northern division of the Bombay command, with an arsenal.

The district of Ahmadabad lies at the head of the Gulf of Cambay, between Baroda and Kathiawar. Area 3,824 square miles. The river Sabarmati and its tributaries, flowing from north-east to south-west into the Gulf of Cambay, are the principal streams that water the district. The north-eastern portion is dotted with low hills, which gradually sink into a vast plain, subject to inundation on its western extremity. With the exception of this latter portion, the soil is very fertile, and some parts are wooded. The population in 1921 was 890,911. The principal crops are millets, cotton, wheat and pulse. The district is traversed by the Bombay and Baroda railway, and has two seaports, Dholera and Gogo, the former of which has given its name to a mark of raw cotton in the Liverpool market.

AḤMAD IBN ḤANBAL (780–855), the founder, involuntarily and after his death, of the Ḥanbalite school of canon law, was born at Baghdad in A.H. 164 (A.D. 780) of parents from Merv, but of Arab stock. He studied the Koran and its traditions (*ḥadīth, sunna*) there and on a student journey through Mesopotamia, Arabia and Syria. After his return to Baghdad he studied under ash-Shāfi'i between A.H. 195 and 198, and became, for his life, a devoted Shāfi'ite. But his position in both theology and law was more narrowly traditional than that of ash-Shāfi'i; he rejected all reasoning, whether orthodox or heretical in its conclusions, and stood for acceptance on tradition (*naql*) only from the Fathers. In consequence, when al-Ma'mūn and, after him, al-Mu'tasim and al-Wāthiq tried to force upon the people the rationalistic Mu'tazilite doctrine that the Koran was created, ibn Ḥanbal, the most prominent and popular theologian who stood for the old view, was imprisoned and scourged. In A.H. 234, under al-Motawakkil, the Koran was finally decreed un-

created, and ibn Ḥanbal, who had come through this trial better than any of the other theologians, enjoyed an immense popularity with the mass of the people as a saint, confessor and ascetic. He died at Baghdad in A.H. 241 (A.D. 855) and was buried there.

BIBLIOGRAPHY.—On his great work, the *Musnad*, a collection of some 30,000 selected traditions, *see* Goldziher in *ZDMG*, l. 465 ff. For his life and works generally, *see* W. M. Patten, *Ahmed ibn Ḥanbal and the Mihna;* C. Brockelmann, *Geschichte der Arab. Lit.* i. 181 ff.; F. Wüstenfeld, *Schafi'iten,* 55 ff.; M'G. de Slane's transl. of *Ibn Khallikan,* i. 44 ff.; Macdonald, *Development of Muslim Theology,* 110, 157, index.

AHMADIYYAH: *see* ISLAM.

AHMADNAGAR, a city and district of British India in the central division of Bombay on the left bank of the river Sina. Pop. (1921) 49,878. The town was founded in 1494 on the site of a more ancient city, Bhingar, by Ahmad Nizam Shah, who established a new monarchy, which lasted till its overthrow by Shah Jahan in 1636. In 1759 the Peshwa obtained possession of the place by bribery, and in 1797 it was ceded to the Mahratta chief, Daulat Rao Sindhia. During the war with the Mahrattas in 1803 Ahmadnagar was invested by Gen. Wellesley and captured. Restored to the Mahrattas, it again became a British possession in 1817, under the Treaty of Poona. There is a large trade in cotton and silk goods, while turbans and copper and brass pots are made. There are also factories for ginning and pressing cotton, indigo works and a tannery. Ahmadnagar is a station on the loop line of the Great Indian Peninsula railway, 218m. from Bombay, a military station of the Poona district and an important mission station.

The district of Ahmadnagar is a comparatively barren tract with a small rainfall. The area is 6,610 square miles. The population in 1921 was 731,552, showing a considerable decrease in the decade. On the north the district is watered by the Godavari and its tributaries, the Prawara and the Mula; on the northeast by the Dor, another tributary of the Godavari; on the east by the Sephani, which flows through the valley below the Balaghat range; and in the extreme south by the Bhima and its tributary the Gor. The Sina river, another tributary of the Bhima, flows through the Nagar and Karjat talukas. The principal crops are cotton, millet, pulse and wheat and dyes are produced.

AHMAD SHAH (1724–73), founder of the Durani dynasty in Afghanistan, was the son of Sammaun-Khan, hereditary chief of the Abdali tribe. While still a boy, Ahmad fell into the hands of the hostile tribe of Ghilzais, by whom he was kept prisoner at Kandahar. In March 1738 he was rescued by Nadir Shah, who soon afterwards gave him the command of a body of cavalry composed chiefly of Abdalis. On the assassination of Nadir in 1747, Ahmad, having failed in an attempt to seize the Persian treasures, retreated to Afghanistan, where he persuaded the tribes to assert their independence and accept him as their sovereign. He was crowned at Kandahar in Oct 1747, and about the same time he changed the name of his tribe to Durani. He first crossed the Indus in 1748, when he took Lahore; and in 1751, after a feeble resistance on the part of the Mohammedan viceroy, he became master of the entire Punjab. In 1750 he took Nishapur, and in 1752 subdued Kashmir. His great expedition to Delhi was undertaken in 1756 in order to avenge himself on the Great Mogul for the recapture of Lahore. Ahmad entered Delhi with his army in triumph, and for more than a month the city was given over to pillage. The shah himself added to his wives a princess of the imperial family, and bestowed another upon his son Timur Shah, whom he made governor of the Punjab and Sirhind. As his viceroy in Delhi he left a Rohilla chief in whom he had all confidence, but scarcely had he crossed the Indus when the Mohammedan wazir drove the Afghan chief from the city, killed the Great Mogul and set another prince of the family, a tool of his own, upon the throne. The Mahratta chiefs availed themselves of these circumstances to endeavour to possess themselves of the whole country, and Ahmad was compelled more than once to cross the Indus in order to protect his territory from them and the Sikhs, who were constantly attacking his garrisons. In 1758 the Mahrattas obtained possession of the Punjab, but on Jan. 6, 1761, they were totally routed by Ahmad in the great battle of Panipat. In a later expedition he inflicted a severe defeat upon the Sikhs, but had to hasten westwards immediately afterwards in order to quell an insurrection in Afghanistan. Meanwhile the Sikhs again rose, and Ahmad was forced to abandon all hope of retaining the command of the Punjab. He died in 1773, leaving to his son Timur the kingdom he had founded.

AHMED I. (1589–1617), sultan of Turkey, was the son of Mohammed III., whom he succeeded in 1603, being the first Ottoman sultan who reached the throne before attaining his majority. He was of kindly and humane disposition, as he showed by refusing to put to death his brother Mustafa, who eventually succeeded him. In the earlier part of his reign he gave proofs of decision and vigour, which were belied by his subsequent conduct. The wars which attended his accession both in Hungary and in Persia terminated unfavourably for Turkey, and her prestige received its first check in the peace of Sitvatörök, signed in 1606, whereby the annual tribute paid by Austria was abolished. Ahmed gave himself up to pleasure during the remainder of his reign—which ended in 1617—and demoralization and corruption had become as general throughout the public service as indiscipline in the ranks of the army. The use of tobacco is said to have been introduced into Turkey during Ahmed I.'s reign.

AHMED II. (1643–95), sultan of Turkey, son of Sultan Ibrahim, succeeded his brother Suleiman II. in 1691. His chief merit was to confirm Mustafa Kuprili as grand vizier. But a few weeks after his accession Turkey sustained a crushing defeat at Slankamen (1691) from the Austrians under Prince Louis of Baden and was driven from Hungary; during the four years of his reign disaster followed on disaster, and on Feb. 6, 1695, Ahmed died, worn out by disease and sorrow.

AHMED III. (1673–1736), sultan of Turkey, son of Mohammed IV., succeeded to the throne in 1703 on the abdication of his brother Mustafa II. He cultivated good relations with England, and he afforded a refuge in Turkey to Charles XII. of Sweden, after his defeat at Poltava (1709). Forced into war with Russia, he came nearer than any Turkish sovereign before or since to breaking the power of his northern rival, whom his Grand Vizier, Baltaji Mohammed Pasha succeeded in completely surrounding near the Pruth (1711). In the treaty which Russia was compelled to sign Turkey obtained the restitution of Azov, the destruction of the forts built by Russia, and the undertaking that the tsar should abstain from future interference in the affairs of the Poles or the Cossacks. Discontent at the leniency of these terms was so strong at Constantinople that it nearly brought on a renewal of the war. In 1715 the Morea was taken from the Venetians. This led to hostilities with Austria, in which Turkey was unsuccessful, and Belgrade fell into the hands of Austria (1717). Through the mediation of England and Holland the peace of Passarowitz was concluded (1718), by which Turkey retained her conquests from the Venetians, but lost Hungary. A war with Persia terminated in disaster, leading to a revolt of the janissaries, who deposed Ahmed in Sept. 1730. He died in captivity.

AHMED KUPRILI: *see* KUPRILI.

AHMED VEFIK, PASHA (1819–1891), Turkish statesman and man of letters, was born in Stambul and educated in Paris. He was appointed to a post in the *bureau de traduction* of the ministry for foreign affairs, and devoted his leisure to the translation of Molière's plays into Turkish and to the compilation of educational books (dictionaries, historical and geographical manuals, etc.) for use in Turkish schools In 1847 he brought out the first edition of the *Salnameh,* the official annual of the Ottoman empire. Two years later he was appointed imperial commissioner in the Danubian principalities, and in 1851 ambassador to Persia. After his return he was appointed a member of the Grand Council of Justice, and was entrusted with the revision of the penal code and the code of procedure.

In 1860 he was sent as ambassador to Paris, to avert the intervention of France in the affairs of Syria. Ahmed Vefik held various important posts in the Turkish Government during the next two decades, and was twice minister of public instruction, but the position in which he rendered his most distinguished

service was as vali of Brusa (1879–82). The drainage of the pestilent marshes, the water-supply from the mountains, the numerous roads, the suppression of brigandage, the multiplication of schools, the vast development of the silk industry through the substitution of mulberry plantations for rice-fields, the opening out of the mineral springs of Chitli, the introduction of rose trees and the production of attar of roses—all these were Ahmed Vefik's work. A few days after his return he was again appointed prime minister (Dec. 1, 1882), but he made conditions which were unacceptable to the sultan, and Said Pasha was appointed in his place. For the rest of his life Ahmed Vefik, by the sultan's orders, was practically a prisoner in his own house.

Ahmed Vefik was a great linguist. He spoke and wrote French perfectly, and thoroughly understood English, German, Italian, Greek, Arabic and Persian. From all these languages he translated many books into Turkish, but wrote no original work. His splendid library of 15,000 volumes contained priceless manuscripts in many languages. In his lifetime he appreciably aided the progress of education; but, as he had no following, the effects of his labour and influence in a great measure faded away after his death.

AHOM, the branch of the Tai race settled in and giving its name to Assam (*q.v.*). This people came into Assam in the 13th century under a leader named Sukupha and gradually extended their rule westward down the Brahmaputra valley, which they dominated till its invasion by the Burmese early in the 19th century. They instituted and retained in Assam a form of government in which taxes were paid by personal service and the population was organized in *paiks* of three householders, one of whom had always to be on duty. Religion was animistic until Hinduized; society was organized in clans (*khel*), originally exogamous, but tending to become under Hinduism endogamous occupational groups. There was a written language in script derived ultimately from Devanagari, but now, like the spoken tongue, extinct, though palm-leaf books written in it are still extant. (*See* also SHAN.)

See Hastings' *Encyclopaedia of Religion and Ethics* (*s.v.*) "Ahom"; E. A. Gait, History of Assam (1926).

AHRENS, FRANZ HEINRICH LUDOLF (1809–81), German philologist, was born at Helmstedt, June 6, 1809, and died Sept. 25, 1881. His most important work is *De Graecae Linguae Dialectis* (1839–43, new ed. by Meister, 1882–89), which, although unfortunately incomplete, dealing only with Aeolic and Doric, and in some respects superseded by modern research, remains a standard treatise. A volume of his minor works (ed. Haeberlin, 1891) contains a complete list of his writings.

AHRIMAN, the name of the principle of evil in the dualistic doctrine of Zoroaster (Gr. Ἀρειμάνιος in Aristotle, or Ἀρειμάνης in Agathias; in the *Avesta, Añgrô Mainyush*)—"the Destructive Spirit"). In the *Avesta* he is called the twin-brother of the Holy Spirits, and contrasted either with the Holy Spirit of Ormazd or with Ormazd himself. He is the all-destroying Satan, the source of all evil in the world Eventually, in the great world catastrophe, he will be defeated by Ormazd and disappear. (*See* ZOROASTER)

AHRWEILER, a town in Rhenish Prussia, Germany, on the river Ahr. Pop. (1925) 6,750. The town is surrounded by mediaeval walls and gates. The Gothic church dates from 1245. There is trade in the red wine of the district.

AHT, a confederacy of 22 tribes of North American Indians of the Wakashan stock. They are settled on the west coast of Vancouver, British Columbia. The chief tribes included are the Nitinaht, Tlaasaht or Makah, Tlaokiwaht or Clahoquaht, Ahansaht and Ehatishaht. In the year 1928 the confederacy numbered some 3,500.

AHTENA ("ice people"), the name of an Athapascan tribe of North American Indians, in the basin of Copper river, Alaska.

See *Handbook of American Indians,* ed. F. W. Hodge (Washington, 1907).

AHURA MAZDA, the Good Spirit in the dual system of Zoroaster, opposed to Ahriman, Angra Mainyu or Druj, the Spiritual Enemy. The name is sometimes translated as the "Wise Lord" and is the origin of the modern Persian *Ormazd* or *Ormuzd* (*q.v.*).

AHWAZ, a town of south-west Persia, in the province of Khuzistan, on the left bank of the River Karun, 85m. by road and 105m. by river from Mohammerah (*q.v.*), 31° 20′ N., 48° 48′ E. It has been identified with the Aginis of Nearchus, and occupies the site of what was once an extensive and important city, of which, however, very few vestiges remain, the present town having been built in the last 50 years from the ruins of the old. Close by are to be seen the ruins of a stone dam of great strength, constructed across the Karun for the purposes of irrigation. Dependent on it was a system of great canals on both banks which served in the 12th and 13th centuries, if not before, to irrigate an area which was estimated by Major W. R. Morton, R. E., in 1907, at approximately half a million acres. Arab historians of the 12th and 13th centuries describe Ahwaz as the centre of a great sugar, rice and silk growing area, exporting its products all over Persia and as far west as Syria. Since the opening of the Karun to foreign commerce in Oct. 1888 another settlement, called Bandar Násiri, in compliment to the Shah Násir ed Din (d. 1896), has arisen, 1m. below Ahwaz, at the point below the rapids where steamers come to anchor. Here are situated the Government post and telegraph offices, the British consulate and the Soviet consular agency. Bandar Násiri is an official port of entry under the Anglo-Persian Commercial Convention of 1903, and a custom-house is established there. The climate is dry and healthy and the town, which was well laid out between 1903 and 1925 by the Arab governor of the province, Shaikh Khazál, has a mixed Persian and Arab population of some 15,000 souls. The Anglo-Persian Oil Company's European staff at Ahwaz, where some 70,000 tons of cargo are transhipped annually and where their work-shops and stores are situated, number about 70, together with some 2,000 Persians, for most of whom special quarters have been built north of the old town. Motor routes run from Ahwaz along the right bank of the Karun and Diz to Dizful (85m.), to Shushtar (64m.), crossing the Karun at Band-i-Qir (28m.), and to Ram Hormuz (60m.) and Behbehan (126m.) (*q.v.*) and Masjid Suleiman (70 miles). An important caravan route also runs from Ahwaz to Isfahan (271m.) via Malamir. This route is closed by snow from December or January till April or May. Motors also run west from Ahwaz to Hawizah (42m.) and along the left bank of the Karun, following the pipeline to Mohammerah (68m.) and Abadan (75m.) (*q.v.*), crossing the Bahmishir river by a ferry.

AI, in Hebrew always with the definite article, *Haai,* "the heap of ruins." Other forms of the name are *'Ayya* (Neh. ii. 31), *'Ayyath* (Isa. x. 28). Some mss read, probably correctly, *'Ayya* for Gaza in I Chron. vii. 28. It was a royal city of the Canaanites and is best known for its complete destruction by Joshua (viii. 28), from which time, indeed, the name may date. Abraham pitched his tent between Ai and Bethel (Gen. xii. 8, xiii. 3). It lay somewhere east of Bethel (Beitin) near Beth-Aven with valleys to the north and west (Josh. viii. 11, 12). Identifications have fluctuated. Et-Tell (*Tell el-Hajar*), Khirbet el-Qudeira, Khirbet el-Haya and Khirbet Hayyan, all of which are mounds or ruined sites in the neighbourhood, have had their advocates. The weight of authority now favours Khirbet Hayyan with visible evidence of extensive habitation in rock-hewn reservoirs and débris of stone buildings. This site is rather more than 2m. south-east of Beitin on the road leading to the Jordan valley.

See *Pal. Expl. Fund Quart. Statement* (1869), p. 123; (1874), p. 62–4; (1878), pp. 10, 132, 195; (1881), p. 254; E. Robinson, *Bib. Researches,* i. 143, ii. 312 ff.; Sellin, *Mitt. des Deutsch. Palästina Vereins* (1900), p. 1 ff.; W. F. Albright, *Annual Amer. Schools of Orient. Research* (1924), appendix v. (E. Ro.)

AICARD, JEAN FRANÇOIS VICTOR (1848–1921), French poet and dramatist, was born at Toulon. He went to Paris to study law, and his first visit was to Victor Hugo, who returned the young man's admiration in kind, and is reported to have said in the Académie Française, "Je promets ce poète à la France." Aicard won the Vitet prize, and soon became known in literary circles in Paris for the charm and luminous simplicity of his verse. His poetry includes: *Les Rébellions et les apaisements* (1871); *Poèmes de Provence* (1874), and *La Chanson de l'enfant* (1876), both of which were crowned by the Academy; *Miette et Noré*

(1880), a Provençal idyll; *Le Livre d'heures de l'amour* (1887); *Jésus* (1896), etc. Of his plays the most successful was *Le Père Lebonnard* (1890), which was originally produced at the Théâtre Libre. Among his other works are the novels, *Le Roi de Camargue* (1890), *L'Âme d'un enfant* (1898) and *Tatas* (1901), *Benjamine* (1906) and *La Vénus de Milo* (1874), an account of the discovery of the statue from unpublished documents.

AICHINGER, GREGOR (*c.* 1565–1628), a distinguished composer. He was organist to the Fugger family at Augsburg in 1584. Proske, in the preface to vol. ii. of his *Musica Divina*, calls him a priest of Regensburg, and is inclined to give him the palm for the devout and ingenuous mastery of his style.

AIDAN (or AEDAN), a monk of Iona, and first bishop of Lindisfarne (A.D. 635–651). In 635 Oswald, who had succeeded to the kingdom of Bernicia in the previous year, re-united the whole of Northumbria under himself. Northumbria had been converted to Christianity by Paulinus (625–633), but had relapsed under the heathen successors of Edwin, and in 635 Oswald, who was an earnest Christian, sent for a new bishop. Paulinus had been a member of the Roman Church, but his successor was summoned from the headquarters of the Celtic church, the monastery of Iona, which Oswald had visited during his exile. The first monk sent was unsuccessful; when he reported at Iona that he could do nothing with the uncouth Northumbrians, Aidan suggested that "he had not first given them the milk of mild doctrine . . . until they were able to understand the more perfect mysteries . . . of God." Thereupon it was decided to send Aidan as bishop to Northumbria.

True to the traditions of the Celtic church, he fixed his abode on the island of Lindisfarne. Under his influence, and that of the Irish monks who joined him, churches were built, and monasteries established, and a school founded where 12 boys were trained as preachers.

Christianity spread apace through Northumbria, partly because Aidan was building on the foundations laid by Paulinus, and partly because of the active support given by Oswald. There was a close friendship between king and bishop, and Bede tells us that when Aidan was preaching, Oswald, who understood Scottish, would often act as his interpreter. But the main cause of Aidan's success was his own character; Bede, though disapproving of his observance of the Celtic Easter, gives him the highest praise for his learning, simplicity of life, and open-handed generosity. "What chiefly commended his teaching to all men was that it agreed with the life he and his followers led"

The defeat and death of Oswald at Maserfield (Aug. 5, 642) did not destroy the Northumbrian Church; though the kingdom was divided, Aidan retained his see, and legend tells that his prayers saved Bamburgh from destruction by Mercian invaders. He died at Bamburgh, Aug 31, 651, eleven days after the murder of his friend, King Oswin of Deira.

Aidan by his energy and saintly character had established in Northumbria Christianity in its Celtic form. But the phase was not lasting; in 664, at the Synod of Whitby, Oswy adopted the Roman Easter, and, abandoning the Celtic church with its monastic ideal, brought Northumbria again into touch with the Christianity of Southern England and the Continent.

See Bede, *Hist. Eccl.* iii. 3, 5, 14–17, 25—Plummer's edition, with excursus on the Paschal Controversy; Oman, *England before the Conquest* (1921), ch. xiv.; W. Bright, *Chapters of Early English Church History* (1897) chaps iv., v. See article EASTER.

AIDAN (d. 606), king of the Scottish kingdom of Dalriada, was the son of Gabran, king of Dalriada, and became king after the death of his kinsman, King Conall, when he was crowned at Iona by St. Columba. He refused to allow his kingdom to remain in dependence on the Irish Dalriada, but coming into collision with his southern neighbours he led a large force against Aethelfrith, king of the Northumbrians, and was defeated at a place called Daegsanstane, probably in Liddesdale.

See Bede, *Historiae Ecclesiasticae gentis Anglorum*, ed. by C. Plummer (1896); Adamnan, *Vita S. Columbae*, ed. by J. T. Fowler (1894).

AIDE-DE-CAMP (Fr. for camp-assistant or, perhaps, field-assistant), an officer of the personal staff of a general, who acts as his confidential secretary in routine matters. On Napoleon's staff such officers were frequently of high military qualifications, and acted both as his "eyes" and as the interpreters of his mind to subordinate commanders, even on occasion exercising a delegated authority. But in modern times, particularly in the British army, they have usually been of very junior rank and their duties largely social. In Great Britain the office of aide-de-camp to the king is given to senior officers as a reward or an honorary distinction. In many foreign armies the word *adjutant* is used for an aide-de-camp, and *adjutant-general* for a royal aide-de-camp. The common abbreviation for aide-de-camp in the British service is "A.D.C.," and in the United States "aid." Civil governors, such as the lord lieutenant of Ireland, have also, as a rule, officers on their staffs with the title and functions of aides-de-camp. The aide-de-camp of the governor of a State in the United States has the title of colonel.

AIDIN. (1) A vilayet in the south-west of Asia Minor including the lower part of the Maeander valley. (2) The principal town of the vilayet about 70m E.S.E. of Smyrna. It was taken by the Seljuks, Aidin and Mentesh, late in the 13th century, and about 1390, when ruled by Isa Bey, a descendant of the first-named, acknowledged Ottoman suzerainty. In the Seljuk period it was a secondary city under the provincial capital, Tireh (*q v.*) In the 17th century it came under the power of the Karasmans of Manisa and remained so till about 1820. Aidin is on the Smyrna-Dineir railway. On a neighbouring height are still to be seen the ruins of the ancient *Tralles* (*q v.*) Aidin itself suffered severely in the Greco-Turkish conflict of 1919–1922. Pop. (1927), 70,307.

AIDONE, a town of Sicily, in the province of Caltanisetta, about 22m. E S E. of the town of that name. Pop. (1921), 7,598. There are ruins of an ancient city on Mte. Serra Orlando near by. Aidone has some interesting 14th-century churches. (*See* E. Mauceri in *L'Arte*, 1906–17.)

AIDS, a term of mediaeval finance, were part of the service due to a lord from his men, and appear to have been based upon the principle that they ought to assist him in special emergency or need. The occasions for demanding them and the amount to be demanded would thus be matters of dispute, while the loose use of the term to denote many different payments increases the difficulty of the subject

Both in Normandy and in England in the 12th century the two recognized occasions on which, by custom, the lord could demand "aid" were (1) the knighting of his eldest son, (2) the marriage of his eldest daughter; but while in England the third occasion was, according to Glanvill, as in Normandy, his payment of "relief" on his succession, it was, according to the Great Charter (1215), the lord's ransom from captivity. By its provisions, the king covenanted to exact an "aid" from his barons on these three occasions alone—and then only a "reasonable" one —except by "the common counsel" of his realm. Enormous importance has been attached to this provision, as establishing the principle of taxation by consent, but its scope was limited to the barons and the City of London, and the word "aids" was omitted from subsequent issues of the charter. The barons, on their part, covenanted to claim from their feudal tenants only the above three customary aids. The last levy by the Crown was that of James I. on the knighting of his eldest son (1609) and the marriage of his daughter (1613).

From at least the days of Henry I. the term "aid" was also applied (1) to the special contributions of boroughs to the king's revenue, (2) to a payment in lieu of the military service due from the Crown's knights. Both these occur on the pipe roll of 1130, the military payment as *auxilium militum* (and possibly as *auxilium comitatus*). The borough "aids" were alternatively known as "gifts" (*dona*), resembling in this the "benevolences" of later days. When first met with, under Henry I, they are fixed round sums, but under Henry II., as the *Dialogue on the Exchequer* explains, they were either assessed on a population basis by Crown officers or were sums offered by the towns and accepted by them as sufficient. In this case the townsfolk were collectively responsible for the amount.

Aids and the Great Charter.—The Great Charter, as before stated, extended specially to London the limitation on baronial "aids," but left untouched its liability to tallage, a lower and more arbitrary form of taxation, which the towns shared with the Crown's demesne manors, and which London resisted in vain. The two exactions, although distinct, have to be studied together, and when in 1296–97 Edward I. was forced to his great surrender, he was formerly supposed by historians to have pledged himself, under *De tallagio non concedendo,* to levy no tallage or aid except by common consent of his people. It is now held, however, that he limited this concession to *aides, mises* and *prises,* retaining the right to tallage. Eventually, by a statute of 1340, it was provided that the nation should not be called upon "to make any common aid or sustain charge" except by consent of parliament. The aids spoken of at this period are of yet another character, namely, the grant of a certain proportion of all "movables" (*i.e.,* personal property), a form of taxation introduced about 1188 and of rapidly increasing importance. These subsidies were conveniently classed under the vague term "aids," as were also the grants made by the clergy in convocation, the term covering both feudal and non-feudal levies from the higher clergy and proportions not only of "movables" but of ecclesiastical revenues as well.

The "knight's aid" of 1130 spoken of above is probably identical with *auxilium exercitus* mentioned in the oldest custumals of Normandy, where the phrase appears to represent what was known in England as "scutage." Even in England the phrase *"quando Rex accipit auxilium de militibus"* occurs in 1166 and appears to be loosely used for scutage.

The same loose use enabled the early barons to demand "aid" from their tenants on various grounds, such as their indebtedness to the Jews, as is well seen in the Norfolk fragments of returns to the Inquest of Sheriffs (1170).

Sheriff's aid was a local payment of a fixed nature paid in early days to the sheriff for his service. It was the subject of a hot dispute between Henry II. and Becket in 1163.

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AIGRETTE, the long back plumes which the egret (*q.v.*) assumes in the breeding season, the use of which as ornaments in women's headdresses has become rare, owing to the protests of humanitarians on account of the cruelty involved in slaughtering the birds and leaving their young to starve. The name is also given to any similar ornament, in gems, etc., to the insignia of rank of colonels in the French army and, in science, to feathery excrescences such as the *pappus* of the dandelion and the luminous rays seen diverging from the moon's edges in solar eclipses.



BY COURTESY OF THE CHAMBER OF COMMERCE OF THOMASVILLE, GA.

EGRETS ON A SOUTHERN RESERVE ESTABLISHED AND MAINTAINED BY THE NATIONAL ASSOCIATION OF AUDUBON SOCIETIES

AIGUES-MORTES, a town of south-east France, department of Gard, 25m. S.S.W. of Nîmes on a branch line of the P.L.M. railway. Population (1926) 3,411. It occupies an isolated position in the marshy plain at the western extremity of the Rhone delta, 2½m. from the Gulf of Lions. Louis IX. embarked from Aigues-Mortes in 1248 and 1270 for the 7th and 8th crusades, and developed the town. The mediaeval fortifications which surround it are of great interest. They form a parallelogram 596yd. long by 149yd. broad and consist of crenellated walls from 25 to 36ft. in height, dominated by towers, of which the Tour de Constance (N.W.), built by Louis IX., was used as a prison for Protestants after the revocation of the Edict of Nantes. The fortifications were completed under Philip III. To further the prosperity of the town a most liberal charter was granted to it, and in addition the trade of the port was artificially fostered by a decree requiring that every vessel navigating within sight of the lights should put in there. This ordinance remained in force till the reign of Louis XIV. The town, although steadily decreasing in population, remains important historically as an outstanding example of mediaeval city planning. Aigues-Mortes is the meeting-place of several canals connecting with Beaucaire, Cette, the Lesser Rhone and the Mediterranean. Fishing and the manufacture of soda are industries, with trade in coal, fruits and wine. In the surrounding country there are important vineyards, which are preserved from disease by periodical submersion.

AIGUILLE (Fr. for needle), the sharp jagged point above the snow-line formed by a part of a mountain which has been split by frost action along joints or planes of cleavage with sides too steep for snow to rest upon them. Aiguilles are thus the forms left from the splitting up of the high ridges with "house-roof" structure into detached pinnacles. (*See* ARÊTE.)

AIGUILLON, EMMANUEL ARMAND DE WIGNEROD DU PLESSIS DE RICHELIEU, DUC D' (1720–1782), French statesman, nephew of the maréchal de Richelieu, was born on July 31, 1720. He was a member of the so-called *parti dévot,* the faction opposed to Madame de Pompadour, to the Jansenists, and to the parlement. In 1753 he was appointed commandant (governor) of Brittany and was engaged in constant disputes with the Breton parlement, in 1768 returning to court, where he resumed his intrigue with the *parti dévot* and finally obtained the dismissal of the minister Choiseul (Dec. 24, 1770). When Louis XV., acting on the advice of Madame Dubarry, reorganized the government with a view to suppressing the resistance of the parlements, d'Aiguillon was made minister of foreign affairs, Maupeou and the Abbé Terray (1715–1778) also obtaining places in the ministry. D'Aiguillon was blamed for having provoked the *coup d'état* of Gustavus III., king of Sweden, in 1772, although the instructions of the comte de Vergennes, the French ambassador in Sweden, had been written by the minister, the duc de la Vrillière. D'Aiguillon, however, could do nothing to rehabilitate French diplomacy; he acquiesced in the first division of Poland, renewed the Family Compact, and, although a supporter of the Jesuits, sanctioned the suppression of the society. After the death of Louis XV. he quarrelled with Maupeou and with the young queen, Marie Antoinette, who demanded his dismissal from the ministry (1774). He died, forgotten, in 1782.

See *Mémoires du Ministère du duc d'Aiguillon* (3rd ed., 1792), probably written by J. L. Soulavie. On d'Aiguillon's governorship of Brittany *see* Carré, *La Chalotais et le duc d'Aiguillon* (1893); Marion, *La Bretagne et le duc d'Aiguillon* (1898); and Barthélemy Pocquet, *Le Duc d'Aiguillon et La Chalotais* (1901–02). The three last have full bibliographies. *See* also Flammermont, *Le Chancelier Maupeou et les parlements* (1883); Frédéric Masson, *Le Cardinal de Bernis* (1884).

AIGUILLON, MARIE MADELEINE DE WIGNEROD DU PONT DE COURLAY, DUCHESSE D' (1604–75), daughter of Cardinal Richelieu's sister. In 1620 she married a nephew of the Constable de Luynes, Antoine de Beauvoir du Roure, Sieur de Combalet, who died in 1622. In 1625, through her uncle's influence, she was made a lady-in-waiting (*dame d'atour*) to the queen-mother, and in 1638 was created duchess of Aiguillon. After the death of the cardinal (1642) she withdrew from the court, and devoted herself entirely to works of charity. She helped St. Vincent de Paul to establish the hospital for foundlings, and also took part in organizing the General Hospital and several others in the provinces. She died on April 17, 1675. Corneille dedicated to her his tragedy of *Le Cid.*

See E. Fléchier, *Oraison funèbre de Mme. Marie de Wignerod, duchesse d'Aiguillon;* Bonneau-Avenant, *La duchesse d'Aiguillon* (1879); *Mémoires de Saint-Simon,* ed. by A. de Boislisle (1879 *et seq.*).

AIGUN (49° 58′ N. 127° 35′ E.) a treaty port on the south bank of the Amur in Northern Manchuria on the extreme north-eastern frontier of China. It lies on the opposite bank to, but about 20 miles below, the Russian city of Blagovyeshchensk, for which it serves as an entrepôt. Its trade is concerned primarily with the shipping of Mongolian cattle and meat and Manchurian grain and flour across the river to Blagovyeshchensk. But, since it was burnt down in 1900 during the Boxer troubles, this func-

tion has passed to Ta-hei-ho T'an which lies immediately opposite Blagovyeshchensk. The trade of Aigun is becoming more and more local and what general traffic it once had has been diverted from the Amur to the Chinese Eastern railway which offers a more direct route between Manchuria and the better-peopled parts of Siberia. Its total trade in 1926 amounted to Hk.Tls.-2,069,279. The Treaty of Aigun (1858) was one of a series of treaties which attempted to define the boundaries between the Chinese and Russian Empires.

AIKEN, a city of South Carolina, U.S.A, 17 m. E.N.E. of Augusta, Ga., on the highest point between Augusta and Charleston, 565 ft. above sea-level; the county seat of Aiken county. It is on Federal highways 1 and 78 and the Southern railway, and is connected with Augusta by an electric line. The resident population is small (4,103 in 1920, of whom 2,286 were negroes) but it is greatly increased by visitors during the winter, spring and autumn, for Aiken is a health and pleasure resort of high repute. The climate is unusually dry and equable, and the air is filled with fragrance from the forests of yellow Southern pine There are many luxurious private estates and country clubs, besides hotels and apartments. Fox-hunting, pigeon-shooting, riding, polo, tennis and golf are popular sports. With its seven polo fields, Aiken has been adopted as the winter training-ground for this game.

Aiken was settled early in the 19th century and was incorporated in 1835. It was on the line of one of the earliest railways, and was named after the first president of that road, William Aiken (1806–87), who was governor of the State (1844–47).

AIKIN, JOHN (1747–1822), English physician and author, was born at Kibworth-Harcourt on Jan. 15, 1747, and died at Stoke Newington, London, on Dec. 7, 1822. He practised as a consulting physician in London from 1792 onwards, but gradually became absorbed in literary pursuits. Aikin and his sister, Anna Letitia Barbauld, wrote popular books which had a great vogue Their admirable miscellany, *Evenings at Home* (1792–95) was translated into many European languages. Aikin's voluminous works include *General Biography* (1799–1815), and *Lives of John Selden and Archbishop Usher* (1812).

His daughter, LUCY AIKIN (1781–1864), born at Warrington on Nov. 6 1781, wrote several books for children, including versions of classical stories written in monosyllables. She also wrote. a novel, *Lorimer* (1814); *Memoirs of the Court of Queen Elizabeth* (1818); *Memoirs of the Court of James I.* (1822); *Memoirs of the Court of Charles I.* (1833) and a *Life of Addison* (1843). Miss Aikin died at Hampstead, where she had lived for 40 years, on Jan. 29 1864.

See a *Memoir of John Aikin, with selections of his miscellaneous pieces* (1823), by his daughter; and the *Memoirs, Miscellanies and Letters of Lucy Aikin* (1864), including her correspondence (1826–42) with William Ellery Channing, edited by P. H. Le Breton.

AILANTHUS (more correctly *ailantus*, from *ailanto*, an Amboyna word probably meaning "Tree of the Gods," or "Tree of Heaven"), a genus of trees belonging to the family Simarubaceae. The best known species, *A. glandulosa*, Chinese sumach or tree of heaven, is a handsome, quick-growing tree with spreading branches, and large compound leaves, resembling those of the ash, and bearing numerous pairs of long pointed leaflets. The small greenish flowers are borne on branched panicles; and the male ones are characterized by having a disgusting odour. The fruits are free in clusters, and each is drawn out into a long wing with the seed in the middle. The wood is fine grained and satiny. The tree, which is a native of China and Japan, was introduced into England in 1751 and is a favourite in parks and gardens. It has been extensively planted in the eastern United States where it is one of the few trees which will grow in smoky manufacturing districts. Two other species, *A. imberiflora* and *A. punctata* are important Australian timber-trees; *A. excelsa* is common in India.

AILANTHUS MOTH (*Philosamia cynthia*), a large silk-spinning moth inhabiting China. The larvae feed on the leaves of the ailanthus tree and yield a silk more durable and cheaper than mulberry silk, but inferior to it in fineness and gloss. The moth measures about 5in. across, and is olive-brown in colour with a whitish spot and a white and purplish transverse bar on each wing. It was introduced with its food-tree into the eastern United States where it is now common.

AILERON, a movable part of the wing of an aeroplane (*q.v*) situated at or near the wing tips as shown in fig. 1. They are so connected to the control column that a movement of it, *e.g.*, to the right (or a corresponding rotation of the control wheel), raises the aileron on the right wing and lowers that on the left wing, causing the aeroplane to bank for a turn to the right.

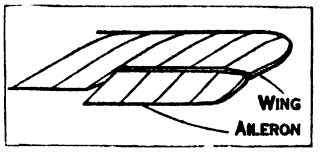

FIG 1.—NORMAL TYPE OF AILERON
The banking of an aeroplane in turning is brought about by two ailerons, one on the rear edge of each wing. One goes up as the other goes down

Ailerons of the type shown in fig. 1 are effective in normal flight but when the aeroplane is stalled they become ineffective and a possible source of danger As the result of research initiated by the Aeronautical Research committee a form of aileron has been developed practically free from this defect The part of the wing covered by the aileron is "slotted" on the principle invented by F. Handley-Page (*see* AEROPLANE). Fig. 2 shows one form. The universal adoption of some device of this kind is of vital concern to the future of flying, since it will remove one of the most serious risks.

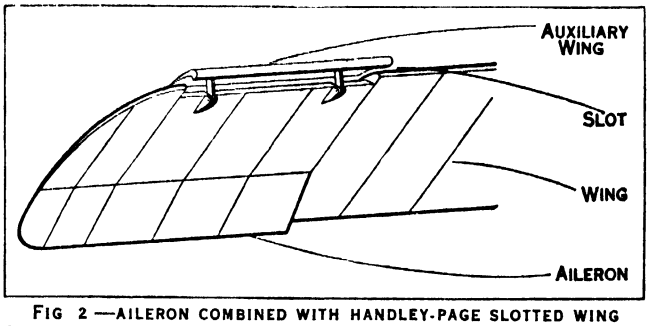

FIG 2.—AILERON COMBINED WITH HANDLEY-PAGE SLOTTED WING
The purpose of this auxiliary wing is to remove one of the most serious risks of flying. In stalling the ailerons become ineffective. By this device the "slot" opens automatically when the wing stalls and this renders the aileron effective. The illustration shows a right wing seen from below

See AERONAUTICS.

AILLY, PIERRE D' or PETRUS DE ALLIACO (1350–1420), French churchman and schoolman, was born at Compiègne and studied at the College of Navarre of the University of Paris. He became master of the college in 1384 and later obtained the highest dignity in the university, the chancellorship of Notre Dame. John Gerson was one of Ailly's pupils and his lifelong friend. The two men played an important part in the later history of the papal schism. Pierre d'Ailly acted as spokesman of the university before the king's council (May 20 1381) with the proposal that the best way of ending the scandal of the existence of two popes, Urban VI. at Rome and Clement VII. at Avignon, was the summoning of a general council. The suggestion was unacceptable and Ailly retired from Paris for some time. As master of the College of Navarre he was twice sent by the university on missions to Clement VII., and on the death of that pope, he was sent by the king to congratulate Clement's successor, Benedict XIII. His acceptance of that mission displeased the university, which was already beginning to demand the resignation of both popes as a preliminary to the re-unification of the church. Suspicion of his attitude was deepened by his nomination by Benedict XIII. as bishop of Le Puy (1395) and then bishop of Cambrai (1397). At the ecclesiastical council, held in Paris in 1406, Ailly, by the king's order, defended Benedict XIII., and it was not until the convocation of the general Council of Pisa (1409) that he forsook Benedict's cause and returned to the point of view of the University of Paris, of which he had been the champion before his preferment. He and Gerson urged that the unity of the church could only be restored by a general council which, in case of schism, would be supreme and legitimate even though it were not convoked by the pope. The nominee of the Council of Pisa died within a year. His successor, John

XXIII., gave Ailly the bishopric of Orange and made him a cardinal. Nevertheless Ailly was one of the most formidable adversaries of John XXIII. at the Council of Constance (Nov. 1414–April 1418). He maintained that, as the decisions of the Council of Pisa had not been accepted and there were now three "popes," it was necessary to begin *de novo* and treat the claims of all three alike, and he made serious depositions against John. The theory put forward by Ailly and Gerson that the general council had jurisdiction over the pope himself was a dangerous one, and, according to later decisions, even heretical; but both men were seeking an outlet from an impossible situation. Ailly found in the end an ingenious compromise on the rights of the Sacred College and the council and the schism was healed by the appointment of Martin V.

During the Council of Constance, Ailly had earned the hatred of the Anglo-Burgundians by trying to reduce the power of the English by contesting their right to form one of the four separate nations. He was compelled to retire to Avignon, where he died on Aug. 9 1420.

Pierre d'Ailly's written works are numerous. Many of them were published with the works of Gerson (by Ellies du Pin, Antwerp, 1706); others appeared in the 15th century, probably at Brussels; and there are many treatises and sermons still unpublished. In philosophy he was a nominalist.

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AILSA CRAIG, an island rock at the mouth of the Firth of Clyde, 10m. W. of Girvan, Ayrshire, Scotland. It is of conoidal form, with an irregular elliptic base, and rises abruptly to a height of 1,097ft. The only side from which the rock can be ascended is the east, the other sides being for the most part perpendicular, and generally presenting lofty columnar forms, though not so regular as those of Staffa. The island is composed of micro-granite with riebeckite, of great interest on account of the rare occurrence of this type in Britain. It is fine-grained and of a greyish colour, and may be of Tertiary age. Pebbles of this rock were carried far south (*e.g.* to Welsh shores) by glaciers of the Ice age. The rock is a favourite material for curling-stones. Hence curling-stones are popularly known as "Ailsas" or "Ailsa Craigs." The rock is also used for paving stones. A columnar cave exists towards the north side of the island, and on the east are remains of a tower. Two springs occur and some scanty grass affords subsistence to rabbits, and, on the higher levels, to goats. The precipices have large breeding colonies of gannets and other sea birds which spend the winter months at sea. A lighthouse on the south side flashes a light visible for 13 miles.

AIMAK, the name of nomadic or semi-nomadic Mongolian tribes inhabiting the north and north-west Afghan highlands north of Herat. *Aimak* is a Mongolian word meaning "clan" or "section of a tribe." They were originally known as "chahar (the four) eimaks," because there were four principal tribes: the Taimani, the Ferozkhoi, the Jamshidi and the Hazara. They number about 250,000, and speak a dialect akin to Kalmuck. They are Sunnite Mohammedans.

AIMARD, GUSTAVE, the pen-name of OLIVIER GLOUX (1818–83), French novelist, who was born in Paris Sept. 13, 1818, and died there June 20, 1883. He made use of the materials collected in a roving and adventurous youth and early manhood in numerous romances in the style of J. Fenimore Cooper. Among the best of them are: *Les Trappeurs de l'Arkansas* (1858); *La grande flibuste* (1860); *Nuits mexicaines* (1863); *La Forêt vierge* (1870).

AIMOIN (*c.* 960–*c.*1010), French chronicler, spent the greater part of his life in the monastery of Fleury. His chief works are: *Historia Francorum* or *Libri V. de gestis Francorum*, a history of the Franks from the earliest times to 633, which was continued by other writers and brought down to the middle of the 12th century; a life of Abbo, abbot of Fleury; and books ii. and iii. of the *Miracula S. Benedicti.*

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AIN, a department of eastern France, formed from Bresse, the Pays de Dombes on the lowland and the Pays de Gex, Valromey and Bugey among the high parallel scarps of the Jura reaching south to the Rhone between Geneva and Lyons. Area 2,248 sq.m. Pop. (1926) 317,195. The name is that of the river which roughly separates the two first from the other districts, running north to south at first between outer hill ranks and then along the foot of the highland to join the Rhone. The western boundary is the Saône, the southern the Rhone, the eastern Switzerland and the northern the departments of Saône-et-Loire and Jura, the boundary over against the latter being closely linked with that of old between Burgundy and Franche Comté. The Pays de Gex includes some of the highest Jura scarps (Crêt de la Neige 5,653-ft.), the Pays de Valromey flanks on the west the deep Rhone gorge below Bellegarde, the Pays de Bugey is the south-pointing triangle of the Rhone focussing on Belley West of the hills, Bresse occupies the fertile north part of the department and is effectively drained to the Saône, thus contrasting with the Pays de Dombes, mantled in boulder clay and possessing endless pools and marshes with, still, a good deal of consequent malarial trouble. The summers are warm in the lowland but the winters, generally, are sharp, the rainfall rises well above 1 metre per annum in the highland. The farms of Bresse are famous for pigs and poultry and the latter (especially geese) are also bred, in Dombes, which also raises horses. In the Jura hill country, pastures feed sheep and cattle from which cheese is produced, while many slopes are well forested. Bresse produces considerable cereal and other crops but the rest of the department is thus concerned mainly with stock-raising or with activities connected with its forests (of fir and oak) or with extensions of the silk industry from Lyons just beyond the south-west corner of the department, thanks to the water power available from the rivers among the gorges of the limestone country. Bourg is the capital of the department; the three arrondissements of which take their names from Bourg, Belley (the seat of a bishop in the archiepiscopal province of Besançon) and Nantua. The departmental appeals are heard at the court of Lyons and the department is also under Lyons educationally. Bourg (*q.v.*) is a market town specially known in connection with the famous church of Brou, wrongly described in Arnold's well known poem as being in Savoy. Among silk towns one may mention Jujurieux, Tenay, St. Rambert, St. Bernard en Bugey; Bellegarde and St. Rambert make wood pulp; and Oyonnax, a rather larger town than several of the others, north of Nantua, makes articles in wood and horn and is specially well known for its combs. Seyssel, on the far east, yields asphalt and many parts of the department give building stones, cement or potter's clay. There is a good tourist industry for winter sports, angling, etc., and some of the gorges and ridges are very striking; near Bellegarde, at the Perte du Rhone, that great river formerly disappeared down a fissure. Though the main P L.M. railway from Dijon to Lyons lies west of the Saône, and so outside the department, the main line from Paris to Geneva runs through Bourg and Ambérieu to Bellegarde; both the Saône and the Rhone are navigable for considerable lengths along the confines of the department.

AINGER, ALFRED (1837–1904), English divine and man of letters, was born in London on Feb. 9, 1837, the son of an architect. He was educated at King's College, London, and at Trinity College, Cambridge, and was ordained in 1860 to a curacy at Alrewas, near Rugeley. His connection with the Temple Church, in London, began in 1866, when he was appointed reader; and in 1894 he succeeded Dr. Vaughan as master. In 1887 he was presented to a canonry in Bristol cathedral, and he was chaplain-in-ordinary to Queen Victoria and King Edward VII. He died on Feb. 8, 1904. Canon Ainger's gentle wit and humour, his generosity and lovable disposition, endeared him to a wide circle. In literature his name is chiefly associated with his sympathetic appreciation of Charles Lamb and Thomas Hood.

His works include: *Charles Lamb* (1882) and *Crabbe* (1903) in the "English Men of Letters" series; editions of Lamb's *Essays of Elia* (1883) and of his *Letters* (1888; 2nd ed., 1904), of the *Poems* (1897) of Thomas Hood, with a biographical introduction; *The Life and Works of Charles Lamb* (1899–1900); articles on Tennyson and Du Maurier in the *Dictionary of National Biography; The Gospel and Human Life* (1904), sermons; *Lectures and Essays* (1905), edited by the Rev. H. C. Beeching.

See Edith Sichel, *The Life and Letters of Canon Ainger* (1906).

AINHARDUS: *see* EINHARD.

AINMÜLLER, MAXIMILIAN EMMANUEL (1807–1870), German artist and glass-painter, was born at Munich on Feb. 14, 1807. In 1828 he was appointed director of the newly-founded royal painted-glass manufactory at Munich. The method which he gradually perfected there was a development of the enamel process adopted in the Renaissance, and consisted in actually painting the design upon the glass, which was subjected, as each colour was laid on, to carefully-adjusted heating. The earliest specimens of Ainmüller's work are to be found in the cathedral of Ratisbon. With a few exceptions, all the windows in Glasgow cathedral are from his hand. Specimens may also be seen in St. Paul's cathedral, and Peterhouse, Cambridge, and Cologne cathedral contains some of his finest productions. Ainmüller had considerable skill as an oil-painter, especially in interiors. He died on Dec. 9, 1870.

AINSWORTH, HENRY (1571–*c.* 1622), English Nonconformist divine and rabbinical scholar, was born at Swanton Morley, Norfolk. He was a scholar of Caius College, Cambridge, joined the Puritan party in the church, and eventually the Separatist. Driven abroad in the persecution of 1593, he found a home in "a blind lane at Amsterdam." He acted as "porter" to a scholarly bookseller in that city, who, on discovering his skill in Hebrew, enabled him to continue his Hebrew studies. When part of the London church, of which Francis Johnson (then in prison) was pastor, reassembled in Amsterdam, Ainsworth was chosen as their doctor or teacher.

In 1596 he drew up a confession of their faith, which he reissued in Latin in 1598. Johnson joined his flock in 1597, and in 1604 he and Ainsworth composed *An Apology or Defence of such true Christians as are commonly but unjustly called Brownists.* In 1610 he was forced reluctantly to withdraw, with a large part of their church, from F. Johnson and his adherents on a question of church government, Ainsworth taking the more congregational view. (*See* CONGREGATIONALISM.) But in spirit he remained a man of peace. The fruit of his rabbinical learning appeared in his *Annotations*—on *Genesis* (1616); *Exodus* (1617); *Leviticus* (1618); *Numbers* (1619); *Deuteronomy* (1619); *Psalms* (including a metrical version, 1612); *Song of Solomon* (1623). These were collected in folio in 1627, and again in 1639. From the outset the *Annotations* took a commanding place, especially among Continental scholars.

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AINSWORTH, ROBERT (1660–1743), English schoolmaster and author, was born at Eccles, near Manchester, in Sept. 1660. Ainsworth's name is associated with his Latin-English dictionary, begun in 1714 and published in 1736 as *Thesaurus linguae Latinae compendiarius.* He died in London, April 4, 1743.

AINSWORTH, WILLIAM HARRISON (1805–1882), English novelist, was born at Manchester, Feb. 4, 1805. He was educated for the law, but at the age of 21 he married a daughter of John Ebers, the publisher, and followed his father-in-law's profession for a short time. A novel called *Sir John Chiverton,* in which he had a share, won the praise of Sir Walter Scott, and he turned to novel-writing. *Rookwood* (1834), with its description of the ride of Dick Turpin to York, had an immediate success. He published about 40 "historical" novels, of which the best known are *Jack Sheppard* (1839), *The Tower of London* (1840), *Old St. Paul's* (1841) and *Windsor Castle* (1843). He edited *Bentley's Miscellany,* in which *Jack Sheppard* was published as a serial, and in 1842 he became proprietor of *Ainsworth's Magazine.* In 1853 it ceased to appear, and Ainsworth bought the *New Monthly Magazine.* He died at Reigate, Jan. 3, 1882.

See S. M. Ellis, *William Harrison Ainsworth and his Friends* (London, New York, 1911).

AINTAB (anc. DOLICHE), a city of Anatolia just outside French mandated territory, pop. about 60,000 (two-thirds are Muslim, mainly of Turkoman origin and there are 15,000 Armenians). In ancient times (2nd Mil. B.C.) Aintab was in the Hittite area and is probably of Hittite origin. Duluk, the site of *Doliche,* famous for the worship of Zeus Dolichenus (Baal), is marked by a mound two hours distant to the north-west. In Crusading times its strong castle (*Hamtab*) was a strategic point of importance and was captured by Saladin in 1183. It served as the last base of Ibrahim Pasha before his victory over the Turks at Nezib, 25m. to the north-east (1839). In the winter of 1920–21 the armed opposition of the Turkish nationalists to the French occupation of north Syria centred in Aintab which became the "Verdun of Anatolia." After an investment lasting six months, despite determined Turkish efforts to relieve it, the city surrendered to the French troops. France returned it to Anatolia under the Angora Treaty of Oct. 30, 1921.

The modern city stands high (3,500ft.) in the open, treeless valley of the Sajur, a tributary of the Euphrates, some 65m. N.E. of Aleppo. Important educational and medical work is carried on by the American Mission Board in their college (founded 1874) and girls' seminary. There is also a Franciscan mission. Manufactures include striped dress materials (the chief of which is a mixture of silk and cotton), black goats' hair cloth for tents, morocco leather (*sakhtiyan*) made from goats' skins (it is estimated that nearly 400,000 are tanned here annually), "Aleppo soap" made from olive oil, *Pekmez,* a sweet paste made from grapes, and the dyeing of yarns. The exports include pistachio nuts, tobacco, cotton and cereals.

AINU, who are racially closely akin to, if not identical with, the Neolithic inhabitants of Japan (*see* JAPAN, *Racial History*) are now very reduced in numbers and live in Hokkaido, the northern island of Japan, in part of Saghalien, and have kinsfolk in the Ryukyu islands (*q.v.*). They are dwindling fast and are unable to compete with the advance of Japanese civilization. Physically they are probably the remains of an old Proto-Nordic population once widely spread over Northern Asia, and are certainly the relics of a very old human stock. Their culture recalls in many ways stone age man and they have preserved the very earliest stage of agriculture, when the men are still hunters but the women have developed beyond the mere collecting stage and are beginning actually to plant crops.



AN AINU VILLAGE CHIEF
The Ainu are now under Japanese rule, but in former times their affairs were administered by hereditary chiefs, three in each village

The Ainu religion is closely akin to the animistic religion practised by various primitive peoples of northern Asia, and they are particularly liable to that peculiar kind of religious ecstasy known as Arctic hysteria. One of their special cults is that of the bear. This animal is caught as a cub, and is carefully tended by the women who will even suckle it. At about three years old the bear is sacrificed with elaborate ceremony. In most of the Ainu villages, the special wooden cages in which the bears are kept can be seen. Prominent also in the villages are sticks which have been whittled (*inao*) and the shavings left on. The sticks are stuck in the ground and have a religious significance.

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AIR, the atmosphere that surrounds the earth. With the development of analytical and especially of pneumatic chemistry, the air was recognized not to be one homogeneous substance, as was long supposed, and different "airs," or gases, came to be distinguished. At the end of the 18th century oxygen gas was known as *dephlogisticated air,* nitrogen or azote as *phlogisticated air,* hydrogen as *inflammable air,* carbonic acid gas as *fixed air.* The name is now ordinarily restricted to atmospheric air (*see* ATMOSPHERE). The sense of atmosphere or environment may have led to the further use of the word "air" to mean "manner" or "appearance"; and so to its employment (*cf.* Lat. *modus*) in music for "melody." (*See* ARIA.)

AIR or **ASBEN,** a country of West Africa, lying between 15° and 19° N. and 6° and 10° E. It is within the Sahara, of which it forms one of the most fertile regions. The northern portion of the country is mountainous, some of the peaks rising to a height of 5,000ft. Richly wooded hollows and extensive plains lie between the hills. The mimosa, the doum palm and the date are abundant. Some of the plains afford good pasturage for camels, asses, goats and cattle; others are desert tablelands. The country generally is of sandstone or granite formation, with occasional trachyte and basaltic ranges. There are no permanent rivers; but during the rainy season, from August to October, the water-courses in the hollows of the mountains are converted into broad and rapid streams. Numerous wells supply the people and their cattle. To the south of this region lies a desert plateau, 2,000ft. above sea-level. Still farther south is the fairly fertile district of Damerghu, of which Zinder is the chief town. There is cultivation in the neighbourhood of the villages. Millet, dates, indigo and senna are the principal products.

Air was called Asben by the native tribes until they were conquered by the Berbers. The present inhabitants combine the finer traits of the Berbers with negro characteristics. The sultan of Air is much dependent on the chiefs of the Tuareg tribes inhabiting a vast tract of the Sahara to the north-west. A large part of his revenue is derived from tribute exacted from the salt caravans. Since 1890 Air has been included in the French sphere of influence in West Africa.

Agades, the capital of the country, which has a circuit of 3½m., is built on the edge of a plateau 2,500ft. high, said to have been founded by the Berbers to serve as a secure magazine for their extensive trade with the Songhoi empire. The language of the people is a dialect of Songhoi. In former times Agades had a great trade, with a population of about 50,000. Since the beginning of the 16th century the prosperity of the town has, however, gradually declined.

AIRAY, HENRY (1560?–1616), English Puritan divine, was born at Kentmere, Westmorland, but no record remains of the date of either birth or baptism. He died on Oct. 6, 1616. His character as a man, preacher, divine, and as an important ruler in the university, will be found portrayed in the Epistle by John Potter, prefixed to his *Commentary on the Epistle to the Philippians* (1618). He must have been a fine specimen of the more cultured Puritans—possessed of a robust common sense in admirable contrast with some of his contemporaries.

AIR-BLADDER, the name given to a structure present in all bony fishes (Teleosts) and homologous with the lungs of land vertebrates. The functions of this organ, which contains gas having a high percentage of oxygen, are obscure; hydrostatic uses have been attributed to it with doubtful validity. In some fishes (especially Siluroidea, *q.v.*), it is connected with the internal ear by a chain of bones, the Weberian ossicles, and in these forms it is possibly concerned with hearing. It usually retains a connection with the alimentary canal (except in most Acanthopterygii, *q.v.*), but is normally dorsal to it. (*See* FISH.)

AIRBRUSH, a machine used for applying liquid colouring to a surface by means of compressed air. The use of compressed air for the atomization of liquids has been known for many years, but it is only in the last quarter century that the principle has been successfully applied to the application of varnishes, enamels, lacquers, etc., in commercial and industrial enterprises, and today there is hardly an institution anywhere whose product requires finishing that does not employ this method of application. The early successful use of airbrushes was in the art field, where artists employed them almost exclusively for executing and retouching various kinds of art work.

The airbrush shown in fig. 1 (p. 441) is used in drawing the most delicate hair-line work, as well as photographic retouching. It is a common implement in all large newspaper art departments. Fig. 2 illustrates the next step towards a commercial airbrush, this style being used for decorative and show-card work.

The natural evolution of the airbrush that was used by the artist brought about the present industrial type (fig. 3) which is used in practically every automobile and furniture factory, or any industry applying liquid finishes to their product. This is a universal airbrush, inasmuch as it may be used with any style of fluid supply, gravity (overhead bucket), pressure tank and cup (either syphon or gravity), thus making the airbrush applicable to all purposes. The heads for this type are made in five sizes, all interchangeable, thus adapting the airbrush to all consistencies of material. The production of as high as 5,000 automobiles per day could never have been reached were it not for the airbrush, which makes it possible to coat a body in less than one minute. Fig. 4 shows a modern industrial installation as used for the finishing of furniture, the booth and ventilating equipment being very necessary to carry off the fumes and excess spray.

Fig. 5 illustrates a complete portable airpainting outfit, such as is used in painting a house. With such a machine one man can do more painting than five men with hand brushes, and do it better. Contract painters everywhere now use these machines for all general painting, and particularly are they of tremendous value in painting stucco work. Large railroad companies have adopted this method of painting their bridges, depots and cars, effecting an enormous saving in addition to the fact that they are now able to get this work done in season. This type of machine is made for both electric and gasolene (petrol) engine operation.

Airbrushes are now made to function in every capacity from that of a cement mixture to the most delicate art work.

(H. W. N.)

AIR COMBAT. Combat between aircraft is a new development of war. It is one that will probably become increasingly important, since aircraft have, so far at any rate, proved in war to be the best antidote to aircraft. The most effective way in fact of preventing enemy aircraft from carrying out their object, be it reconnaissance, observation of artillery fire or bombing, is to oppose them in the air with other aircraft.

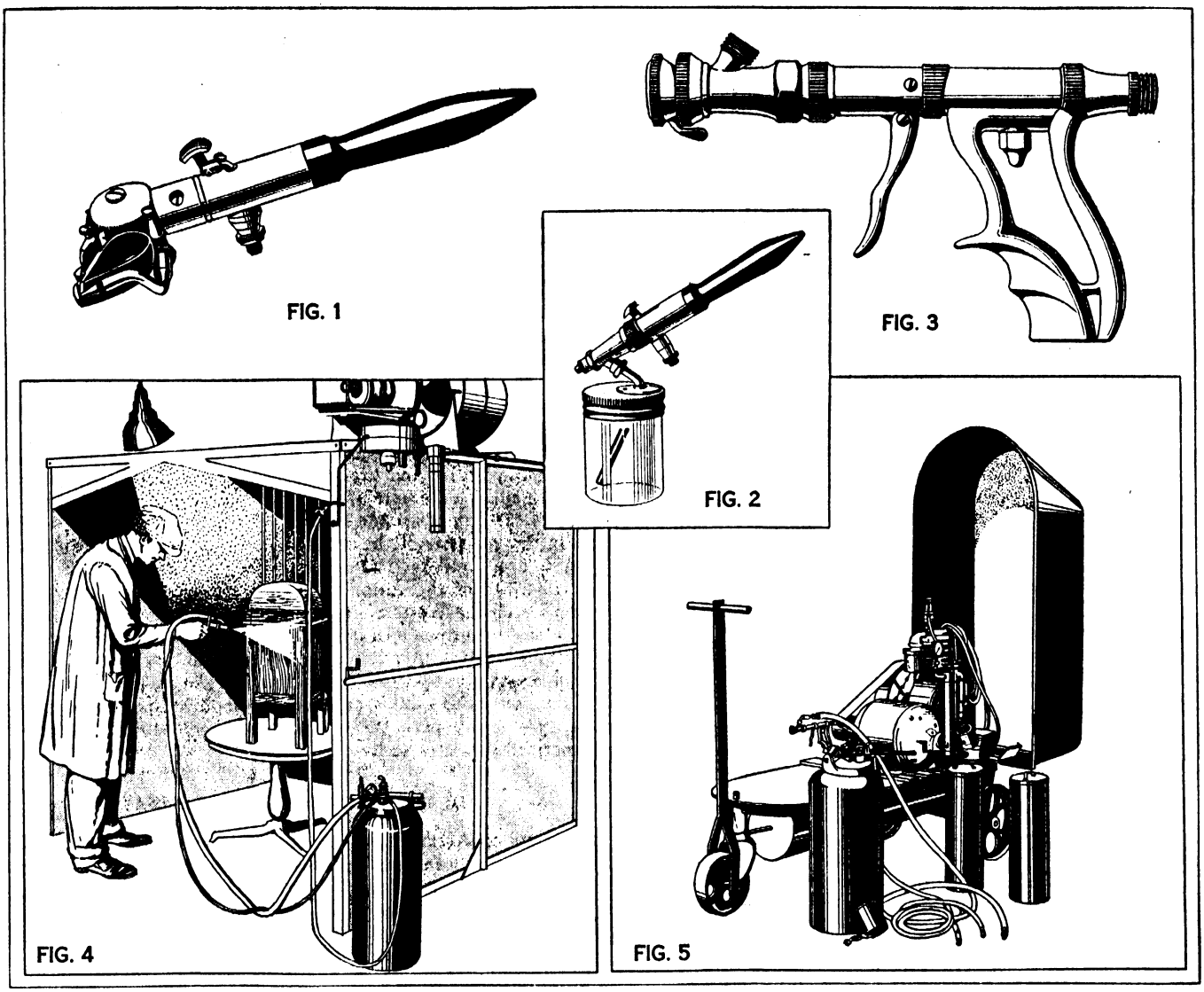
I. HISTORICAL

The term air combat covers fighting between aeroplanes and between aeroplane and airship. There has been no instance recorded of airship fighting airship.

Early History.—Prior to the outbreak of the World War, none of the belligerents had devoted much attention to air combat. Reconnaissance was regarded as the primary, indeed almost the only, duty of aircraft. There was thus little or no specialization of duties among aeroplanes; in fact it is, broadly speaking, true to say that all the belligerents began the war with one class of aeroplane—a two-seater designed solely for reconnaissance. There were a few single-seaters of high performance, but their rôle was that of fast scouts. As the war went on, specialization appeared, and a class of aeroplane designed specifically for air fighting was evolved, followed by a class of bombing aeroplanes.

Prior to the outbreak of war the British had experimented with machine-guns in aircraft, and firing tests had been carried out in the air. But on the outbreak of war no aeroplane on the Western Front was actually armed with a machine-gun. Rifles, carbines, pistols, shotguns and hand grenades were carried by pilots and observers. The tactics employed in the stray combats that did occur at this time were rudimentary. The pilot simply flew close to the enemy aeroplane, and, when within range, he or his observer blazed away with whatever weapon they happened to be carrying.

In the summer of 1915, all belligerents began to mount machine-



BY COURTESY OF PAASCHE AIRBRUSH COMPANY

FIG. 1.—AIRBRUSH USED EXTENSIVELY BY COMMERCIAL ARTISTS. FIG. 2.—LARGER THAN THE AIRBRUSH IN FIGURE 1 AND DIFFERING CHIEFLY IN HAVING A LARGER COLOUR RESERVOIR. FIG. 3.—ONE TYPE OF INDUSTRIAL AIRBRUSH. FIG. 4.—MODERN INDUSTRIAL INSTALLATION USED FOR PAINTING FURNITURE. FIG. 5.—COMPLETE PORTABLE AIR-PAINTING OUTFIT

guns in their standard two-seater reconnaissance aircraft, the great majority of which were of the tractor type (*i.e.*, aeroplanes in which the pilot sits behind the engine). In these aeroplanes the gun was usually mounted on a swivelling bar at the back of the observer's seat. The observer could only fire the gun backwards towards the tail of the aeroplane and over the pilot's head. (At that time the observer was always seated in front of the pilot.) The arc of fire was consequently restricted; and it was necessary, owing to the fact that the gun pointed towards the aeroplane's tail, to fly *away* from the enemy aeroplane in order to bring fire to bear upon it.

It was at once apparent that, in order to attack effectively, it was essential to be able to fire *forwards* in the direction in which the aeroplane was flying. The British had already designed an aeroplane embodying this principle. This aeroplane, the Vickers Fighter, was a two-seater of the "pusher" type (*i.e.*, the pilot and observer sat in a nacelle in front of the engine). The observer, who sat in the very front of this nacelle, was armed with a Lewis gun on a swivelling mounting. Two squadrons of these aeroplanes were sent to France in the summer and autumn of 1915 respectively. The machine, however, lacked speed and climbing power, and was soon outclassed by a new type of German aeroplane—the Fokker monoplane.

The Fokker Monoplane (Autumn 1915).—This was a small, fast single-seater, of the tractor type. It was fitted with a fixed machine-gun firing straight ahead and a synchronizing gear by which the actions of the engine and the machine-gun were so co-ordinated that the gun only fired when the propeller blade was *not* opposite the muzzle of the gun. The pilot aimed the gun by pointing his aeroplane at the enemy. This, the first effective "fighter" aeroplane, began to appear on the Western Front in the autumn of 1915, and by the end of the year had achieved such success as to be practically master of the air.

Meanwhile the Allies had not been idle. Shortly after the advent of the Fokker E.I., the French produced the "Baby" Nieuport, a single-seater tractor biplane with a Lewis gun so fixed on its top-plane as to fire straight ahead outside the arc of the propeller; while early in 1916 the British sent to France the D.H.2, and later the F.E.8. These were small single-seater fighters of the pusher type, in which the pilot operated a Lewis gun on a moveable mounting in the front of the nacelle.

By this time the need for the specialization of functions among aircraft was becoming apparent; and both the Allies and the Germans, besides producing aeroplanes designed solely for air fighting, had, by the beginning of 1916, grouped these aeroplanes into specialist fighting squadrons.

Formation Flying (Spring 1916).—The success of the Fokker monoplane had a direct and immediate effect on the tactics of air combat, and on the design of all types of aeroplanes. As regards tactics, it was responsible for the birth of formation fly-

ing. Towards the end of 1915, owing to the casualties among British and French aircraft, it became the custom to send out two or three aeroplanes to fly in close company for mutual protection, whenever their duties necessitated their penetrating more than a few miles into enemy territory. The German Fokker pilots retaliated by working together in slightly larger formations, so as to have the advantage of numbers on their side. As the war proceeded, by reason of this competition to outnumber the enemy, formations tended to increase in size, until by the end of the war formations of 50 or 60 aeroplanes, working together in close co-operation, were not uncommon.

As formations increased in size and the tactics of fighting in formation developed, individualism in air fighting tended to disappear in favour of co-operation—that is, it was found, as the war went on, to be usually of little use for one pilot to go out alone to search for and shoot down enemy aeroplanes. Not only was he liable to be attacked by a formation of enemy fighters and so outnumbered, but it was also found to be a hazardous business for one man to attack single-handed a close-knit formation of two-seater reconnaissance or bombing aeroplanes.

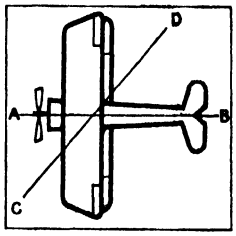


FIG. 1—THE SUPERIOR ACCURACY OF FIRE ALONG THE LINE OF FLIGHT
When firing along AB the line of flight, no allowance need be made for the speed of the aeroplane, but when firing any other direction, as CD, this factor has to be taken into account

The System of Offensive Patrols (Summer and Autumn 1916).—By the summer of 1916 therefore the customary British method of employing fighter squadrons was to send them out in small formations of five or six aeroplanes on what were termed "offensive patrols." These formations flew out over enemy territory, often as far as the enemy aerodromes, with the object of searching for and dispersing enemy fighting patrols, and so affording indirect protection to the British reconnaissance, artillery observation and bombing aircraft. To the French must be given the credit of first employing this system on a wholesale scale. This they did at Verdun in the spring of 1916. But the system was brought to full flower by the British during the battle of the Somme, where its success was so great as to transfer for a time to the Allies the mastery of the air that had been previously won for the Germans by the Fokker monoplane

Modifications in Design of Two-Seaters (Summer 1916).—In 1916, as a result of the increasing importance of air combat, all belligerents began to devote far more attention not only (as already described) to the development of fighting aircraft and their methods of employment, but also to the design of the two-seater reconnaissance and bombing aeroplanes, and to the tactics by which they could best defend themselves against the attacks of fighting aircraft. Thus there gradually came into vogue a more or less standard "lay-out" for the two-seater reconnaissance and bombing types—a lay-out that has not so far been materially modified. The design that was found to be most effective was a tractor biplane, in which the pilot was seated *in front of* the observer or gunner. The pilot had a fixed machine-gun, firing straight ahead, and a synchronizing gear—an armament in fact similar to that of the fighter pilot. The observer was seated facing backwards, behind the pilot, with a light machine-gun on a swivelling mounting with which he was able to cover an arc of rather more than 180 degrees towards the aeroplane's tail. Since—for reasons that will be explained later—the usual method of attack in the air is to take the enemy in the rear, the main defence of a two-seater was found to be in the fire of the observer from this rearward gun, supplemented of course, by such tactical manoeuvrings as the pilot thought fit to carry out. The first two-seater aeroplane of this type to be used on the Western Front was a British machine, the Sopwith "1½ Strutter," the first squadron of which was sent to France in the early summer of 1916. Later aeroplanes with a similar lay-out and armament were the British R.E.8, D.H.4, Bristol Fighter and D.H.9; the French Breguet; and many types of German two-seaters, of which the L.V.G. was perhaps the most common.

Germany's Second Period of Mastery (Spring 1917).—Early in 1917 the Germans made a determined effort to regain the mastery of the air, which they had lost the previous summer on the Somme. They produced two new types of single-seater fighters—the Albatros D.III. and the Halberstadt—which for some months outclassed the fighters of the Allies at that time on the Western Front. Their success was due partly to their superior performance, and partly to the fact that they were armed with *two* machine-guns, fixed to fire through the propeller, instead of one as heretofore. The Allies, caught short of effective fighters, quickly lost the superiority in the air that they had won the previous year at Verdun and on the Somme. By February 1917 German superiority was clearly marked.

Second Period of Franco-British Superiority.—Once more, however, the pendulum swung. In the spring of 1917 the British brought to the Western Front a new type of single-seater fighter, the S.E.5, followed in the early summer by another fighter, the Sopwith Camel and by two two-seaters of exceptional performance, the D.H.4 and the Bristol Fighter. The French moreover produced an improved Spad With the machines now at their disposal, the British and French fighting pilots gradually won back for the Allies a measure of superiority in the air that was not lost before the Armistice was signed.

In the last year of the war the tactics of fighting in formation crystallized, and tactical systems were evolved adapted to the peculiarities of the various types of aeroplanes. In the summer of 1918 on the Western Front it was rarely that either fighter or bombing squadrons operated in formations of less than squadron strength; and, as already stated, it was not uncommon for three or four squadrons to work together in one large, but rather loose formation. The tactics customarily employed in the formation fighting of this period have not materially changed and will be described in a later section.

II. THE TACTICS OF AIR COMBAT

Types of Aircraft.—From the point of view of air fighting, aeroplanes fall into two categories—first, aeroplanes designed solely for air fighting, and, secondly, aeroplanes designed primarily for some other duty, such as reconnaissance or bombing.

Aeroplanes in the first category are called "fighters" (U.S. "pursuit planes"; Fr. "avions de chasse"); they are usually single-seaters of great speed and climbing power, armed with two fixed machine-guns firing straight ahead through the propeller by means of a synchronizing gear.

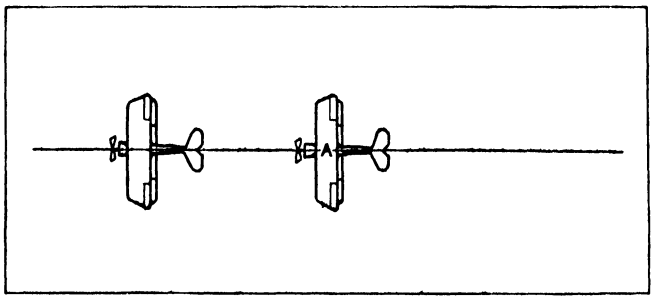


FIG 2.—SHOWING THE EASIEST TARGET IN AIR COMBAT
In direct line pursuit the pilot of the pursuing machine A is aiming at the equivalent of a stationary target

Among aeroplanes not designed solely for air fighting there is a wide variety in design and lay-out. Broadly speaking, however, they fall into two main classes—single-engine and twin-engine aeroplanes. The modern single-engine machine is usually a tractor biplane of medium size carrying a crew of two, or less frequently three, men. The pilot is seated in front of the gunner, and is armed in the same way as the pilot of a fighter aeroplane with one or two fixed machine-guns firing straight ahead. The gunner or observer sits behind the pilot, facing backwards, and is armed with one or two light machine-guns on a swivelling mounting.

In the case of twin- or multi-engine aeroplanes two gunners are carried; one sits in the very front of the aeroplane's fuselage and

covers the forward arc; the other sits behind the pilot and covers the rearward arc.

The Manoeuvres Preliminary to an Air Combat.—When two hostile aeroplanes meet, the higher of the two has the advantage. The reason for this is that an aeroplane can descend more quickly than it can ascend. The higher of the two aeroplanes can dive down to its opponent's level in a few seconds; whereas the lower will take several minutes to climb up to the other's height. This is why in air fighting a pilot is constantly striving to outclimb his opponent, since superior height gives him the power to attack at once or to avoid combat altogether, just as he wishes. This also explains why speed and climbing power are such vital factors in "fighter" aircraft, since, if they lack these characteristics, their natural prey, the enemy's bombers and reconnaissance aircraft, will, by coming over high up, be able to avoid combat.

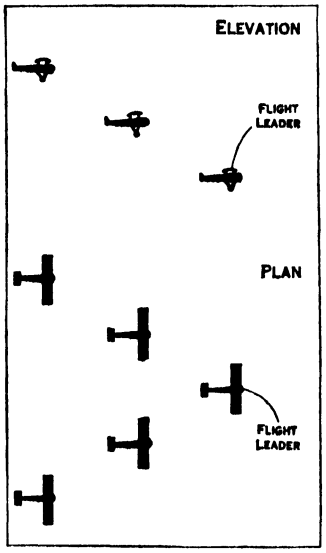


FIG. 3.—FLIGHT OF 5 AEROPLANES FLYING IN FORMATION
The leading aeroplane flies at the lowest elevation, while the second and third lines fly at heights that enable them to keep their leader in full view and catch up easily if they drop behind

The Tactics of Attack.—A fighter pilot therefore, when on patrol, will always try to get above his opponent. He will then dive to close quarters and attack. His method of attack now requires explanation.

Referring to fig. 1, the first fact to be grasped is that it is easier for the pilot of the aeroplane depicted to hit a target with a gun firing along the line A–B (either forwards or backwards) than with one firing along any other line (*e.g.*, the line C–D). The reason for this is that, when firing along the line A–B, he does not have to take into account the speed of his own aeroplane or the direction in which it is moving with reference to the target. This is an important consideration in view of the high speed of aeroplanes. Generally speaking, therefore, the most effective way to attack a hostile aeroplane is for the pilot to fly towards it and shoot at it with a gun fixed so as to fire straight ahead parallel to the path of his own aeroplane, since by doing so he has to make no allowance for the speed and direction of flight of his own aeroplane.

Now if the enemy aeroplane was a stationary object that could not shoot back the problem of attack would be simple. The attacking pilot would simply fly straight at his target, aiming his gun at it by steering his aeroplane. But the target is not stationary; it is moving in three dimensions at a speed of anything up to 180m p.h., and can moreover shoot back. The attacking pilot has therefore two objects—first to attack in such a way that the enemy aeroplane presents a reasonably easy target, and secondly to attack in such a way that the enemy cannot shoot back effectively.

A glance at fig. 2 will show that the easiest target for the pilot of the attacking aeroplane (marked A in the diagram) is an aeroplane flying directly ahead of him and in precisely the same direction as himself.

It will be seen that when the attacking pilot is flying directly behind, and in the same direction as the aeroplane he is attacking, and is shooting at it with a fixed gun firing straight ahead, not only does he have to make no allowance for the speed and direction of flight of his own aeroplane, but he also has to make no allowance for the speed and direction of flight of the enemy aeroplane. In fact he gets a straight shot at the enemy over open sights. It is true that he himself is exposed to a straight shot over open sights from the enemy gunner, firing to the rear. But this can usually be avoided by the attacking pilot placing his aeroplane in such a position (slightly below and to the rear of the enemy aeroplane) that he is concealed from the view of the enemy gunner by the tail-plane of the enemy aeroplane.

While therefore a pilot may attack from any direction—from the front, flank or rear—to confuse an opponent or to break up an enemy formation, he will generally, when he wishes to fire for effect or deliver the *coup de grâce*, fly directly behind the enemy aeroplane, and shoot at it over open sights.

Tactics of Defence.—How will a pilot attacked in this way defend himself? He will rely of course to a certain extent on the accuracy of the gun-fire of his gunner behind him. But over and above this he will have two objects in view at the moment of attack: first to get out of the enemy's line of fire as quickly as possible; and secondly to try and turn the tables and himself become the attacker. There are various alternative manoeuvres by which these two objects may be attained. But it is usually accepted that the most effective manoeuvre is to do a steep, climbing turn. The turn carries the pilot attacked out of the enemy pilot's line of fire in a lateral direction; by climbing on the turn he gains that all important factor—height; and, with the help of the height so gained, he stands a good chance, by means of a second turn and a dive, of turning the tables and himself becoming the attacker.

Fighting in Formation.—The most convenient formation for air fighting is the wedge or "vee" (*see* figs. 3 and 4).

The reasons why the "vee" is the most suitable shape for a formation of aircraft are first, that all pilots can see the leader in front and so conform readily to his movements; secondly, that each pilot can fire in a forward direction without hitting one of his fellow-pilots, while in the case of two-seaters the gunners can obtain a good concentration of fire in a rearward direction; and lastly that no aeroplane is flying in another's propeller wash.

A formation is usually "stepped" upwards in height from front to rear, *i e*, the leader's aeroplane is the lowest; the pilots on either side of him fly slightly higher; while the rear rank of the formation flies higher still.

A formation must not be so small as to be easily overwhelmed by superior numbers, or so large as to be unwieldy. Fifteen aeroplanes are about the maximum number that can be handled in one formation. When greater numbers than this are required for an operation, it is usual to form two or more separate formations which work together in close co-operation.

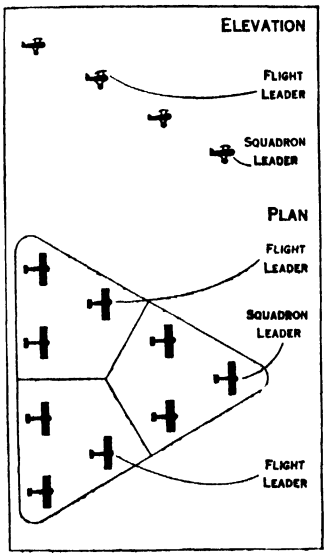


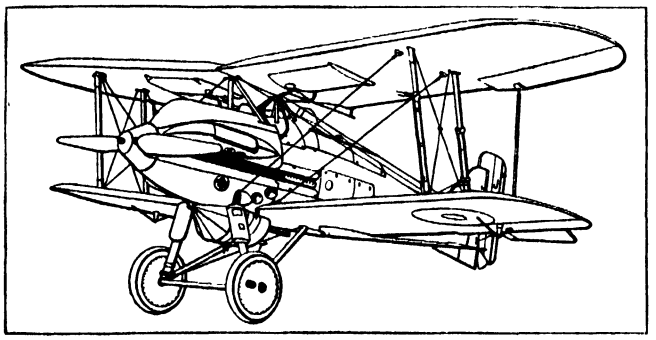
FIG. 4.—FLIGHT OF 9 AEROPLANES IN SQUADRON FORMATION
The formation is spear-headed and is composed of 3 flights of 3 aeroplanes each

The first essential of fighting in formation is that the formation should hang together, and not be split up Once the formation becomes disintegrated, each aeroplane is liable to be set upon separately by superior numbers and defeat in detail results. Further, the concentration of gun-fire that an organised formation of aeroplanes can bring to bear is far more likely to achieve results than the spasmodic gun-fire of the same number of single aeroplanes working independently of each other.

A consequence of this is that when one formation of aeroplanes meets another (*e.g.*, a formation of fighters meets a formation of bombers), the first object of the attacking formation (the fighters) is to break up the bombers' formation. Once the bombers' formation is broken, each bomber can be dealt with separately by a superior concentration of fighters. Conversely, the bombers' object is to avoid having their formation broken. For this they will rely primarily not on manoeuvre, but on the concentration of fire that their gunners can bring to bear on the fighting formation, as it dives in to attack. In other respects the principles of fighting in formation are similar

to those already alluded to in the case of combat between individual aeroplanes.

Night Fighting.—Aeroplanes can fight at night. The tactics employed are the same as by day, except that aeroplanes do not fly in formation at night. It is moreover far more difficult at night for a fighting pilot to locate an enemy aeroplane; in fact he



AFTER A PHOTO BY "FLIGHT"

FIG. 5.—A BRITISH GLOSTER "GORCOCK SINGLE-SEATER FIGHTER" The machine gun groove with barrel fixed for forward firing through the propeller arc is shown in black. Another gun is carried on the opposite side

will not usually be able to do so without the assistance of a ground organization of sound locators and searchlights.

The Future.—The performance of aeroplanes is gradually improving. This is unlikely, however, to affect air tactics greatly, unless one nation falls far behind another in air development.

It is probable that the calibre of the guns carried in aircraft will increase. The chief obstacle to this is the great increase in the weight of the ammunition involved in even a small increase of gun calibre.

It is possible that aeroplanes will be armoured But here again considerations of weight apply.

Finally, radio telephony, which enables pilot to speak to pilot in the air, will undoubtedly make for better co-operation in a fight-

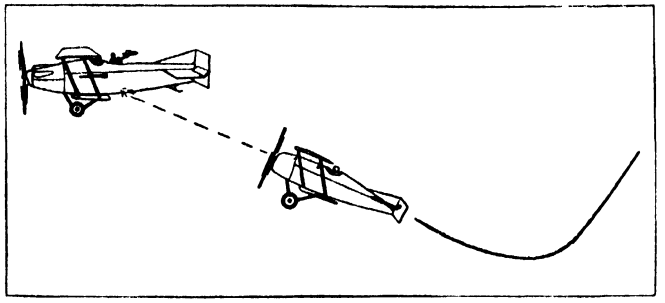


FIG. 6.—LINE OF ATTACK ON TWO-SEATER FROM THE "BLIND SPOT" By approaching along the line indicated the attacking pilot is immune from the fire of the enemy and is himself well-placed to get in a burst of fire at close range

ing formation. Combined tactics of a more elaborate nature will be possible when the commander of a formation can give orders to his pilots by means of the spoken word. By this means also the size of the formation that can be controlled by one man will tend to increase.

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These two books are the personal reminiscences of two of the most successful fighting pilots of the war 1914–18, one an Englishman, the other a German. They contain accounts of air combats which give a good general impression of air combat in the late war. *See* also Major Oliver Stewart, M.C., A.F.C., *The Strategy and Tactics of Air Fighting* (1925), a technical treatise on the tactics of air combat.

(W. S. D.)

AIR CONDITIONING. The term is derived from the word "conditioning" which was applied to the determination of the moisture content of textiles, and covers the treating of air in an enclosure to regulate its moisture content, temperature, purity and usually its circulation. For increasing human comfort and for the manufacturing or processing of certain materials, an accurate control of the moisture content of the air is most important. It is sometimes roughly effected by adding water vapour or mist directly to the enclosed air, but more precisely by using an air-conditioning apparatus by which the air is purified and its temperature and moisture definitely controlled before it is introduced into the space to be conditioned.

Originally only places where equable and moist climatic conditions prevail, such as Lancashire, England, and the Fall River district in Massachusetts, could be chosen for the building of cotton mills. Then moisture was added to the air by evaporating water in steam pots. This method sufficed for small mills, but was inadequate in the larger mills on account of the heat generated by the great concentration of machinery. In the latter half of the 19th century the direct introduction into the room of an atomized spray of water both cooled and moistened the air, thus making it practicable to spin fine cotton yarns in all climates. At about the same time moist air was supplied to malting floors by passing the air through coke filters over which water trickled, or through a large series of wetted baffle plates. In 1897 Joseph McCreary of Toledo, O , patented an air washer intended primarily for purifying the air, but incidentally it cooled it and increased the moisture content. In 1906 Stuart W. Cramer of Charlotte, N.C., and Willis H. Carrier of Buffalo, N.Y., working independently, made two important contributions to the art. Cramer automatically controlled humidity by a system which depended upon the relation between the wet and dry bulb temperatures. This was applied to the humidifying spray heads located in the room. Carrier devised the "dew point control," an improved form of air washer which not only brought the air to saturation, but also controlled automatically the temperature of such saturation, thus determining the moisture content of the air supplied.

Types of Apparatus.—Of the two main types of humidifiers, the "direct spray" type, which provides for the atomization of the water and its introduction directly into the room, is made in relatively small sizes. The nozzles or distributors are placed just below the ceiling, and provide for humidifying only. The "saturated air" type, on the other hand, employs larger volumes of saturated air at the required temperature. In the conditioning chamber it is brought into intimate contact with water finely divided by spraying through special nozzles under moderate pressure. All of the free particles of water are then removed by an "eliminator," which usually consists of a series of specially formed baffle plates on which all free particles of moisture are caught, leaving the air saturated but free of all suspended water particles. The spray water may be heated or cooled, and the temperature of the saturated air may be modified before passing it into the room at the theoretic dew point. Portable self-contained humidifiers, operating on the above principle, are also employed.

Under certain conditions it is desirable to remove dust and soot from air without modifying its humidity. In such cases either "cloth filters" or "viscous filters" are employed. The cloth filters are large areas of closely woven cotton cloth held in frames, provision being made for frequent cleaning. The viscous filters are either intricate metal baffles or cells filled with masses of fibre-like metal. These are dipped in a viscous oil which causes the particles of dust or soot to adhere to the metal surfaces.

Usually temperature is automatically controlled by thermostats governing the admission of steam to the air heaters, or regulating the supply of cold dehumidified air. Another form controls the sprays, but is mostly used in the direct spray type humidifiers.

The quantity of moisture which may remain in the vapour state in a unit volume of space is dependent only upon its temperature. The saturation pressure of water vapour is approximately doubled for each 20°F rise in temperature, *i.e.*, the maximum vapour pressure increases approximately in a geometric ratio for equal increments of temperature. The relation of the weight of water vapour in the atmosphere to the weight of air varies approximately in accordance with Dalton's law of partial pressures (*see* DALTON, JOHN). When water is brought into contact with unsaturated air it evaporates. If the air is the sole source of heat necessary to produce evaporation, an eventual equilibrium saturation temperature is established depending on the initial air temperature and its initial degree of saturation. The reduction in the *sensible heat* of the

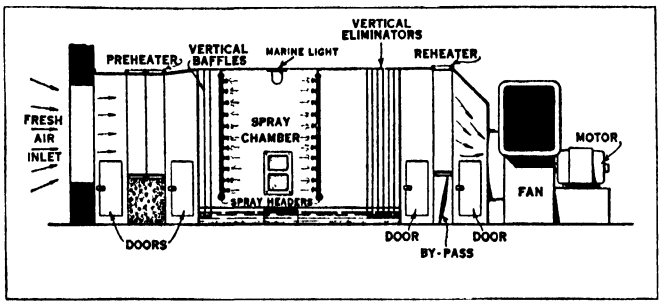
atmosphere is equalled by the *latent heat* of the acquired water vapour; the *total heat* remains constant. The equilibrium temperature of evaporation is observed with practical accuracy by a wet-bulb thermometer. The general formula based upon this heat balance is:

$$W = [r'W' - C_{pa}(t-t')] / [r' + C_{ps}(t-t')]$$

in which

W=the weight of moisture per unit weight of pure air.
W'=the weight of moisture per unit weight of pure air saturated at the temperature t'.
$(t-t')$=the true wet-bulb depression
C_{pa}=mean specific heat of air at constant pressure between temperature t and t'.
C_{ps}=specific heat of water vapour at constant pressure between t and t'.
r'=latent heat of evaporation at wet-bulb temperature t'.

When unsaturated air is passed through an air washer and brought to saturation without changing the temperature of the spray water, it will be cooled to the temperature of evaporation



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DESIGN OF AIR CONDITIONING APPARATUS FOR LARGE BUILDING

(substantially, to the wet-bulb temperature of the entering air) For example, when the outside air is at 95°, the average wet-bulb temperature will be approximately 75°, and the air passing through a spray humidifier will be cooled to substantially 75°. This method of cooling is especially valuable in textile mills and tobacco factories where the increased humidity as well as the lower temperature is desirable.

The temperature of evaporation is independent of the actual rate of evaporation. The rate of evaporation of water into air is dependent upon the air velocity over the water surface and upon the difference in vapour pressure existing between the water and the air. The determinations of these relationships have important applications in the drying of materials in air.

Regain.—The ratio of moisture content to the weight of dry material is technically termed *regain*. The maximum regain for various materials varies widely, the amount depending principally upon the relative humidity of the air and to a slight extent upon the temperature. There is, however, no exact constant ratio between change of regain and change of relative humidity. Materials such as natural and artificial silk, wool, cotton, yarn and tobacco are sold on the basis of a standard percentage of regain, so in the drying and manufacturing of these materials it is necessary to control their relative humidity.

Comfort.—The relation of moisture, heat and air motion to human comfort and physiological efficiency has been the subject of much research, which has determined the points of equivalent comfort, or temperature sensation. A mathematical curve can be drawn showing the relation between temperature and humidity which will give the same sensation of temperature. Such a curve is termed an "effective temperature" line. Temperature by itself, even when automatically controlled, does not determine comfort. Humidity is equally important. The proper relation between temperature and humidity can be maintained only by complete conditioning.

Some instrument of measurement besides the dry-bulb thermometer has yet to be devised as an indicator of comfort. One instrument attempting to accomplish this, devised by Dr. Leonard Hill in England, was known as the "kata-thermometer." Under conditions of high humidity this is a reliable indicator but it does not follow with precision the experimental effective temperature lines under varying humidities.

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(W. H. CA)

AIR CO-OPERATION. A result of the growth of aerial navigation in the first quarter of the 20th century has been to accent the importance of co-operation between the air forces and the armies and navies of the countries of the world. The problems to be solved in the military and naval spheres though in some ways alike are in others so different as to make separate treatment desirable. (X)

CO-OPERATION WITH AN ARMY

To gain information about one's enemy has always been one of the first preoccupations of a military commander, for, until he has accurate knowledge concerning the strength and dispositions of his opponent, it is difficult for him to evolve an effective plan to bring about the defeat of his enemy.

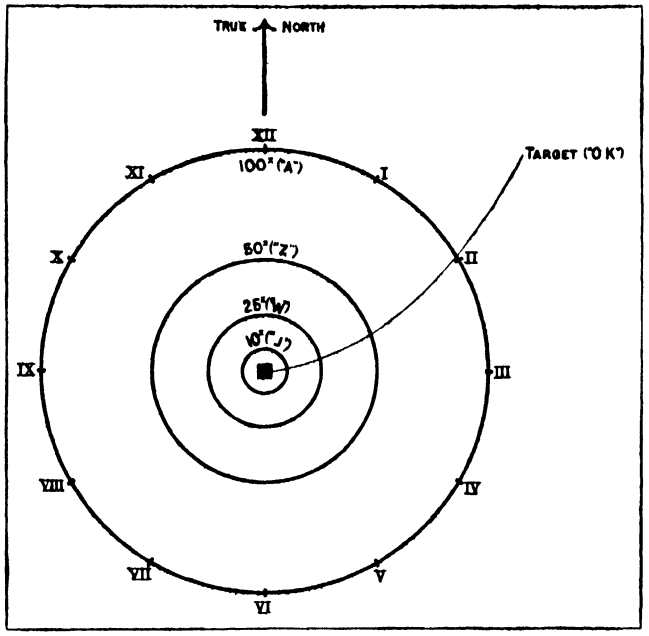
HISTORICAL

It did not need a very great stretch of imagination in 1903, when Orville and Wilbur Wright made the first successful flight in an aeroplane, to realize that it would be possible to obtain a great deal of the essential information concerning an enemy by flying over his positions. The practical realization, however, was slow, owing both to conservatism and technical difficulties. By the time the World War broke out in 1914, the French, Germans and British all had military aeroplanes; we were actually able to send out four squadrons of twelve aeroplanes each, with the original Expeditionary Force. The stage reached in technical progress was that aeroplanes and engines were sufficiently reliable to enable flights of 50 miles into the enemy's country to be undertaken. Although all the pilots and observers of these aeroplanes were Army officers, and many of them had passed the Staff college, it is fair to say that British military leaders were still rather sceptical as to the value of the information which could be obtained by this means. The one idea underlying the employment of the aeroplane at that time was that they should obtain information. The aeroplanes did not carry any armament, and only two had been fitted with wireless for experimental purposes.

As a result of the first few weeks of the War several new ideas emerged.—

(*a*) Several combats in the air took place during those weeks, revolvers and rifles being taken into the air for the purpose; and in some cases enemy aeroplanes were actually forced to land in our lines. In consequence it was realized that aeroplanes should be equipped with machine guns for the sole purpose of fighting

enemy aeroplanes. For this, special mountings were required. It was also realized that the easiest way to fight another aeroplane would be to point your own aeroplane straight at it, and be able to fire a machine gun straight out through the propeller Actually, the first purely fighting aeroplane which achieved this was the German Fokker, which made its appearance in May 1915. Our first fighters were pushers (*i.e.*, they had the engine behind the main planes). It was not till 1916 that the Allies produced



CODE USED IN AIR CO-OPERATION WITH THE ARTILLERY
The clock figures used to indicate the position, and the concentric circles the distance, of the burst from the target. Thus "Z.IX." would indicate a burst of 50 yd. west of the target

their first aeroplane with machine guns capable of firing through the propeller.

(*b*) Many of the pilots, while carrying out reconnaissances found roads packed with German troops and transport. Small bombs were taken up and dropped over the side of the aeroplanes, with little effect. But it was speedily realized what havoc might have been produced if it had been possible to drop large bombs accurately. To do this, suitable bombs, the means of attaching them to and releasing them from aeroplanes, and a sight which would enable the bombs to be dropped accurately, had all to be designed and produced.

(*c*) The two aeroplanes (mentioned above) equipped with wireless, rudimentary though it was, immediately became in great demand, and it became obvious that reconnaissance aeroplanes would have to be fitted with wireless as soon as practicable.

(*d*) The idea of taking photographs from aeroplanes as a useful adjunct to the usual reconnaissance report, was also initiated by some photographs being taken over the side of an aeroplane with a press camera. From this it became evident that the information contained on such photographs was of the utmost value to the general staff. To do this on a large scale many new things were necessary; a suitable camera, which could be fixed on to an aeroplane, and mobile photographic workshops in which developing, printing and camera maintenance could be carried out.

As a result of these early ideas, a vast air organization grew up. Instead of having one type of aeroplane as a "maid of all work," separate types were evolved for fighting, bombing, and the normal reconnaissance duties—and the pilots began to receive special training accordingly. In addition, vast specialist sections were trained to deal with wireless, photography, stores and overhauls of aircraft and engines.

POSITION AT THE END OF THE WAR 1914–18

By the end of the War, the force, which by then had become the Royal Air Force, was organized in brigades, wings and squadrons. One brigade was allotted to G.H.Q. This brigade had two wings, one of bombing squadrons and one of fighters. These bombers were used for carrying out long distance reconnaissance and bomb raids under G.H.Q. orders; the fighters were utilized to reinforce the brigade allotted to each army, according to the requirements of the situation. These brigades usually consisted of one wing of bombers, one of fighters, and one corps wing. From early in the war, one squadron had been attached to each corps (these squadrons are now called army co-operation squadrons). These squadrons operated under the orders of the corps to which they were attached, and carried out reconnaissance up to a depth of about eight miles, photography of the whole corps front, and supplied all the observation for the artillery. All aeroplanes working for the artillery were equipped with wireless telegraphy. Those carrying out reconnaissance duties, in addition to making out a written report on their return to the aerodrome, used to drop messages on the headquarters for which they were working. In addition to these allotments, special provision was made to provide co-operation for the Tank corps, one corps and one fighter squadron being allocated for this work.

CO-OPERATION AS ENVISAGED IN THE YEAR 1928

In a war of any magnitude it is reasonable to assume that very large air forces will be employed on each side. These are likely to consist of squadrons of the following types and capabilities:

(*a*) *Army Co-operation.*—Consisting of two-seater aeroplanes capable of staying in the air about three hours, fitted with either radio telephony, or wireless telegraphy, a camera and defensive equipment in the form of machine guns. Their first duty is to obtain information, and they should only fight when forced to do so. In the British Air Force, the pilot carries out all the observation work, the passenger being employed in looking out for enemy aircraft.

(*b*) *Day Bombers.*—Day-bombing aeroplanes will probably have a radius of action of about 200m., and be capable of carrying about 500 lb. of bombs; they can also be fitted with wireless telegraphy and a camera for occasions when they are employed on reconnaissance duties

(*c*) *Night Bombers*—Multi-engined aeroplanes, which will be capable of carrying about one ton of bombs, with a radius of action of about 500 miles

(*d*) *Fighters.*—Single-seaters, very fast, able to climb and manoeuvre very rapidly. They will be employed chiefly in fighting enemy aircraft.

The organization of these squadrons would be in groups and wings since the group has now taken the place of the brigade. Instead of there being one army co-operation squadron per corps, there would normally be one army co-operation wing with each corps, composed of a number of army co-operation squadrons equal to the number of divisions in the corps. The actual number of army co-operation squadrons may, however, vary as the size of the force increases. Having shown the types of aircraft that the commander-in-chief of an army would have at his disposal, it is now proposed to discuss their employment in helping the military force to achieve its object. These duties will be examined under the following headings: reconnaissance, artillery, co-operation, offensive action and protection.

Reconnaissance.—Before a military commander can formulate a definite plan for the defeat of his enemy, he must have ample information concerning him. He must know where the enemy has his main force, the line along which he is intending to develop his attack, the location of his reserve troops, and whether or no the enemy has troops working round his flanks. A military commander has several sources of information—from spies, from captured prisoners, reports coming through neutrals, and possibly captured orders. All these will give him a portion of the information he wants, but even when he has pieced together all the evidence available from these sources, the real movements of the enemy will, in all probability, be a matter of conjecture, arrived at by drawing deductions from the incomplete information available. The enemy is likely to secure the movements of his force by a screen of mobile troops. In the days before aero-

planes, a commander would seek to gain information concerning the movement of the enemy's main forces by using his cavalry to penetrate this screen. The information so obtained might prove very costly in casualties, much of the information obtained would, in all probability never get back to the commander who required it, and would only reveal what was happening at certain points, where the screen had been penetrated. In other words, the military commander would still feel that he wanted to see what was really happening the other side of the hill. Having aeroplanes at his disposal enables him to accomplish this. His day bombing aeroplanes have the additional function of carrying out long distance reconnaissance. By this means he is able to direct his reconnaissance aircraft as far as 200m. into enemy country, and from the information which they obtain, and from the information available from the other sources already mentioned, the military commander should be able to anticipate the plan of his enemy.

It must not, however, be supposed that these reconnaissance aeroplanes can be sent such a distance at a height from which it would be easy to see with the eye what was happening on the ground. They will carry out this duty singly, flying at about twenty thousand feet, and by far the greater proportion of their information will be obtained by taking photographs of the important points over which they pass. Consequently, the success of the reconnaissance will, to a great extent, depend on the accuracy with which the military commander has chosen the places to be reconnoitred. By means of this long-distance reconnaissance, a military commander will be able to obtain his strategical information; his subordinate commanders, however, will require much tactical information concerning the enemy's movements within 50m. of our own troops. Thus, a corps commander will want to know if the enemy is increasing the number of troops in his area, or if there are any signs of a withdrawal; early information of the presence of tanks is particularly important. Again, a divisional commander will require the fullest details of what is happening on his immediate front. He will want to know where the enemy has his reserves, where he is digging trenches, and details of his disposition.

This reconnaissance for corps and divisions will be carried out by the army co-operation squadrons. These squadrons are usually allotted to a corps on the basis of one per division in the corps. The squadrons in each corps are administered by a wing headquarters, which will be situated at corps headquarters, the wing commander acting as air adviser to the corps commander. If the war is one demanding the maximum effort, and a national army is produced, the allotment of army co-operation squadrons may be altered from a divisional to a corps basis. The reconnaissance for corps and divisions will be carried out at a much lower height than the strategical reconnaissance, and consequently much information will be obtained from the actual observation made by the pilot. It is obviously essential that it should be transmitted without delay to the military commander who has ordered the reconnaissance. For the reconnaissance carried out for corps, aeroplanes are fitted with wireless telegraphy. The messages are received at corps headquarters direct, and, if he wishes, the corps commander can also communicate with the aeroplane by this means. The aeroplanes carrying out reconnaissance for a division are in very intimate touch with the divisional commander, since they are equipped with radio telephony sets, which enable the pilot to telephone his reports direct to divisional headquarters, and also make it possible for the divisional commander to telephone instructions to the pilot in the aeroplane. Besides this visual reconnaissance, these aeroplanes carrying out reconnaissance for corps and divisions take many photographs, from which the staffs of these formations can draw an accurate picture of the enemy's organization and disposition.

Artillery Co-operation.—An important part of the work of the army co-operation squadron is co-operation with the artillery. The undulations of the ground often make it impossible for artillery commanders either to find suitable targets to aim at, or to be able to range their guns on to important points, such as bridges and crossroads, which they may want to shell. Consequently, aeroplanes are employed to "spot" the positions of enemy batteries. This is usually done by seeing the flash of the enemy guns when they fire, and then sending down their position by wireless. These reports are usually confirmed by photographs, which show clearly where the enemy batteries are. Other targets, such as bodies of troops or transport, are also reported to the artillery. If the artillery commander wishes it, a pilot having "spotted" a target can range a battery on to it. This is effected by means of a simple code, the target being taken as the centre of a clock, twelve o'clock always being the north point. Imaginary circles radiate outwards from the centre of the clock at distances of 10, 25, 50, 100, 200yd., etc. These circles are lettered, the corrections to the guns being sent down by sending the letter of the distance circle followed by the hour of the clock "A" is the letter for the 100yd. circle. Thus, if the shell burst 100yd. due east of the target, the correction would be A.3. (*i.e.*, 100yd. at 3 o'clock). By this means our aeroplanes are able to tell the battery commander exactly where his shells are falling, it being his province to work out the actual corrections for the guns. To receive these messages, artillery brigades and batteries are equipped with wireless telegraphy receiving sets (*see* fig , p 446).

Offensive Action.—The duties described above, which are performed by aircraft assisting the army, are confined to obtaining information. A military commander will, however, have at his disposal bombing aeroplanes, which if directed on to suitable objectives, may have a far-reaching effect on the course of the campaign. Having gained information concerning the movement of his enemy's main forces, he will obviously try to hamper the enemy in the achievement of his plan, and the weapon with which he will be able to strike his enemy first, and nearest his vitals, is his bombing force. For the employment of this force, he has before him three main courses. He can direct it against his enemy's industrial areas, his communications, or his troops, if in a favourable situation to offer a target. He should select one of these objectives, and concentrate his whole strength on it, for, to be effective, bombing must be concentrated and continuous. A military commander, by concentrating a big bombing force on to the enemy's industrial area, can reduce enormously their output of the munitions, clothing and food which are essential if their armies are to be maintained in an efficient fighting condition. In choosing such a target as this, a military commander would have as his object the cumulative effect of the raids over a period probably lasting several months. The military commander may want to produce some more immediate effect on the situation; for instance to prevent reinforcements and supplies from reaching an area in which he intended to strike some decisive blow. An effective way might be to create a block on a railway or a main road, and having created it, to maintain it by subsequent bombing raids at frequent intervals both day and night. As a general rule, the further back a line of communication can be blocked, the more extensive will be the area affected.

Situations will arise occasionally, when the employment of aircraft to attack tactical targets is imperative. These occasions will occur at the most critical moments of the land campaign. For instance, if one's own army were retreating, all available bombers, and possibly fighters too, would be turned on to attack the advancing columns of the enemy so as to disorganize their advance and give our own army time to get established on a defensive position. Conversely, at the crisis of some great offensive, the enemy army might just be breaking and starting to retreat; then every available aeroplane would be concentrated on the creation of such havoc amongst the retreating columns of the enemy that the retreat would be turned into a rout.

Protection.—For a commander to obtain the full value of his reconnaissance and offensive action, he must be protected against similar enemy action. He will, in other words, wish to attain and maintain, air-superiority. To enable him to achieve this, he will have fighter aircraft whose main function is to fight enemy aircraft, and enable the reconnaissance and bombing aircraft to carry out their work without undue interference. Experience in the past has shown that air-superiority is apt to fluctuate. One side will suddenly bring several new squadrons into the field, or

re-equip all its fighter squadrons with a new type of aeroplane more efficient than the fighters of the other side. Consequently a continuous progressive effort is required, and even then, it is difficult to ensure the continuous maintenance of air superiority.

The Future.—To look into the future at a transitory stage like the present, is difficult. Most of the great Powers are thinking about mechanization. The mechanization of armies, however, will not alter the principles underlying the conduct of a land campaign, and, consequently the requirements of mechanized armies will probably be much the same as those equipped with the present day appliances. The air units working with mechanized forces will obviously have to be highly mobile. There is, however, a possible development which may take place, in which the attainment of the ultimate object (the subjugation of the will of the enemy people) will be achieved by the air rather than the land forces In such a case, the function of these highly mobile land forces would be to secure suitable bases from which great bombing formations could strike at the vitals of the enemy nation.

(T. L L.-M.)

CO-OPERATION WITH A NAVY

The object of aircraft co-operation is to assist a navy in the destruction or neutralization of a hostile battle fleet, and in the control of sea communications. Aircraft can afford indirect assistance in battle by providing information of enemy naval forces obtained from long-distance or close reconnaissance, and can give direct assistance by offensive action against enemy surface and submarine craft with torpedo, bomb, and machine-gun. It is also their duty to afford protection to a fleet from enemy aircraft by attacking them in the air, on the sea, or at shore bases, and thus deny the enemy the use of his aircraft. In the control of sea communications, aircraft can be employed on reconnaissance, anti-submarine patrol, convoy escort, and for torpedo and bomb attacks on enemy forces which dispute control. Aircraft for naval co-operation operate from aircraft-carriers and from shore bases within flying range of the fleet. Aircraft borne in carriers are specially designed for launching from and alighting on their carriers, and are called ship-planes. They may be landplanes, floatplanes (aircraft provided with floats for alighting on the water), or amphibians (aeroplanes which can alight on or rise from both land and water) Shore-based aircraft may be landplanes, seaplanes (floatplanes and flying-boats), amphibians, or lighter-than-air craft.

HISTORICAL

Prior to the War 1914–18, there were few instances of aircraft co-operation with a fleet, although seaplanes took part in the British naval manoeuvres of 1912–13–14. At the outbreak of war in 1914 none of the Powers had many naval aircraft, and the development of naval aviation was slow; in fact throughout the whole war the development of aircraft for naval purposes was not as rapid as that of aircraft for work with land forces. Perhaps the hardest problem was to provide aircraft to work with a fleet operating beyond the limited range of aircraft based on shore. Seaplane carriers were hastily improvised from fast merchant steamers, but the inability of the seaplanes of that time to rise from a rough sea, and the risk from submarine attack when stopping to hoist the seaplanes in and out, militated against their use. However about a dozen ships were so equipped by the Allies, and their aircraft were able to carry out observation and bombing flights.

To cope with the Zeppelins used by the Germans on long-distance reconnaissance, experiments were begun in Nov. 1915 in flying small fighting landplanes from British cruisers and seaplane carriers. These were successful, and in Aug. 1917 a Zeppelin was shot down by an aeroplane from the British cruiser "Yarmouth." The practice of carrying landplanes in fighting ships was extended in 1918 to all British battleships, battle-cruisers, and cruisers; the two former types carrying in addition to a fighter a two-seater aeroplane for observation duties. Flights were thus possible in weather which precluded the use of seaplanes. Such aircraft were, however, unable to return to their ships, and were forced to fly to the nearest land or alight on the water.

In the meantime experiments in landing aircraft on the decks of specially designed ships had been progressing. In Aug. 1917 an aeroplane alighted on the deck of a ship for the first time, and in Oct. 1918 the British aircraft carrier "Argus," constructed for aircraft to fly both on and off, was commissioned for service in the Grand Fleet.

As regards employment, naval aircraft played a small part in close co-operation with the fleets in the War 1914–18. Seaplanes, kite-balloons, and airships carried out limited reconnaissance for the Grand Fleet, one British seaplane being present at the battle of Jutland. This aircraft sighted the German light cruisers, but low visibility prevented further observation, and only one flight was made. Seaplanes and kite-balloons were also used to observe the fire of the monitors off the Belgian coast, and of the bombarding ships in the Dardanelles. In the German fleet, Zeppelins provided valuable reconnaissance by reporting the approach of British surface craft, and by keeping down British submarines in the Heligoland Bight. The value of aircraft observation was greatly enhanced by developments in wireless telegraphy from the air.

Except for a few German attacks on British shipping in 1916 and 1917 and the attack on the Turkish battle-cruiser "Goeben" aground in the Dardanelles in 1918, there were very few instances of bombing attacks on surface craft at sea. Many naval objectives on shore, however, were bombed; as examples, Cuxhaven in 1914, the airship sheds at Dusseldorf and Friedrichshafen in 1914, the Zeppelin sheds at Tondern in 1918, and the intensive bombing of submarine bases in Flanders throughout the war.

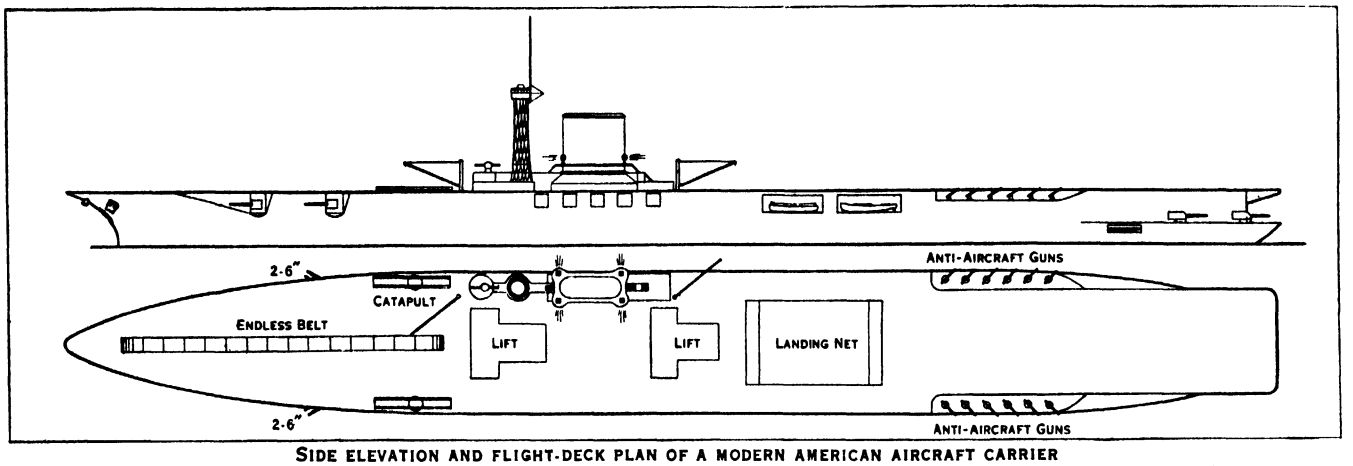
Although as early as 1913 a Sopwith seaplane had carried a torpedo, the first torpedo attack by aircraft was carried out on Aug. 12, 1915, when for the first time in history a seaplane from the British seaplane carrier "Ben-my-chree" sank a steamer off Gallipoli. This form of attack was, however, slow to develop, and although in Oct. 1916 the British Admiralty decided to build large numbers of torpedo aircraft, it was not until three weeks before the Armistice that a squadron of torpedo-carrying aircraft was ready for service in the Grand Fleet.

By far the largest parts played by naval aircraft were those of anti-submarine patrol and convoy escort Airships, kite-balloons, seaplanes, and, in 1918—when the supply of aircraft for the western front exceeded the demand—landplanes, were all used on these duties From the first days of the war, when the British Expeditionary Force was crossing to France, until the Armistice, areas round the British Isles, off the Belgian coast, and in the Mediterranean—small at first, but increasing rapidly in size as the supply of aircraft became more plentiful—were systematically patrolled by aircraft: as the result, submarine activity was greatly reduced. Only 10 of the 178 German submarines sunk by anti-submarine measures were actually sunk by aircraft, although another 21 were probably seriously damaged, but the value of aircraft thus employed lay in their power to harass the submarine commander, to force him to dive to escape detection, to prevent him from taking up a suitable position for attack, and to locate submarines for their subsequent destruction by surface craft. In 1917, when the convoy system was introduced for the protection of merchant shipping, air escort was provided and a fair measure of security was afforded to convoys. For example, from April 1917 to Nov. 1918, neglecting ocean convoys, a total of 312 ships were torpedoed in convoy, but only two of these attacks occurred when vessels of the convoy were under air escort.

MODERN DEVELOPMENTS

Since the War 1914–18, rapid developments have been made, and aircraft now form an integral part of a modern fleet. Their employment may conveniently be discussed under the headings of carrier-borne aircraft and shore-based aircraft.

Carrier-borne Aircraft.—Aircraft carriers provide the aircraft for close co-operation with the battle-fleet. Their duties are reconnaissance prior to and during action, observation of gunfire, attacks on enemy ships with torpedo and bomb, and air fight-



SIDE ELEVATION AND FLIGHT-DECK PLAN OF A MODERN AMERICAN AIRCRAFT CARRIER

The Landing Net will be seen just before the recessed stern portion of the flight deck; it is about 100 ft. long. Before it is a large T-shaped elevator for moving aircraft from the flight to the hangar deck. There is another and similar T-shaped elevator abeam of the cage mast. Before the mast, disposed as one to port, one to starboard, are two aircraft catapults, worked by compressed air and capable of launching the heaviest aircraft.

ing. Early and accurate information of the enemy is of paramount importance to a naval commander to enable him to dispose his fleet To obtain this information aircraft patrol ahead of and on the flanks of the fleet, and, when action is joined, they observe and report the movements of individual units of the enemy fleet, and control the effect of gun-fire. Only second in importance to the work of reconnaissance is the observation of gun-fire. By reporting the range, course, and speed of the enemy and observing the fall of shot, aircraft enable a fleet to engage a target which, owing to low visibility, smoke-screens, or the long range of modern guns, may be unseen

Another function of aircraft in carriers is to fire torpedoes and to drop bombs. This is done by torpedo-bombers, aircraft which carry a torpedo or the equivalent weight of bombs Torpedo-carrying aircraft can be employed against ships at sea or at anchor Although, at the present state of development, to release their torpedoes the aircraft must fly close to the water and may thus offer a target for gun-fire, nevertheless their high speed, and the possibility of sun, haze, low clouds, or smoke, may enable them to approach undetected, and so provide an invaluable tactical weapon. If bombs are carried, the objective may be ships at sea, ships in harbour, or shore targets The effect of bombs against modern armoured ships is largely conjectural Trials against ex-German warships have been carried out by Great Britain and the U S A., but the results were inconclusive With the development of armour-piercing bombs, however, this form of attack would appear to offer great possibilities

A third duty of carrier-borne aircraft is air fighting In order to provide freedom of movement in the air for aircraft employed on observation or other duties, it is essential to neutralise the action of enemy aircraft. Obviously the most satisfactory way of achieving this is to destroy the sources of enemy aircraft which, in a fleet at sea beyond flying range from shore bases, are the aircraft carriers. Since low visibility and the large area involved may render the discovery of enemy carriers impossible, resort is had to single-seater fighters—small, fast, highly manoeuvrable aircraft—to seek out hostile aircraft in the air and to provide protection for friendly observation aircraft These fighters may also be employed to attack lightly-armoured ships with machine-guns and small bombs.

Shore-based Aircraft.—These, if within range of a naval battle, will be called upon to carry out any of the duties performed by carrier-borne aircraft, but they will more often be employed to co-operate with a fleet in its function of controlling sea communications, and their work will then consist in reconnaissance, anti-submarine patrol, convoy escort, and torpedo and bombing attacks. Reconnaissance may take the form of independent long-distance reconnaissance of enemy forces and bases, trade routes, and focal areas, or of close reconnaissance in co-operation with surface craft. Reliable information of enemy movements or defences, confirmed if possible by photographs, will be most valuable. Anti-submarine patrol is perhaps the most important duty falling to the lot of shore-based aircraft. Shipping of all kinds requires protection from enemy submarines: areas round the coasts and on the trade routes—particularly in areas where shipping routes converge and in narrow waters—require constant patrolling. Such patrols may be carried out by aeroplanes operating independently of ships, but the experience of the War 1914–18 has taught that it is not by one weapon alone that submarines are destroyed but by the cumulative efforts of air, surface, and submarine craft working in close co-operation Further, convoys of merchant ships lightly escorted by surface craft are very vulnerable to attack by hostile surface, submarine, and aircraft, and will be escorted whenever practicable by aircraft in order that they may give warning of the approach of enemy forces, attack submarines, and warn the convoy of the presence of mines Attack by shore-based aircraft with torpedo or bomb against ships at sea or in harbour will not differ from that on similar targets by carrier-borne aircraft, though it may be necessary to operate from advanced bases to be within flying range Shore-based aircraft will afford a valuable coast defence weapon

Aircraft Carriers.—Under the terms of the Washington Treaty the total tonnage of aircraft carriers allowed to each of the Contracting Powers is limited and is as follows:—British Empire and U S A. 135,000 tons, Japan 81,000 tons, France and Italy 60,000 tons. At the end of 1927, the aircraft carrier tonnage was —British empire 69,900 tons, Japan 27,000 tons, U S A. 14,700 tons, France 21,000 tons, and Italy nil

FUTURE DEVELOPMENT

Experience gained in the War of 1914–18 and since, under active service conditions, is limited Thus the functions of aircraft in naval warfare are largely conjectural They would appear, however, to depend on two factors, namely: the degree in ease of operation of carrier-borne aircraft, and the development in endurance and seaworthiness of the flying-boat type of aircraft.

(D. G. D.)

AIRCRAFT CARRIER. The advent of the aeroplane has provided navies with a new means of reconnoitring for an enemy; of observing his movements; and correcting gunfire In fact, aircraft have joined the cruiser of to-day, the frigate of old, as the "eyes" of the fleet Moreover, they have extended the vision of an individual ship from that due to the height of her masthead to one limited only by the range of an air observer who can maintain wireless communication. In addition they have provided a new method of attacking naval objectives by means of bombs and by torpedoes launched from the air.

To be of practical value to a fleet at sea, however, it is necessary that naval aircraft should be available whenever their services may be required, and weather and other conditions permit of their being used. Owing to their limited fuel endurance and inequality

AIRCRAFT CARRIERS (1927)

Country and Vessel.	Date of Launch.	Date of completion.	Length between Perps.	Breadth.	Draught.	Displacement.	Speed.	Horse-power.	Armament.
BRITISH EMPIRE			ft. in.	ft. in.	ft. in.	tons.	knots.		
Argus	1917	1918	535—0	68—8	21—0	14,450	20½	20,000	6-4in., A.A.
Hermes	1919	1924	548—0	70—3	18—7	10,950	25	40,000	7-5·5in., 3-4in. A.A.
Eagle	1918	1924	625—0	105—2	21—11	22,600	24	50,000	9-6in., 5-4in. A.A.
Furious	1916	1925	735—0	88—0	21—6	22,400	31	90,000	10-5·5in., 6-4in. A.A.
Courageous	1916	Being reconstructed	735—0	81—0	22—3	18,600	31	90,000	18-4·7in.
Glorious	1916	Being reconstructed	735—0	81—0	22—3	18,600	31	90,000	18-4·7in.
UNITED STATES									
Langley (converted)	1912	1922	520—0	65—0	19—0	12,700	14½	7,160	4-5in. 30 aeroplanes.
Lexington* (converted)	1919	1928	888—0 Extreme	106—0	30—0	33,000	33-34	180,000	
Saratoga* (converted)	1925	1928	888—0 Extreme	106—0	30—0	33,000	33-34	180,000	8-8in., 12-5in. A.A. 72 aeroplanes (carries a catapult).
JAPAN									
Hosho	1921	1922	510—0	62—0	20—3	9,500	25	30,000	4-5·5in., 2-3in. A A. (26 aeroplanes).
Akagi	1925	Bldg.	820—0 Extreme	103—0	21—6	26,600	28½	131,200	Stowage for 50-70 aeroplanes.
Kaga	1921	Bldg.	700—0	106—0	28—0	26,900	23	91,000	10-8in., 4-4·7in., 12-4·7 A.A.
FRANCE									
Béarn	1920	1928	574—0	89—0	26—2	21,160	21½	35,000	8-6in., 6-3·9in. A.A.

*The Lexington and the Saratoga were launched as battle-cruisers before the Washington Conference. As a result of that conference, the designs were greatly modified, and both were relaunched in 1928.

A.A. = Anti-aircraft.

of speed with ships, it is impracticable for aircraft to fly continually with the fleet. Flying-boats, capable of moving on the surface, have not yet been sufficiently developed to withstand the buffeting of what, for ships, would be very moderate seas. They can, therefore, only operate with a fleet which is within easy range of a sheltered base.

The alternative to summoning aircraft from a shore base is to carry aircraft with the fleet and launch them into the air as and when required. Owing to the innumerable obstructions on the upper deck of a warship, it is very difficult even to find stowage room for more than one or two aircraft, and quite impossible to provide the necessary space for them to alight on the deck; but in some of the latest ships in modern navies arrangements are now fitted for aircraft to be projected into the air by a species of catapult. All of the battleships and new cruisers of the United States Navy carry aircraft, and many of them are fitted with catapults.

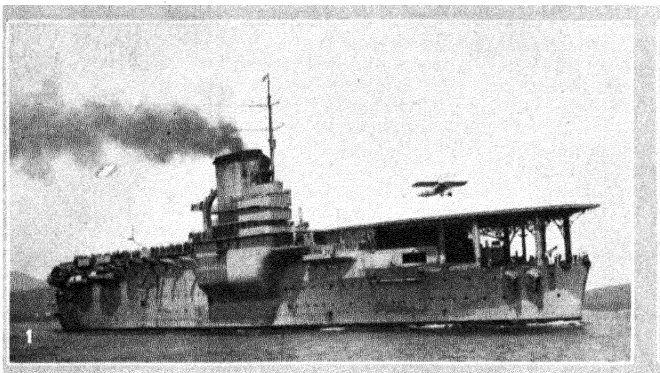
In order to provide the necessary number of aircraft which a fleet will require in the future, and a suitable ship for them to return to when they have completed their flight, the aircraft carrier has been designed. This type of vessel combines a roomy hangar with a clear, flush deck, free from obstructions, for taking off and alighting. At the same time it has introduced a new problem in fleet tactics; for the aircraft carrier can only work her aircraft by steaming into or directly away from, the wind, which may result in her becoming detached from the main fleet during an engagement. This, and the fact that, by the nature of her construction, she is very vulnerable and a large target, means that she is a comparatively easy prey to a force of enemy cruisers. In other words, aircraft, carried in carriers, will operate in a fleet action with the handicap that their mobile base is not a very secure resting place either for their departure or return. This, and the limitations imposed on them by bad weather, fog and darkness, preclude their becoming a complete substitute for cruisers and destroyers, for, clearly, the fleet cannot be dependent on intermittent scouting, and it may often be under just such conditions as prevent aircraft operating that information concerning the enemy, and a means of countering his own light craft, are most important. In other words, aircraft and their carriers have become indispensable auxiliaries to navies, but they cannot replace the older types of warships. (E. A.)

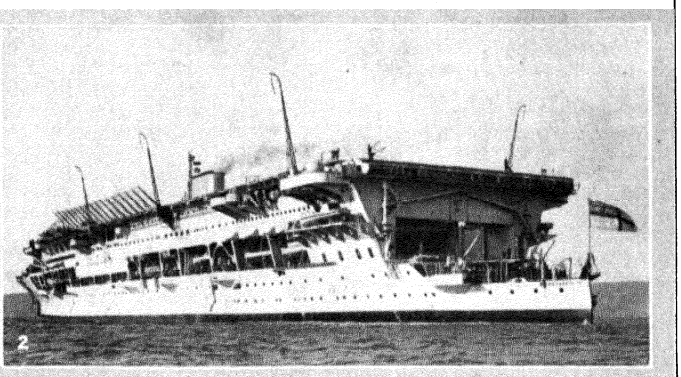
Types of Aircraft Carriers.—Between 1910 and the beginning of the World War, trial flights had been made from warships in the U.S. and British Navies, but the progress made was slow, and it was not until just prior to the outbreak of war in 1914 that a vessel was taken in hand for conversion to an aircraft carrier. The British Government then took over a tramp steamer, renamed the "Ark Royal," and fitted her with a flying-off deck forward and two cranes for lifting the seaplane inboard after returning from a flight. In the summer of 1917 the first landing was made upon a British warship while under way.

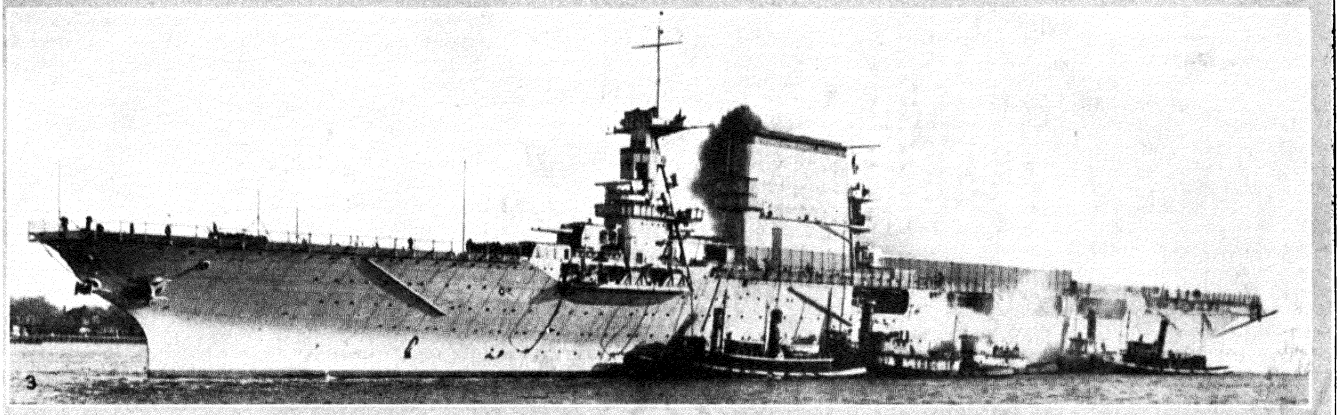
Further carriers being needed, several passenger vessels were taken over and converted into seaplane carriers. The largest of these, the "Campania," was taken up in 1915, and a large flying-off deck fitted forward for the purpose of flying seaplanes off wheel trollies. These alterations were completed early in 1916, and proved fairly successful. A demand arose for further carriers to accompany the British fleet at sea. Amongst the smaller vessels adapted as carriers were the "Riviera" and "Engadine," the latter being the only carrier present at the battle of Jutland. Later the "Pegasus" and "Nariana" were similarly equipped.

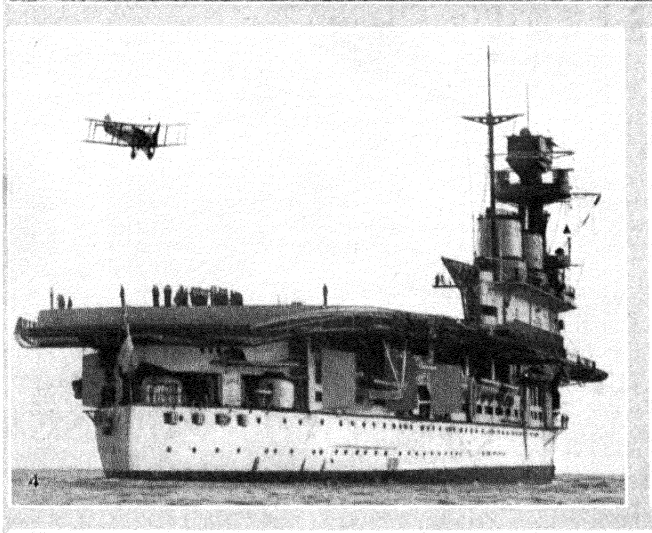
The next vessel taken over was the Italian passenger and cargo ship "Conte Rosso," renamed "Argus," which in 1916 was building at Beardmore's. A complete flying deck was fitted fore and aft with a hangar for stowing the machines under this deck. The funnels were made to run horizontally beneath the flying deck to the stern, so as to discharge all funnel gases abaft the stern with the aid of fans. For transporting purposes lifts were fitted from the hangar to the flying deck, and cranes to lift the machines from the water. To enable machines to be carried on the deck in addition, wind-breaking palisades were fitted which could be raised simultaneously above the level of the flying deck. The "Argus" was the first ship to prove a really satisfactory carrier on which aeroplanes could alight and fly off with safety. Workshops were fitted on board and the vessel was, in fact, a floating aerodrome which could accompany the fleet in all circumstances.

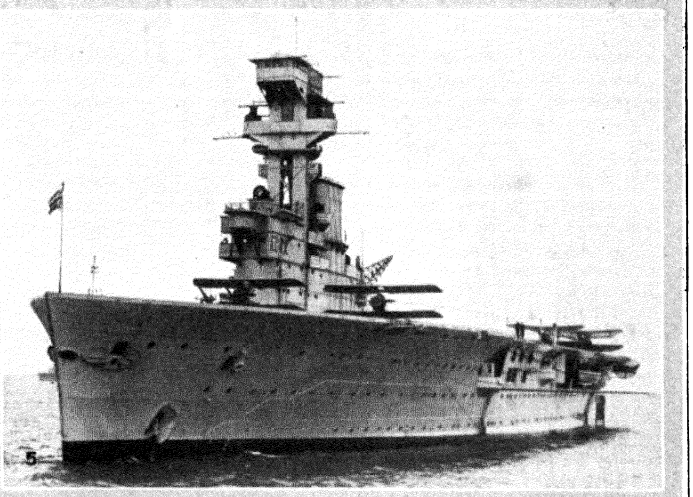
Whilst the first trials of this vessel were proceeding, early in 1917, it was decided to appropriate the "Furious," then completing at Messrs. Armstrong's naval yard, for aircraft-carrying purposes. This ship was originally designed as a large light cruiser to carry two 18in. guns in single turrets, one forward and one aft. The first stage of conversion was to remove the forward turret and fit a flying-off deck and hangar, and from this deck seaplanes and aeroplanes could be flown off successfully. Later, the stern 18in. gun was removed, and a big flying-on deck fitted, the two flying decks

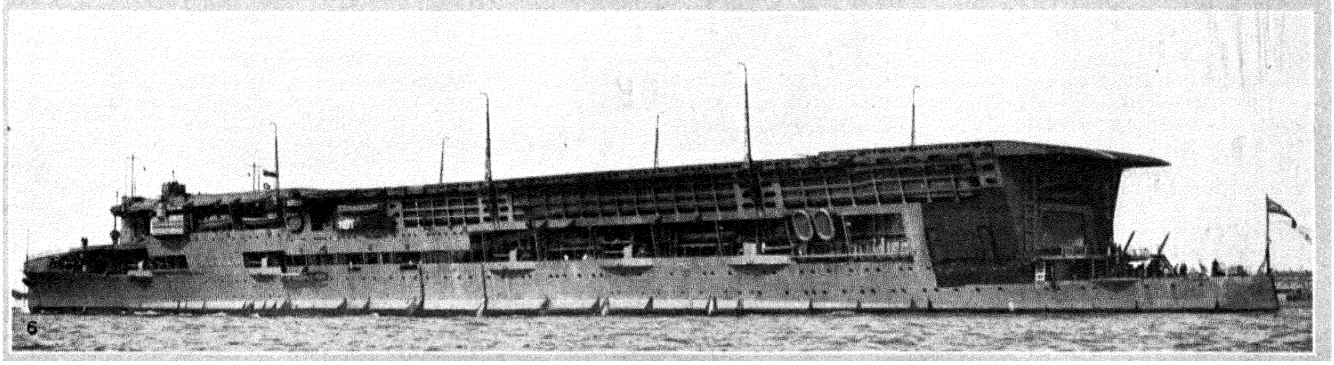










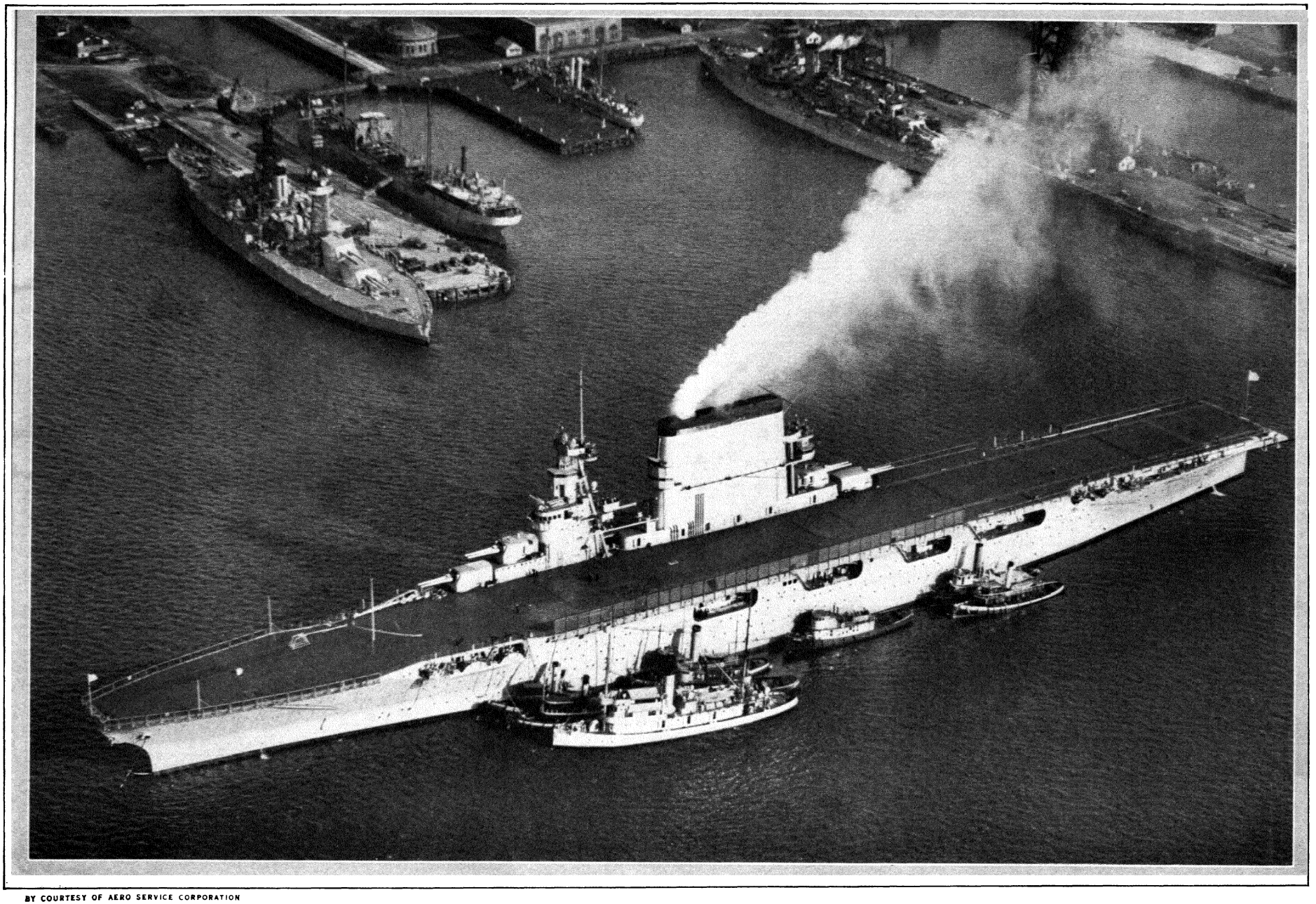


PHOTOGRAPHS (2) TOPICAL PRESS AGENCY, (4, 5, 6) STEPHEN CRIBB, SOUTHSEA

FRENCH, BRITISH AND UNITED STATES AIRCRAFT CARRIERS WITH CLEAR DECK AND ISLAND LANDINGS

1. French carrier "Béarn," showing parasol type aeroplane taking off
2. H.M.S. "Courageous," which carries six flights of aeroplanes in hangar
3. The U.S.S. "Saratoga," upon whose flying deck the airship "Los Angeles" was successfully landed
4. H.M.S. "Eagle," with a sloping landing deck and a capacity of 18 aeroplanes
5. H.M.S. "Hermes," with four single-seater fighters resting on flying deck
6. H.M.S. "Furious," which has accommodations for 36 aeroplanes

AIRCRAFT CARRIER



BY COURTESY OF AERO SERVICE CORPORATION

THE U.S.S. "SARATOGA," LAUNCHED IN 1925 AND COMPLETED IN 1927, WITH A CARRYING CAPACITY OF 72 AEROPLANES

Originally designed as a battle cruiser, the U.S.S. "Saratoga" is capable of very high speed, being equipped with all the recently developed improvements suited to naval mid-ocean bases

forward and aft being joined by a walking way around the mast and funnel. Owing to disturbances set up by funnel gases and eddies around the funnel structure, this flying-on deck was not a great success, and the ship was further reconstructed, being finally completed in 1925. This vessel was fitted, like the "Argus," with a clear fore and aft flying deck, the funnel gases being led out over the stern. She has two very large hangars, one above the other, and has a deck forward from which aircraft may fly off, in addition to the main flying off and alighting deck; this was an entirely new and important feature which is being copied in later aircraft carriers.

About the same time as the appropriation of the "Furious" for conversion, designs were prepared for a carrier named the "Hermes," and this was the first vessel primarily designed as an aircraft carrier. Some six months after, the Chilean battleship "Almirante Cochrane," building at Messrs. Armstrong's works, was taken over for conversion and renamed the "Eagle."

The "Island" Type.—In both these vessels a departure was made in the construction of the flying deck, since a completely clear fore and aft deck was not fitted, as in the "Argus" and "Furious." The funnels and navigating positions were incorporated in an "island" arranged on the starboard side, thus giving a clear deck of a width only slightly less abreast the island than just forward or aft of it. This feature is shown in Pl. I., figs. 4–5.

Following on the satisfactory results obtained with the "Furious," it was decided, in 1926, to convert the two larger light cruisers "Courageous" and "Glorious" into aircraft carriers. In these two ships a reversion is made to the island type, as in "Eagle" and "Hermes," and the clear deck, as in "Furious" and "Argus," is not repeated. The island type has also been adopted in the U.S., French and Japanese navies, but it is still doubtful which type will eventually prevail.

This question of the choice between the clear deck, with no obstruction at all, and the alternative of the island type—that is, with the navigating position and bridge, with all instruments such as range finders, fire control, etc., and the mast, funnel and perhaps some guns, all being located in a small, very narrow space on one side of the deck, as shown in the photos of "Hermes" and "Eagle"—is a much disputed one. The clear deck has the advantage of presenting no obstruction whatever to the aeroplane pilot as he approaches the ship with the intention of alighting on deck The island type, whilst providing a much better navigation and control position on an elevated bridge, presents a serious obstruction on one side of the ship, and the pilot, in alighting on board, must so steer that, whilst one wing is in no danger of touching, the other is clear of the island standing up on that side of the deck. Some pilots, however, prefer the island, which gives them a good indication of the exact height they are above the deck when about to alight, it being more difficult to estimate this height with accuracy in the case of the clear deck. The stern view photograph of H.M.S. "Eagle" indicates very well the kind of view of the ship which is presented to the pilot when approaching to alight on board; it shows the deck curved downwards towards the stern to help him, in case the ship is rising and falling in the swell of the sea, and it also shows a good view of the island on the starboard side.

How Aeroplanes Board Ship.—It should be explained that the aeroplane about to land on board must always approach from behind the ship; the ship herself must, both for flying on and for flying off be head to wind and steaming directly into the wind at a good speed. The speed of the ship therefore assists the aeroplane to alight on deck against the wind, and also helps the plane to rise when taking off. Speed has a double value for aircraft carriers, as it helps in alighting and flying off, and also enables the carrier to keep pace with the fleet, to retreat rapidly in case of attack by superior forces, or to regain station if separated from the fleet.

United States Aircraft Carriers.—In addition to a carrier named "Langley," which is comparable with H.M.S. "Argus," but of less speed, the U.S. Navy completed in 1928 as aircraft carriers of the island type, two very large vessels, the "Saratoga" and "Lexington," which were originally laid down as battle cruisers. These vessels will have a very high speed, and will carry 70 to 80 aeroplanes, and in addition will have a 50% reserve carried in crates.

French Aircraft Carrier.—The French Government has recently completed a carrier named "Béarn" which is of the island type, and is a converted battleship. In many respects it closely resembles the British carrier, H.M.S. "Eagle."

Japanese Aircraft Carriers.—The "Hosho" is an aircraft carrier on similar lines to H M S. "Argus," except that the funnels come through one side of the ship, and can be laid level along the side below the height of the deck to facilitate flying on and off the deck. Two other large aircraft carriers, the "Akagi" and "Kagu," were being converted in 1928, the first from a battle cruiser and the second from a battleship. It is understood they are both of the island type, but in other respects resemble H.M S. "Furious."

WASHINGTON CONFERENCE RESTRICTIONS

Restrictions on aircraft carriers formed part of the Washington Treaty (*q.v.*). These restrictions implied that the aircraft carrier is now recognized as a definite and essential unit in a modern fleet. The other naval Powers followed the British lead in building this type of war vessel, and the aircraft carriers in service and building in 1928 for all Powers are shown in the table given. This table is restricted to aircraft carriers proper, the earlier and smaller vessels being excluded. (E. T.-D'E.)

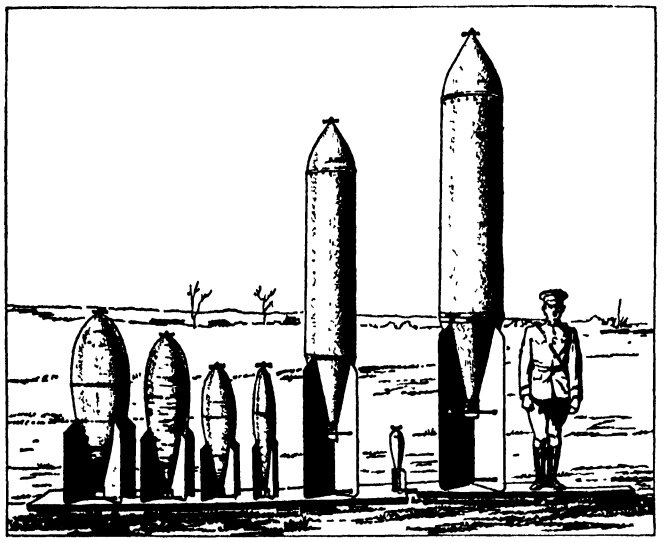
AIRCRAFT IN WAR. Airships and aeroplanes, as distinct from captive balloons, were first used in warfare by the Italian army during the campaign against the Turkish forces in Tripoli in 1911 and 1912. With the exception of aerial combat, there being no enemy aircraft to encounter, most of the features of modern air warfare were introduced by the Italian airmen. Both aeroplanes and airships were used extensively for reconnaissance work; the Turkish positions were frequently bombed by both types of aircraft, which in some cases received damage from rifle fire and from guns trained vertically by the simple expedient of placing them on the slopes of hillsides; and enemy troops were subjected to fire from aeroplanes armed with rifles and revolvers. Extensive photographic reconnaissance flights were made by airships and the photographs obtained formed into a mosaic from which a revised general staff map of the Tripolitan area was prepared

The World War.—In the World War the first squadrons of the British Royal Flying Corps flew from Dover to France on Aug. 13, 1914. Squadrons 2 and 4 were homogeneously equipped with B E.2 type aeroplanes, but Squadron 3 had both Bleriot monoplanes and Henri Farman biplanes, while 5 used Farman and Avro biplanes. Though the Lewis gun had been tested in an aeroplane in 1913, the adoption of machine-guns had not been general, and indeed no provision was made for the arming of these early machines, bomb sights and bomb racks being also lacking. This was partly because their primary duty was held to be visual reconnaissance, and partly because of the narrow margin of lift available, which prohibited any addition to the load beyond the weight of the pilot and of petrol. The same consideration prevented the carrying of cameras, but valuable work was done by the early reconnaissance flights, the first of which was made on Aug. 19. On Aug. 23 the reports of the massing of German troops led directly to General French's order for the retirement which saved the British army, and timely warning was given on Sept. 4 of the commencement of von Kluck's attempted enveloping movement against the French left, which led to the battle of the Marne.

The first approach to a fight in the air occurred on Aug. 22, 1914, when a German Albatross machine appeared over the aerodrome at Maubeuge and was chased by several British machines. Two days later the first German machine to be brought down was forced to land by machines of Squadron 2. It was considered at that time that the most suitable type for aerial combats was the slow two-seater Henri Farman with propeller in the rear giving a free field of fire for the observer armed with a rifle. Before the end of 1914 it was, however, beginning to be recognized

that the greater speed and manoeuvrability of the single-seater gave it advantages over the slower type. (*See* AIR COMBAT.)

The cessation of movement and settling down into trenches and a war of positions led to the development of aerial photography, in order that changes in the positions or sizes of enemy railheads, ammunition dumps and camps might be recorded. Early attempts at co-operation with the artillery also began,



BY COURTESY OF THE U S. WAR DEPARTMENT

FROM LEFT TO RIGHT, 1,100, 600, 300, 100, 2,000, AND 25 POUND FRAGMENTARY BOMBS AND A 4,000 POUND DEMOLITION BOMB

generally with the aid of coloured signal lights fired by the aeroplane to indicate the fall of shell; but as early as Sept. 15, 1914, an experiment in the use of wireless telegraphy on active service was made, and on Sept. 27 the R F.C. headquarters wireless section was formed.

Air Fighting Develops.—Air fighting and organized bombing raids developed in 1915. Early in January the Germans made several raids on Dunkirk with a number of machines flying together, in place of the isolated attacks by individual machines which had hitherto been the practice. On Jan. 22, for instance, 13 machines appeared and dropped bombs on the docks. During the battle of Neuve Chapelle in March 1915, in addition to the routine work of reconnaissance and artillery co-operation, the Royal Flying Corps interfered with the enemy's movements by attacking such important points on his lines of communication as Menin, Courtrai and Douai. During the battle of Loos, on Sept. 25, co-operation with the artillery was considerably improved and a system of "zone" calls introduced, by which the guns could be rapidly put on to "fleeting" targets.

The co-ordination of aeroplane bombing attacks with army operations was also further developed during this battle and attacks were made on railway lines, trains and important junctions. Early in March the R F.C. had received the first batch of a newly designed aerial camera, from which greatly improved photographs resulted. In May the Germans produced the Fokker monoplane equipped with an interrupter gear which enabled the machine-gun to be fired through the revolving tractor screw blades, a device which took by surprise the Allied air services, which for some time to come were to continue to rely mainly upon "pusher" machines for fighting. At the beginning of 1916 the uses to which British aeroplanes were being put were reconnaissance, artillery observation and bombing with B E.2 machines; and aerial fighting with Vickers and F.E. two-seaters, and with D H.2 single-seater "pusher" machines and the new Bristol Scout single-seater tractor biplane with a machine-gun firing over the airscrew. The universal adoption of the tractor type for fighting was still awaiting the synchronized gear operated by the engine for firing through the airscrew, which appeared on the curiously named Sopwith "Pup," a high performance scout, in the summer of 1916. Squadrons for the definite purpose of fighting in the air were organized and a regular patrol was kept up by each squadron over its own sector of the trenches to engage and drive back the enemy's long-range reconnaissance and bombing machines.

Verdun and the Somme.—During the battle of Verdun, which opened on Feb. 21, 1916, the French introduced a new and successful form of air fighting in sending their own machines into German territory to seek out the enemy machines before they reached the lines. This to a large extent enabled their own reconnaissance and artillery machines to do their work undisturbed. The Germans replied to this by developing the "circus" system, never copied by the Allies, of giving a recognized star pilot, or "ace" as the French called him, command of a special fighting squadron for which he chose his own pilots. The originator of this system was the German pilot Boelcke; another famous leader being von Richthofen, whose "circus" would move to different parts of the line, where the needs of the moment called for it, in an effort to obtain local air supremacy. The opening of the battle of the Somme on July 1, 1916, was signalized by intensive British reconnaissance and bombing flights, as well as by attacks with small 20-lb. bombs and machine-guns on the front line troops, in the trenches and billets and on transport immediately behind the lines The same battle was also the occasion of the introduction of "contact patrol" work in an organized manner and on a large scale. This consisted in locating units of Allied forces, and keeping headquarters informed of the progress from hour to hour; reporting on the positions of the enemy, and in particular on movements of his reserves; transmitting messages signalled by the infantry from the ground to headquarters; and dropping ammunition and supplies to isolated bodies of troops.

The year 1917, and indeed the remainder of the war period, was chiefly occupied in developing and bringing to perfection the different operations in which aeroplanes had already been engaged. Fighting in formation was developed until it became a highly scientific operation in which whole squadrons and even larger formations were frequently engaged. Bombing raids were also carried out in formation on a large scale, both by "day bombers" operating from behind the lines upon reserve ammunition dumps, railheads, concentration camps and similar objectives, and by twin-engined "night bombers" working from bases on the coast and far in the rear of the front line upon munition works and industrial centres in the heart of the enemy country itself. Raids of this nature had been carried out by the Germans from 1915 onwards, but it was not until 1917 that the appearance of the large Handley Page machine made retaliation possible; a development which led to the formation of the Independent Air Force on June 6, 1918, for the definite purpose of bombing German munition centres. (*See* AIR RAIDS.)

In dealing with the use of aircraft with the military forces during the War attention has been confined to operations on the Western Front because the work in other scenes of war was mainly on the same lines, except for such spectacular performances as the wiping out of a part of the Turkish VII. army on Sept. 16, 1918, when it was caught in a ravine and bombed to extinction by relays of British aeroplanes Nothing has, however, been said of the growth of the kite balloon service, which developed from two naval sections that arrived in France in May 1915, until at the end of the War there was a row of them along the whole line of trenches co-operating with the artillery, for which work they possessed the advantage of rendering possible direct communication by telephone between the observer and the battery.

Operations by Naval Airmen.—The first naval flying operation of the War was a patrol by Parseval Airship IV. during the night Aug. 5–6 of the approaches to the mouth of the Thames. Airships and aeroplanes patrolled the English channel during the crossing of the expeditionary force to France. For the remainder of 1914 the naval air service was chiefly engaged upon bombing operations with land machines from aerodromes on the coast of France upon the Zeppelin sheds at Cologne, Düsseldorf, Friedrichshafen and other points. The navy introduced the kite balloon to the British services and in March 1915 the first kite balloon section left for the Dardanelles in the "Manica," from which ship the balloon was used to good effect in spotting for the battleships engaging the Turkish batteries and ships.

About the same time a programme of "S.S." (submarine scout) airships, for use in patrolling the channel and approaches to the Irish sea, was laid down. By the end of 1914 three seaplane carriers were in commission in home waters, and shortly after the New Year the "Ark Royal," soon followed by the "Ben-My-Chree," left for the Dardanelles. From the "Ben-My-Chree" were launched the seaplanes which made history in attacking and sinking surface vessels by torpedoes dropped from the air. All these vessels carried the seaplanes in their holds and hoisted them out over the side by derricks to start from the water. In July 1915 seaplanes were used on the east coast of Africa in spotting for the monitors engaged upon destroying the German light cruiser "Königsberg." On Nov. 3, 1915, a Bristol scout aeroplane rose from the foredeck of the "Vindex" and thus became the forerunner of the ship aeroplanes subsequently developed.

The autumn of 1915 saw the production of the first "coastal" two-engined type airship, for anti-submarine operations from stations on the east coast. During 1916 aeroplanes of the naval air service were still employed in bombing aerodromes, coastal batteries, docks and also points of military importance, while in the Mediterranean regular anti-submarine and reconnaissance patrols by seaplanes and airships were instituted. In 1917 the navy introduced the Handley Page bombing machine, which made it possible to extend the range of bombing attacks. In home waters a more powerful airship, in the "North Sea" class, was produced and still further increased the length of anti-submarine patrols, while airships and, to a less extent, seaplanes began to accompany for prolonged periods the convoys of merchantmen which were organized by the Admiralty. Progress was made in the development of large flying boats operating from Yarmouth and Felixstowe, which patrolled the southern part of the North sea for submarines and Zeppelins. The principle of carrying aeroplanes in ordinary ships of the navy and flying them from platforms revolving with the gun turrets was introduced, while the torpedo-carrying seaplane was also very considerably developed during this period

Aircraft versus Submarine.—In 1918 the German submarine campaign reached its height and anti-submarine operations were intensified. Airships accompanied the Scandinavian convoy on the greater part of its journey, while a practically constant supervision was exercised by seaplanes, aeroplanes and airships over the "east coast lane," a narrow belt of water close to the shore to which merchant ships were required to keep for their own protection in their passage up the coast. The covering of approach to port by the use of aircraft undoubtedly contributed materially to the safety of American troop convoys. Aircraft were a potent factor in combating the submarine menace in convoy work as in reconnaissance, in co-operation with surface vessels and direct attack. Kite balloons were also installed on monitors, patrol boats and even battleships as an aid to the location of submarines.

Towards the end of the War the "Furious" appeared in its converted form as a seaplane carrier with a long flying deck on which aeroplanes could land as well as take off. An instance of the production of a special device for a specific purpose may be mentioned in the mounting of a Sopwith "camel" aeroplane on a lighter, towed behind a destroyer, for the purpose of making a surprise attack on a patrolling Zeppelin airship. At the date of the Armistice the British airship service was on the point of producing rigid airships capable of accompanying the Grand Fleet to sea as advance scouts, but the German navy employed Zeppelins for this purpose on many occasions and throughout the War maintained a patrol of the North sea which helped them to receive early warning of the movements of the British fleet. (*See* CONVOY.)

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United States.—In April, 1917 there was almost an entire absence of aviation interest and of aviation industry in the United States. The total number of military aeroplanes possessed by the Government at this time amounted to about 60 and none of these was equal to those commonly employed in European service. The entire personnel of the air services of the Army, Navy and marine corps then amounted to about 100 officers and 1,300 men. But immediately upon entering the World War aviation became an active party to the extravagance in funds and the confusion of effort incidental to America's complete lack of military preparation. A chief difficulty was found in the quantity production of aviation materials. Models were obtained and attempts made to copy the latest war aeroplanes but, due to a lack of understanding of the aviation problem, an optimistic scale of production which unhappily could not be met was mapped out.

Due to a great abundance of man-power, the personnel problem was better handled. Training of pilots was begun and carried out on an extensive scale in accordance with advice supplied by officers of the Allied forces. Nineteen months after entrance into hostilities, the membership of the army air service totalled nearly 200,000, of which over 78,000 were in France, England and Italy. A large number of American pilots were received into the air services of England and France, where they served with distinction. On four fronts the United States was represented by over 1,400 pilots, 750 observers and 250 balloon observers.

Naval and marine aviation, like that of the air service of the army, grew to a strength of some 7,000 officers and 33,000 men at the time of the Armistice. Of these, over 17,500 were sent abroad, manning 15 coastal aviation stations in France, two stations in England, five in Ireland and three in Italy. In addition, a strong bombing group was formed and conducted operations in northern France. The work of constructing air stations on the shores of foreign countries was successfully accomplished and constituted a definite deterrent to the activities of the U-boat. In addition, they supplied protection to the American troop-ships.

Immediately following the Armistice, most of the naval barracks and air station equipment were moved into the devastated regions of northern France, and were placed at the disposal of the commission for the relief of Belgium. From salvaged materials shelters were erected for the repatriated and destitute population by American sailors, who constituted the first organized unit to be employed after the war in humanitarian work in this region.

(T. T C.)

AIRD, SIR JOHN, 1ST BART. (1833–1911), British engineer, was born in London Dec. 3, 1833, the only child of John Aird, contractor for gas and water plants. He joined his father's business at 18, and was entrusted with the removal of the Crystal Palace buildings from Hyde Park and their re-erection at Sydenham. He took part in many enterprises, such as the Hampton and Staines reservoirs, the waterworks of Amsterdam, Copenhagen, Moscow, Bahia, Pará, Calcutta, Simla and Berlin, and later (in the joint firm of Lucas and Aird, afterwards John Aird and Co) St. John's Wood railway, Hull and Barnsley railway and docks, the W. Highland railway and the great Aswan dam across the Nile. He represented N. Paddington in Parliament as a Unionist from 1887 to 1905, and was its first mayor in 1900. In 1901 he was created a baronet. He made a fine collection of pictures by British painters, the illustrated catalogue to which was printed in 1884. He died at Beaconsfield, Bucks, Jan. 6, 1911

AIRD, THOMAS (1802–76), Scottish poet, and journalist, was born at Bowden, Roxburghshire, on Aug. 28, 1802, and died at Dumfries on April 25, 1876. In 1848 he published a collected edition of his poems, which met with much favour. Carlyle said that he found in them "a healthy breath as of mountain breezes." Among Aird's friends, besides Carlyle, were De Quincey, Lockhart, Stanley (afterwards dean of Westminster) and Motherwell.

See a *Life* by J. Wallace prefixed to the 5th edition (1848) of his *Poems.*

AIRDRIE, burgh of barony, municipal and police burgh, Lanarkshire, Scotland. Pop. (1921) 25,092. It is 11m. E. of Glasgow by the L.N E. railway, and connects with Glasgow by

the Monkland Canal, as well as by the L.M S. railway via Coatbridge and Whifflet. The canal (constructed 1761–90) connects with the Forth and Clyde Canal near Maryhill. Airdrie was a market town in 1695, but owes its prosperity to coal and iron beds. Other industries are iron and brass foundries, engineering, and cotton manufactures. The burgh was the first town in Scotland to adopt the Free Library Act. Airdrie unites with Coatbridge in sending one member to parliament. The parish of New Monkland, in which Airdrie lies, was formed (with Old Monkland) in 1640 out of the barony of Monkland, land granted by Malcolm IV. to the monks of Newbattle.

AIRE, a town of north France, on the Lys, in the department of Pas-de-Calais, 12m. S.S.E of St. Omer by rail. Pop. (1926) 4,292 The town lies in a low and marshy situation at the junction of three canals. In the middle ages Aire belonged to the counts of Flanders, and a charter (1188) is still extant It was given to France by the Peace of Utrecht (1713). The church of St. Pierre (15th and 16th centuries) shows three stages of Gothic architecture. The hôtel-de-ville is 18th century. Aire has considerable trade in agricultural produce. In the World War it was one of the headquarters of the British Army (1917–18).

AIRE, a town of south-west France, in the department of Landes, on the Adour, 22m. S E. of Mont-de-Marsan on the railway between Morcenx and Tarbes. Pop. (1926), 1,913. Aire (*Atura, Vicus Julii*) was the residence of the kings of the Visigoths, and there Alaric II. (*q.v.*), drew up his famous code. It is the seat of a bishopric (5th century) and has a cathedral (12th century) and an episcopal palace (11th, 17th and 18th centuries). Both have been restored. The church of St. Quitterie in Mas d'Aire, a suburb, is a building of the 13th and 14th centuries, with a choir in the Romanesque style, and a fine western portal now much disfigured. The crypt contains several Gallo-Roman tombs and the sarcophagus (5th century) of St. Quitterie

AIR-ENGINE. The practical drawbacks to employing air as the working substance of a heat-engine are so great that its use has been very limited. Such attempts as have been made to design air-engines on a large scale have been practical failures, and are now interesting only as steps in the historical development of applied thermodynamics In the form of domestic motors, air-engines had some application, prior to the development of the internal combustion engine and the extended use of electricity. The type survives in a few motors of very small power. One of the chief practical objections to air-engines is the great bulk of the working substance in relation to the amount of heat that is utilized in the working of the engine. Another is the difficulty of getting heat into the working air through the walls of the containing vessel. Air takes up heat from such a surface with much less readiness than does water. The waste of heat in the chimney gases is accordingly greater; and further, the metallic shell is liable to be quickly burned away as a result of its contact at a high temperature with free oxygen. The temperature of the shell is much higher than that of a steam boiler, for in order to secure that the working air will take up a fair amount of heat, the upper limit to which its temperature is raised greatly exceeds that of even high-pressure steam.

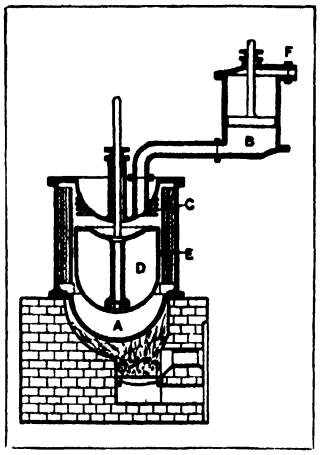


FIG. 1.—STIRLING'S AIR ENGINE

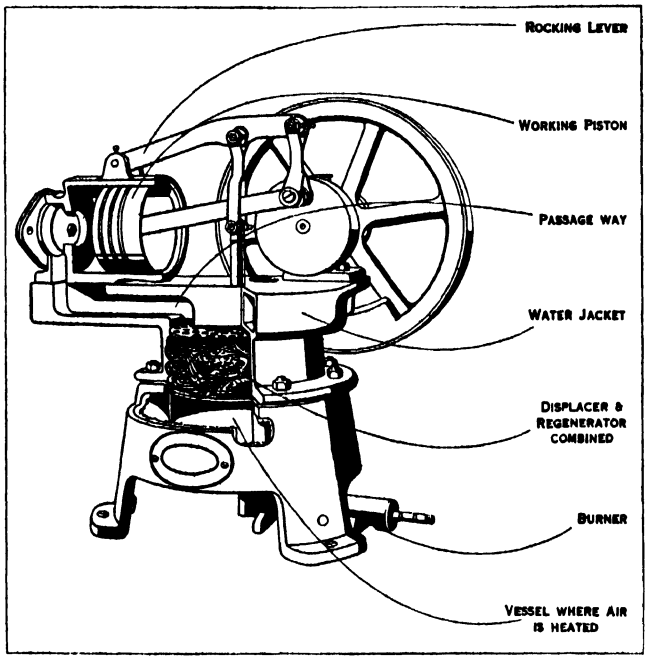
The working parts shown are:

A. Externally fired heating vessel
B. Working cylinder
C. Cooling pipes
D. Displacer
E. Regenerator
F. Connecting flange to another heating vessel

A form of air-engine invented in 1827 by the Rev. R. Stirling is of special interest as embodying the earliest application of what is known as the "regenerative" principle, namely, the principle that heat may be deposited by a substance at one stage of its action and taken up again at another stage with but little loss, and with a great resulting change in the temperature of the substance at each of the two stages in the operation. The principle has since found wide application in metallurgical and other operations. In any heat-engine it is essential that the working substance should be at a high temperature while it is taking in heat, and at a relatively low temperature while it is rejecting heat.

An attempt to develop a powerful air-engine was made in America about 1833 by John Ericsson, who applied it to marine propulsion in the ship "Caloric," but without permanent success. Like Stirling, Ericsson used a regenerator, but with this difference, that the pressure instead of the volume of the air remained constant while it passed in each direction through the regenerator.

(J. A. E.)



BY COURTESY OF SCIENCE MUSEUM, LONDON

FIG 2.—ROBINSON'S FORM OF STIRLING'S AIR ENGINE

In this domestic motor, the displacer and regenerator are combined thus simplifying the machine. A gas burner takes the place of the furnace

AIREY, RICHARD AIREY, BARON (1803–1881), British general, served in the Crimean War as quartermaster-general to Lord Raglan. He was recognized in the army as one of the best men on the staff, but public opinion held him responsible for the failures of the commissariat Airey demanded an inquiry in which he completely cleared himself. He was governor of Gibraltar (1865–70), was promoted full general in 1871, received a peerage in 1876, and in 1878–80 presided over the commission on army reform.

AIR FORCES. The World War provided a powerful stimulus to war flying, and great advances were made in technical equipment and experience. This intensive development led to constant changes in the practice and application of flying, so that when peace came it was expected that progress would be as rapid as in wartime. This led to a hesitancy on the part of most nations to commit themselves definitely to a rigid line of policy in aviation matters. The tendency was to wait for what the future disclosed rather than to base programmes of development entirely upon past experience.

The nations therefore shaped their aeronautical policies with an open mind, and in most cases refrained from radical adjustments and expedients which progress to date might have suggested as desirable. What in externals appeared stagnation was not necessarily so. Every forward step, if it is to be sure, must be preceded by much research and experiment before it is presented as a concrete achievement.

Analysis of available data, research and experiment, although less apparent, equals in importance the more tangible evidence of aeronautical progress. A policy readily adjustable to whatever changes the future may bring; an elastic organization that lends

itself readily to expansion; adequate provision for research and experiment; training facilities; a husbanding of the resources, industries and trades that subserve the needs of aviation, and the national attitude towards flying give a truer perspective of potential air power than mere numbers of machines. Policy and organization are the most important criteria.

Two Theories of Control.—Two different schools of thought exist in regard to the general principle that should govern the organization, administration and development of air forces. One school regards flying as a science that can best be applied to war uses by entrusting armies and navies with its adaptation to their own respective needs. Aviation is, accordingly, constituted a component of these services, and its application in war is governed by naval and military considerations. Although this system has certain advantages, in that it grafts a novel instrument of war upon an existing stem and so avoids the disadvantage of setting up an entirely new organization, there is no doubt that it exerts a limiting influence. The soldier and the sailor naturally approach aviation from the angle of their own profession

Such advances as are made are likely to follow divergent courses. An apparently inevitable spirit of competition between armies and navies also leads to duplication and tends to deprive effort of its full measure of results. The other school considers that the air merits a profession of its own, and that untrammelled devotion to the science and art of flying is necessary to do full justice to possibilities, not only in relation to war but as a factor in modern life. It accordingly seeks to concentrate all aeronautical effort into one main channel, with branches to the various departments which flying can serve.

Unity of Air Control.—Great Britain was the first to gather together the threads of aeronautical activity and place them in the hands of a central authority; and at the beginning of 1918 the air branches of the Admiralty and War Office departments were amalgamated into the Air Ministry. In April 1918, the flying branches of the navy and army were merged into the Royal Air Force. The idea was not a new one, and, although the impulse of war made obstacles easier to overcome, it was not in war that the conception had its origin. The sub-committee of the Committee of Imperial Defence, charged in 1911 with the study of aviation in its relation to defence, mentioned in its report that such a step might be desirable when flying was more advanced The germ of the idea is also to be found in the constitution of the Royal Flying Corps, formed in 1912, with its naval and military wings In this instance, however, the measure was too far in advance of the time to survive inter-service jealousies, and shortly before the outbreak of the World War the Royal Naval Air Service was formed, the Royal Flying Corps becoming part of the army

As air warfare grew in volume and importance, the defects of the dual system under war conditions became more and more apparent. Full use of the nation's resources was prejudiced, and civilian ministers were not only denied unanimous advice on air matters, but were sometimes forced to choose between discordant views and to settle vital differences of opinion. The drawbacks of this competitive system were particularly glaring in the matter of technical supply. Improvement was sought in the principle of joint naval and military Air Boards to co-ordinate supply for the two air services. These boards had, however, no executive control over policy, and achieved but little. Finally the Air Ministry was brought into being as the only apparent alternative to the existing evils.

Although a war measure, the Air Ministry survived the peace, and administers not only the Air Force but controls civil aviation as well. It was, however, not allowed to continue its existence as a department of State without considerable hostility and adverse criticism. Its chief opponents were the navy and army. With their establishments reduced to a minimum, and their budget grants diminishing every year, the older fighting services viewed with misgiving the allotment of funds to the newcomer. They argued that the main use of aircraft in war is to assist directly or indirectly the army and the navy, and that accordingly these services should have entire control of their respective air arms. The reply to this objection is that the conquest of the air has disclosed possibilities which transcend the scope of land and sea warfare; that to narrow the viewpoint to naval or military problems is to bring their possibilities into a false perspective; and although that aerial assistance to the forces that fight upon the sea and on land is necessary, this need by no means marks the limit that should be set to aerial operations. Moreover, to regard the air merely as an auxiliary to the sea and the land is a dangerous doctrine, since circumstances may render naval and military operations secondary to those carried out by air forces. Another criticism was that a separate air force is extravagant, since it involves additional overhead expenditure. The reply is that this is offset by the economy achieved in having a single authority dealing with air matters.

One result of recognizing aviation as a profession in its own right has been a breakaway from traditional practice in policing the British mandates in the East. Security in these territories is the responsibility of the Royal Air Force; aeroplanes are recognized as the chief instruments for the support of law and order, and military forces are used as auxiliaries. The measure has been justified by the great economy achieved. The development of this conception and its successful application would not have been possible without an Air Staff. Another result is a reversal of principle governing the air *vis-à-vis* the land and sea forces in the defence of Great Britain against air attack. Instead of dividing the air into two portions, one above the land and the other above the sea, and making the army and navy responsible for their respective spheres, the air is regarded for purposes of national defence as a single field of activity. The Air Force is accordingly responsible for guarding against air attack, and such ancillary ground forces as may be necessary conform to air defence measures.

Italy (*q.v*) was the first of the Great Powers to follow the lead of Great Britain in establishing a separate Air Force. This step was taken in 1923 as a result of Signor Mussolini's assumption of power The decayed state into which the air services had fallen helped to facilitate a complete reconstruction on new foundations, and under the impulse of Signor Mussolini's keen interest in air questions, Italy has rapidly risen to be one of the most efficient and active air Powers of the present day.

In 1928, under pressure of public opinion following repeated accidents, and in particular the death of the minister M. de Bokanowski in an accident, France followed the example of Great Britain and Italy in unifying the control of her air activities under a separate ministry.

Aviation in Peace and War.—Since it is sometimes claimed that a true appreciation of a nation's air strength cannot be reached without taking into consideration the civil aspect of flying, it is desirable to note the relationship existing between the peace and war sides of aviation. Air strength is represented by air forces maintained in peace, ready to function the moment war breaks out Heavy losses in life and equipment are, however, to be expected in air warfare, especially if the belligerents are at all equally matched. Air power will, therefore, depend ultimately upon the means available for rapidly making good these losses—that is to say, upon a reserve of flying personnel and on a healthy aircraft industry. It is in respect of these two important factors that civil aviation must make its contribution to a nation's air strength Hence the practice of granting Government subsidies to commercial air transport enterprises. It may, however, be a long time before civil aviation will occupy, in relation to air strength, a position analogous to that occupied by the mercantile marine in relation to British naval strength.

The requirements of civil and war flying differ considerably. For commerce, economy in running and maintenance and paying load are the factors that count most. For war, speed, climbing power, the carriage and use of armament, and fighting qualities in general are the chief factors that control design. Consequently, apart from the fact that they connote an aircraft industry and the existence of a potential reserve of pilots, aeroplanes used for civil purposes do not contribute directly to a nation's strength in the air.

Details of the various air forces or air arms and the system of

control and organization in the different countries, are given under the heading of each country, as part of the section on *Defence*.
(A. W H. E. W.)

UNITED STATES

When in April 1917 the United States entered the World War, but little had been done by the country toward the creation of an air component for either the army or the navy. The aviation personnel consisted of 65 officers and 1,120 men in the army, 35 officers and 163 men in the navy. There were on hand no planes but those used for training, and of these only about 300, some of which were of inferior types. Aviation in the army was then a function of the Signal Corps, whose prime mission was to provide means of communication, telephone and telegraph systems in the theatre of military operations. In the navy there was no well defined agency charged with the development of aviation. During the war the aviation section of the Signal Corps was abolished and instead there was created in the United States under the War Department, the division of military aeronautics, while in France the air component of the army was organized as the Air Service, with an officer, chief of the Air Service, in charge. In the navy, in March 1918 aviation was placed under the chief of naval operations, and was administered by an officer called the director of naval aviation.

At the Armistice in Nov. 1918 the army aviation personnel consisted of 20,000 officers, 600 cadets and 164,000 men; that of the navy, 6,716 officers and 30,692 men. There had been delivered in the United States about 8,500 training planes; there had been built for the army some 3,300 service type observation planes, the so-called De Haviland 4's, for the navy 1,600 anti-submarine flying boats, while 15,700 motors for training planes and 13,396 Liberty motors had been produced. The Liberty motor development was one of the most strikingly successful projects undertaken during the war. Service type aircraft, that is, those actually used in military operations, were frequently and greatly changed, modified and improved during the war. This was especially true of the smaller, single-seater pursuit or fighting planes. Acting upon the best advice obtainable, the production efforts of the United States were concentrated upon planes of the larger types mentioned above which were not likely to be superseded so quickly, and upon the production of motors.

Post-War Problems.—The close of the war found the United States with large numbers of these war-built planes and motors on hand, but military aviation had developed so that planes of other types, pursuit, bombing, attack, were absolutely necessary with which to equip the properly organized and constituted air components of its military forces. The possibilities and the importance of commercial aviation were also forcing recognition, and this from both the economic and the national defence standpoints. Planes for all these purposes had to be designed, tested and then built in larger and larger numbers. The designs of both planes and motors were constantly being improved, and there was the danger that if quantity production were undertaken too quickly, those thus turned out would be too soon rendered obsolete. It was decided, and no doubt correctly, to make use of the planes and motors on hand while devoting the major effort and the larger part of the funds, as they became available, to the progressive development and perfecting of planes and motors built according to new and better designs. The result of this policy was that at the end of June 1928 planes and motors designed and built in the United States were at least as good as any produced elsewhere, and furthermore they could be manufactured in quantities in relatively short periods of time.

In addition to airplanes, lighter-than-air craft, dirigibles or airships, are employed in both military and commercial operations. These are in use in both the army and the navy, though their development has been carried on more extensively by the latter service. Congress in 1928 authorized the navy to contract for two airships, each of about 5,000,000 cu.ft. capacity, at a cost of about $8,000,000.

The best way in which the air effort of the United States should be organized and administered has been much discussed. There were those who advocated the creation of a department of aeronautics, under a cabinet officer, charged with the conduct of all aviation activities, military and civil. Others urged the setting up of a department of national defence, with a cabinet officer at the head, and under him three assistants in charge respectively of the land, the sea and the air forces. Still another view advanced was that the air components of the army and navy should remain separate, each under the control of the corresponding department head, and up to 1928 this view prevailed. Naval aviation, under the secretary of the Navy, is administered by the bureau of aeronautics, created in 1922, with a navy officer as its chief. Army aviation was made a separate combat arm, called the Air Service, by act of Congress in June 1920. This organization is under the secretary of War, an army officer its chief. In 1926 the name was changed to the Air Corps. In that year, 1926, Congress created in the Department of Commerce an aeronautical section charged with all matters concerning civil or commercial aviation, with an assistant secretary of Commerce at its head, and also provided additional assistant secretaries of War and of the Navy, each to have charge of aviation, under the secretary, in his own department.

During the session which ended July 2, 1926, Congress adopted definite continuing programmes to govern the development of army and navy aviation during the following five-year period. The necessary money was not appropriated until the next session, so that the carrying out of these programmes could not be started until July 1, 1927. In accordance with this legislation, it was intended that by June 30, 1932, the Army Air Corps should have a total of 1,518 officers and 16,000 men, and 1,800 airplanes of the most modern designs, with provision for annual replacements of about 400 planes; the navy, 850 officers and 12,000 men, with not less than 1,000 planes, likewise of up-to-date designs.

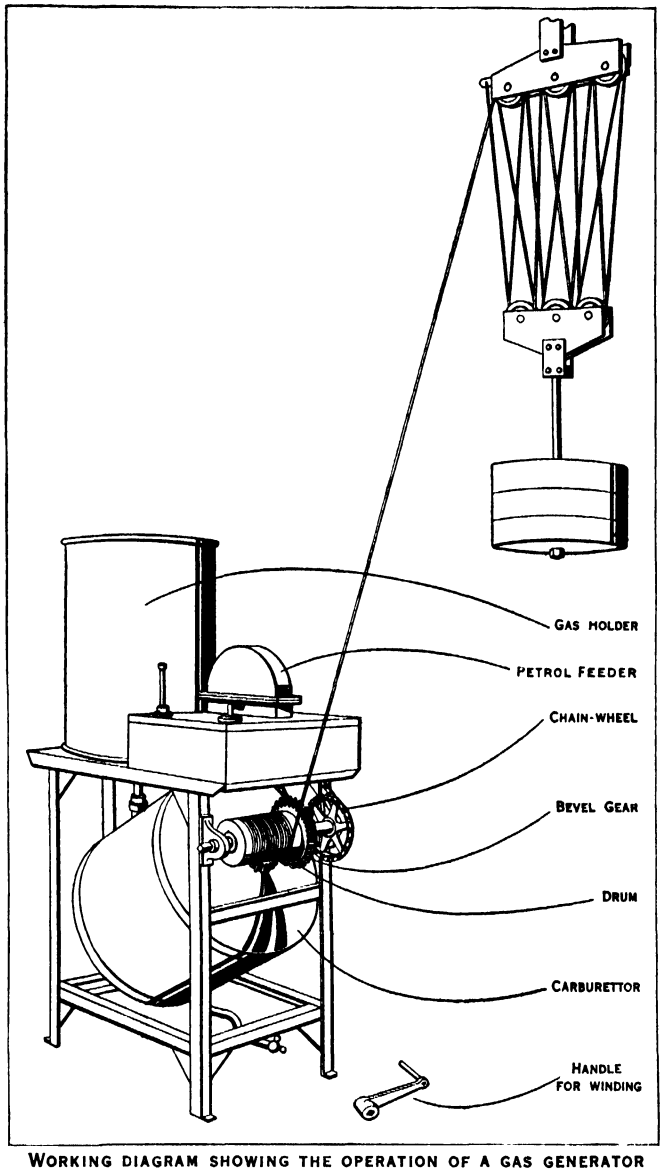
As of June 30, 1928, the Army Air Corps consisted of 1,016 officers, 9,494 men, with 511 post-war built planes; the navy of 750 officers, about 10,000 men, with 428 such planes; a total for the United States of 1,766 officers, 19,494 men, and 939 service type planes. Training planes are not included in these figures (M. M. P.)

AIR-GAS, air carburetted with the vapour of a highly volatile hydrocarbon, such as petrol (gasolene). This product, originated about half a century ago, can be generated in a simple plant, operated by weights on a small scale, or by shafting, electric motor, or water-power for greater capacities, with self-regulation according to the quantity of gas consumed. About 500 cubic feet of air-gas may be produced from a gallon of good petrol, one cubic foot giving 16 candle-power per hour. A special spirit, which leaves practically no residue, is used. Benzene may also be used.

The figure shows a simple weight-driven apparatus. As the weight descends it pulls the cord wound around the drum of the machine, chain-connected to a wheel inside the casing, standing upon the petrol tank. The wheel has cups that pass through the petrol, pick it up in measured quantities, and discharge it through a pipe into the obliquely-set carburettor. This compresses and carburets the air, using an archimedean screw that rotates and prevents irregular carburation, due to the cold produced by the rapid evaporation of the petrol. Cessation of action automatically occurs from the fact of a vacuum being set up when the bell of the gasholder has risen to a certain height. The machine thus generates rapidly or slowly according to the number of burners in use, and stops if they are all turned off. The larger electrically-driven outfits will produce as many as 2,250 cu. ft. per hour.

A product called gas-machine gas is used in America for making air-gas. Gas-machine gas is a special "cut" or fraction of natural gasolene. This last-named product is isolated from the majority of natural gas produced in America by compression and cooling, or either by oil absorption or charcoal adsorption and subsequent heating. From the natural gasolene thus produced, the gas-machine gas is obtained by a well-controlled distillation, to ensure having a highly volatile material with no residue when carburetted.

Air-gas, commonly known in America as gasoline-gas, consists of air charged with gasoline vapor to a point in excess of the



WORKING DIAGRAM SHOWING THE OPERATION OF A GAS GENERATOR
The action of the weights turns the drum, which rotates the carburettor and the gasolene feeder by means of the bevel gear. The gas thus produced passes into the holder

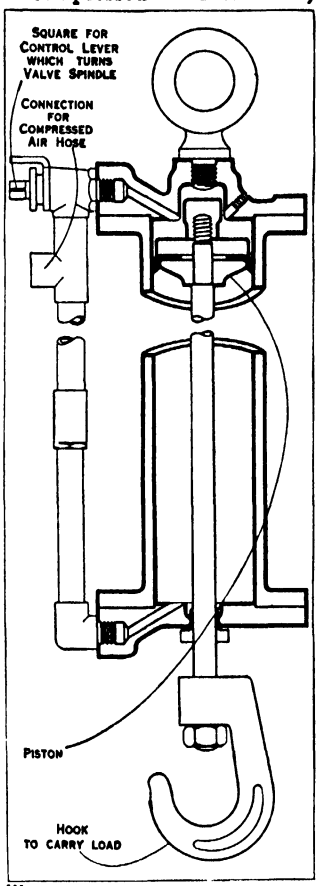
maximum percentage which can form an explosive mixture. It is widely used for isolated plants in villages and country houses for lighting and other purposes. It is rarely used in larger communities. The mixture commonly found most desirable (for a flame source in the Welsbach burner) is about 6 gallons of gasolene per thousand cubic feet of air. The illuminating power of such air-gas compares favorably with that of ordinary commercial gas The following table shows theoretical combining proportions for various gases (used as fuels) at room temperature:

Limits of Proportion for Explosive Air-Gas Mixture
(percentage of gas in the mixture by volume)

Gas	Combining proportions	When air is in excess	When gas is in excess
Acetylene	7·9	3·35	52 3
Coal Gas		6·7	18·4
Illuminating Gas		7·9	19·1
Benzene	2·7	2·65	6·5
Gasolene 86° Be		1·54	4·76
Gasolene 71° Be		1·54	4·76
Gasolene 65° Be		1·31	4·76

AIR-GUN, a gun in which the force employed to propel the bullet is the elasticity of compressed atmospheric air. It has attached to it, or constructed in it, a reservoir of compressed air, a portion of which, liberated into the space behind the bullet when the trigger is pulled, propels the bullet from the barrel by its expansion. The common forms of air-gun, which are merely toys, are charged by compressing a spiral spring, one end of which forms a piston working in a cylinder; when released by a pull on the trigger, this spring expands, and the air forces out the bullet.

AIR-HOIST. In factories and other places where a supply of compressed air is available, its use for operating lifting tackle is much favoured, because of the cleanliness, absence of noise, and ease of connection with flexible hose. The direct hoist, raising a load 4 or 5ft., and dealing with from 1 to 70cwt. in different sizes, is the simplest. It comprises a cylinder, a piston, a rod attached thereto and carrying the lifting hook at the bottom, and an operating valve, controlled by pendent chains. An eyebolt at the top affords means of suspension to a fixed beam, or a swinging jib, or to a trolley running on a girder, either stationary or forming part of a jib or travelling crane.



WORKING PARTS OF AN AIR HOIST
The hoist is suspended from the eye at the top and the load is slung on the hook. The piston is shown at the top of the chamber, it having been forced upwards to the full length of its stroke by the pressure of the air from below

The hoist shown in the diagram is controlled by balanced pressure. The full air pressure of 80lb. per sq. in. is maintained at the underside of the piston throughout all the operations of lifting, lowering and remaining stationary. For lifting, the attendant manipulates the valve so that air leaks off the top piston.

Another way of applying air power is to use a special pulley block to which is attached a small pneumatic motor, the cylinders of which actuate connecting-rods and so drive a crankshaft, this being geared to the rope drum in order to gain power. Loads up to 10 tons can be lifted in this way.

For colliery service, another class of air-hoist is built, a winch or haulage engine, the rope drum being driven through gears from a pneumatic motor. This is essential in circumstances where compressed air is the power supply in use Some of the engines can be run either with air or steam.

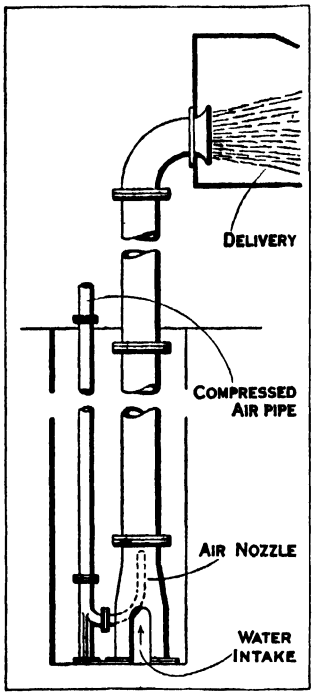
AIR-LIFT, a system of lifting liquids by compressed air without a pump. For Artesian-wells the method consists in carrying down a smaller air-pipe either within the water delivery pipe or alongside it, and connecting up an air-compressor. The compressed air forms with the water a mixture of lower specific gravity than the surrounding water in the well or bore-hole, with the result that the mixture of air and water in the tube is forced by the weight of the surrounding water to the point of discharge (*see* overleaf). When the supply flowing into a well is not enough to give constant working, waste of energy may be avoided by a governor. Some air-lifts yield as many as 285,000 gals per hour per well.

The Shone ejector, another form of air-lift, is utilized for raising sewage and other liquids automatically from one or any number of points, and forcing to any spot desired. The difference between this and the well lift just described is that the liquid gravitates into a bell-shaped casting through an inlet pipe and rises until the vessel is nearly full. Then the air trapped up at the top becomes slightly compressed, and acts on a metal cup that lifts a valve and admits a supply of compressed air into the vessel. This drives the sewage out through an outlet pipe to reach a higher level or any distance away; a fresh supply enters

through the inlet pipe, which has been automatically closed during the discharge, and the cycle commences again.

AIR-LOCK, a steel-plated chamber provided in a tunnelling shield or a caisson (*qq.v.*), to prevent the escape of compressed air during the passage of workers. The pressure in the caisson may be 25 to 30 lb. per sq.in., though higher pressures have been used. A steel door at each exit of the lock provides for the safe passage of men or material, one being opened while the other is shut. There will be several locks in a tunnel shield and in some big caissons. The diagram indicates the shape of a caisson, sunk to make the foundation for a bridge pier, two shafts for material and one for men being fitted. The shaft down which concrete is shot has its air-lock placed lower than those of the other shafts, because the concrete-mixer happens to be located on the lower platform.

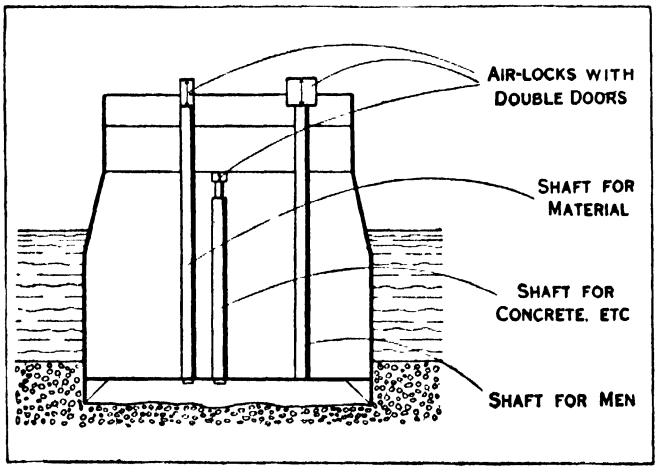
Air-lock also means the trapping of air in a bend; *e.g.*, of a water or petrol supply, stopping the flow.



THE OPERATION OF AN AIR LIFT
The diagram shows water being forced up from a well by compressed air. Although chiefly supplied to wells and for lifting sewage, the method can be also used for moving acids, sludges, slimes and heavier liquids

AIR LOG or **AIR DISTANCE RECORDER,** an instrument which measures the distance flown by an aeroplane relative to the air. It consists of two units: a transmitter which is installed on a wing strut or in some other position on the aircraft where it receives undisturbed air, and an indicator which is mounted on the instrument board The transmission may be either pneumatic or electric.

The transmitter comprises an impellor or wind-mill, which revolves as the aircraft moves through the air, the number of revolutions being proportional to the air distance travelled The motion of the impellor is reduced by gearing to actuate a valve or contact at a predetermined unit of distance, the resulting impulse of air or electric current operating a ratchet in the indicator. The latter unit is simply a counter. By properly relating the pitch of the impellor blades and the gearing, the instrument will record any unit of distance, such as geographic miles, nautical miles or kilometres. The instrument is rendered inoperative below a predetermined minimum speed, in the pneumatic type by relating the air pressure to the speed in such a way that operating pressure is not available below the minimum speed, and in the electric type by using a centrifugally controlled switch. This protection is necessary to prevent the operation of the air log by the wind, while the aircraft is on the ground. (C. H. C.)



THE USE OF AIR-LOCKS IN CONNECTION WITH A BRIDGE CAISSON
The usual air pressure in caissons is 25 to 30 lb. per sq.in. and steel locks are provided for each shaft. Excavated material is raised by power and, at great depths, cages are used to bring workers to the surface. Under the high pressure work becomes laborious and every effort is made to minimize the worker's fatigue

AIR PORT: *see* AERODROME.

AIR-PUMP. This appliance was introduced by James Watt in 1765, when he invented the separate condenser for steam engines, in order to extract a mixture of air, water and vapour from the condenser, so providing the maximum practical vacuum. The air-pump may be built with the engine and its piston is moved to and fro by a rocking lever, or sometimes by an extension of the engine piston-rod through the back cover of the cylinder. A separate drive by engine or motor makes the air-pump an independent unit. An arrangement of valves allows the inrush of air and vapour on the suction stroke, and expulsion through other valves on the return stroke

A simplified pump has a conical-shaped piston or bucket (fig 1) which dashes at high speed down on to the water collected below which it drives upwards into the pump barrel above the bucket, which has just uncovered the ring of ports. The water, vapour and air shoot up the barrel and out through the top valve

Modern pumps move the air independently of the water. The ejector type of air-pump is the most popular. A steam jet extracts the air and vapour from the condenser, which it discharges to the second jet, which finally ejects the air against atmospheric pressure. The ejector may incorporate a small condenser, an arrangement seen in the drawing (fig. 2), consisting of a series of small tubes through which water from the condenser (termed the "condensate") is pumped. The primary steam jet sucks in air in the direction of the arrow at A, and discharges it along with the operating steam into the first condensing compartment. The secondary jet withdraws the aerated vapour from the first compartment and sends it with its operating steam into the second condensing compartment. The heat remaining in the steam after it has done its work is thus transferred to the condensate, so acting as a feed-water heater to the latter on its way to the boiler. The tyre pump is a familiar example of simple reciprocating

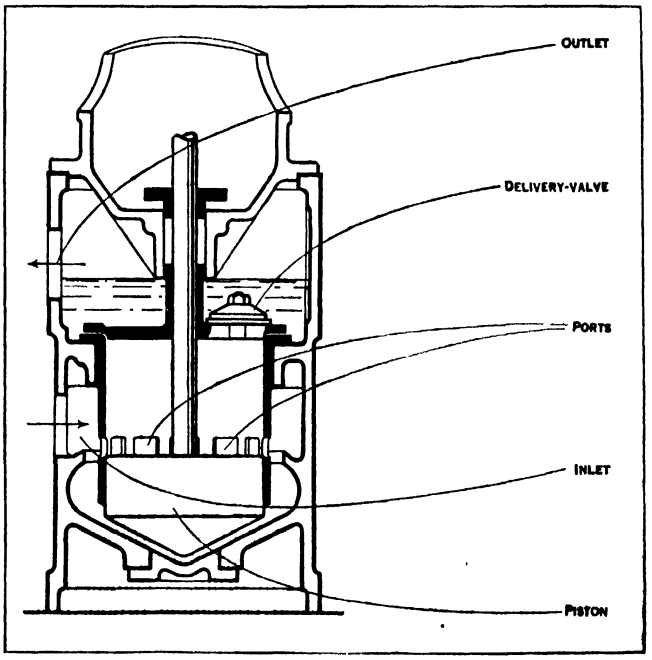


FIG. 1.—THE WORKING PRINCIPLES OF EDWARD'S AIR-PUMP
The function of the pump is to extract the water and air from a condenser. As the piston descends at high speed the water collected below it is driven with force up the curved walls and through the ports. On the rise of the piston the air is forced out through the delivery-valve with a portion of the water

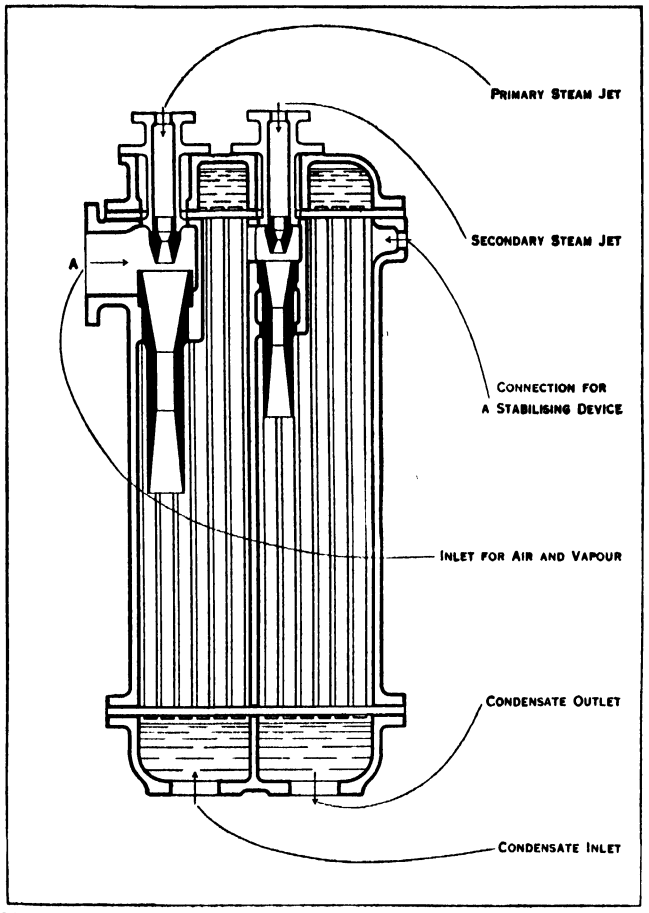


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FIG 2.—DIAGRAM SHOWING OPERATION OF AN EJECTOR AIR-PUMP
The type shown is operated by steam jets The primary steam jet withdraws air and vapour from the main condenser and discharges to the secondary jet which finally ejects the aerated vapour at about atmospheric pressure. The tubes constitute a small condenser which helps to warm the condensate ready to go back into the boilers

class, though strictly it should be termed an air-compressor. (*See* also VACUUM PUMP)

AIR RAIDS. Directly Great Britain came into the World War, the German High Command began to encourage their public with prophecies of the havoc the Zeppelins were about to work in England, but it soon became evident that for airships to fly in daylight over enemy territory was to invite disaster. Hence, although reconnaissances over the North Sea towards England were begun by airships, the first actual attacks were made by aeroplanes.

Raids in 1914–15.—In Dec. 1914 a couple of bombs were dropped in the sea off Dover, and three days later, on Dec. 24, the first German projectile hit English soil. A few half-hearted attacks by aeroplanes and seaplanes, made during 1915, were ineffective, and it was left to the lighter-than-air machines to cause the first serious damage. In the evening of Jan 19, 1915, two naval airships approached the coast between Yarmouth and Cromer. They separated and dropped bombs on both towns. Four people were killed.

On April 14, Mathy, boldest of all German air commanders, commanding L9, made a considerable tour over the northern counties. On this occasion he was not particularly successful, most of the bombs falling harmlessly in open country, but the following night L9 caused some damage in Suffolk. The next four raids were similar. Capt. Linnarz, very active about this time in command of one of the military airships, succeeded in bringing his ship over London on the night of May 31, 1915. There was on this night only one raider, armed with an inefficient type of bomb, but there were 41 fires, while five people were killed and 14 injured.

Further raids in Yorkshire and Kent on June 4 had little result, but two nights later Mathy again attacked the north. He found Hull, and killed 24 people, besides wrecking some 40 houses. Another airship, LZ37, that attempted to raid on the same night, was destroyed by Lt. R. A. J. Warneford, R N , while returning home near Ghent. The first serious military damage in England was done by a single ship that raided the north on June 15.

A series of nine raids took place in the latter part of 1915. It opened inauspiciously for the Germans, a zeppelin engaged in bombing Dover being hit by a 3-in. gun that had just been mounted there. She struggled across the Channel and was finished off by bombing aeroplanes.

London was reached on four nights during this period. On Sept. 8 Mathy bombed the city deliberately; the damage done amounted to more than £500,000. Mathy also took part in the raid of Oct 13, when his ship bombed Woolwich. On this occasion the casualties were 33 killed and 77 wounded. Two buildings were destroyed, 20 seriously damaged, and there were 13 fires, the total damage being estimated at £50,250.

Raids of 1916.—The defences could do no better in the early raids of 1916. Nine zeppelins manoeuvred over the midland counties on the last night of January, one getting nearly to Shrewsbury, and 59 people were killed. Out of 16 British aeroplanes that went up in pursuit, 8 crashed on landing. A month later two airships were able to sit over Hull and bomb it from a low height, without any interference from the defence From this time, however, the defences improved L15, one of the five ships that attacked on March 31, 1916, was hit by the gun at Purfleet; it was then attacked in the air by Lt A de B Brandon, of the Royal Flying Corps, eventually falling into the sea off the coast of Essex Fifteen airship flights were made over England and Scotland during this April. The British losses were 84 killed.

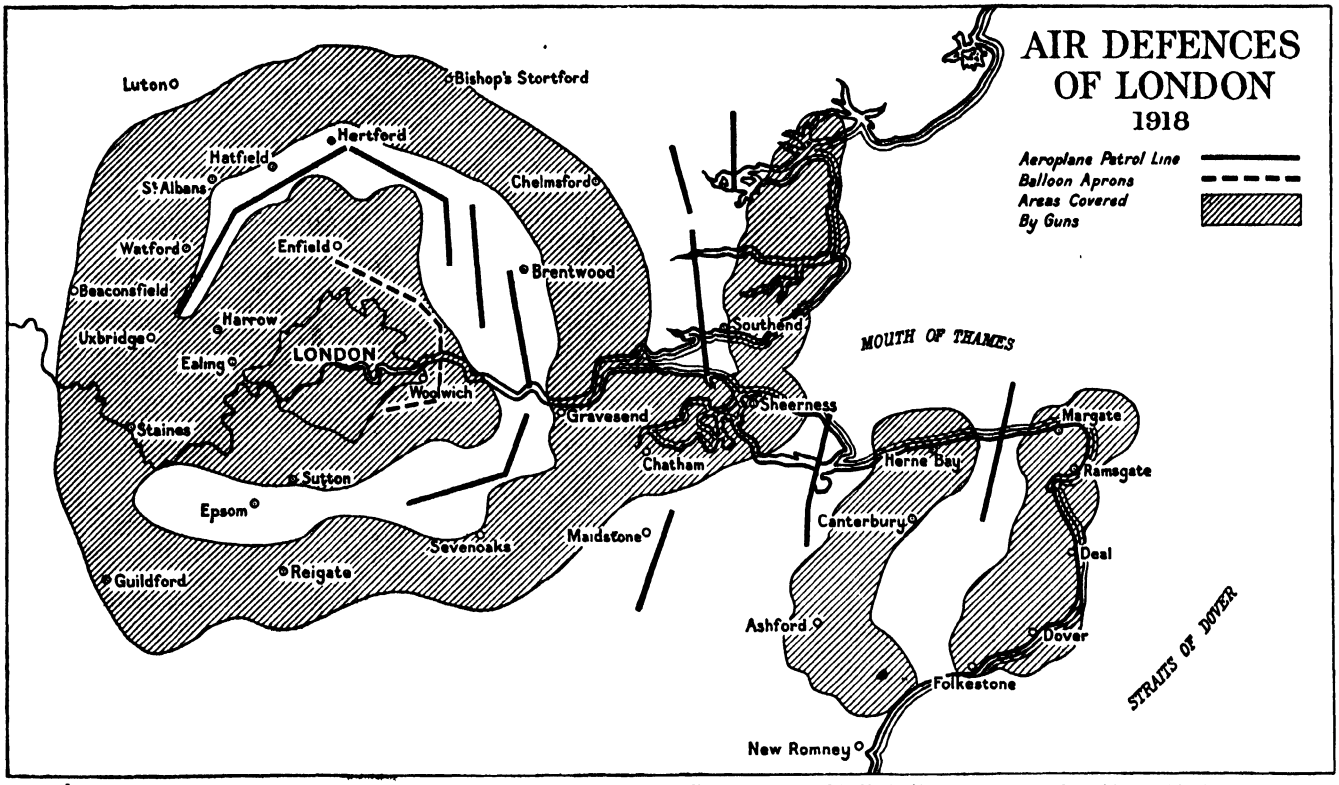
Further raids at the end of April were organized in conjunction with the naval bombardment of Lowestoft and Yarmouth. A large number of airships took part but the result was small. London was saved from bombing by its defences on April 25. One zeppelin was eventually destroyed on the coast of Norway.

An abortive raid on Harwich was followed on Aug. 24 by an attack on London by Mathy A determined attempt on London was carried out by 14 ships on Sept 2. The Metropolis was undoubtedly saved by Lt W L Robinson of the R.F C., who attacked the military airship SL11. She fell, a burning mass, near Cuffley, Middlesex

On Sept 23, 1916, 11 airships left Germany and the main attack was directed on London by three of the newest super-zeppelins. Having crossed the Essex coast shortly before 11 P.M., L33 was over east London ten minutes after midnight, and dropped 20 bombs London, however, was no longer helpless. The searchlights continually lit up the hull of the airship; she was badly holed by the guns, one of her engines was damaged and she began to lose gas and fly clumsily To add to her miseries, Brandon now brought his machine close up to her. For 20 minutes he stuck to her, pumping bullets into the fabric. As she laboured back towards the North Sea, the crew threw out everything on which they could lay their hands. Her commander crossed the coast at Mersea Island, going out due east. But the certainty that his ship would fall into the sea was too much for him; he turned her about and came to earth near Colchester.

Mathy meanwhile brought his ship L31, in company with L32, up the English Channel and, turning in over the Kent coast, passed straight over the centre of London. South London and the extreme north of the Metropolis suffered severely; but, for some reason, Mathy threw no bombs in the central districts. The handling of the companion ship, L32, was not of nearly so bold a character Her commander spent an hour circling about Romney marshes As he crossed the Thames near Dartford he was picked up by lights and attacked by guns Lt Frederick Sowrey succeeded in setting the ship on fire in several places; she fell at Billericay. The British casualties on this night were 40 killed

On the night of Sept. 25, seven ships raided the north. Mathy, on this occasion, took his ship on an entirely new line; he flew up the Channel as far as the Isle of Wight, where he turned north



AFTER THE GERMANS HAD RAIDED LONDON WITH SOME SUCCESS IN THE SUMMER OF 1917, THE AIR DEFENCES WERE COMPLETELY REORGANIZED UNDER ONE COMMAND. PATROLS OF FIGHTER AEROPLANES WERE DOVETAILED INTO THE GUN DEFENCES A SYSTEM OF BALLOON APRONS NEAR LONDON HAD A CONSIDERABLE MORAL EFFECT AND LIMITED THE HEIGHTS AT WHICH BOMBERS WERE TO BE EXPECTED

and went over Portsmouth. He dropped no bombs on the fortress or dockyard.

Yet another serious attempt to bomb London was made on the night of Oct. 1. Eleven ships started from Germany. Mathy, in L31, came in over Lowestoft about 8 P.M. and as usual steered an excellent course on London. Soon after passing Chelmsford, however, he found that the outer defences on that side of the capital were ready for him. He therefore turned and steered north-east Turning again, he flew south-west, in order to get into position for his favourite dash down wind over the city. After drifting a few moments toward Ware, he set his engines going and started for north London at full speed. Suddenly a heavy gunfire was opened on him and he decided to abandon his attempt. Sec-Lt W. J. Tempest came up to the ship at 12,700ft. and brought her down in flames at Potter's Bar. During the whole of this great raid the only British loss was one man killed. The defence of London had now definitely got the better of the lighter-than-air attack; after this period no German airship ever flew intentionally over the Metropolis.

Deterred by the victory of the London defences, the Germans turned their attention to the north for the final effort of 1916. They met with no better success. Of the ten ships that left Germany in the course of Nov. 27, eight came over land. One was destroyed on the coast near Hartlepool before midnight by Capt. J. V. Pyott of the R.F.C. Another raider, L21, after a remarkable journey right across England to Cheshire, was caught in the early morning, when she was leaving the coast at Yarmouth. She fell into the sea from 8,000ft. and sank at once. During 1916, 18 raids were made on England by aeroplanes and seaplanes.

The first aeroplane attack on London itself was made on Nov. 28, 1916, by a single machine; the only intimation was the fall of six small bombs between Brompton road and Victoria station.

Raids of 1917.—Before the end of 1916 it had become evident to the German command that, if effective bombing was to be kept up on targets that were worth attacking, it would be necessary to try new methods. Early in 1917, therefore, they began equipping a squadron with machines for bombing England systematically.

The first attempt came on May 25, 1917. The 3rd bombing squadron, 16 machines strong, left Belgium early in the afternoon and made the coast about 5 P M There were thick banks of cloud over Essex The task of navigating to London was found too difficult and the leader had to give up the attempt. He therefore turned south. Bombs were dropped on the Canadian camp at Shorncliffe, where there were 100 casualties. The worst effect was produced in Folkestone itself. One bomb fell in a crowded street and killed 33 people, mostly women. The second unsuccessful attempt was made on June 5; 18 machines bombed Sheerness with some effect. The guns at Sheerness succeeded in hitting one of the raiders, which fell into the river off Banton's Point.

London Seriously Damaged.—The third attempt on London was more successful. The whole of the 3rd squadron started in the morning of June 13; London was reached a little before noon. A few bombs were dropped in the East End and near the Royal Albert docks; then, at a signal from the leader, the formation loosed 72 bombs over a small area having Liverpool street station as its centre. The station itself was hit by three bombs. The casualties were severe, 104 killed and 423 injured.

The next raid on London on July 7 was also successful. Twenty-four machines started. The main body of 22 machines came to London. The city received 76 bombs, one of them starting a fire in the General Post Office; 46 persons were killed and 123 injured; 22 buildings were destroyed, and 87 seriously damaged, the total damage being estimated at over £200,000. The anti-aircraft guns produced no effect.

The failure of the defensive arrangements caused considerable agitation, and the British Government ordered a complete reorganization. The London air defences were formed as a separate command to include all the means of defence, both from the ground and in the air. Gen. E. B. Ashmore was brought from France to take charge of the new arrangements.

The new arrangements were soon tested; on Aug. 12 a party of nine gothas made the land near Harwich. After following the coast to the Blackwater, they turned inland for London. The communication system of the defence control worked well, and

AIR RAIDS 1914–1918

(1) Aeroplanes.			Casualties.								
Date.	Number.	Number of bombs.	London.				Rest of England.				
			Day.		Night.		Day.		Night.		
			Killed.	Wounded.	Killed.	Wounded.	Killed.	Wounded	Killed.	Wounded.	
1914 . .	3	4	..			.		..			
1915 . . .	4	30	.	.	..		2	6	.		
1916 . .	28	201	.	3			10	47			
1917 . .	341	2,247	202	540	76	315	184	390	150	148	
1918	59	387			163	386			1	9	Total Casualties:— Killed, 1,316. Wounded, 3,000. No. of bombs dropped, 8,776.
Total	435	2,869	202	543	239	701	196	443	151	157	
(2) Airships.											
1915 . .	42	1,526			81	224			103	223	
1916	126	3,575	.		34	110	.		258	469	
1917	30	620	.		31	49			7	23	
1918	10	186							14	58	
Total	208	5,907			146	383			382	773	
Total aeroplanes and airships	643	8,776	202	543	385	1,084	196	443	533	930	

the squadrons immediately defending London were at the required height in time to meet the enemy formation. The German commander turned his formation about before reaching the outer line of guns. A number of bombs were unloaded on Southend as the enemy made off, and 32 people were killed. An attempt on Aug. 18 was frustrated by bad weather.

An abortive attack on the midlands by eight airships on the night of Aug. 21 was followed by the last day attack on England on Aug. 22, when Capt. Kleine, commander of the 3rd squadron, started out with 13 gothas to bomb Sheerness and Dover. A number of naval machines turned the Sheerness bombers from their objective, and the German formation, harassed by the British pilots, wheeled south by Ramsgate. Here the anti-aircraft guns, working with great accuracy, shot down two of the raiders. A third was shot down off Dover

Night Attacks Begin.—The first group of night attacks came in the beginning of Sept. 1917 and one of these reached London itself. On the night of Sept. 3–4, about 10 30, hostile aeroplanes were reported near the North Foreland, and warnings were sent out by the central control a few minutes later when it was clear that they were coming up the Thames. Unfortunately there was serious telephone delay in getting the warning out at Chatham, and before cover could be taken a bomb had fallen on a drill hall in which a large number of naval ratings were asleep. No fewer than 107 were killed and 86 wounded.

Although on this night the defence was ineffective certain points gave hope for the future Three pilots went up in fast scout machines, and found that it was by no means impossible to handle them at night. The idea also was evolved of barrage fire, a curtain of bursting shell put up in the path of the raiders.

The last raid of this moon period, on Sept. 4, reached London. The barrage fire, organized since the previous night, turned back some of the pilots, but ten raiders reached the metropolitan area. Considering the magnitude of the raid, the damage caused was small, and the total casualties for the night included only 14 killed and 48 injured.

Favourable weather produced a sustained series of raids, opening on the night of Sept. 24, with an attack on London by aeroplanes, in conjunction with an airship raid on Hull and the north. Nine at least of the pilots attempted to attack London itself, but considerable improvement had by this time been effected in putting up barrage fire, which was successful in turning back all but three of the attackers. Although 27 English machines went up they failed to find any of the enemy; the gunfire brought down one of the gothas, which fell in the river near Sheerness.

The attack on the north was carried out by ten airships under Capt. Peter Strasser. Although Hull was found, the raid had very little success. On the following night, Sept. 25, ten aeroplanes attacked, and nine people were killed The attacks were continued on the 28th, when some 20 machines came over; the night was cloudy and a few only approached London; they were all kept off by the barrage fire.

The barrage was again effective on the following night, Sept. 29. Out of the 18 or 19 machines that came over only four penetrated far enough to bomb London. The Dover guns did well, bringing one of the enemy down in flames. On the next night, Sept. 30, five German pilots got over London and bombed places as far apart as Highgate, Edmonton and Woolwich; 14 people were injured and two killed. The last raid of the series, on Oct. 1, was made by about 18 machines.

During these raids a large proportion of the attackers had been turned before reaching their target, but the defences were still far from complete. The barrage fire was expensive in ammunition and there was a doubt if the supply could be kept up The defending squadrons had not reached the necessary efficiency in machines or pilots.

The "aprons," a new defence devised after the raid of Sept. 5, were only beginning to be installed. The central control as organized in Sept. 1917 could give no information to pilots when once they had been sent on their patrols, but schemes to rectify this had already been initiated

The airship raid of the night Oct. 19–20, 1917, which became known in London as the "silent raid," has points of special interest. Eleven airships met on the evening of the 19th off the Yorkshire coast for an attack on the industrial centres of the midlands. While over England, the ships flew well over 16,000ft. At this altitude the efficiency of the crews was much impaired by height sickness and the intense cold. Another and fatal condition was produced by the weather. Near the ground the air was misty and there was very little wind, but at the height of the airships a strong gale was blowing from the north, and in this the zeppelins drifted blindly south. One airship passed over London without recognizing it and dropped a few explosive bombs; one of 50kgm. fell in Piccadilly near the circus and caused some casualties.

Realizing that, on account of the ground mists, searchlights would have no chance of lighting up a high zeppelin, the defence ordered them to remain covered unless an airship could be heard. London was saved from a combined attack and the raid ended in disaster to the attackers. One airship only returned to Germany in the usual way; six got back after flying over Holland or across the Allied lines. The remaining four were destroyed during the following day on French territory.

Aeroplane raiding was resumed during the moon period at the end of October. An attempt on the 31st was carried out by 24 machines. Considering that a good many of them got over

London, the effect of the bombs was small, eight persons being killed and 21 injured.

The weather in Dec. 1917 was unfavourable and only three attempts were made on London. The defences showed steady improvement. Two gothas were brought down by anti-aircraft gunfire during a raid in the early morning of Dec. 6. On the night of the 18th one gotha was so damaged that it fell into the sea off Folkestone and was destroyed. On this night the new giant aeroplane dropped one 300kgm. bomb near Eaton square, making a large crater but doing little serious damage. The whole raid, however, cost London more than £225,000, 42 buildings being seriously damaged and nine destroyed, while there were 13 fires. On Dec. 22 the last raid of the year was frustrated by unfavourable weather; one gotha was forced by engine trouble to descend near Margate, where it was destroyed by the crew.

Raids of 1918.—In the five aeroplane raids of the first quarter of 1918 there was a tendency to replace the smaller gotha machines by the new giants. A gotha was destroyed by a defending aeroplane on Jan. 28. During this raid a bomb dropped by a giant fell on a building in Long Acre that was being used as an air-raid shelter, and 41 people were killed. Three giants attacked on Feb. 16; the only one that penetrated to London demolished a house in Chelsea hospital with a 300kgm. bomb. The raid of March 7, 1918, was remarkable as being the only occasion on which aeroplanes attacked London in the absence of any moonlight. Warrington crescent was terribly wrecked.

To turn to the airships, raiding was not resumed until the nights of March 12 and 13, 1918. Both these raids were made at an immense height, and the damage did not amount to much. Five airships of the newest and largest type attacked the midlands on the night of April 12. The end of the airship raiding came on Aug. 5–6, 1918. Five ships came up to the coast of Norfolk, no bombs were dropped on land, but L70, the latest word in airship construction, was destroyed.

In the great aeroplane raid of May 19, 1918, the Germans made their maximum effort in this form of attack; between 30 and 40 gothas of the 3rd bombing squadron took part, with at least two giant machines. Thirteen of the raiders managed to get over London. The casualties included 34 killed and 98 injured and £130,000 worth of damage was done in the London area alone. But the defence had by now made very real progress. The Germans lost seven machines, three shot down in air combat, three destroyed by gunfire, and one from engine failure. This success of the defence was final, and the London area was saved from further bombing.

In addition to casualties (1,413 killed, 3,407 injured) and damage, the German raids on England produced actual results by no means negligible. A night raid stopped munition work over a large area. In order to establish a defence, men and material were kept back from France. Two hundred aeroplanes of the best performance and 200 highly trained pilots were available about London at a time when they would have been of the utmost value on the western front.

European Air Raids.—Apart from raids that formed part of the ordinary operations on the various battle fronts, there were raids on towns of France, Germany and elsewhere, similar in intention to those on Great Britain. On Sept. 27, 1914, the first bombs were dropped on Paris by a German aeroplane. On March 18, 1915, bombs were dropped on Calais, killing 7 French refugees and injuring twelve. On Sept. 22, 1915, French aeroplanes dropped bombs on Stuttgart as a reprisal for the bombardment of open towns by the Germans. In December there were air raids on Calais, and Salonika was bombed by the Germans.

In 1916, on Jan. 29, a zeppelin flew over Paris, dropping bombs which killed and wounded over 50 persons. In Feb. and March 1917 the Germans raided Salonika, and in April 1917 a large squadron of British and French aeroplanes bombarded Freiburg as a reprisal for attacks on British hospital ships. During the autumn of 1917 the British and French repeatedly carried out raids on the towns of western Germany, and in particular on Saarbrücken and Kaiserslautern. On Dec. 24, 1917, a British squadron dropped a ton of bombs on Mannheim-on-the-Rhine.

Early in 1918 the British and French flying corps carried out raids against the towns of western Germany. One of the most successful of these was on Jan. 14 by the British upon Karlsruhe, when the main railway station was heavily bombarded and many buildings set on fire. On March 11, 1918, hostile aeroplanes raided Paris. On March 29, 1918 (Good Friday), a shell from "Big Bertha" hit the church of St. Gervais, killing and injuring many of the worshippers. In May of the same year British airmen dropped 33 bombs on Cologne in daylight and also bombed the port of Durazzo in Albania and sank an Austrian torpedo boat. On July 19, 1918, British seaplanes bombed the Zeppelin sheds at Tondern (Schleswig) and did much damage. (E. B. A.)

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AIR ROUTES. A route between any two air ports which offers the best navigational conditions does not always follow a straight line, since it is sometimes necessary to deviate in order to avoid mountainous country or unfavourable weather conditions. In long distance flying, prevailing winds have an important influence in the choice of route, especially for airships. It is well-known that the early sailing ships plying between Spain and America made use of the prevailing trade winds by going out on a southerly course and by taking a more northerly course on the return journey. So when the route to Canada is flown, probably the most advantageous outward course will be via the Azores, while the return journey—during the summer months at least—will be in a direct line to London, as in this higher latitude the wind drift is in an easterly direction.

An aeroplane route organization consists of (i.) terminal aerodromes equipped with accommodation for the aircraft and operational organization, (ii.) intermediary aerodromes at intervals depending on the nature of the route, and (iii.) the necessary meteorological and wireless services and lighting equipment.

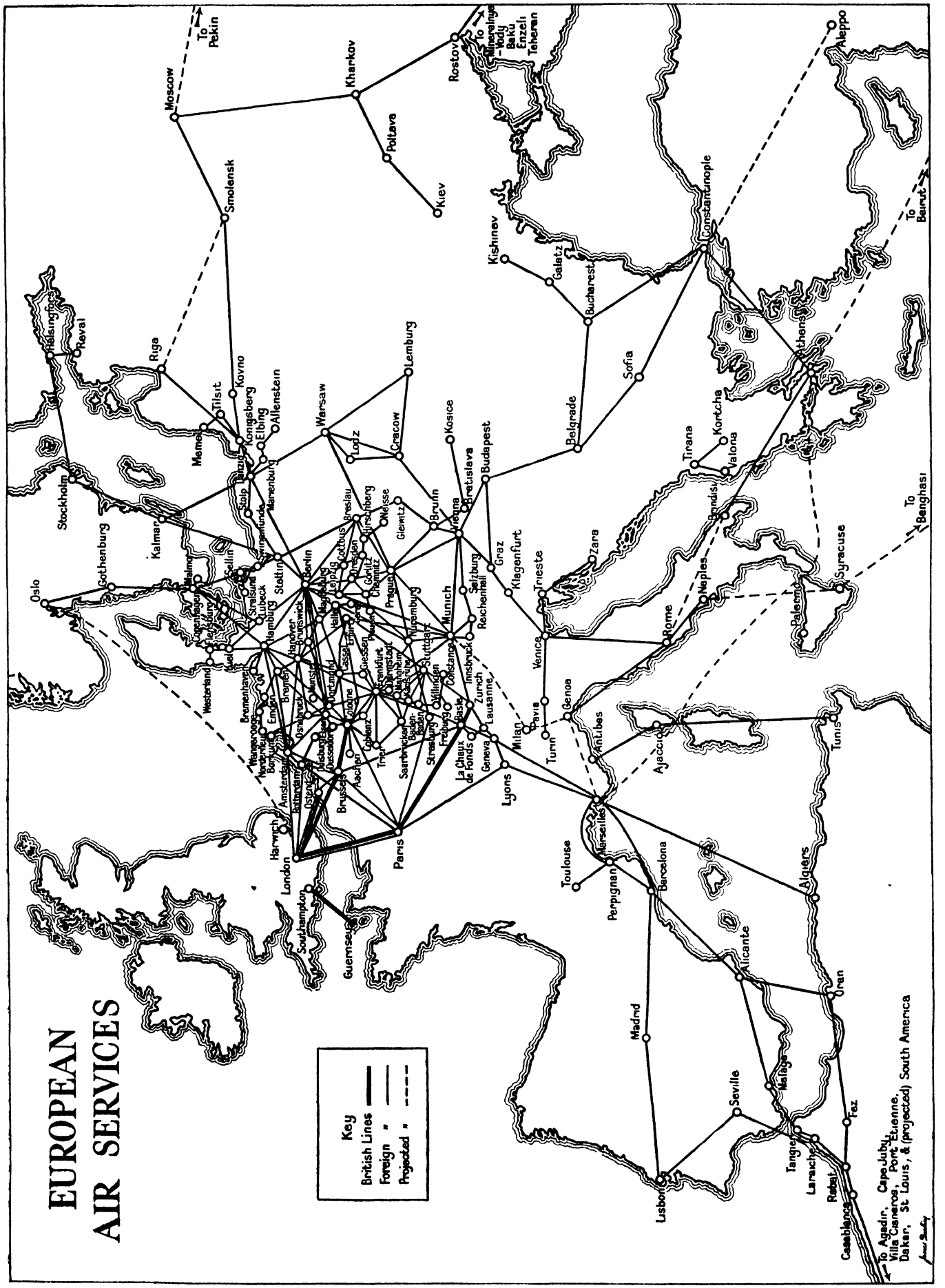
Flight Over an Air Route.—In flight over an organized air route certain simple rules must be observed. The most frequently flown route in the world is that across the Channel from England to the Continent. Brief details of the organization of this route are here given.

Before leaving Croydon the pilot acquaints himself with the weather reports which are exchanged between the principal aerodromes every hour. Permission to take off is signalled to the pilot and when his machine is clear of the aerodrome he is required to report by wireless the passing of certain fixed points on the route. If he decided to fly along a route that has been officially "recognized," he must keep well to the right of the line in order to avoid collision, and if he decides to cross such a line he must fly at right angles to it and as high as is practicable.

On passing over Lympne, Ostend or Flushing the pilot sees signals which indicate the meteorological conditions ahead. Machines which are equipped with wireless can be warned of bad weather or the proximity of other machines. The wireless stations are provided with direction finders (*q.v.*). If a pilot is uncertain of his whereabouts, he can be informed accurately of his position within two minutes. A continuous watch on the safety of the route is kept by a control officer at Croydon, who charts the progress of each machine.

Great Britain.—British air routes to the nearer European capitals have been operated since 1919. A policy for the creation of British imperial air routes is in preparation. Shipping has apparently reached the economic limit of speed, and aircraft alone can supply the more rapid travel facilities that are demanded. It is recognized that commercial development and political unity within the empire are both dependent upon more rapid facilities for personal travel. Aircraft are also well suited to the work of opening up territory before the construction of a railway, and a number of air routes of this kind are already working or being developed, particularly in Australia.

France.—In 1927 French air routes covered 8,304m. and gave rapid communication on the one hand with Prague, Vienna, Belgrade, Bucharest and Constantinople, and, on the other, with Casablanca (Morocco) and Dakar (Senegal). Shorter lines run


EUROPEAN
AIR SERVICES
Key
British Lines
Foreign "
Projected "
To Pekin
To Mineralnye Vody Baku Enzeli Teheran
To Beirut
To Benghasi
To Agadir, Cape Juby, Villa Cisneros, Port Etienne, Dakar, St Louis, & (projected) South America
Moscow
Kharkov
Rostov
Poltava
Kiev
Smolensk
Kishinev
Galatz
Bucharest
Constantinople
Aleppo
Athens
Riga
Kovno
Tilsit
Memel
Konigsberg
Elbing
Allenstein
Warsaw
Lemburg
Lodz
Cracow
Kosice
Budapest
Bratislava
Belgrade
Sofia
Kortcha
Tirana
Valona
Brindisi
Syracuse
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Emden
Osnabruck
Amsterdam
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Ostend
Harwich
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Kalmar
Malmo
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Stettin
Berlin
Stolp
Marienburg
Danzig
Stralsund
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Copenhagen
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Westerland
Bremenhaven
Wangeroog
Norderney
Borkum
Helsingfors
Reval
Riga
Tilsit
Kovno
Memel
Kalmar
Stockholm
Gothenburg
Malmo
Sellin
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Kiel
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Hanover
Brunswick
Magdeburg
Leipzig
Cottbus
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Breslau
Hirschberg
Gleiwitz
Neisse
Cracow
Lemburg
Warsaw
Lodz
Kosice
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Bratislava
Vienna
Brunn
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Klagenfurt
Trieste
Zara
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Rome
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Syracuse
Brindisi
Tunis
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Marseilles
Toulouse
Perpignan
Barcelona
Algiers
Oran
Alicante
Madrid
Seville
Malaga
Tangier
Larache
Fez
Rabat
Casablanca
Lisbon
Harwich
London
Southampton
Guernsey
Brussels
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Trier
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Freiburg
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Cologne
Dortmund
Hamburg
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Strasburg
La Chaux de Fonds
Geneva
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Basle
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Reichenhall
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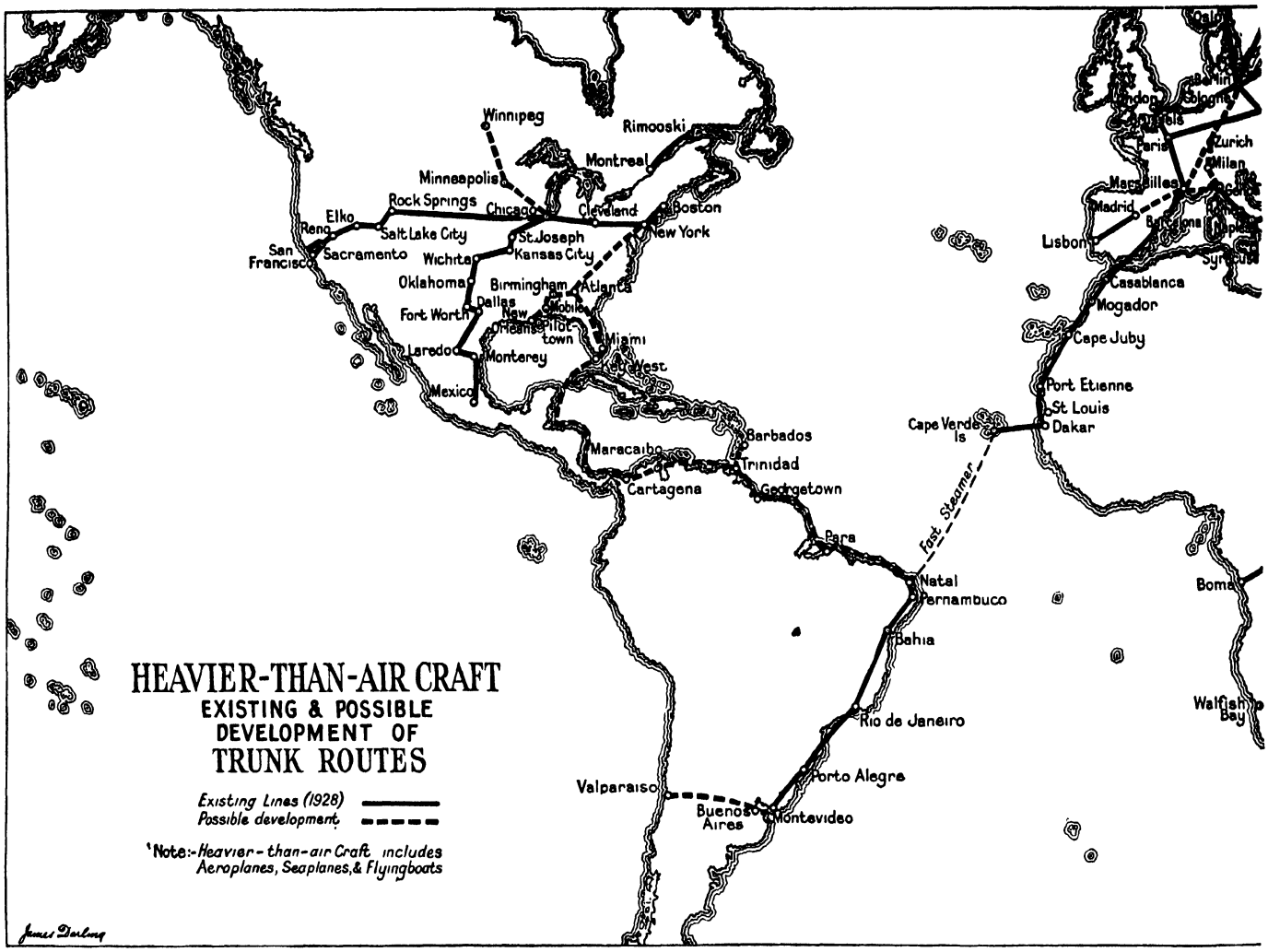


also to London, Brussels, Amsterdam and Berlin. The line to North Africa is to be extended to South America via the Cape Verde islands and Fernando-Noronha. At the commencement fast steamers will be employed on the Transatlantic stage, but these will be replaced by large seaplanes. The distance to Buenos Aires is approximately 8,000m., and it will be covered in the early stages in eight days as against three weeks by ship Eventually the time will be reduced to four to five days. A seaplane line to Syria across the Mediterranean is also in course of organization.

Germany.—The German air system consists of trunk routes and a network of internal lines, about 14,000 route miles in all. Among the most important routes are: (1) Berlin–London; (2) Berlin–Moscow; (3) Berlin–Barcelona (extension to Seville by a Spanish company); (4) Berlin–Stockholm (and Copenhagen–Oslo); (5) Copenhagen–Berlin–Prague–Vienna.

Night flying via Berlin has brought London within 34 hrs. of Moscow, a saving of 38 hours. Eventually this route will extend from London across Europe and Asiatic Russia to China. The route from Berlin to Seville will feed a proposed Spain–South American airship service. The possibility is being considered of running a seaplane service down the west coast of Africa to the Cape.

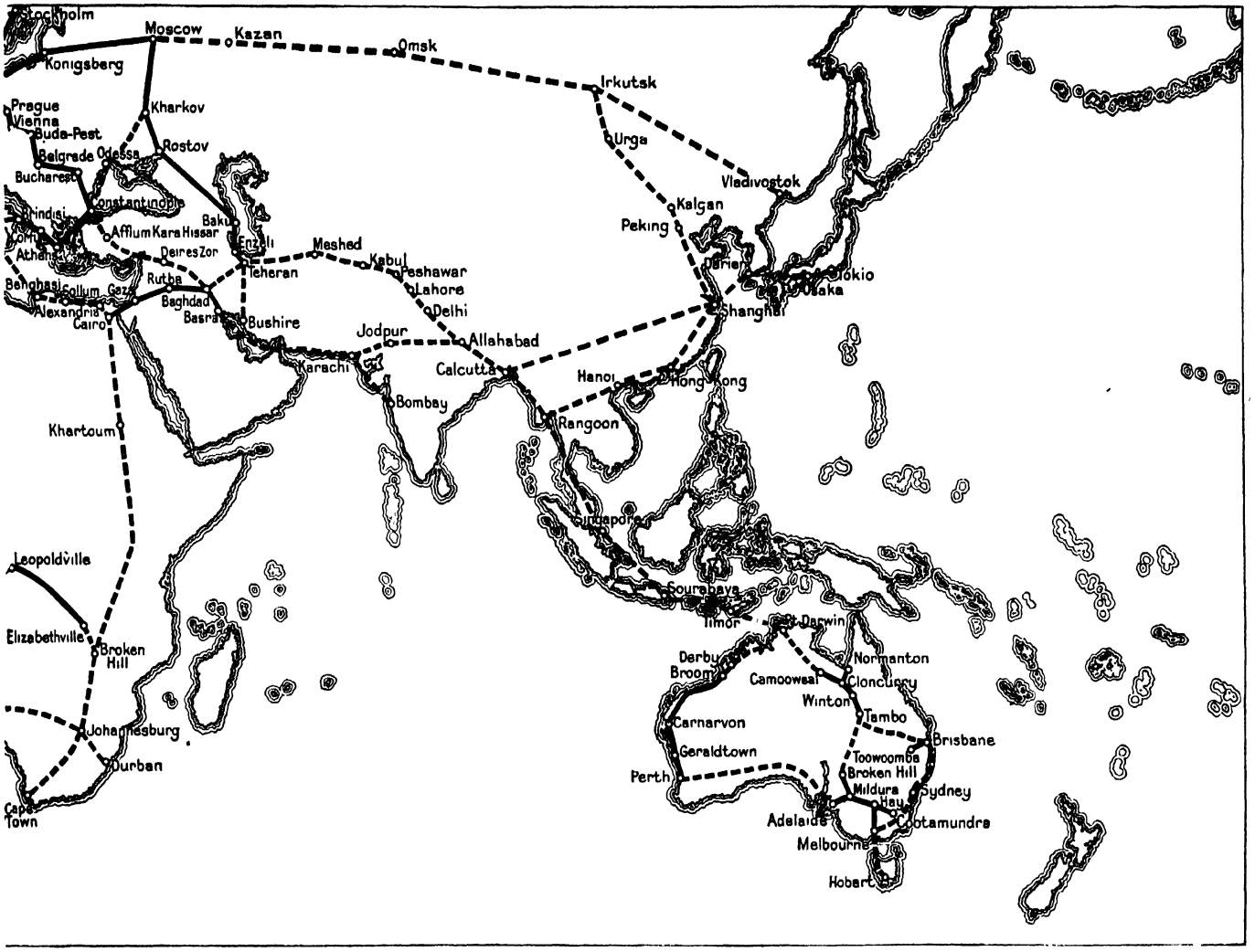
Belgium.—The Belgian Government has devoted most of its effort to the Belgian Congo. An air line connects Boma on the coast with Elisabethville in the Katanga, a distance of 1,400 miles. A further 1,600m. of air routes are being organized.

Holland.—Holland operates 1,330m. of air routes in Europe and is now effecting communication with her colonies. In 1927 a flight was made from Amsterdam to Batavia and back in 25 days actual flying time The regular mail steamer takes 33 days on the outward journey alone. A plan is now being prepared that contemplates linking up Batavia with Singapore and Australia.

The United States.—The United States has been chiefly concerned with improving her internal communications An air mail service from New York to San Francisco (2,660m) was inaugurated in 1920 by the Post Office. By the introduction of night flying in 1924, letters were carried from coast to coast in 32 hours as against three days by the fastest train By Jan. 1, 1928, 26 contracts had been placed with private contractors, 18 lines were in operation, and the total route mileage flown regularly was 8,441, of which 5,500 had been illuminated for night flying. The total air mail mileage on March 1, 1928, was 11,712 The total distance flown on air mail routes alone in the first six months of 1927 was 2,642,364 miles. The New York–San Francisco route has been entirely transferred to contractors, and the Post Office operating organization has been dispersed. A map of the air routes of the United States appears in AVIATION, CIVIL.

British Empire Routes.—The first empire aeroplane route is that from Cairo to Basra, 1,135m, which is flown weekly and carries a large portion of the mails to and from Iraq. An extension of this line to Karachi, India, has been provided for, and extensions to Bombay and Calcutta are being considered. Later, the route will extend beyond Calcutta to Rangoon, Singapore, the Netherlands East Indies and Australia. In Australia three routes have been established, one from Perth to Derby (1,467m); a second connecting Charleville, Cloncurry and Camooweal in Queensland, with a branch to Normanton on the Gulf of Carpentaria (1,045m.); and a third from Adelaide to Cootamundra, with branches to Broken Hill and Melbourne (1,000m.). The Australian Government has decided upon a mail service flying by day and night from Perth to Adelaide.

Various flights from Cairo to the Cape have been successfully



made and in the East African colonies an experimental air line from Khartum to Kisumu (1,400m) exists Another centre of activity for aircraft is in the West Indies; and in British Guiana, a journey to the mines that takes nearly three weeks via the Mazaruni river is flown in 2½ hours.

Airship Routes.—At the Imperial Conference in the autumn of 1926, it was made clear that, before airships could operate over any route, meteorological investigations must be carried out and bases provided. Canada decided to construct a base at Montreal; South Africa to provide one at Durban; and Australia one at Melbourne or Perth, or at both places, as soon as the first experimental flights have been successfully made. Prior to 1927, the British Government had decided to erect bases suitable for a series of experimental flights to India. Karachi was selected as the Indian base and has been equipped with a shed and mooring mast, whilst an intermediary landing place was established at Ismailia, Egypt, where a mooring mast has been constructed.

Six airship routes have been selected, including the one to India. These are as follow.—

Route	*Bases*
(a) England-Egypt-India.	Ismailia (Egypt), Karachi.
(b) England-Egypt-South Africa.	Ismailia, Mombasa, Durban.
(c) England-South Africa, via West Africa.	Bathurst, Cape Town.
(d) England-Australia, via India.	As in (a), together with Colombo, Perth, Melbourne.
(e) England-Australia, via South Africa.	As in (b) or (c), together with Perth, Melbourne.
(f) England-Canada.	Montreal.

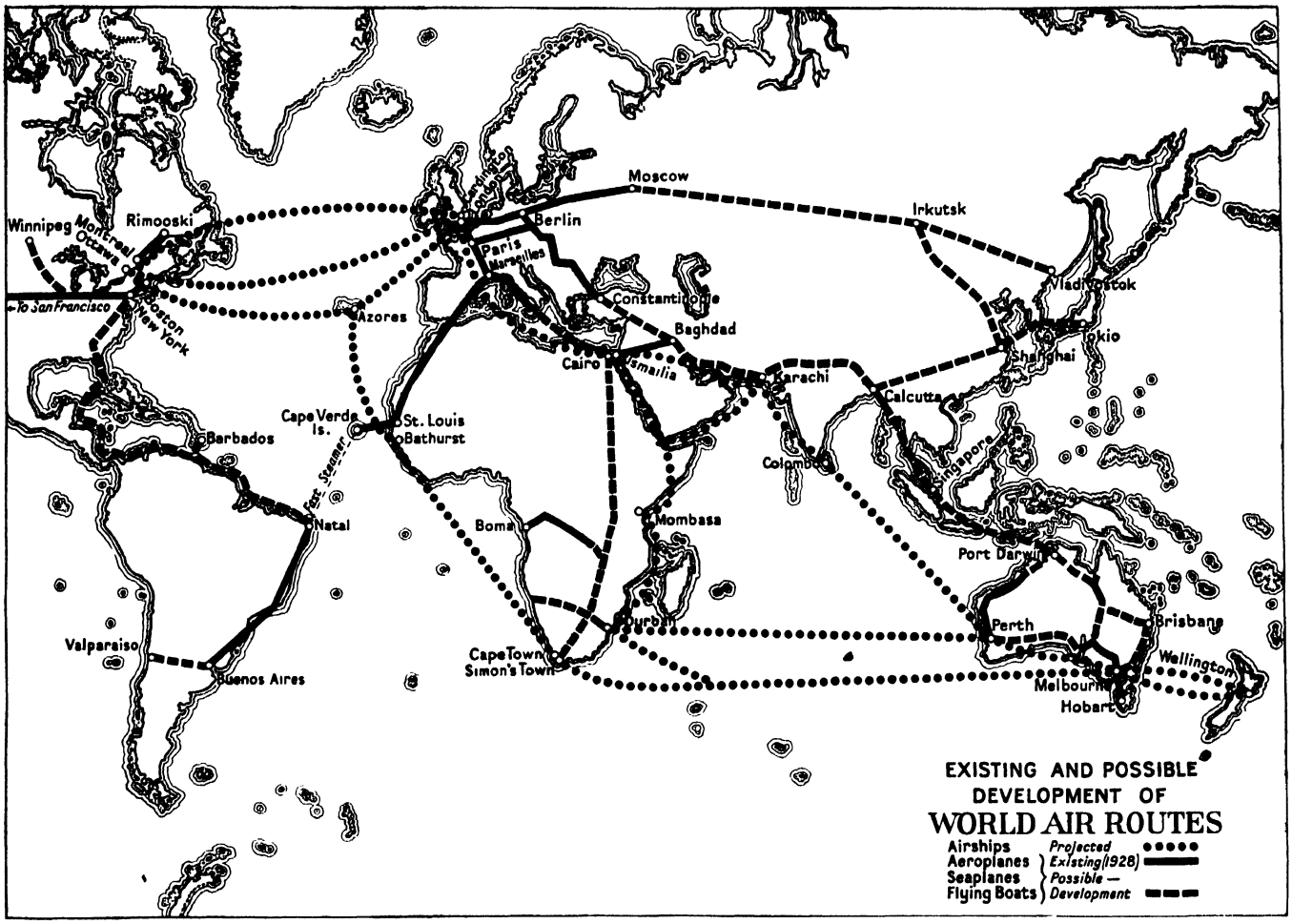
An estimate (in accompanying table) has been made of the saving of time based on a speed over the ground of 50m. an hour.

Route.	Steamship times.	Airship times.	Saving.
	Days.	Days.	Days.
England-Egypt	6	2½	3½
On to Bombay	15	5	10
On to Perth	28	11	17
England-South Africa			
Via W. A.	20	6½	13½
Via E. A.		6	
On to Australia		10½	
Australia-New Zealand	6	1½	4½
England-Canada	6	2½	3½
India-Australia.	22	6½	15½
India-Canada			
Via England	24	9	15
Australia-Canada			
Via South Africa and England	48	15¾	32¼

The air routes of the world covered in 1928 a distance of about 55,000 m. In Europe the network totalled 36,000m in 1927. The control of air routes in the future will be as important as is the control of shipping lines to-day. (*See* also AVIATION, CIVIL; AERODROMES.) (I. A. E. E.)

AIRSCREW, the designation of all those devices which, when rotated, tend to screw their way forward, sucking the air from in front and throwing it away behind, or which, when placed in a moving stream of air, are themselves rotated. The term covers (1) fans of a certain type, (2) screw propellers working in air, (3) helicopters, (4) windmills, (5) gyroplanes.

(1) If the airscrew is rotated but restrained from forward movement, air is drawn in from the front and thrown back behind, and the airscrew acts purely as a fan.



(2) If the airscrew is not so restrained, the thrust caused by moving the air backwards drives forward the airscrew and the aircraft, or body, to which it is attached. The airscrew is then acting as a propeller. The thrust exerted, and the volume of air moved, have their maximum value when the airscrew is acting purely as a fan. As the airscrew moves forward, the volume of air delivered and the thrust exerted decrease, and at a certain speed become nothing. At this forward speed the distance moved in one complete revolution is known as the "experimental pitch" of the airscrew. The thrust acts approximately in a horizontal direction.

(3) If, however, the airscrew is placed so that it exerts its thrust upwards in an approximately vertical direction, it is then acting as a helicopter.

(4) In the above conditions the airscrew is driven by some engine or motor, but if it is placed freely on a shaft in a wind, or if it is moved forward through the air, it will rotate and some of the energy in the moving air will be transformed into useful work, and transmitted to whatever mechanism is attached to the airscrew. The airscrew is then acting as a windmill. The wind blows approximately in the direction of the airscrew shaft; *i.e.*, at right angles to the plane of rotation.

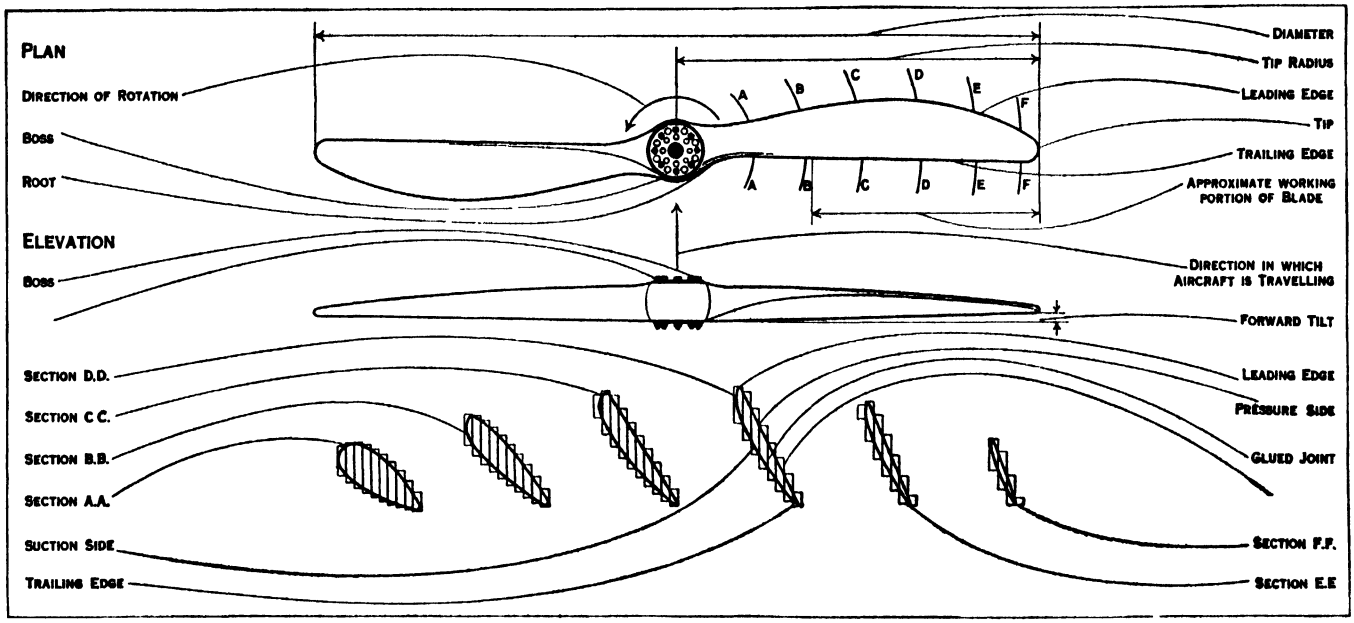
(5) If the wind blows at a small angle to the plane of rotation, the airscrew will not only be caused to rotate, but in doing so will exert a thrust. It is then acting as a gyroplane. The best known example of this use of the airscrew is the autogiro, invented in Spain by Señor Don Juan de la Cierva. In this case the plane of rotation is approximately horizontal and the thrust approximately vertical.

General Description.—An airscrew consists of a boss or hub with spokes radiating therefrom—like a wheel without a rim. The number of spokes or blades, as they are technically termed, is usually two, though more are used in special circumstances.

In fig. 1 is shown the plan and elevation of a two-bladed airscrew intended for use as an aircraft propeller. Below them are shown the sections which would appear if the blade were cut through at points A, B, C, etc. The terms used in connection with airscrews are also shown. Note the term "diameter," the distance from the tip of one to the tip of the opposite blade. For aircraft propellers the diameter varies from as little as four to as much as 20 feet. Note also the characteristic shape of the cross sections of the blade. Sections of this shape are called aerofoil sections; their properties will be found described in any standard work on aero-dynamics. The shape of these cross sections has an important influence on the efficiency of the airscrew. It will be noticed that the blades are twisted; the angle is greater at the root than at the tip. This twist is necessitated by the fact that in order to work most efficiently, an aerofoil section must move at a small angle to the relative air flow.

Now any point in the blade has two simple motions: (1) In the direction of rotation, (2) The forward motion at right angles to (1). In fig. 2 these two simple motions are illustrated to scale as AB and AC for a point near the tip of the blade, and in fig. 3 for a point near the root of the blade; AD is the resultant direction and speed of movement. The speed AC of the forward movement is the same for both points, but the speed AB in the direction of rotation is proportional to the distance of the point from the centre. Its value is zero at the centre and a maximum at the tip.

Thus as will be seen from figs. 2 and 3, the resultant direction of movement of the point near the tip is at a smaller angle to the plane of rotation than that of the point near the centre. Since the aerofoil section must be placed at a small angle to its direction of movement, the blade has a smaller angle at the tip than near the centre. The distance travelled in one complete revolution, when the direction of the resultant motion is along the line joining the leading and trailing edge of the section (*see* fig. 1, section DD), is the geometrical pitch. It has approximately the same value for all parts of the blade, and is usually referred to by the word "pitch."



FROM WATTS, "SCREW PROPELLERS FOR AIRCRAFT"

FIG 1—PLAN, ELEVATION AND CROSS-SECTIONS OF A TWO-BLADED PROPELLER. THE CROSS-SECTIONS IN LOWER HALF OF ILLUSTRATION WERE MADE AT THE POINTS A, B, C, D, E, F, ON THE TOP FIGURE. THEY SHOW THE TWISTED SHAPE OF THE AIRSCREW BLADE

Problems of Design.—The main difference between various airscrews is in the diameter and pitch, and it is the designer's object to choose these for the attainment of certain specified results. He has three aims. (1) To ensure that the airscrew runs at a certain rate of rotation when driven by a certain power, when the aircraft to which it is attached is travelling at a certain speed at a certain height above sea level. (2) To ensure that under these conditions the airscrew will give its maximum efficiency. The efficiency is the ratio of the useful work done by the airscrew to the work done by the engine in turning it Efficiencies of from 70 to 85% are commonly attained. (3) To ensure that the airscrew is reliable and safe. Airscrews rotate at a high speed Their tips travel at speeds varying from 700 to as much as 1,200ft. per second—a velocity exceeding that of sound This sets up a centrifugal pull in the blade of as much as from 10 to 20 tons, in addition to which the blade must withstand the bending caused by its own thrust.

To satisfy these various requirements, the designer will specify an airscrew of a certain diameter and pitch, with blades of a certain width and thickness. If any one of these conditions alters—the rate of rotation, the power or the aircraft speed—a different airscrew will be required. Hence the infinite number of designs involved.

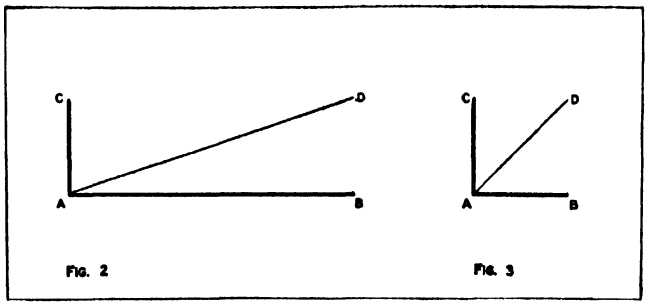


FIG. 2 FIG. 3

FIGS 2 AND 3—DIAGRAM SHOWING THE MOVEMENT OF A POINT NEAR THE TIP OF THE BLADE AND NEAR THE BOSS OF THE AIRSCREW
AB=Velocity of rotation. AC=Velocity of forward motion. AD=Resultant velocity

Variable Pitch Airscrews.—It will be correctly deduced that since an aircraft can travel at any speed between its lowest and highest speed, and at different heights, it needs for maximum efficiency a different airscrew for each different combination of height and speed. Alternatively it requires an airscrew capable of being varied in pitch and diameter to suit the speed, and the height The design of such an airscrew presents almost insurmountable difficulties, and has not been seriously considered. Although it does not give the greatest efficiency for all conditions, an airscrew of which the pitch only can be varied is a practical compromise Even this presents difficulties, but experiments are proceeding in most countries, and the problem may be said to be well on the way to solution.

For the ordinary engine the variation of pitch is only required to suit the varying speed of the aircraft It is true that the power required to drive an airscrew at a certain rate of rotation at a certain aircraft speed varies with the density of the air, which diminishes with the altitude. But the power of the engine also falls off in much the same ratio, hence no great change in pitch or diameter is required for changes in altitude, and the advantage of variable pitch for speed variation alone is extremely limited. But for supercharged engines, which are designed to maintain a constant power at all altitudes, a variable pitch airscrew is desirable.

Materials of Construction.—At first airscrews were invariably constructed of hardwoods, such as walnut or mahogany. The airscrew is built up of a number of superimposed planks or laminae about one inch thick, suitably cut to shape. In the plate the cut planks for a four-bladed airscrew are illustrated. The planks are glued together to form the rough block from which the airscrew is shaped This and the finished airscrew are also shown.

Wooden airscrews are affected by the humidity and temperature of the atmosphere, and have been found unsuitable for tropical climates. Hence there has arisen a need for metal airscrews. Of such there are two distinct types: airscrews with hollow blades, and those with solid blades The former are constructed of steel and the latter of a light metal, usually an aluminium or magnesium alloy. Both types have met with a considerable degree of success, but both are heavier and more costly than the wooden airscrew. In large sizes the weight of the solid type appears likely to be excessive, while that of the hollow steel type approaches very closely to that of a wooden airscrew

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AIRSHIP, a power-driven aircraft which is sustained in the air through the agency of the lift of a buoyant gas contained in an outer envelope.

To understand the modern airship as it is to-day and to visualize the problems and possibilities of the future one must have some knowledge of the various stages of development from its precursor, the spherical free balloon. The history of this development with all the struggles, the failures and the successes of the pioneers is not only an interesting but also a very human record.

The first known flight made by a lighter-than-air balloon was with one filled, not with gas, but with heated air.

Two French brothers, J. M. and J. E. Montgolfier, were the inventors of this embryo airship. Their family owned a paper mill at Annonay where they experimented with large paper envelopes open at the bottom; under the aperture they burnt more paper; the air inside becoming hotter than the air outside, the envelope rose. Their success so pleased the brothers that they repeated their experiments throughout 1783, each time on a larger scale, until in April they built a balloon with a capacity of 23,000 cu ft. In June this balloon made a public ascent from Annonay before astounded onlookers, and, indeed, to the intense wonderment of the civilized world.

The Montgolfiers built more balloons, one lifting a load of some 400–500 lb. whilst a third made an ascent at Versailles in the presence of Louis XVI. and Marie Antoinette. It landed its passengers, consisting of a cock, a duck and a sheep, safely two miles away.

The first human ascent was made by J. F. P. de Rozier on Oct 15, 1783, in a captive balloon; *i.e.*, one attached by a rope to the ground. The King, who, like everyone in Paris, was taking an interest in balloons, would not allow his subjects to risk their lives by rising in a free balloon. He conceded that two convicts should be the first aeronauts, and be pardoned if they came down alive. However, this honour was snatched from them by the enthusiastic young Frenchman, de Rozier, who obtained Louis' permission to make an ascent, taking with him as companion his friend the marquis d'Arlandes.

The Montgolfier balloon for this flight was 74ft. high by 48ft. diameter, having a large opening underneath, below which was slung, by iron chains, a brazier.

On Nov. 21, 1783, at 1.54 P.M., after one false start this historic flight started before a vast crowd in the Bois de Boulogne. The balloon rose to 3,000ft. and remained visible to all Paris for some 20 minutes, landing 1¼m. from the point of departure. The fuel used was straw put into the brazier and stirred by the marquis d'Arlandes, who is referred to in contemporary accounts as the "chauffeur." This was literally an epoch-making flight—a flight which opened men's eyes to the fact that there actually existed a new mode of transport.

Invention of J. A. C. Charles.—As with other inventions and discoveries, once the note was struck, progress was very rapid. Only 10 days after the first flight ever recorded, a second one was made by a balloon of a somewhat different type. Professor J A. C. Charles, a physicist of Paris, realized that the *Montgolfières* rose because hot air was light. He was familiar with hydrogen, which Cavendish had discovered in 1776, and was aware that it was yet lighter. Experiments taught him how easily it would escape through the pores of paper or linen. Fortunately, the brothers Robert had recently discovered that rubber was soluble, and with a solution of rubber he covered his fabric. Then with hydrogen, laboriously prepared from iron filings and sulphuric acid, he filled his balloon. On Aug. 29, 1783, he released it in drenching rain before an enthusiastic crowd, estimated at 300,000, on the Champs de Mars. It disappeared from sight and eventually came to earth in the country.

All the features of a modern balloon as now used are more or less due to Charles, who invented the valve at the top and suspended the car from a hoop, which was in turn attached to the balloon by netting.

Free ballooning having started with a dash remained for a century not much more than a desultory sport. Few could afford it as a pastime even after the introduction of coal gas by the English balloonist, Green, in 1821. It, therefore, except in time of war, fell into the hands of professional balloonists who gave exhibitions at fairs and entertainments. From time to time attempts were made to organize an industry, but without success. The utter helplessness of the pilot to control its direction prevented the balloon from ever becoming a practical means of transport, and since the place of descent might be the sea, as a speculative amusement it had more than a fair share of danger.

The Modern Airship.—The first steps in the transition to the dirigible balloon were due to Guyot, who, in 1784, proposed to build a balloon with the envelope egg-shaped, the length being greater than the height, and to General Meusnier, who was the first to introduce air bags or ballonets in the outer envelope to preserve the shape as the buoyant gas was lost It was proposed that these vessels should be propelled by aerial oars worked by hand

It was not until 60 or 70 years later, in 1851, that the next step was accomplished, when an engineer named Henri Giffard, well known as the inventor of the steam injector, constructed a 5 h p. steam engine weighing 100 lb., or 20 lb per h p., which he used as the motive power for an elongated balloon. Giffard calculated that this engine would give a speed of about 4–5 m p.h. and such was approximately the result obtained. He constructed several other airships with a certain measure of success, and it is interesting to note that he planned one of 1,970ft. long by 98ft. diameter, with a capacity of 7,800,000 cu.ft. He estimated that the engine would weigh 30 tons and give a speed of 45 m p.h. The cost was far too great to permit him to carry out this plan.

Among other experimentalists of the second half of the 19th century may be mentioned Charles Renard and Kreb, who created a sensation in 1885 by forming a figure of eight in the air. They drove their airship by means of an electric motor at a speed of about 14 m p.h. Experiments were also carried out in Germany and Austria.

The year 1898 may be considered the birth year of the modern airship, which the advent of the internal combustion engine, with its more reasonable proportion of weight to horse power, made a practical proposition. A steam engine with its necessary adjuncts of boiler and boiler water was always too heavy, besides which the boiler itself throwing out smouldering sparks was not the best possible companion to an inflammable gas.

This year saw two men of widely different character, with different ends in view, commence a series of interesting trials with airships, one Alberto Santos Dumont, a young Brazilian, in France, the other, in Germany, an elderly German, Count Ferdinand von Zeppelin.

A. Santos Dumont.—Santos Dumont built in all some 14 small airships, and had every sort of accident and adventure. They came down into fields, trees and the sea. He nearly collided with the Eiffel Tower and on one occasion the Paris firemen rescued him from the side of a building. Another time he was making an involuntary descent when he was saved by shouting to some boys to run against the wind with his guide rope. His airships were none of them rigid, and cannot have been very comfortable; for example in "No. 4" he rode on a bicycle saddle. It was with "No. 6" in 1901 that he had his great triumph of winning the Deutsch Prize of 100,000fr. for flying round the

Eiffel Tower and back, a distance of about 7m., in under half an hour. The speed was not high, but it must be remembered they were still early days for motoring. "No. 6" eventually came down into the sea near Monte Carlo.

Count F. von Zeppelin.—Count von Zeppelin, a retired German Army officer, started work in 1898 on the construction of a dirigible which was not only the largest balloon yet built but differed from all previous ships in that it possessed a rigid framework. It was 420ft. long, 38ft. in diameter and had a capacity of 400,000 cu.ft. The framework was of aluminium, which was covered with specially treated linen and silk. The hydrogen was contained in special compartments or gasbags inside. The engines were two 16 h p. motors, each on a separate car. He also adopted the same idea as Santos Dumont of having a sliding weight with which to raise or lower the nose. On the first trial this caused trouble; the winch working it broke and the framework or hull was deformed. However, the descent was made with fair success except that the airship was damaged by a pile This was in July 1900. It was repaired, and a second trial flight was made on Oct. 21, 1900, when a speed of nearly 20 m p h. was attained.

Zeppelin at first found considerable difficulty in raising funds However, by 1905, he had collected enough to build an improved model very slightly smaller than "No. 1" but with two 85h p motors which were actually lighter than the 16h p. of the former —the whole airship weighing 9 tons or a ton less than its predecessor. The first trial of this ship was unfortunate, the tow rope fouling a propeller. On landing the airship did damage to itself, which took six weeks to repair, at the end of which time a second trial was commenced. This was not too successful and the airship anchored for the night, when a strong wind so damaged it that Zeppelin had it destroyed. He then started work on "No 3," an airship which in 1906 justified his faith German patriotism and enthusiasm were now roused; subscriptions were started and a quarter of a million pounds quickly raised. The Kaiser decorated Count Zeppelin with the Order of the Black Eagle, and shortly afterwards issued orders that "No. 3" should be known as "S.M S. Zeppelin No 1."

The LZ 127, named the "Graf Zeppelin" in memory of Count Zeppelin, was constructed at Friedrichshafen, Germany, and made a voyage to the United States in Oct. 1928, covering nearly 6,300m., remaining aloft 112 hours. It was able to navigate around many storm areas but suffered a badly damaged stabilizing fin when over the mid-Atlantic. This ship carried 20 passengers, freight, mail and a crew of 40. The return flight was made over a direct north-Atlantic course in 69 hours.

THE DEVELOPMENT OF AIRSHIPS IN THE 20TH CENTURY

Great Britain cannot be said to have contributed in any degree to the development of airships prior to the World War and the whole history of British airship activity has been one of private individuals urging the Government to stimulate and encourage their development. As a result of persistent advocacy by Mr. Coswell the British War Office was induced to form a balloon department under Captain Templar in 1879. This corps served in Suakin in 1885 and in the Boer War, but it was not until after private individuals, such as Dr. Barton in 1900 and Mr. Willows in 1904, had constructed and demonstrated small non-rigid airships that the War Office were prevailed upon to start work upon a few small airships at the Government balloon factory in 1907. Although, as it will be remembered, Zeppelin had achieved a decided success with his airship "No. 4" by this date, the British Government factory proceeded to construct a succession of small non-rigid vessels of from 21,000 to 77,500ft.—the "Nulli Secundus," "Nulli Secundus No. 2," "Army Airship No. 2," the "Beta" (1910) and the "Gamma" (1912). No novel feature was introduced and the vessels, because of their small size, compared unfavourably with contemporary foreign vessels. In 1910 a French "Lebaudy" and a "Clément Bayard" were added to the Army fleet but neither made a successful flight after delivery.

In the meantime in Germany Count Zeppelin had formed a commercial company, and between 1910 and 1914 this German Zeppelin company built a succession of rigid airships, which, utilized as commercial vessels, carried, during these years, over 17,000 passengers and flew 100,000 miles without one fatality.

In 1909, British public opinion becoming alarmed at the disparity of achievement between Germany and England induced the Government to take action and the British Admiralty undertook the production of a rigid airship, and a contract was placed with Messrs. Vickers, Ltd. to build "Naval Airship No 1," subsequently called the "Mayfly."

"The Mayfly."—The design was prepared by Messrs. Vickers, Ltd. in conjunction with Admiral Bacon and other officers.

The following were the principal objects aimed at:—(*a*) The airship was to fulfil the duties of an aerial scout. (*b*) She was to be capable of maintaining a speed of 40 knots for, if possible, 24 hours (*c*) She was to moor by the nose to a post on the water (or possibly on land also). Floating on the water, she would then swing round always head to wind and be capable, it was hoped, of remaining out in all weathers, and be independent of her shed, except for docking, as in the case of ordinary vessels. (*d*) She was to carry wireless telegraphy. (*e*) Sufficient arrangements were to be made for the comfort of her crew to allow of them living in the airship itself without suffering hardship (*f*) She should ascend to a height of 1,500ft or more. (*g*) The first ship to be purely experimental and as cheap as possible.

These conditions necessitated the ship being of larger size than any hitherto built.

This was the first attempt at the construction of a rigid airship in England, and ended in disaster, happily without loss of life, the ship being destroyed in September 1911 upon emergence from the shed, and before she ever took the air After this setback airship development was suspended in England until the end of 1913, when an airship section of the Royal Naval Air Service was set up by the Admiralty This new department placed an order with Messrs. Vickers, Ltd for a rigid airship of approximately 800,000 cu ft., the control of the general design being undertaken by the Admiralty and the preparation of the actual drawings and details by the contractors. Construction was commenced in the early part of 1914. After the outbreak of the World War the Admiralty countermanded the order and all work was suspended in March 1915, it being thought that the vessel would not be completed before the war ended. A few months later, the "Zeppelin" bombing attacks induced a further change of policy and not only was the ship proceeded with but orders were given for further vessels. This vessel, the "R.9," was completed in April 1917.

Germany, in the meantime, had forged ahead and by the outbreak of war no less than 30 "Zeppelins" had been built.

An account of "Zeppelin" activities during the war is given elsewhere in the Encyclopædia under "Air Raids," and will not be further commented upon except to say that by the end of the war Germany had constructed well over 100 rigid airships.

Non-rigid Airships.—As a result of the Government's vacillating policy in regard to rigid airships, the war found both the British Admiralty and the War Office unprepared in this direction, and in the first few months efforts were concentrated upon the small non-rigid airship for coast patrol and the kite balloon for Army observation work. The first of the small airships, named officially the "S S." type (Sea Scout) but more popularly called *Blimp*, was completed by Feb. 1915 and in 1916 a more developed type called the "S.S.Z." was produced. These were followed a year later by the "S S.T." type (Sea Scout Twin) and in each case an increase of size, speed and range was involved. The "S S.T." had a speed of 50 m.p.h. and could patrol for 50 hours at a stretch.

These vessels were supplemented by larger vessels of the same type, the most notable being the "N S." (North Sea) type of 360,000 cu.ft. displacement, with a maximum speed of 55 m h p. These vessels did remarkably good work and in 1918 there were only nine days in which British airships did not fly, and in that year up to the time of the armistice they had completed over 50,000 flying hours.

Rigid Airships.—To return to the rigid airship programme, the "R.9," with a displacement of 800,000 cu.ft., had a speed of

45 m.p.h. Her useful lift was very small and on that account she had limited endurance, rendering her of little value except for training purposes, although she carried out several patrols in the North Sea. No new feature of importance was embodied and she compared unfavourably with contemporary German vessels.

In 1916, the German "Zeppelin L. 33" was brought down in good condition at Colchester and served as a model from which the "R.33" and "R.34" were built. These vessels, which were not completed until after the war, were a marked improvement on any vessel that had previously been built in England. In 1915, the Admiralty placed contracts for further rigid airships with Messrs. Vickers, Ltd., Messrs. Beardmores and Messrs. Armstrong Whitworth and Co. These vessels were known as the "R.23" class, and were an improvement upon the "R 9" but embodied no really novel feature, and still compared unfavourably with contemporary German vessels.

In 1917, another vessel of 1,250,000 cu.ft. was ordered from Messrs. Vickers, Ltd. This vessel, called the "R.80," was the first rigid airship built in England that embodied any new feature other than those of minor constructional importance. The departure from contemporary practice consisted in building the hull of a good streamline form without any parallel portion. Unfortunately the performance of this vessel was not great, chiefly because of poor engine equipment. Completed in 1920, she compared unfavourably with the German-built "Bodensee," a vessel of approximately the same size, and completed about a year earlier. This latter vessel was used upon a regular service in 1919 between Friedrichshafen and Berlin, and made 103 voyages carrying 2,430 passengers without mishap. The high speed of 81 m.p h. has been claimed for her.

In 1917, another vessel of 1,250,000 cu.ft. was ordered from (2,700,000 cu ft. capacity), was begun at the Government airship works at Cardington. In Oct. 1919, all airship work was transferred from the Admiralty to the Air Ministry In 1920, the "R.38" was sold by the British to the American Government. The purchase price was £500,000 and the vessel was to be delivered to the United States by air. The first flight was carried out in June 1921, and revealed defects in rudders, elevators and controls. Further defects were discovered in a second flight a few days later; and a third flight revealed structural weakness in the girders. The fourth flight, Aug. 23, 1921, ended disastrously, the ship breaking into two portions and 44 persons being killed. The loss of life was unduly heavy owing to the fact that both American and British officers and men were on board.

As a result of this disaster the airship department of the Air Ministry was closed down and all airships, airship bases and material turned over to the Disposals Board for sale.

United States.—The history of airship development in the United States is not unlike that of Great Britain. In 1908, the War Department purchased a small 20,000 cu ft. non-rigid, and in 1911, a 50,000 cu ft. non-rigid, from the French Zodiac Company. No further development took place until 1916, when, in view of possible intervention in the World War, the Navy Department produced five types of sea scout non-rigids ranging from 18,000 cu.ft. to 84,000 cu.ft, the largest having a maximum speed of 60 m.p.h., and an endurance at moderate speed, of 1,800 m.

About 60 of these vessels were built by the Goodyear Tire Company. After the United States entered the war, British experience of rigid airships was placed at their disposal, and, in 1918, work was started by the United States naval authorities upon the designs of a rigid vessel about the same size as the British "R 33." This vessel, subsequently called the "Shenandoah" (2,148,000 cu. ft.), was completed in 1923, and made her first flight in September of that year. Two developments were made in this vessel, (1) she was designed to be about 30% stronger than contemporary vessels of the same size; and (2) helium was employed as a lifting gas instead of hydrogen. After carrying out a large number of flights and experimental trials at mooring masts the Shenandoah was destroyed in Sept. 1925 on encountering a line squall when over Ohio. The violent vertical gusts generated in this line squall broke the ship into three portions and, unfortunately, the captain and several of the crew were killed. In July 1927, the American Government started negotiations with the Goodyear Zeppelin Company for a new rigid vessel of 6,500,000 cu.ft. at a price reported to be £800,000.

France.—Airship development in France subsequent to Santos Dumont and Zeppelin starting their experiments did not justify the hopes encouraged by that country's early contribution to aeronautics. The Astra Company, the Clément Bayard Company and Lebaudy Frères, all built a succession of non-rigid and semi-rigid vessels, ranging in size from 100,000 cu.ft. to 800,000 cu ft., for the French and foreign Governments, and one company only, the Zodiac Company, built a rigid airship, the "Spiess," of 575,000 cu. ft. in 1912-13. This vessel had a wooden structure and was unsatisfactory. Since the war, France, with the exception of building two excellent airship sheds upon novel lines, has done nothing in airship development.

Italy and Semi-rigids.—Italy has specialized in semi-rigid airships, and, commencing in 1907, has achieved considerable success in this direction, the Forlanini Company of Milan being prominent in this sphere.

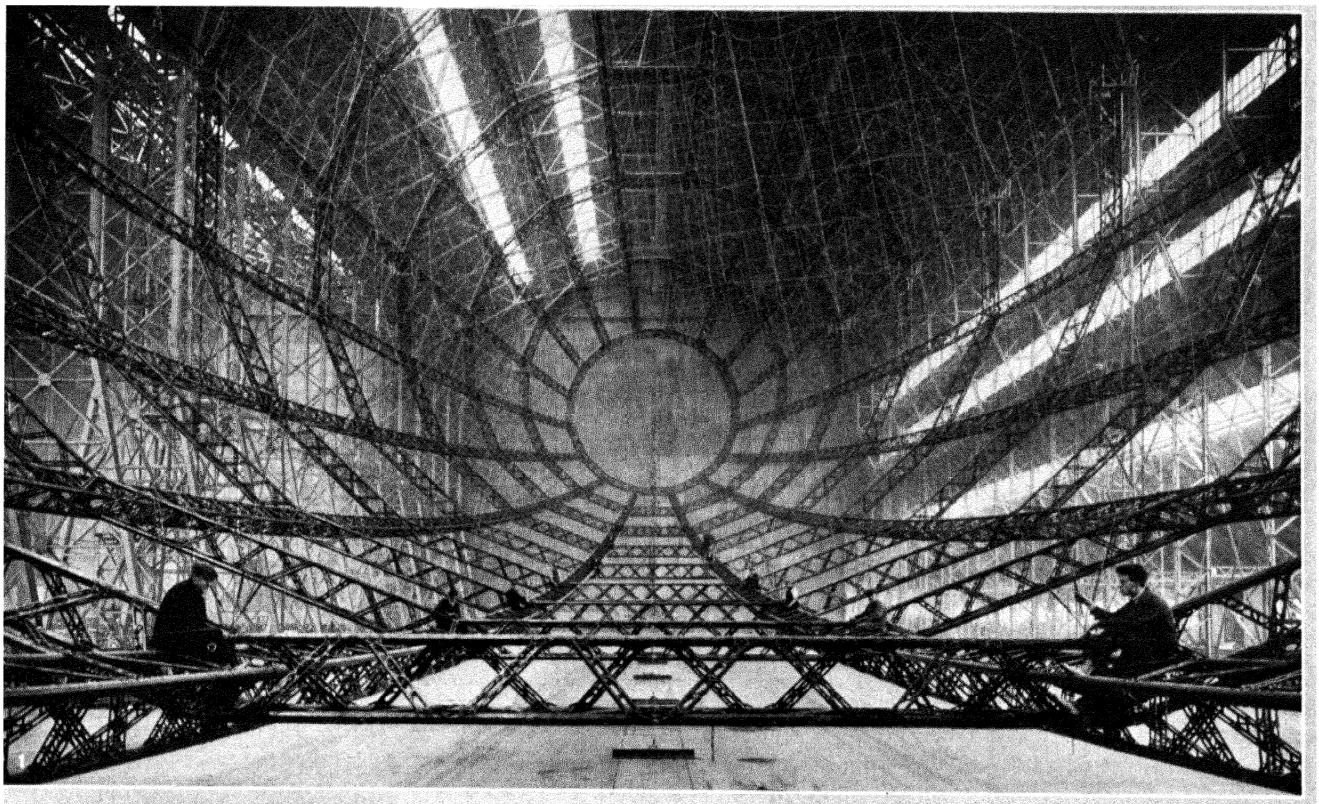
The most notable flight made by a semi-rigid vessel was that of the Italian-built "Norge" in May, 1926, when Captain Amundsen's Arctic expedition started from Kings Bay in Spitsbergen; flew across the Arctic regions, crossing the North Pole; and landed at Teller after having flown 3,000 miles in 71 hours. The "Norge" had previously flown from Italy to Kings Bay by easy stages.

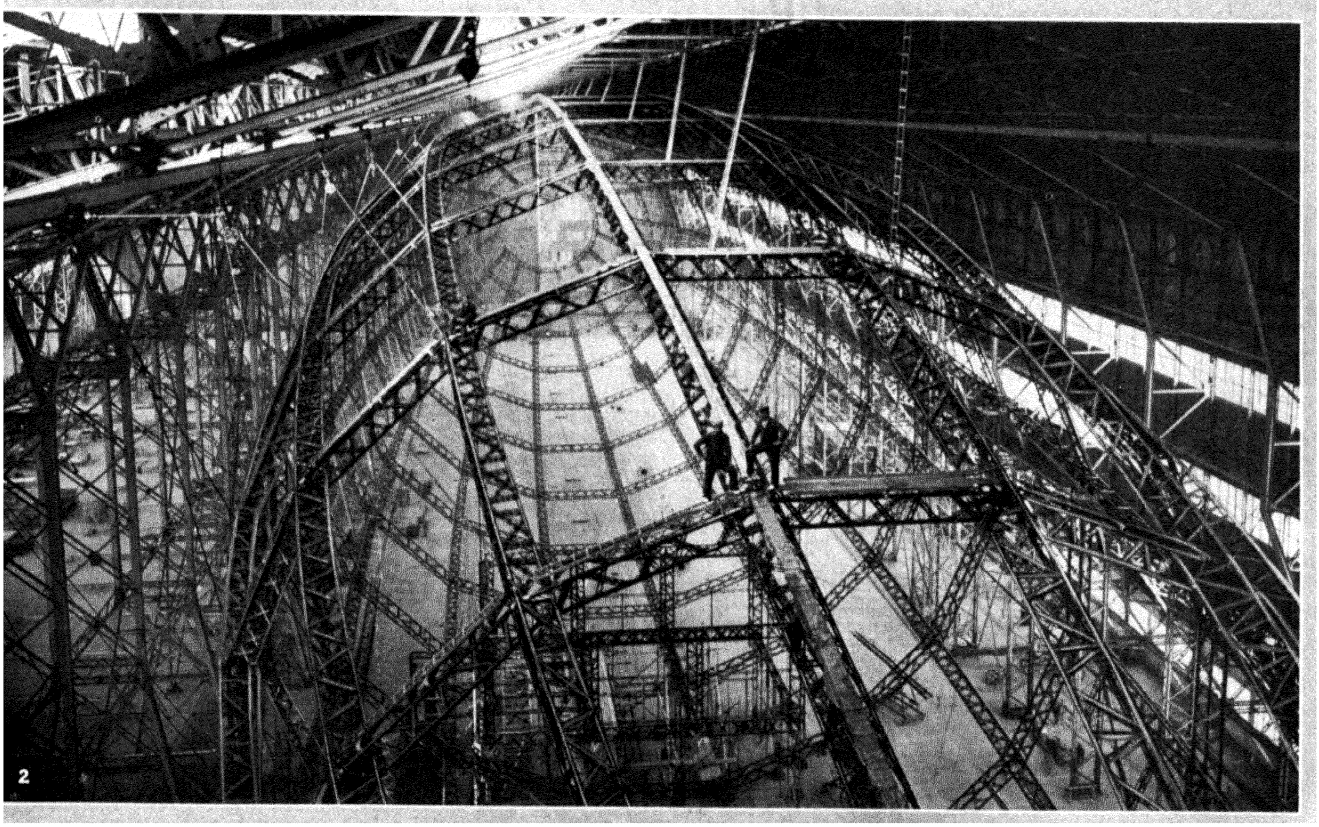
Post-war Developments.—Airship building in Germany, after the World War, was suspended on account of the provisions of the Treaty of Versailles, which prohibited the building of any airship of more than 1,000,000 cu.ft. All German "Zeppelins" were either destroyed or ordered to be delivered to the Allies. The "Bodensee" was taken by Italy as part of that country's reparations, "L.59" and "L.71" by England and other vessels by France. One new vessel only, the "Z R.3," of 2,400,000 cu.ft., was built by the Zeppelin Company during this period, and delivered to the United States in conformity with the reparation arrangements. This vessel was subsequently re-named the "Los Angeles," and flew from Friedrichshafen to Lakehurst in New Jersey, U.S A., via the Azores, a distance of 5,000m in 81 hours, in November 1924, and has since been operated by the United States Navy. The completion of the "Los Angeles" may be said to mark the end of a definite stage in airship development. Up to this time activities in Germany, England and the United States had been mainly confined to producing a vessel that would be useful for war purposes, and with the exception of the "R 80" no new development of a basic character had been attempted. It is true that the British copy of the German "L.33," the "R.34," crossed the North Atlantic and returned successfully in 1919, but even this successful flight did not equal in distance that of the German "L 57" two years earlier, which, in 1917, left Jamboli in Bulgaria, arrived at the Daka Oasis in East Africa, and returned without alighting, having covered a distance of 4,200m. in 96 hours. In each case grave risks were taken during the flight and each was of the nature of a *tour de force* rather than an example of what the existing vessels could be expected consistently to perform.

THE COMMERCIAL AIRSHIP AND ITS PROBLEMS

After the destruction of the "R.38" no new vessel was laid down until 1925, when, as the result of a new policy adopted by the British Government, the "R.100" was laid down at Howden. An endeavour was to be made to produce airships capable of fulfilling the rôle of swift imperial transports, and in October 1924 a contract was placed with the Airship Guarantee Company, for a 5,000,000 cu.ft. ship (now called the "R.100").

Instructions were given that both vessels should achieve a speed of 70 m.p.h. and each should have accommodation for 100 passengers. The British and Dominion Governments decided to proceed with the erection of mooring mast bases in Canada, South Africa, Egypt, India and Australia. The Airship Guarantee Company was given a free hand in the design and construction of the "R.100," and the "R.101" was designed by Air Ministry officials.





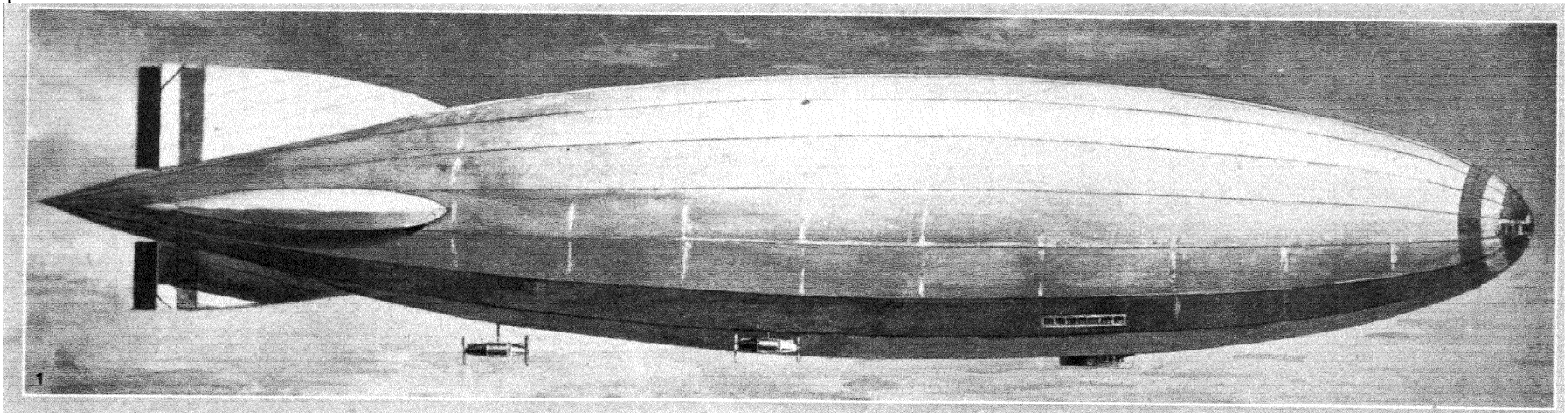
BY COURTESY OF (1 AND 2), VICKERS, LTD.

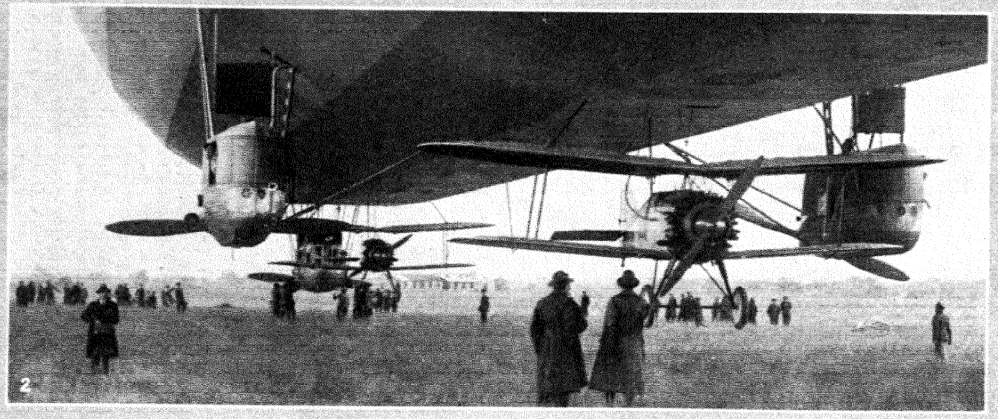
CONSTRUCTIONAL INTERNAL AND EXTERNAL VIEWS, LOOKING AFT, OF THE AIRSHIP R-100

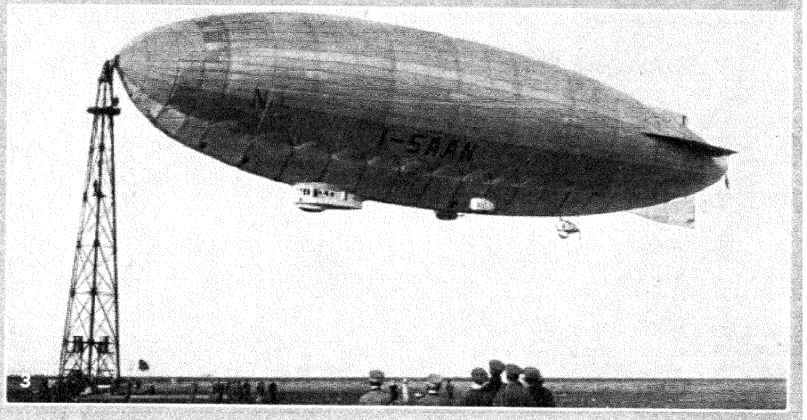
1. INTERNAL VIEW 2. EXTERNAL VIEW

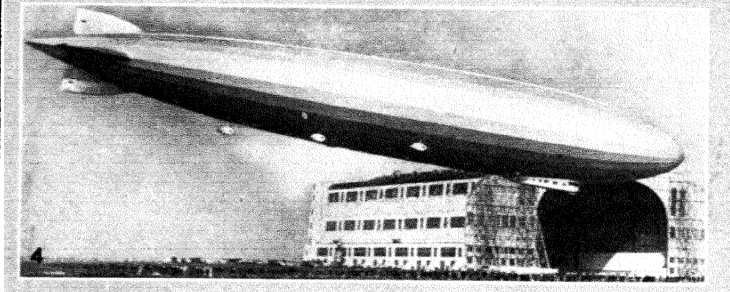
The hulls of practically all the airships built since the World War are greater in diameter than those constructed before that time. This change is a result of experiments proving that the long narrow cigar shape, characteristic of the lighter-than-air craft first built, is not necessary for the reduction of head resistance. The interior of the hulls is divided into 15 or more compartments containing gas bags. The whole structure is wrapped in an "outer cover" treated with aluminium powder to make it reflect the sun's rays and minimize the absorption of heat. Besides acting as a protection for the gas bags, this covering gives the needed smooth surface to the vessel

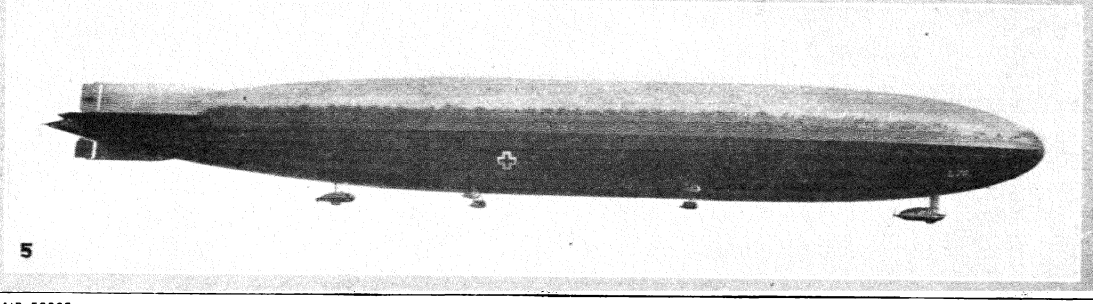
AIRSHIPS











BY COURTESY OF (1) TOPICAL PRESS AGENCY, (3) "THE AEROPLANE," (4) "FLIGHT," (5) THE ROYAL AIR FORCE

AIRSHIPS RECENTLY LAUNCHED

1. R-100, English dirigible designed for commercial use
2. R-33, British airship and defensive aeroplanes
3. Italian semi-rigid "Norge" type airship
4. The "Los Angeles" entering the shed at Lakehurst, New Jersey
5. L-70, a German Zeppelin built in 1918

Types of Airship.—As will have been realized from this short history of the airship, the whole tendency of development has been towards larger vessels and higher speeds. Starting as a gas-bag with a motor carried on a small metal framework suspended beneath, the airship has gradually developed into a complicated structure demanding the highest mechanical and engineering knowledge in its design.

In general there have been two distinct parallel lines of development from the free balloon. The non-rigid type of ship is in effect merely an elongated free balloon with car and engine suspended beneath by a suitable arrangement of rigging. In this type of ship the shape is preserved by maintaining the buoyant gas inside the envelope at a definite pressure above the air outside, usually through the agency of air ballonets or bags inside, which, being only partly inflated, are free to expand and in which the air pressure is maintained either by airscoops and valves or by an independent air compressor in the car. The semi-rigid type of ship, often treated as a distinct class, is in reality merely a variation of the non-rigid type. In this, some sort of elongated framework is provided, usually in the form of a stiff keel, carrying the power unit, for the purpose of better distributing the weight of the latter over the length of the envelope. In the rigid type of ship, on the other hand, the shape is maintained by a stiff framework built up of girders over which fabric is stretched to produce the required shape or form and the buoyant gas is carried in independent bags or containers inside. The gas in these gasbags is not maintained at an excess pressure above that of the surrounding air; in fact, the gasbags may not necessarily be fully inflated.

Lifting Power.—All airships obtain their ascensional power by the displacement of air by a lighter gas in exactly the same way that a bladder filled with air and submerged in water will rise to the surface of the water. The magnitude of the "lift" is determined by the kind and purity of the gas, the size of the gas container, and the condition of the atmosphere. Conditions affecting the densities of the atmosphere and any given lifting gas are temperature, pressure and humidity.

At sea level, under normal conditions 1,000 cu.ft. of air weigh approximately 80 lb., 1,000 cu.ft. of pure hydrogen under the same conditions weighs only 5 lb. and 1,000 cu.ft. of pure helium weighs 12 lb If, therefore, a small balloon is filled with pure hydrogen it will have a "lift" of 80—5 or 75 lb., and with pure helium 80—12 or 68 lb. for each 1,000 cu ft. of capacity.

In practice, owing to the presence of impurities, the lift of hydrogen in airships is usually about 70 lb. and of helium 60 to 64 lb. per 1,000 cu.ft. Hence in the case of an airship having a total displacement of 5,000,000 cu.ft. the effective buoyancy or lift when filled with hydrogen will be 5,000 × 70 lb. or 156 tons, and with helium from 134 to 143 tons only

These figures give the total lift available and therefore, the hull, engines, fuel, ballast, crew, etc., or "fixed weights" cannot be allowed to total more than this amount. "Disposable" lift is the amount of lift available after all fixed weights have been deducted and is usually given as a percentage of the total lift.

Helium Versus Hydrogen.—Since the United States Government adopted helium in place of hydrogen for the lifting gas of its airships there has been considerable controversy as to the relative merits of the two gases. It is still a matter of opinion which is the more desirable gas to use. British and German experts prefer hydrogen while in America helium is generally used.

The advantage of helium is its non-inflammability, and it is idle to pretend that hydrogen is in any way comparable to it in this respect. On the other hand if the above figures for the 5,000,000 cu.ft. ship are examined and it is assumed that in each case the fixed weights total 110 tons, the disposable lift in the case of the hydrogen-filled ship will be 46 tons, while in the case of the helium ship only from 24 to 33 tons. This represents a very considerable percentage loss in performance, as compared with the same vessel operated upon hydrogen.

Helium is £5 per 1,000 cu.ft. against 5s. for hydrogen, and at present is only obtainable in the United States, although it is reported that it exists in quantity in Canada. (*See* HELIUM.)

Variation of Volume.—Since the volume of a gas depends upon its pressure and temperature and since with a rise in height the pressure becomes less, it is clear that if the gasbags were full at sea level they would be overflowing at, say, 2,000ft. One of two things must happen in such a case, either the bag must be so strong that the difference in atmospheric pressure between sea level and 2,000ft. can be withstood by the bag or some of the gas must be allowed to escape. In practice it is found undesirable to make gasbags to withstand the difference in pressure due to an alteration of more than about 200ft. in altitude, and accordingly, automatic gas valves have to be fitted to all gasbags. The height at which, with a given amount of gas, the gasbags are just full is known as the "pressure height." An airship can alter its altitude substantially below this height without change of lift, since as the ship descends the surrounding air being denser compresses the gas automatically, but if it exceeds this height it must lose gas, and a new "pressure height" is established. It is clear from this that the higher an airship flies, the less becomes its useful lift, as the gross lift of the gas is less by the amount that has to be allowed to escape through the automatic valves to establish the new "pressure height" at the higher level.

Temperature Variations.—The first flight ever made depended, as has been described, upon the fact that heated air is less dense than cold air. Similarly, heated hydrogen or heated helium is lighter than cold hydrogen or cold helium. Now in an airship it is possible to obtain much the same effect as that noticeable in a glass-house on a sunny day. The sun's rays striking upon the envelope of the ship heat the gas in the gasbags to a higher temperature than that of the surrounding air, with the result that the gas expands and an increased lift is given. This is called superheating. The reverse effect is often found to occur when flying through the clouds.

Height Control.—The control of the flying level of an airship is effected in two ways: for minor alterations of height by the elevators or horizontal rudders and for large alterations by releasing ballast or gas. The action of the elevators is dynamic and can only operate when the ship is moving, and the magnitude of their effect depends upon the speed of the vessel. In the "R.100" at full speed, the "dynamic lift" is estimated to be as much as 17 tons and except for mooring and landing is mainly depended upon to keep a constant height level.

Hull Structure.—The most striking development in the more modern ships as compared with the earlier war-time "Zeppelins" lies in the changes made in the shape of the hull. The early "Zeppelins" had long, narrow, cigar-shaped bodies, the ratio of length to diameter being about 10–1 and embodied a very long parallel portion with a relatively short conical bow and tail. This original shape was adopted partly from the desirability of keeping the diameter as low as possible to meet shed difficulties, partly because it may have seemed that the obvious way to reduce head resistance was to make the ship as long and narrow as possible. Experimental investigations have shown, however, that, providing the hull is correctly streamlined, the head resistance per unit of volume of a hull, having a length-diameter ratio of only 5–1, may be very considerably less than of these old shapes, which were extremely poor aero-dynamically. Again, the vast amount of investigation into the distribution of stresses in the hull framework carried out during and since the war has shown that with the shorter ships it is possible to obtain a strength and factor of safety double that allowed in the older ships for the same proportional weight of structure.

This development is strikingly shown when comparing Pl. II.-2 (the "R.33") with Pl. I.-1 (the "R.100"). The length diameter ratio of the "R 33" is 9–1 and the "R 100" 5·3–1. The "R.100" is truly streamlined and the "R.33" has a long parallel portion. The resistance of the "R.100" shape is only half that of the "R.33" shape per unit of volume.

The hull itself consists of a metal framework, divided into 15 or more compartments into each of which a gasbag is placed. The gasbag consists of linen fabric coated with gold-beater skin and made up in the shape of a cylindrical container. Surrounding and containing each gasbag is a network of wires, distributing and

conveying the lift from the bag to the hull structure. The whole structure is then covered with an envelope of fabric called the "outer cover," the function of this outer cover being to give a smooth surface to the vessel, protect the gasbags and, being specially treated with aluminium powder, to reflect the sun's rays and minimize the absorption of heat.

The engines of the ship are usually carried in separate cars or gondolas suspended from the metal framework of the hull, although, in order still further to reduce resistance, proposals are now being made to place the engines inside the envelope.

The fuel tanks are carried inside the hull suitably suspended from the girder work, and the control cars, passenger quarters, etc., are either built into the hull or suspended from it. As can be seen from Pl. II.-2 showing the girder work of the "R 33" and Pl. I.-1 showing that of the "R.100," considerable differences exist in different designs.

There seems little doubt, however, that the enclosure of the passenger quarters entirely within the hull, as developed for the first time in the "R 100" design, will form a precedent that will be universally accepted, owing to the reduction of resistance. It has also been proposed to situate the control car in the extreme bow.

Performance.—If the atmosphere was always calm the performance of an airship would be almost incredible, since the power required to drive her at a given speed varies as the cube of the speed, and consequently at low speeds her range would be immense. Under practical conditions, however, that is not the case as average winds that may be encountered upon any flight range up to 30 m p h. Under adverse conditions the winds may be as much as 60 m.p h. or more. If, therefore, the airship is to be a dependable means of transport her speed must be high as compared to the winds she may encounter, and for practical purposes, especially from the commercial point of view, a cruising speed of less than 75 m p h. is not of much value, and in the opinion of those who have studied the problem a cruising speed of 100 m p h. will be required before the airship will be able to maintain a regular commercial transport service. For commercial work, an equal division between fuel and paying load gives the maximum ton-miles and determines the distance between stopping and consequently refuelling bases.

Consider the performance of the "R 100" as an example, as she is the first really commercial vessel that has been designed The useful lift is 73 tons. From this must be subtracted 21 tons for crew, ballast, loss of lift to 2,000ft , etc., leaving 52 tons for fuel, passengers and freight. Half of this is 26 tons. The consumption of fuel at 75 m p.h. is half a ton per hour, thus giving a total endurance of 52 hours at 75 m p h., or 3,910 m.

To allow for contrary winds fuel for 50% more than the geographical distance must be carried, so the performance of the "R 100" can be said to be 2,600m. at 75 m p h., carrying 26 tons of paying load.

Strength and Factor of Safety.—The development of the airship, unlike that of the aeroplane, was hindered rather than helped by the World War, owing to the much longer period of time involved in producing a new design. The necessity for the rapid increase of the number of airships after the outbreak of war prevented the natural improvement in shape which would otherwise have developed, and furthermore, the height of the sheds or hangars limited an increase of diameter. The result was that both in Germany and England long, parallel-bodied and cigar-shaped ships, having an extremely high head resistance per unit volume were to a certain extent standardized even although their defects were obvious. These vessels, owing to their great length and small effective depth considered as a beam, were subjected to excessive bending moments and stresses when turned rapidly or manoeuvred under gusty atmospheric conditions. In these circumstances, with the small total lift available, it was impossible to provide a really adequate margin of strength and structural failures, as in the case of the "R 38" and "Shenandoah," followed.

In the case of an airship, structure strength has to be provided to meet two distinct sets of conditions; the first, definite and readily calculable, arising from the tendency of the ship to deform under the pressure action of the buoyant gas in the hull, and secondly, the bending condition arising out of rudder action, gust action, etc., which are known with much less exactitude. In the case of the latter an assumption has to be made as to the character and magnitude of the worst possible condition the ship will have to meet, and an arbitrary condition is used of somewhat similar character to that employed by naval architects in the design of marine vessels. When the magnitude of the worst condition is fixed the distribution of the corresponding stresses throughout the structure can readily be calculated, since the airship structure is an open lattice structure amenable to exact calculation. The factor of safety of the "R.100" is several times as great as that of the older types of ship when calculated under parallel conditions.

Air Currents and Storms.—The airship has to encounter three general types of air-currents First, the ordinary depression, which may be anything, in temperate zones from 700 to 1,500m. across. The wind will be steady and blowing in a horizontal direction at speeds varying from a few miles per hour to 30–40 m p h. at low altitudes. An airship is not much affected by such a wind in so far as the structure is concerned, and although such a wind would create a rough sea, the air-borne vessel is flying almost as calmly as in still air. The distance the vessel makes good over the ground will, of course, be altered by an amount corresponding to the strength and direction of the wind.

Secondly, there is what is known as a "line squall." This meteorological phenomenon is caused by cold currents meeting and overlapping hot currents of air These line squalls may be several hundred miles across and generate dangerous vertical currents. These vertical currents will affect the airship in much the same way as the vertical motion of the waves affect a marine vessel. In certain cases the vertical velocity of these gusts is very high and, moreover, being in some cases of small diameter may be likened to a stream of air being discharged from the nozzle of a hose. If an airship strikes one of these vertical gusts when flying at high speed, she will be thrown violently out of her horizontal path and be subjected to severe stresses It is computed that the vertical gust which destroyed the "Shenandoah" had a velocity not less than 1,400ft. per minute. The effect of these gusts upon an airship structure was largely neglected in all vessels prior to 1925.

In the "R 100" a factor of safety has been provided to enable the vessel to encounter a vertical gust of no less than 4,000 ft. per minute, and of a diameter of only 800 ft., when encountered at the full speed of the vessel. Experience of the behaviour of airships in "line squalls" is still very limited.

Thunderstorms.—Thirdly, there are the still more violent and intense forms of atmospheric disturbances such as thunderstorms, waterspouts, cyclones and hurricanes All these have one characteristic in common in that they are of a very local character and usually travel at a slow speed seldom exceeding 20 m.p.h. Every endeavour should be made by an airship commander to avoid disturbances of this character, and hitherto no experience has been obtained as to the behaviour of an airship encountering such disturbances other than thunderstorms. The chief danger in the thunderstorm is the violent vertical and horizontal gusts and electrical discharges such as lightning. There have been a considerable number of cases of rigid airships being struck by lightning, but so far experience has shown that the metallic framework of the ship affords sufficient capacity to absorb the electrical charge, and the water vapour in the exhaust of the engines forms a sufficient conductor for the gradual discharge of the induced current. Lightning is a grave danger to non-rigid and semi-rigid vessels owing to the absence of this metal framework.

Engines.—Up to the present no efficient and satisfactory airship engine has been evolved. The general line of attack in order to avoid the use of petrol, with its attendant dangers, has been to develop a light Diesel engine using heavy oil, or a sleeve-valve engine using hydrogen and kerosene as fuel. In Great Britain one engine of each type was under trial in 1928; the plan being to equip the "R.101" with light Diesel engines if successful. The "R.100" was first fitted with petrol engines, but it was antici-

pated that these would be changed for one of the other types as soon as they could be considered serviceable.

Experiments upon light Diesel engines are being conducted both in Germany and America.

Mooring Masts.—A large airship cannot be moved into or out of its shed or hangar except in a comparative calm, unless the wind is blowing in the line of the length of the shed. In Germany a revolving shed was made, so that, whatever the direction of the wind, the length of the shed could always be made to coincide with the direction of the wind. When it is realized that a modern shed may be 850ft. long, 180ft. wide and 180ft. high, weighing several thousand tons, it is obvious that the engineering problems involved in rotating so vast a structure are so great as to render a simpler and cheaper solution to the problem imperative.

As will be remembered, the specification of the first British rigid, the "Mayfly," in 1909, included a mooring tower or mast. Prior to that vessel's destruction she was moored to a mast and remained safe during winds with gusts up to 48 m p h In 1912 this idea was adapted by the Royal Aircraft Factory at Farnborough to the mooring of a non-rigid vessel. Many of the essential features employed at Farnborough, such as the fixation point being free to rotate about the axis of the mast and the ship being free to rock vertically, have remained in all masts hitherto constructed. Recently the U S. Government has awarded contracts for short mooring masts which are mounted on caterpillar trucks, and can be used for handling or towing airships on the ground.

Subsequent to 1912, a further set of experiments were carried out at Barrow, a somewhat taller mast with a horseshoe being utilized. In 1919, a prolonged series of trials with the "R 34" were undertaken at Pulham. The ship remained continuously at the mast for 70 days and experienced gusts up to 43 m p h.

These experiments were continued in 1921 with the "R.33," various modifications being made both to the mechanical details at the mast-head as well as to the method of operating the vessel

In 1925, the Royal Airship Works at Cardington, in conjunction with the Works Department, designed and erected a mast some 200ft. in height at Cardington for use with the "R 100" and "R.101." Similar masts are either approved or in course of erection in Egypt, Canada, South Africa and Australia. Considerable criticism against the actual type of mast-head and the necessary complementary fittings in the airship itself was levelled against this design by the Airship Guarantee Company in 1925 and 1926, and an alternative system was suggested by that company The whole question is involved and highly technical and it seems likely that further experience is likely to result in considerable modification to the existing types. The U.S.S. Patoka, an aircraft tender, carries a mooring mast. The breaking away of the "Shenandoah," and the "R 33" from their masts in 1925 indicating the necessity of improvement.

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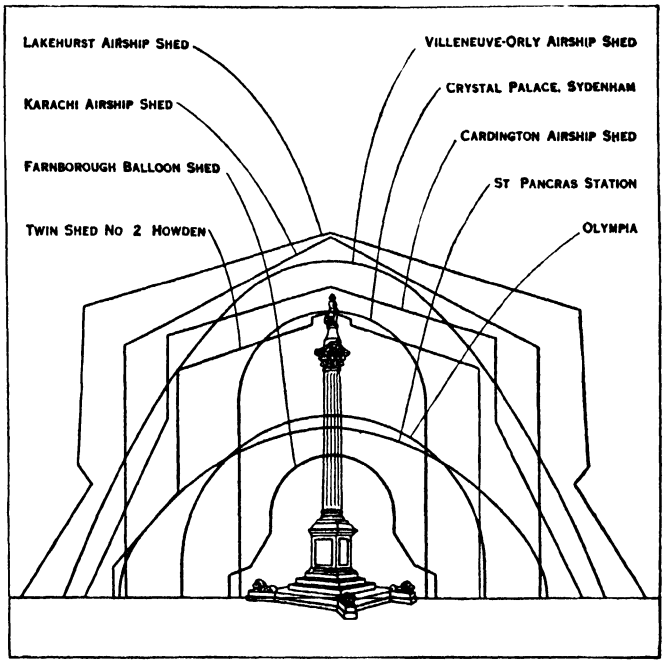
AIRSHIP SHEDS. Airship sheds or hangars are used to accommodate airships during construction, repair or docking. The continuous increase in the cubic capacity of airships has necessitated a corresponding increase in their housing accommodation until the modern hangar ranks amongst the biggest buildings of the world.

When the dirigible was in its infancy such funds as its protagonists commanded were needed for the construction of the ship itself and little could be ear-marked for its shelter; but as the airship emerged from the early experimental stages it became evident that accommodation was an important factor in development M. Santos Dumont, contemplating with pardonable pride the *"first* airship station" which was completed in a Paris suburb in 1903, describes its doors. "Tourists" he says "told each other (quite correctly) that doors so great as these had never been before in ancient times or modern." Each of these doors ("sensational features" in 1902) was 50 ft. high, 16½ ft. wide and weighed 4½ tons. The shed itself had sides and roof of canvas, the central stall being 165 ft. long, 31 ft. wide and 44½ ft high. Seven years later, in 1910, the British War Office built a hangar at Farnborough, Hampshire, 360 feet long with a clear span of 60 ft. and a height inside of 75 ft. A year later the roof was raised 15 ft. to allow space for the Army Airships, Alpha and Beta.



RELATIVE SIZES OF GREAT AIRSHIP SHEDS

In this diagram the height and width of several great airship sheds are compared with well-known London landmarks. The Nelson monument is 142 ft. high. For comparison it may be noted that the Statue of Liberty is 151 ft. 5 in. high

In 1927 the largest hangar in the world was at Lakehurst, New Jersey, U S A. where it was erected in 1919–20 This immense building encloses a gross area of 41,852,360 cubic feet.

In England the largest shed was built for the Admiralty at Howden, Yorkshire, in 1917–18. This is a twin shed (to house two ships) the enclosed volume being about 37,837,500 cubic feet. It covers an area equal to 7·1 acres or including the doors about 8½ acres, a greater superficial area than is occupied by the American shed. The total amount of structural steel absorbed is about 4,600 tons.

The measurements of some of the great hangars of the world are given in table overleaf.

Where situated.	Date of building.	Volume of shed. cu. ft.	Lgth.	Hght. inside.	Span.	Remarks.
Nordhotz, Germany	1915	.	664	98	116 each	Twin span shed.
Orly, France	.	34,108,524	984	164	230	..
Howden, Yorks	1917–18	37,837,500	754	140	150 each	Twin span shed.
Cardington	1925	27,234,480	812	157	180	..
Karachi	Completing	33,430,500	850	170	202	..
Lakehurst	1919–20	41,852,360	800	172	258	..

Construction.—Hangars are usually constructed with steel framing covered by galvanized sheets on sides and roofs, the flooring being of concrete. The roof covering of some of the more recent sheds is of corrugated sheeting coated during manufacture with alternate layers of asbestos and bitumen.

A simple framework is usually found advisable, and the three-pin arch or some adaptation thereof is a type that provides as far as possible against temperature stresses or settlement of the foundations.

One of the few examples where reinforced concrete has taken the place of steel is to be found in a remarkable shed built at Orly in France taking the form of a parabolic fixed arch, springing direct from the ground level giving a clear width and height at the doors of 230ft. and 164ft. respectively. The arch ribs form continuous walls in corrugated form, the depth of the corrugation varying from 17ft. at the ground to 10ft. at the crown, the centres of the corrugations being about 24ft. apart longitudinally. (*See* fig. on p. 473.)

When a wind is blowing other than fore and aft the shed, an airship can only be housed or unhoused with difficulty and risk. Sheds are therefore built with their longitudinal axes in line with the prevailing wind. Further efforts to overcome this difficulty have been made:

(a) By erecting wind screens from 70ft. to 130ft. high framed in steel and sheeted No appreciable benefit resulted.

(b) By anchoring a shed like a floating dock on a sheet of tideless water, where this shed would naturally swing head on to the wind.
Such a method was tried by Count Zeppelin on Lake Constance but the disadvantages were found to outweigh the advantages gained and the idea has not been developed.

(c) By constructing revolving sheds. With the increasing size of the shed required this presents an interesting and very expensive though not unsurmountable problem.

The revolving shed built at Nordhotz therefore merits description. The framework is all steel, the sides and roof have a steel corrugated sheet covering, a portion of the floor being of concrete, the remainder being of timber.

The total revolving load is about 4,000 tons and rests on sixteen four-wheeled bogies, running on a circular rail track of 5ft. 3in. gauge, the diameter being about 475ft. A massive concrete pivot 26ft. in diameter centres the whole structure. The shed itself revolves about this point in an annular pit of 650ft. diameter and 13ft. depth, the floor of the shed being level with the ground surface. Electric motors are fitted to all bogies for turning the shed, the total horse power being about 184.

Sliding or rolling doors have generally been used at both ends of the shed, but in later designs at one end only. Two types have been used, (a) a vertical door, travelling across the end of the shed on bottom wheels on a concrete rail track, the top being supported horizontally on guide girders, either fixed to the shed or supported independently on towers; (b) which is more generally adopted, a door framework rolling on parallel rail tracks, sufficiently far apart to make the door, when suitably ballasted, self-supporting and independent of the shed altogether. This involves moving a much heavier weight when opening and closing, but has proved satisfactory and costs less than type (a).

Doors are usually operated by hand gear. In some cases a capstan, fixed on the door, is used, driving by means of spur gearing direct to the travelling wheels. A more efficient method, however, is a cable or chain, fixed at each end to a ground anchorage and passing over the drum of a winch fixed on the door framework. At Cardington each door consists of four separate leaves, each weighing (including the necessary ballast) about 245 tons. Two leaves coupled together are opened easily in 10 minutes by 6 men. (*See* AIRSHIPS.) (C. D. B.)

AIR SICKNESS: *see* ANOXAEMIA.

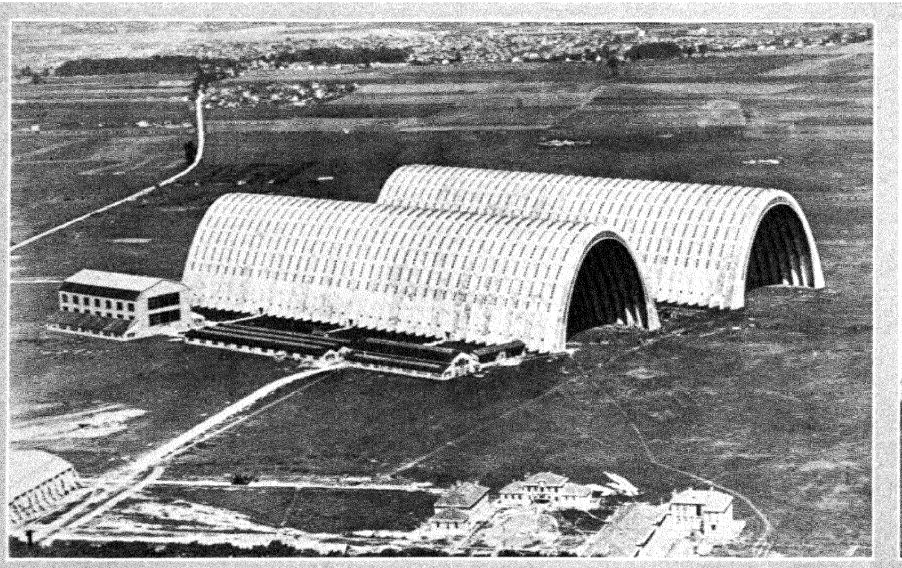
AIR WARFARE. This article deals with the general principles governing the employment of air forces in war, and with the effect of the advent of air power upon problems of the defence of the British empire. It does not enter into any details either of air fighting (for which *see* AIRCRAFT IN WAR) or of co-operation with a navy or an army (for which *see* AIR CO-OPERATION).

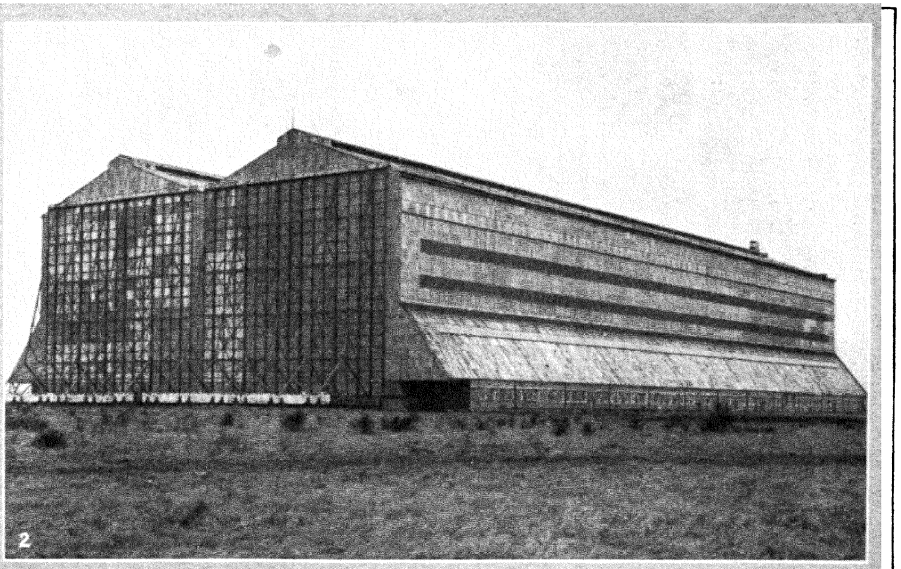
Characteristics of Aircraft.—Aircraft move very rapidly and the time during which they have to remain in contact with their objective is very short, merely sufficient for accurate bomb-sighting. It must not be supposed that aircraft attacks are affairs in which the main object is to get away without being caught; they are deliberate actions which are completed quickly owing to the nature of the instrument. Aircraft are not limited to any definite line of advance, but are free to move in any direction and can approach their objective from practically any direction and at any height between say, 100ft and 20,000ft. This means that the defenders of an area 16 miles square have about 1,000cu m. to watch. Or, again, if, as often occurs, there are continuous cloud layers, aircraft patrolling a line have two or more separate fronts to watch, *e g.* in the case of two cloud layers, one above the top layer, a second between the two layers and a third below the bottom layer.

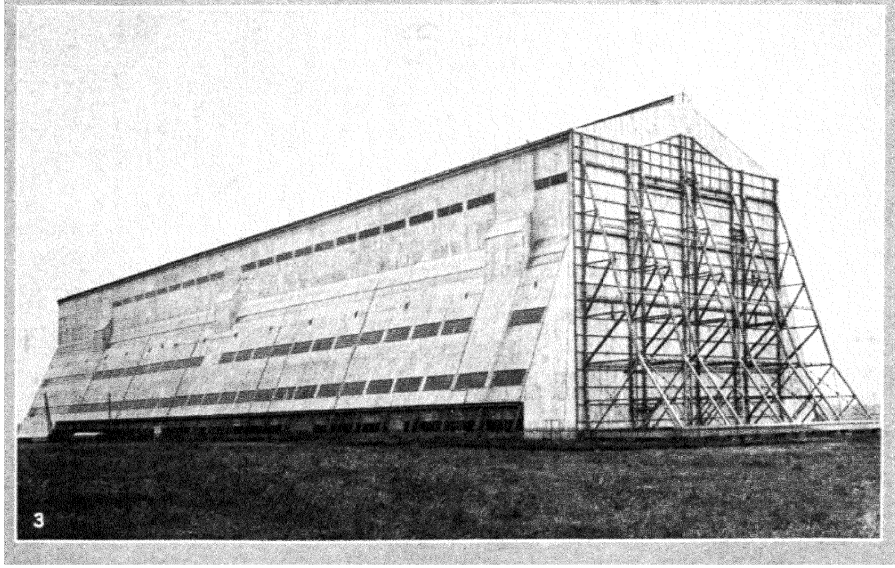
With the possible exception of high mountain ranges, aircraft are not stopped by any ordinary obstacle, either natural or artificial. The stretches of sea or lines of fortresses that used to form the frontier defences of nations are barriers no longer. They are not tied down like an army by a line of communication from the fighting front to their base; they can go back to their aerodromes by an entirely different route from that by which they arrived. On the other hand, the time during which they can remain active *i e.*, in the air, is short, owing to the limitations of their fuel and ammunition capacity; they have no physical stopping power, such as is afforded by barbed wire or bayonets and they are handicapped by certain weather conditions, especially fog and low clouds.

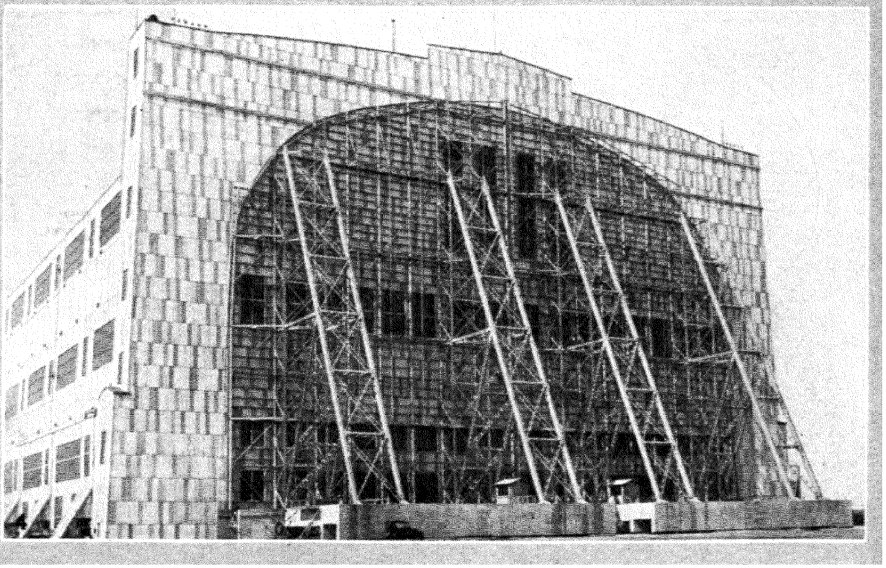
There is a prevalent idea that large aircraft are necessarily more effective fighting instruments than small aircraft, and that there is no inherent difficulty in constructing a battleship of the air. This idea is based upon the assumption that, as regards scalar effect, aircraft follow the same law as ships. This is so in the case of dirigibles, but there is a fundamental difference between ships and aeroplanes. Increasing the dimensions of a ship results in an increase in the ratio of useful load to total weight, hence in the case of warships it is possible, by increasing the total tonnage sufficiently to have a greater ratio available for engines, fuel armour and armament, and thus to get any desired combination of speed, endurance, protection and gun power. Increasing the dimensions of an aeroplane, at any rate with the present methods of construction, will increase the absolute load that can be carried but does not increase the ratio of useful load to total weight; the ratio remains constant or even decreases with increase in size. Speed, rate of climb and handiness are of first importance in air fighting, and these can be obtained to a higher degree in small aeroplanes than in large. The fighting aeroplane of to-day is the comparatively small machine, generally with one occupant—sometimes with two—and not the big heavy weight-carrier.

It has sometimes been said that aircraft are wasteful in man power because it requires a large number of men to keep one aeroplane serviceable at the front. Actually, on the Western front in the war of 1914–18, the numbers were less than those required for a field gun, but in any case the argument is wrong. We do not want to kill off our young men in war; we want to keep them for the peace which is beyond war. By the use of









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CONCRETE AND STEEL SHEDS BUILT TO HOUSE MODERN AIRSHIPS

1. Corrugated, reinforced concrete sheds at Orly, France, built in the form of a parabolic arch
2. Twin airship sheds at Howden, Yorkshire, covering approximately eight and one half acres
3. Airship shed, Royal Airship Works, Cardington, Bedfordshire, made of corrugated sheeting in a steel framework
4. Hangar doors at Lakehurst, New Jersey, 177 ft. high, 136 ft. long and 77 ft. deep, operated by electricity and braced by steel, with an approximate weight of 640 tons each

aircraft we are substituting machinery for flesh and blood; instead of exposing one-third of our serving men to steel, lead and gas, we are exposing but one twenty-fifth. Provided we attain our end, the fewer men we expose to risk of wounds and death the better. War machinery of all kinds should not be regarded as wasting a large number of men in maintenance, but as effecting a vast economy in the utilization of available man power.

Means of Winning Wars.—Destruction, moral or physical, of the enemy's army, followed or preceded by invasion of his country, is the most obvious method of forcing a nation to accept its opponent's solution to a matter in dispute, but it is not always easy to achieve, is frequently a lengthy process and always involves a heavy sacrifice of life. Being, however, the normal method by which wars have been won in the past, it is often assumed to be the only method of winning wars in the future. This assumption fails, however, to take into account certain results of the world's progress; it is one method, but by no means the only one and under some conditions, not the most important.

The means which a nation can now utilize in order to bring pressure to bear upon the enemy people, may be grouped roughly as follows:—

(*a*) Moral (i) Propaganda; (ii) Dislocation of normal life.

(*b*) Economic; Stoppage of movement of goods.

(*c*) Physical (i) Deprivation of necessities; (ii) Injury to person or property; (iii) Loss of means of winning the war.

Many of these interact; for instance, stoppage of movement of goods may lead to deprivation of necessities which will in turn render the people more susceptible to moral effect. Again, the same stoppage will mean reduction of trade which may lead to a nation being unable to keep sufficient credits in foreign countries to purchase essential material for munitions. To deprive an enemy nation of the possibility of winning a war, part at any rate of the system by which it carries on that war must be destroyed, viz.:—(1) The centre of government. (2) The navy, army and air forces. (3) Munition factories and transport system. Let us now briefly consider what means each of the three fighting services utilize in order to bring pressure to bear upon the enemy nation.

A navy acts mainly by economic methods, through control of overseas communications; the result of this will not usually become apparent for a considerable time.

An army ultimately brings pressure to bear by occupation of the enemy's country but cannot do this until it has disposed of the enemy's army; as has already been stated, this is usually a slow and costly process both to life and property

An air force acting separately can contribute its share of pressure in several ways; by dislocation of the normal life of the people, by deprivation of supplies through attacks on transportation systems, by bombing the centre of government. Many of the objectives which an air force can attack at the beginning of a war, could, prior to the advent of aircraft, be reached only after prolonged fighting. This power of bringing direct pressure to bear upon its enemy from the start of the war, may be a deciding factor in reducing the time required to compel an opponent to come to terms.

Separate Action of Air Forces.—When reference is made to an air force acting independently or separately, this does not imply it will carry out a war on its own account without reference to the action of the other services. All it means is that there are forms of air action other than those carried out in direct co-operation with a navy or an army For an air force now is more than a separate arm of the other two services.

Aircraft may be used for the observation of gunfire from battleships or to carry out photography prior to an attack by an army. These are examples of direct co-operation when aircraft may be looked upon as an arm of the other two services. On the other hand, take the situation in 1917 when the Germans were sinking so many ships by unrestricted submarine warfare, that food and other supplies in Great Britain were getting perilously short. Had the Germans had available at that time an efficient fleet of bombing aircraft the best way of utilizing them to increase the effect already being caused by submarines, would not have been in direct co-operation with them by bombing British merchant ships at sea, but by attacking the port of London. This would not only have been within easier reach but would also have offered a more effective target. Again in June 1918, the Germans had advanced dangerously near Paris, and the *moral* of the French people was seriously affected. The most effective means of utilizing aircraft to increase the effect of the German army's success on the French people would not have been to bomb the French army entrenched on the flanks of the German salient but to attack Paris itself and its communications. These are examples of aircraft acting separately but in co-ordination with the action of a navy or an army. The nature of the objectives of an air force acting separately will be decided by a government in accordance with its general policy for the conduct of the war.

Control of sea communication may be a vital matter, in which case a government might decide that the objectives were to be such as would best assist its navy to carry out this duty. To gain complete control necessitates destruction of the enemy's main fleet. Merely containing a fleet *i e.*, bottling it up in harbour, is not so effective as destruction. In the past the chief difficulty has not been so much in defeating the enemy fleet as in bringing it to action; this mainly because a hostile fleet can avoid battle by taking refuge in a protected harbour. It is not impossible that by continuous attack with bombs and torpedoes, aircraft may in another war force an enemy fleet out of harbour, or else reduce it to impotence if it refuses to move. Or the objective might be the enemy centre of government, in which case attacks would be made on buildings housing his various ministries and on the communication system. Again the duty assigned to an air force might be to bring about a continual dislocation of the normal life of the enemy people; and the objectives would then be centres of production, railways, docks and shipping or water and lighting systems.

How far air forces in another war will attack centres of population with the deliberate intention of terrorizing the inhabitants is an open question. Such a method of conducting war is opposed to all instincts of chivalry. It will, after the war, react on the moral condition of the nation that started it and, to quote from an article by Marshal Foch:—"La guerre n'est pas le but suprême, car au-dessus d'elle il y a la paix." On the other hand, it will usually be a very effective method of bringing pressure to bear. It was resorted to, although on a very small scale, in the World War; and when a nation's existence is at stake, it is unlikely to be bound by any rules, but only by expediency. The conclusion to be reached is that such action is well within the bounds of possibility and therefore that every step must be taken to meet such action on the part of an enemy.

Action Against Hostile Air Forces.—As has been said above, a navy cannot carry out completely its main function, *i.e.*, control of overseas communications until the enemy's main battle fleet is destroyed—hence destruction of this fleet becomes its primary object. Similarly the primary object of an army is the destruction of the enemy's army; destruction in both cases being that of the fighting value and being therefore moral as well as physical. It has frequently been argued that because this has been proved correct in the case of the older services it must apply to air forces as well and that their primary object must be to destroy the enemy air force This argument fails to take into account the peculiar characteristics of aircraft. Firstly, as has been stated above, they possess great freedom of movement, can act very quickly and can take advantage of wind and clouds to conceal their movements. All this means that it is exceedingly difficult to stop them. Secondly there is nothing in air fighting corresponding with a defensive attitude in land fighting, where the defender takes up a position in which he is able to compel the attacker to fight or else abandon his object An air force cannot entrench itself behind barbed wire to protect a vital area, because the attacker can move in three dimensions; it cannot take up a waiting position on the flank of its enemy's line of advance because the attacker may approach from any direction. Thirdly, difficult as it has been in the past to bring an enemy fleet to

action, it is still more difficult to bring an enemy air force to action; he cannot be compelled to take the air at the required moment, nor is it possible to wait indefinitely for him, because of the limitations of petrol capacity. Fourthly, air fighting is in its nature indecisive. We can hardly ever hope to destroy an enemy's air force, we can never ensure a permanent command of the air; all we can do is to obtain a local and temporary superiority. There will be much fighting in the air, there will usually be a continuous struggle for this local superiority, but there will be nothing corresponding to a decisive naval engagement or to a Gravelotte or a Sedan. Fifthly, fighting in the air is not an end in itself, it is only the means to an end, that end being to bring such pressure to bear upon the enemy people that they will force their government to sue for peace and do this as quickly as possible. Defeat of the enemy air force, even if it were possible, will not in itself contribute much towards this pressure, nothing corresponding to a decisive victory over the enemy's army. The ordinary man, accustomed as he is to movement only on the surface of the land, may see a dozen of his country's machines brought down in flames or may hear that one of the aerodromes of his bombing squadrons has been badly damaged, but he will not be overcome with despair. What does affect him is the fact that his railway has been broken so that he cannot get home, that his club can give him no dinner because the water supply is cut and that the town is in darkness because the power station is destroyed.

The situation of an air force is similar to that of a reconnoitring party, though on a different scale. In a paragraph dealing with the action of troops employed on reconnaissance it is laid down in the Army Field Service Regulations (August 1924): "The enemy's advanced troops will be engaged only if the commander considers this will be the best means of accomplishing his mission." This argument does not imply that an air force may expect to carry out its duties without fighting; it will have to fight, and fight hard to reach its objectives for attack. But it does imply this, that if its mission is to attack the enemy centre of government, it will not begin by concentrating all its efforts in an attempt, almost certainly a vain one, to destroy the enemy air force, for to do so would be to throw away one of the greatest assets of aircraft, the power to act simultaneously with the declaration of war. It will attack the enemy centre of government at once, will make these attacks its main object and regard fighting in the air as a diversion, whatever the extent of the fighting may be. For continued attacks on one area will undoubtedly lead to fighting in the air, and the more localized the attacks the more intensive the fighting. This was what occurred in France in the World War. At that time the mission of the British air service was co-operation with the army. This co-operation took place mainly over a narrow belt in which the enemy fighters were certain to find our co-operation aircraft. To enable these to carry out their work a continuous offensive was carried out against the enemy fighting machines, but as was laid down at the time this offensive was not an end in itself, only the means by which the main mission assigned to the air service could be accomplished. Further, at no time could our air force be said to have obtained more than a local and temporary superiority; the enemy air force on the Western front could never be said to have been definitely defeated, yet in spite of this the army co-operation squadrons carried on with their work. Had they waited till victory in the air had been won, they would have made but little progress with their mission.

Employment of Aircraft.—Aircraft are essentially offensive weapons, and it is only when they are used offensively that their potentialities can be utilized. Any use of aircraft in a purely defensive rôle is an anachronism A large number of squadrons are detailed for the defence of England, but two-thirds of them are to defend by attacking the enemy; the remainder are fighting squadrons on the defensive only in so far as they lie in wait for the enemy's approach, but, from that event onwards, wholly offensive in their action; all the ground organization of observer posts, lights, communications to some extent, the anti-aircraft guns, can be looked upon as forming a prepared battle-ground for the purpose of enabling the fighter squadrons to carry out their attacks with success. Similarly close escorts of fighters to bombing formations are wrong, because the fighters will be tied down to the bombers, will be limited to defensive action, and will be unable to make use of their speed and power of manoeuvre. If action against an enemy air force is necessary in order that the bombers may reach their target, the correct method of operation for the fighters is to attack the enemy aircraft either at their own aerodromes or in the air, synchronizing these attacks with the movements of the bombers.

The mobility of aircraft is a great asset, and must be utilized to the full in order to concentrate effort on the decisive object. This mobility is not only a matter of moving quickly from one part of the world to another, but also of the power to use the same machines for many different purposes whether it be over the sea or over the land. The mobility and freedom of action of aircraft confer great potentialities for surprise which must be exploited to the utmost. These same assets may also tend to lead to a dispersal of any available force of aircraft; this is wrong and must be guarded against, concentration of effort is as essential in the air as on land or sea.

The extent to which aircraft can bomb battleships is still a subject of discussion, but there is no doubt that they are able to sink or disable merchant ships, either by bombs or torpedoes Under the Washington Agreement, which has, however, never been ratified, it is laid down that merchant ships must be visited and searched before seizure, and further that they must not be destroyed unless adequate arrangements are made for the safety of the crews. At the present time this agreement is not held to apply to aircraft, but only to fighting ships. Should the agreement eventually be applied to aircraft it would be very difficult for them to act by themselves against merchant shipping, but, as stated above, when considering the bombing of centres of population we cannot be certain that our enemies in another war will comply with any agreement that may be made on the subject In any case, in co-operation with warships aircraft will be of great value, both in scouting for merchant vessels and also in forcing them to heave to until one of their own warships can arrive. They will also possibly act effectively against forts and seriously hamper work in them. Aircraft must, therefore, be regarded as an added danger to overseas communications. On the other hand, experience in the War of 1914–1918 showed that aircraft were very valuable for anti-submarine defence and their mere presence with a convoy was nearly always sufficient to secure it against submarine attack. In 1918 out of 7,000 convoys which had aircraft escort, only six were attacked by submarines.

Aircraft in Tribal Operations.—Aircraft have proved of the utmost value for the control of semi-civilized or uncivilized countries and for carrying out those classes of wars which may be grouped under the term of tribal operations. In the past, when the operations were carried out on the ground, there have been four main difficulties to contend with.—(1) that of movement owing to the absence of roads and railways; (2) that of supply owing to the country being usually barren; (3) that of closing with the enemy owing to his superior mobility; (4) that of acting rapidly. Although but a small force would be needed to defeat the enemy, that force required a line of communications, frequently a long one. This line of communications had to be protected and this generally necessitated a much larger force than was required to defeat the enemy. As a result a large number of men, animals and supplies had to be collected before the operations could commence

All these difficulties are avoided by the use of aircraft. Acting from a secure base they can operate up to 200 miles or more without the need for any line of communications, other than that from their home country to their base, or for any troops to guard one. The nature of the country forms no obstacle to their movement and their speed is far greater than anything the enemy can attempt. Provided, therefore, that the distances are not too great, aircraft are able to act within a few hours, whereas previously the preparations took weeks, or even months. This rapidity of action is an invaluable asset; any rising that takes place in uncivilized countries is usually small and local in the first instance

but if left unchecked will quickly spread. Aircraft can usually nip trouble in the bud. But the value of aircraft lies not only in carrying out tribal operations but in obviating their necessity. It must be remembered that a tribesman usually fights for two reasons; firstly, he is poor and wants loot, secondly, he likes fighting for its own sake provided the odds are in his favour. Aircraft offer him neither of these two allurements. There is no line of communication to raid with the probability of obtaining boots and ammunition, no camps from which to steal camels and rifles, no pickets to be surprised and overwhelmed by superior numbers. All he can do is to fire away valuable ammunition at targets which, if hit, are seldom brought down and even then are useless to him. Again, in the control of a country, ground forces act mainly by occupation. This leads to the establishment of a large number of small posts which are often isolated and difficult to supply, reinforce or relieve. They form tempting objectives to unruly natives. On the other hand, when aircraft control a country there is no need for dispersion and isolation. Because of their potentiality for rapid action at a distance, they can be concentrated in one or two secure spots and still be able to deal with any disturbance in a few hours, either by taking a political officer to confer with the malcontents, by dropping leaflets, by demonstration flights or by actual attack.

Aircraft and Imperial Defence.—We may now apply these generalities to problems of the defence of the British empire. There was a time when Great Britain was exposed to the danger of an invasion and adopted extensive measures of protection Invasion is hardly within the bounds of possibility to-day but Great Britain is exposed to another form of attack from the air In the last war a few desultory raids were carried out on this country, but even then the effects were by no means negligible. The total weight of bombs dropped by aeroplanes on London was under thirty tons, the machines were unsuitable for their job and the *moral* of the squadron that carried out the attacks was low. The casualties, however, amounted to 441 killed and 1,244 injured. Besides this the moral effect was great —for instance, the number of people who took refuge in the tubes increased from 100,000 on Sept. 24, 1917, to 300,000 on Feb. 16, 1918. Serious dislocation was caused to the work on munitions and to railway traffic.

In the future it will be necessary to prepare to face not spasmodic attacks of this nature but determined and serious attacks and these, it must be remembered, will be delivered straight against the heart and brain of the empire and may in themselves form the declaration of war. London is badly situated for defence against aircraft attack. It is close to the coast on the east and south, which means that not only will warnings of impending attacks be very short, but also that the enemy will be able to take advantage of winds to reduce still further the period during which he is obliged to remain over British soil; the time available to the defending squadrons to get off, climb to the necessary height, find and stop the enemy will often be less than twenty minutes. Another added danger lies in attacks of aircraft on merchant shipping. If a map of ocean trade routes be opened and thereon is painted the area within range of foreign aircraft bases, this area will be found to cover most of our trade routes at one point or another. This is particularly impressive in the Mediterranean So far the development of aircraft tends to add to the difficulty of imperial defence—but there is another side to the picture.

Aircraft forms a most effective means of defence against the possibility of overseas invasion. The invading force can be attacked while still many miles out at sea and such attacks are likely to result in severe damage both to transport and to the *moral* of the troops they carry. Again, during the process of disembarkation, ships at anchor and men in open boats, form easy targets to aircraft. In fact it is now generally admitted that landing on a hostile coast is impracticable unless air superiority has first been obtained. It would be difficult to do this unless a land base is first established within easy range of the defenders, since aircraft working from carriers are at a serious disadvantage when opposed to aircraft working from land. It would therefore appear that aircraft forms a most valuable means of coast defence for certain parts of the empire such as Australia. And there is a further point to remember. Guns mounted for coast defence are fixed and immobile. They represent a very large capital expenditure which can be used for no other purpose and may never be required at all. Substitute aeroplanes for guns and we not only have the means of attacking the hypothetical invader at a vastly greater range, but we can use these aircraft for other purposes. A squadron at, say, Singapore may be sent to prevent trouble on the north-west frontier of India and if the situation in the Far East became serious could be moved back to Singapore at short notice.

It would manifestly be expensive to keep enough aeroplane squadrons to meet all possible eventualities in any part of the world and there is no necessity to do so. Aircraft are very mobile; aeroplanes have already flown to every part of the British empire in the eastern hemisphere and all that remains is to develop these imperial air routes that have already been blazed Such an air route from Cairo, through Palestine and 'Iraq to India, and on via Burma to Singapore and Australia, would give possibilities of the utmost value for rapid concentration at any threatened or troublesome spot and such power of concentration would have great deterrent effect against a potential enemy. With another route from Cairo to the Cape, with a branch to Nigeria, the problem of imperial defence and control assumes another aspect. These routes may be regarded as the modern counterparts of the roads which linked up the parts of the Roman empire But to gain value from them we must never look upon aeroplane squadrons as fixed garrisons but as mobile units, located normally at some station but ready to move to any point.

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AIRWAY, an artery of a mine, along which the ventilation is conducted. The districts branching from the fresh air "intakes" are ventilated by "splits" taken off the main airway. The current conducted along the branch or district intakes, round the "working face," returns by the district "return airway," enters the main "return airway" and proceeds thence to the upcast shaft up which it is drawn to the surface by fans. This is the practice in coal-mining in Great Britain. In France the ventilation is generally carried out by compression, that is by fans forcing the air down the "downcast" shaft and through the workings to the "upcast."

The position, number and arrangement of the airways in an ideal coal mine are shown in the figure overleaf, as well as the manner in which the air is "split" for district ventilation. (*See* also COAL-MINING: *Ventilation.*) *See* Diagram overleaf. (R. R)

AIRY, SIR GEORGE BIDDELL (1801–1892), British astronomer royal, was born at Alnwick on July 27, 1801. He was educated at Colchester grammar school and at Trinity college, Cambridge, where he graduated as senior wrangler in 1823. He became a fellow of his college (1824), Lucasian professor of mathematics (1826), and then (1828) Plumian professor of astronomy and director of the new Cambridge observatory. Before long a mural circle was installed, and regular observations were instituted with it in 1833. In the same year the duke of Northumberland presented the Cambridge observatory with a fine object-glass of 12in. aperture, which was mounted according to Airy's designs and under his superintendence, although the erection was not completed until after his removal to Greenwich in 1835. Airy's writings during this time are divided between mathematical physics and astronomy. The former were for the most part concerned

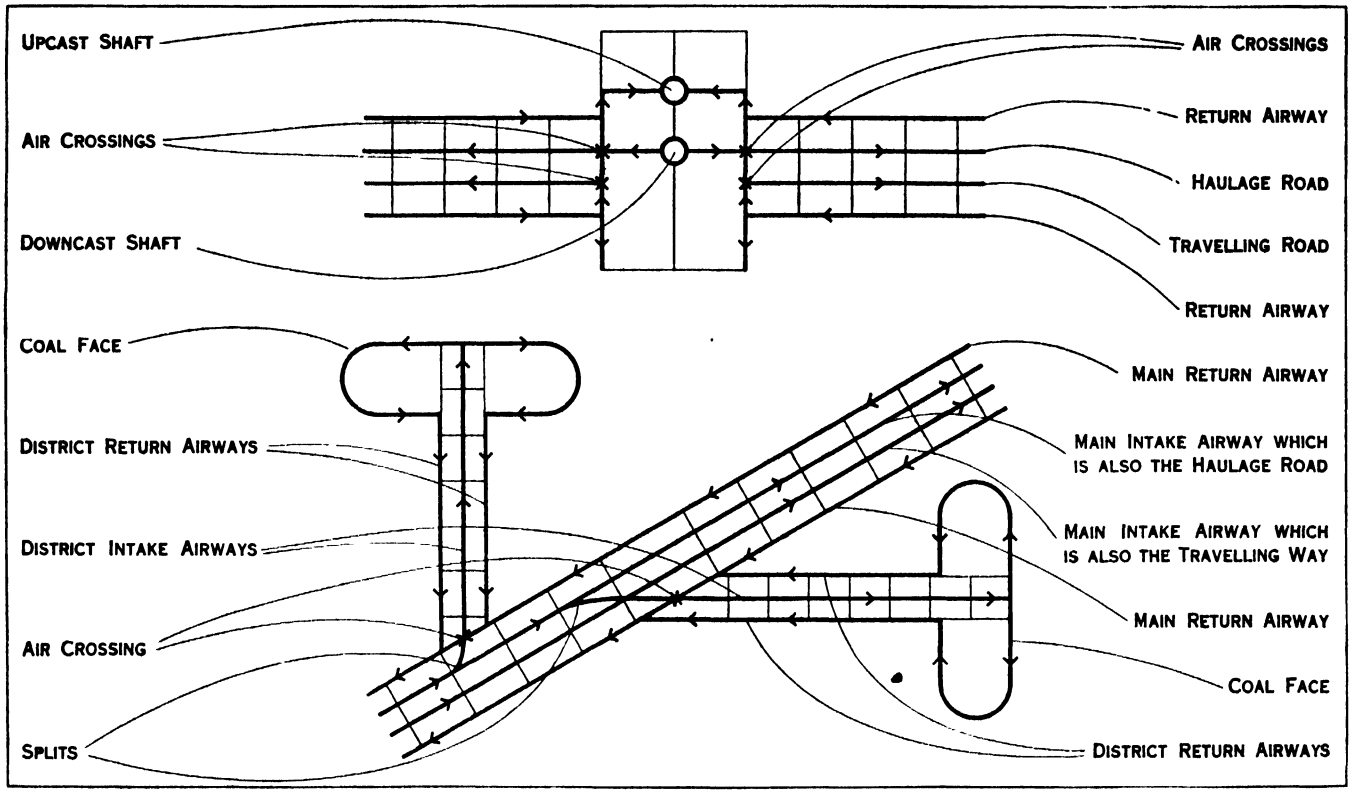


DIAGRAM ILLUSTRATING THE INSTALLATION OF AIRWAYS AND VENTILATING CURRENTS IN MINES—(SEE PAGE 477)

The upper plan shows the shaft pillars and the position of the main airways in the neighbourhood. The lower plan shows the main and district airways. The arrows in both plans indicate the direction of inward and outward air currents which make up the system of ventilation below ground

with questions relating to the theory of light, arising out of his professorial lectures, among which may be specially mentioned his paper "On the Diffraction of an Object-Glass with Circular Aperture." Of his astronomical writings during this period the most important are his investigation of the mass of Jupiter, his report to the British Association on the progress of astronomy during the 19th century, and his memoir *On an Inequality of Long Period in the Motions of the Earth and Venus.*

Airy's discovery of a new inequality in the motions of Venus and the earth was a remarkable achievement. In correcting the elements of Delambre's solar tables he discovered an inequality overlooked by their constructor. Eight times the mean motion of Venus is so nearly equal to 13 times that of the earth that the difference amounts to only the $\frac{1}{240}$th of the earth's mean motion, and from the fact that the term depending on this difference, although very small in itself, receives in the integration of the differential equations a multiplier of about 2,200,000, Airy was led to infer the existence of a sensible inequality extending over 240 years (*Phil. Trans*, cxxii. 07). The investigation leading to this result was probably the most laborious that had been made up to Airy's time in planetary theory, and represented the first specific improvement in the solar tables effected in England since the establishment of the theory of gravitation.

In June, 1835, Airy was appointed astronomer royal in succession to John Pond. Under Airy's administration modern apparatus was installed, and the whole organization placed on a scientific footing. No fewer than 8,000 lunar observations were rescued from oblivion, and were, in 1846, placed at the disposal of astronomers in such a form that they could be used directly for comparison with the theory and for the improvement of the tables of the moon's motion. (*See* HANSEN, PETER ANDREAS.)

One of the most remarkable of Airy's researches was his determination of the mean density of the earth. In 1826 the idea occurred to him of attacking this problem by means of pendulum experiments at the top and bottom of a deep mine. After some failures, successful experiments were made at the Harton pit, near South Shields, in 1854. Their immediate result was to show that gravity at the bottom of the mine exceeded that at the top by $\frac{1}{19,286}$th of its amount, the depth being 1,256ft. From this Airy was led to the final value of 6·566 for the mean density of the earth as compared with that of water (*Phil. Trans.* cxlvi. 342). At the age of 71 Airy embarked on a new method of treating lunar theory. A general description of his method will be found in the *Monthly Notices of the Royal Astronomical Society,* Vol. xxxiv. No. 3. It consisted essentially in the adoption of Delauny's final numerical expressions for longitude, latitude and parallax, with a symbolic term attached to each number, the value of which was to be determined by substitution in the equations of motion. The work was published in 1886, when its author was 85 years of age. In 1881 Sir George Airy resigned the office of astronomer royal and resided at the White house, Greenwich, not far from the Royal observatory, until his death, which took place on Jan. 2, 1892. The learned societies of his own and other countries conferred many honours on him.

BIBLIOGRAPHY.—A list of Airy's papers will be found in his *Autobiography,* edited in 1896 by his son, Wilfrid Airy, B A., M. Inst. C.E. *See* also his *Mathematical Tracts* (1826) *on the Lunar Theory, Figure of the Earth, Precession and Nutation,* and *Calculus of Variations,* to which, in the second edition (of 1828), were added tracts on the Planetary Theory and the Undulatory Theory of Light; *Experiments on Iron-built Ships, instituted for the purpose of discovering a correction for the deviation of the Compass produced by the Iron of the Ships* (1839); *On the Theoretical Explanation of an apparent new Polarity in Light* (1840); *Tides and Waves* (1842).

AISLABIE, JOHN (1670–1742), English politician, born Dec. 7, 1670. He was made chancellor of the Exchequer in 1718, and supported the proposal of the South Sea Company to pay off the national debt. At the collapse of the company he was imprisoned in the Tower with other politicians accused of attempting to profit fraudulently from the scheme, but was soon released, through Walpole's intervention.

AISLE, in architecture, a term primarily meaning the wing of a house, but more commonly used to indicate any long, narrow space separated from the remainder of the building by a line of piers, columns or arches. It is specially used to designate the lateral portions of a church or other large room in which interior supports occur. The term also has come to mean a passageway,

specially a passageway between groups of seats, as in a church or theatre. From the time of the early Christian basilica, the use of one or more side aisles flanking a central nave has been almost universal in church building, and church aisles are known as nave aisles, transept aisles or choir aisles from their position in relation to the nave, transept or choir. The choir aisle around the east end of a choir is known as an ambulatory (*q.v.*). In the normal Romanesque or Gothic church the roof of the aisles is lower than the central nave; but in certain examples in southern France (*e.g.*, St. Nazaire, Carcassonne), in Spain (*e.g.*, Barcelona), and especially in Germany, where for the smaller churches it is almost normal, the nave and aisles are of the same height. A church with nave flanked by one aisle on each side is known as a three-aisle church, one with two side aisles on each side as a five-aisle church, and so on.

AISNE, department, northern France, west of Ardennes (*q.v.*). Area 2,866sq.m Pop. (1926) 488,999. It touches the western end of the Ardennes (930ft.) in the north-east, but its surface is all of secondary or tertiary rocks. The outlying masses of the latter, often with steep flanks, form important sites such as that of Laon, the capital, and the famous *Chemin des Dames.* The Aisne enters the department from the east just as it leaves the chalk scarp and flows west to the Oise, the other river of the department. It has been made to stretch down to include the deep Château-Thierry portion of the Marne valley, too far west to focus on Épernay or Reims and allied to the hill country farther north rather than to Paris on the west. The department was the scene of much of the World War. It had a number of forests, but it lacks metallic ores, though quarries yield building stone, gypsum and clay. Mostly in the belt of rainfall 600–800mm., and well watered and sheltered, it has had great farming prosperity, with specialization in dairying towards the north-east. Of the towns, Guise in the north does agricultural and other engineering and St. Quentin and numerous villages do weaving of cotton, wool and silk. St. Gobain has made mirrors since the 17th century Sugar has been an important crop and industry. Communications are good by rail and by navigable rivers (Aisne, Oise, Marne). St. Quentin, Vervins, Laon and Soissons give their names to arrondissements and are, with Château-Thierry and Hirson (*q v.*), the chief towns. This department and that of Oise were rich in architectural monuments several of which are now ruined, but the churches at Laon, Braine and Urcel (mainly 12th century) have survived the devastation and the splendid *Basilique* of S Quentin has been largely repaired, while the castle-ruin (1400) of La Ferté-Milon has not suffered. Soissons is the seat of a bishop in the province of Reims, the court of appeal is that of Amiens (Somme), which is also the centre of the 2nd Army Corps. The department belongs to the educational province (*académie*) of Douai

Aisne, Battle of the, 1918.—This title is one of several alternatives used to designate the third great German offensive of 1918, launched on May 27, against the Chemin des Dames ridge and rapidly carried across the Aisne and southward to the Marne. It is described under CHEMIN DES DAMES, BATTLE OF THE, 1918.

AÏSSÉ (a corruption of HAIDEE), MADEMOISELLE (*c.* 1694–1733), French letter-writer, was the daughter of a Circassian chief, and was born about 1694. Her father's palace was pillaged by the Turks, and as a child of four years old she was sold to the comte de Ferriol, the French ambassador at Constantinople. She was brought up in Paris by Ferriol's sister-in-law with her own sons, MM. D'Argental and Pont de Veyle. Her great beauty and romantic history made her the fashion, and she attracted the notice of the regent, Philip, duke of Orleans, whose offers she had the strength of mind to refuse. She formed a deep and lasting attachment to the Chevalier d'Aydie, by whom she had a daughter. She died in Paris on March 13, 1733. Her letters to her friend Madame Calandrini contain much interesting information with regard to contemporary celebrities, especially on Mme. du Deffand and Mme. de Tencin, but they are above all of interest in the picture they afford of the writer's own tenderness and fidelity.

Her *Lettres* were edited by Voltaire (1787), by J. Ravenel, with a notice by Sainte-Beuve (1846) and by Eugène Asse (1873). Mlle. Aissé has been the subject of three plays· by A. de Lavergne and P. Woucher (1854), by Louis Bouilhet (1872) and by Dejoux (1898). *See* also Courteault, *Une Idylle au XVIIIe siècle, Mlle. Aissé et le Chevalier d'Aydie* (Maçon, 1900); and notices prefixed to the editions of 1846 and 1873. There is an interesting essay by Sir E. Gosse in his *French Profiles* (1905).

AITKIN, ROBERT GRANT (1864–), American astronomer, was born in Jackson, Calif , on Dec. 31, 1864. He was educated at Williams college, Williamstown, Mass., from which he graduated in 1887 and received the degree of M.A. in 1892 In 1888–91 he was instructor of mathematics in Livermore college, and from 1891 to 1895 he was professor of mathematics and astronomy in the University of the Pacific In 1895 he was appointed astronomer at Lick observatory, Mt. Hamilton, Calif , of which he was made associate director in 1923. Here he specialized in the study of double stars, of which he discovered more than 3,000. For these discoveries he was awarded in 1906 the Lalande prize by the Academy of Sciences of France. His published writings include *Binary Stars* (1918) and numerous articles contributed to astronomical and other scientific journals.

AITON, WILLIAM (1731–93), Scottish botanist, was born near Hamilton in 1731, and died on Feb 2, 1793. As director of Kew Gardens (1759–03) he effected many improvements, and in 1789 he published *Hortus Kewensis,* a catalogue of the plants there cultivated. A second and enlarged edition of the *Hortus* was brought out in 1810–13 by his eldest son, WILLIAM TOWNSEND AITON (1766–1849), who succeeded him at Kew.

AITZEMA, LIEUWE (LEO) VAN (1600–1669), Dutch historian and statesman, was born at Doccum, in Friesland, Nov. 19, 1600, and died at The Hague, Feb. 23, 1669. His most important work was the *Saken van Staet in Oorlogh in ende omtrent de Vereenigte Nederlanden* (1655–71), embracing the period from 1621 to 1668 It contains a large number of state documents, and is an invaluable authority on one of the most eventful periods of Dutch history.

Four continuations of the history, by the poet and historian Lambert van den Bos, were published successively at Amsterdam in 1685, 1688, 1698 and 1699. The *Derde Vervolg Zijnde het vierde Stuck van het Vervolgh op de Historie,* etc., brings the history down to 1697.

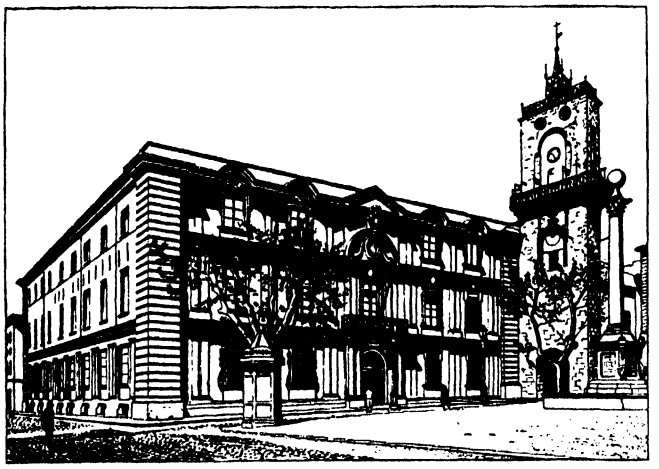
AIVALI, a town on the west coast of Asia Minor (vilayet of Karasi), opposite the island of Mitylene. Pop (1927), 16,744. It stands near the site of the Aeolian *Heraclea,* on rising ground at the end of a bay which is separated from the Gulf of Adramyttium, and protected from the prevailing winds by the Moschonisi islands (*Hecatonnesoi*) It was formerly an exclusively Greek town; the Greek population was "exchanged" for Muslim immigrants in 1924.

AIX, city of south-east France, capital of an arrondissement in the department of Bouches-du-Rhône, 18m. N of Marseille. Pop. (1926) 23,402 It is situated in a plain overlooking the Arc, about a mile from the right bank of the river Aix (*Aquae Sextiae*) was founded in 123 B C, by the Roman consul Sextius Calvinus. In 102 B C it was the scene of the defeat of the Cimbri and Teutones by Marius In the 4th century it became the metropolis of Narbonensis Secunda. Occupied by Visigoths in 477, and repeatedly plundered by Franks and Lombards, it was taken by Saracens in 731. During the middle ages it was the capital of the county of Provence and reached its zenith after the 12th century, when the houses of Aragon and Anjou made it an artistic centre and seat of learning. It passed with Provence to the crown in 1487, and had the parlement of Provence (1501–1789). In the 17th and 18th centuries it was the seat of the *intendance* of Provence.

The Cours Mirabeau divides the town into the new town to the south and the old town to the north. Aix is the seat of the faculties of law and letters of the University of Aix-Marseille. The cathedral of St. Sauveur dates from the 11th, 12th and 13th centuries. It has a rich Gothic portal with elaborately carved doors. The archbishop's palace and a Romanesque cloister adjoin the cathedral on its south side. The church of St. Jean de Malte (13th century), contains valuable pictures. The *hôtel de ville* (17th century) contains fine wood-work and a large library

with valuable mss. Aix has thermal springs, remarkable for their heat and containing lime and carbonic acid; baths have been built (1705) near the site of the Roman baths. The industries include flour-milling, the making of confectionery, the manufacture of hats and the preparation of olive-oil. Trade is in olive-oil, almonds and flour.

The town, which is the seat of an archbishop and court of appeal and the centre of an *académie,* has a court of assizes, tribunal of commerce, and a chamber of arts and manufactures. It



THE SQUARE IN AIX SHOWING THE COURT HOUSE AND CLOCK TOWER

also has museums of antiquities, natural history and painting, and several learned societies.

Aix, Battle of (Aquae Sextiae).—After the Roman disaster at Arausio (*q.v.*) in 105 B.C. the great migration of the Cimbri and Teutones turned aside to Spain, thus enabling Marius (*q.v.*) to gain breathing space to organize and train his "new model" army. But in 102 B.C., returning to Gaul, these tribes moved to invade Italy, the Cimbri going round the north of the Alpine barrier and the Teutones by the Mediterranean coast. On their approach Marius entrenched himself and refused to be drawn out to battle, content to repulse their assault and to acclimatize his men to the sight and ways of their strange and terrifying foe. When the host passed onwards, Marius cautiously followed until on reaching Aquae Sextiae, now Aix, 20m. N. of Marseille, a partial engagement was brought on by the common desire to gain possession of the only available water supply. The Romans were successful and after a two days' pause, Marius judged the moment ripe for battle, having detached a force of 3,000 men to take up a concealed position on the enemy's flank. His cavalry and light infantry were then used to draw out the Teutones to attack, which Marius awaited on the slope of a hill. This first onslaught was stopped with difficulty, but gradually the Romans pressed their assailants downhill. Before the Teutones could reform on the level, they were struck in rear by the flank detachment, and their very numbers then intensified the press and their difficulty. The disaster was so complete that not merely the menace but the tribe itself was dispersed.

See Henry Bordeaux, *La Vallé d'Aix* (1921); M. A. E. Clerc, *Aquae Sextiae* (1916).

AIX-LA-CHAPELLE: *see* AACHEN.

AIX-LA-CHAPELLE, CONGRESSES OF. Three congresses have met at Aix-la-Chapelle—in 1668, in 1748 and in 1818.

1. The treaty of May 2, 1668, which ended the War of Devolution, was the outcome of that of St. Germain signed on April 15 by France and the representatives of the Triple Alliance. The Treaty of Aix-la-Chapelle left to France all the conquests made in Flanders during 1667, with all their *"appartenances, dépendances et annexes,"* a vague provision of which, after the peace of Nimwegen (1680), Louis XIV. took advantage to occupy villages and towns adjudged to him by his *Chambres de réunion* as dependencies of the cities and territories acquired in 1668. On the other hand, France restored to Spain Cambrai, Aire and Saint-Omer, as well as Franche Comté. The Treaty of Aix-la-Chapelle was placed under the guarantee of Great Britain, Sweden and Holland, by a convention signed at The Hague on May 7, 1669, to which Spain acceded.

See Jean du Mont, baron de Carlscroon, *Corps universel diplomatique* (Amsterdam, 1726–31).

2. On April 24, 1748, a congress assembled at Aix-la-Chapelle to end the War of Austrian Succession. The definitive treaty was signed on Oct. 18. Its most important provisions were those stipulating for (1) a general restitution of conquests, including Cape Breton to France, Madras to England and the barrier towns to the Dutch; (2) the assignment to Don Philip of the duchies of Parma, Piacenza and Guastalla; (3) the restoration of the duke of Modena and the republic of Genoa to their former positions; (4) the renewal in favour of Great Britain of the Asiento contract of March 16, 1713, and of the right to send an annual vessel to the Spanish colonies; (5) the renewal of the article of the treaty of 1718 recognizing the Protestant succession in the English throne; (6) the recognition of the emperor Francis and the confirmation of the pragmatic sanction, *i.e.,* of the right of Maria Theresa to the Hapsburg succession; (7) the guarantee to Prussia of the duchy of Silesia and the county of Glatz.

Spain having raised objections to the Asiento clauses, the Treaty of Aix-la-Chapelle was supplemented by that of Madrid (Oct. 5, 1750), by which Great Britain surrendered her claims for a sum of £100,000.

See Comte G. de Garden, *Hist. des traités de paix,* iii. p. 373 (1848–87).

3. The congress or conference of Aix-la-Chapelle in 1818 was primarily a meeting of the four Allied Powers—Great Britain, Austria, Prussia and Russia—to decide the question of the withdrawal of the army of occupation from France and the consequent international relationships of the Powers. The congress, which opened on Oct. 1, was attended by Alexander I. of Russia, Francis I. of Austria, and Frederick William III. of Prussia, in person. Great Britain was represented by Lord Castlereagh and the duke of Wellington, Austria by Prince Metternich, Russia by Counts Capo d'Istria and Nesselrode, Prussia by Prince Hardenberg and Count Bernstorff. The duc de Richelieu, by favour of the allies, was present on behalf of France. The evacuation of France was agreed to in principle at the first session, the consequent treaty being signed on Oct. 9. The rest of the time of the congress was mainly occupied in discussing the form to be taken by the European alliance, and the precautions to be adopted against a fresh outburst on the part of France. The proposal of Alexander I., to establish a "universal union of guarantee" on the broad basis of the Holy Alliance, broke down on the opposition of Great Britain; and the main outcome of the congress was the signature, on Nov. 15, of two instruments: (1) a secret protocol confirming and renewing the Quadruple Alliance established by the treaties of Chaumont and Paris (Nov. 20, 1815) against France; (2) a public "declaration" of the intention of the Powers to maintain their intimate union, of which the object was to preserve peace on the basis of respect for treaties. The secret protocol was communicated in confidence to Richelieu; to the declaration France was invited publicly to adhere.

The congress also concerned itself with the questions of the suppression of the slave trade and the Barbary pirates. In neither case was any decision arrived at, owing (1) to the refusal of the other Powers to agree with the British proposal for a reciprocal right of search on the high seas; (2) to the objection of Great Britain to international action, which would have involved the presence of a Russian squadron in the Mediterranean. A great variety of lesser questions was considered, but an attempt to introduce the subject of the Spanish colonies was defeated by the opposition of Great Britain. The congress represents the highest point reached in the attempt to govern Europe by an international committee of the Powers.

See W. Alison Phillips, *The Confederation of Europe* (2nd. ed. 1919).

(W. A. P.)

AIX-LES-BAINS, thermal spa and fashionable resort, east France, in the department of Savoie, near the Lac du Bourget, 9m. by rail N. of Chambéry. Pop. (1926) 7,891. The sulphur springs were known as *Aquae Gratianae* by the Romans, and the



BY COURTESY OF THE ARCHAEOLOGICAL DEPARTMENT OF HYDERABAD

FRESCO PAINTING OF THE BODHISATTVA, VAJRAPANI, A DIVINE-HUMAN BEING ARMED WITH A THUNDERBOLT, FROM THE CAVES OF AJANTA

The illustration was taken from Cave I. There are about 30 caves excavated in the south side of the bank of the ravine of the river Wagura, some three and a half miles from Ajanta, India, which were used as dwellings and meeting-halls by the Buddhist Order from 200 B.C. to the seventh century A.D. Many of the interior walls of these caves are covered with fresco paintings, which are very decorative. These have been preserved and form an important body of evidence of pre-Hindu art in India

neighbourhood has numerous ancient remains. Over 50,000 visitors are attracted annually; the main season is July–September, but Aix also serves as a base for Alpine winter sports.

AIYAR, SIR SHESHADRI (1845–1901), Indian statesman, the son of a Brahman of Palghat, Malabar, rose from a humble position as translator in his native district to be prime minister of Mysore under the Maharaja Chamarajendra. To him Mysore owes many important public works and the development of the Kolar gold-fields. Aiyar retired in 1900 and died on Sept. 13, 1901.

AIYAR, SIR TIRUVARUR MUTUSWAMY (1832–1895), native Indian judge of the high court of Madras, was born of poor parents in the village of Vuchuwadi, near Tanjore, on Jan. 28, 1832. His widowed mother was forced by poverty to remove with Mutuswamy and his brother to Tiruvarar, where the former learnt Tamil, and soon set to work under the village accountant at a monthly salary of one rupee. Aiyar worked his way through a series of minor offices until he was able to take his degree in law. He then became a judge of the Madras small causes court, and in 1878 he was raised to the bench of the high court, which office he occupied with ability and distinction for over fifteen years, sometimes acting as the chief justice. He attended by invitation of the viceroy the imperial assemblage at Delhi in 1877. In 1878 he received the honour of C.I.E. and in 1893 the K.C.I.E. was conferred on him. He died suddenly in 1895. Aiyar took his full share in the affairs of the Madras university, of which he was nominated a fellow in 1872 and a syndic in 1877, and was well acquainted with English law, literature and philosophy. He was through life a staunch Brahman, devout and amiable in character, with a taste for the ancient music of India and the study of the Vedas and other departments of Sanskrit literature.

AJACCIO, capital of Corsica, on the west coast of the island. Pop. (1926) 20,797. Ajaccio occupies a sheltered position at the foot of wooded hills on the north shore of the Gulf of Ajaccio. The harbour, to the east, is protected on the south by a peninsula which carries the citadel. To the south-west of this peninsula lies the Place Bonaparte, frequented by winter visitors attracted by the mild climate. Apart from one or two fine thoroughfares, the streets are narrow and the town has a deserted appearance. The present town of Ajaccio lies about two miles to the south of its original site, from which it was transferred by the Genoese in 1492. Occupied in 1553 by the French, it again fell to the Genoese after the treaty of Cateau Cambrésis in 1559. The town finally passed to the French in 1768. Since 1810 it has been the capital of the department of Corsica. The associations of Napoleon I. with the town are everywhere emphasized by street-names and statues. The town is the seat of a bishopric (7th century) and of a prefect. It has tribunals of first instance and of commerce and a museum. Ajaccio makes cigars and macaroni and carries on shipbuilding, sardine-fishing and coral-fishing. Its exports include timber, citrons and skins.

AJAIGARH, an Indian state in Bundelkhand, under the Central India agency. It has an area of 802sq m., and a population in 1921 of 84,790. The chief, who is a Bundela Rajput, bears the title of sawai maharaja and has a salute of eleven guns. He resides at the town of Naushahr, at the foot of the hill-fortress of Ajaigarh, from which the state takes its name. This fort is situated on a very steep hill, more than 800ft. above the town, and contains the ruins of temples with elaborate sculptures.

AJANTA (more properly Ājūnthā), a village in the dominions of the Nizam of Hyderabad in India, celebrated for its cave hermitages and halls, in a wooded and rugged ravine about 3½m. from the village. The ravine is that of the river Wâgura which falls from the east over a bluff forming several waterfalls. The caves, about 30 in number, are excavated in the south side of the precipitous bank of the ravine, and are of two kinds—dwelling-halls and meeting-halls. The former have a broad verandah, its roof supported by pillars, and giving towards the interior on to a hall averaging in size about 35ft. by 20ft. Dormitories are excavated opening on to this hall, and an image of the Buddha usually stands in a niche facing the entrance. In the larger caves pillars support the roof on all three sides, forming a sort of cloister running round the hall. The meeting-halls which back into the rock about twice as far as the dwelling-halls, were used as chapter-houses for the meetings of the Buddhist Order. The oldest caves date from 200 B.C. to A.D. 200, the next belong approximately to the 6th, and the youngest to the 7th century A.D. Most of the interior walls of the caves are covered with fresco paintings, of considerable merit, and somewhat in the early Italian style. When first discovered, in 1817, these frescoes were in a fair state of preservation, but they fell later into decay. The remains are now properly preserved, and form, with copies of those destroyed, important evidence as to pre-Hindu art in India. Ajanta was a kind of college monastery.

AJAX (I.) *the Greater* Gr. Aîas, son of Telamon, king of Salamis. In Homer's *Iliad* he is described as of great stature and colossal frame, second only to Achilles in strength and bravery. He engaged Hector in single combat and, with the aid of Athene, rescued the body of Achilles from the hands of the Trojans. In the competition between him and Odysseus for the armour of Achilles, Agamemnon, at the instigation of Athene, awarded the prize to Odysseus. This so enraged Ajax that it caused his death (*Odyssey,* xi. 541). According to a later and more definite story, accepted by Sophocles as the basis of his drama, his disappointment drove him mad; he rushed out of his tent and fell upon the flocks of sheep in the camp under the impression that they were the Greeks; on coming to his senses he slew himself with the sword which he had received as a present from Hector. From his blood sprang a red flower (*see* HYACINTHUS) which bore on its leaves the initial letters of his name AI, also expressive of lament (Pausanias i. 35. 4.). He was the tutelary hero of the island of Salamis, where he had a temple and an image, and where a festival called *Aianteia* was celebrated in his honour (Pausanias i. 35).

II., *the Lesser,* son of Oïleus, king of Locris, called the "lesser" or Locrian Ajax, to distinguish him from the son of Telamon. In spite of his small stature, he held his own amongst the other heroes before Troy; he was brave, next to Achilles in swiftness of foot, and famous for throwing the spear. But he was boastful, arrogant, and quarrelsome. Athena wrecked his ship on his homeward voyage (*Odyssey,* iv. 499), presumably for his crime (not definitely mentioned by Homer) in dragging Cassandra from the statue of the goddess, during the sack of Troy, and violating her. This led to the thousand years' penance of his people; nevertheless, he was worshipped as a national hero by the Opuntian Locrians (on whose coins he appeared), who always left a vacant place for him in their battle line.

See articles in Roscher's *Lexikon* and Pauly-Wissowa, *Realencyklopädie;* L. R. Farnell, *Hero-Cults,* pp. 293 *et seq.* and 305 *et seq.*

AJMERE or **AJMER,** a city of British India in Rajputana, which gives its name to a district and also to a petty province called Ajmere-Merwara. It is situated on the lower slopes of Taragarh Hill, in the Aravalli mountains. To the north of the city is a large artificial lake called the Ana Sagar, and farther up the valley is a new lake, the Foy Sagar, from which the water supply of the place is now derived.

The chief object of interest is the *darga,* or tomb of the famous Mohammedan saint Muin-ud-din Chishti. It is situated at the foot of the Taragarh hill, and consists of a block of white marble buildings without much pretension to architectural beauty. To this place the emperor Akbar, with his empress, performed a pilgrimage on foot from Agra in accordance with the terms of a vow he had made when praying for a son. An ancient Jain temple converted about A.D. 1200 into a mosque, is situated on the lower slope of the Taragarh hill. With the exception of that part used as a mosque, nearly the whole of the ancient temple has fallen into ruins, but the relics are not excelled in beauty of architecture and sculpture by any remains of Hindu art. Forty columns support the roof, but no two are alike, and great fertility of invention is manifested in the execution of the ornaments. The summit of Taragarh hill, overhanging Ajmere, is crowned by a fort, the lofty thick battlements of which run along its brow and enclose the tableland. The walls are 2m. in circumference, and the fort can only be approached by steep and very roughly paved planes,

commanded by the fort and the outworks, and by the hill to the west. Ajmere was founded about the year A.D. 145 by Ajaipal, a Chauhan, who established the dynasty which continued to rule the country (with many vicissitudes of fortune) while the repeated waves of Mohammedan invasion swept over India, until it eventually became an appanage of the crown of Delhi in 1193. Its internal government, however, was handed over to its ancient rulers upon the payment of a heavy tribute to the conquerors. It then remained feudatory to Delhi till 1365, when it was captured by the ruler of Mewar. Akbar took it back in 1556; and it continued in the hands of the Moguls, with occasional revolts, till 1770, when it was ceded to the Mahrattas, from which time up to 1818 the unhappy district was the scene of a continual struggle, being seized at different times by the Mewar and Marwar rajas, from whom it was so often retaken by the Mahrattas. In 1818 the latter ceded it to the British in return for a payment of 50,000 rupees.

The modern city (pop. 113,512 in 1921) is an important administrative and railway centre. It is well laid out with wide streets and handsome houses. The city does an active trade in salt which is imported in large quantities from the Sambar lake and Ramsur. Oil-making is also a profitable branch of trade. Cotton cloths are manufactured to some extent, for the dyeing of which the city has attained a high reputation. The educational institutions include the Mayo Rajkumar college, opened in 1875, for training the sons of the nobles of Rajputana, on the lines of an English public school. Seven miles from Ajmere lies the lake of Pushkar, one of the most sacred pieces of water in India, where a pilgrim fair is held every autumn, and Brahma has the only temple dedicated to him in India.

The district of Ajmere, which forms the largest part of the province of Ajmere-Merwara, has an area of 2,125 square miles. The population in 1921 was 378,960, inclusive of Ajmere city. Besides the city of Ajmere, the district contains the military station of Nasirabad, with a population of 19,651.

AJMERE-MERWARA, a division or petty province of British India, in Rajputana, consisting of the two districts of Ajmere and Merwara, separated from each other and isolated amid Indian States. The administration is in the hands of a commissioner, subordinate to the governor-general's agent for Rajputana. The capital is Ajmere city. The area is 2,599sq.m. The Aravalli range is the distinguishing feature of the district. The range of hills which runs between Ajmere and Nasirabad marks the watershed of the continent of India. The rain which falls on one side drains into the Chambal, and so into the Bay of Bengal; that which falls on the other side, into the Luni, which discharges itself into the Runn of Cutch. The province is on the border of what may be called the arid zone; it is the debatable land between the north-eastern and south-western monsoons, and beyond the influence of either. The south-west monsoon sweeps up the Nerbudda valley from Bombay and crossing the tableland at Neemuch gives copious supplies to Malwa, Jhalawar and Kotah and the countries which lie in the course of the Chambal river; but it is only when the monsoon is in considerable force that Merwara gets a plentiful supply from it. The north-eastern monsoon sweeps up the valley of the Ganges from the Bay of Bengal and waters the northern part of Rajputana, but hardly penetrates farther west than the longitude of Ajmere. The agriculturist in Ajmere-Merwara can thus rarely rely upon two good harvests in succession. A province subject to such conditions can hardly be free from famine or scarcity for any length of time; and the pop. in 1921 (448,078) was actually lower than it had been 30 years earlier. Among Hindus, the Rajputs are land-holders, and the Jats and Gujars are cultivators. The Jains are traders and money-lenders. The aboriginal tribe of Mers are divided between Hindus and Mohammedans. The chief crops are millet, wheat, cotton and oil-seeds. There are several factories for ginning and pressing cotton, the chief trading centres being Beawar and Kekri.

AJODHYA, an ancient city of India, situated on the right bank of the Gogra, in the Fyzabad district of the United Provinces. In remote antiquity Ajodhya was one of the largest and most magnificent of Indian cities. It is said to have covered an area of 96 sq.m., and was the capital of the kingdom of Kosala, the court of the great king Dasaratha, who was the father of Rama, the hero of the *Ramayana.* The opening passages of that epic recount the magnificence of the city, the glories of the monarch and the virtues, wealth and loyalty of his people. A period of Buddhist supremacy followed the death of the last king of the Solar dynasty. On the revival of Brahmanism, Ajodhya was restored by King Vikramaditya (*c.* 57 B.C.). Kosala has claims to be the birthplace of the founders of both Buddhism and Jainism. The Chinese traveller, Hsüan Tsang, in the 7th century, found 20 Buddhist temples with 3,000 monks at Ajodhya among a large Brahmanical population. The ancient city is now represented by a heap of ruins, with a few fine temples, and the modern town is only a small suburb of Fyzabad.

AKA HILLS, a tract of country on the north-east frontier of India, occupied by an independent tribe called the Akas. It lies north of the Darrang district of eastern Bengal and Assam, and is bounded on the east by the Dafla Hills and on the west by independent Bhutia tribes. The Aka country is very difficult of access, the direct road from the plains leading along the precipitous channel of the Bhareli river, which divides the Aka from the Dafla country. The Akas are a brave people, and the men are strong and well-made. They have clans graded socially, a dual organization and burial of the dead. They worship the Bhareli river annually, poison their arrows with aconite and play both varieties of nose flute. Their reputation as raiders is sufficiently shown in the division of the tribe into two clans, the Hazari-khoas or "eaters of a thousand hearths," and the Kapah-chors or "thieves that lurk in the cotton fields." In the early years of British occupation, about 1829, they gave much trouble; and in 1883 they broke out once more into their old habits. They raided into the British district of Darrang and carried off several native forest officers as hostages. An expedition was sent against them under Gen. Sale Hill with 860 troops, which was completely successful. Living among them as a labouring but not servile class is the Niggiya or Khoa tribe divided into four clans.

See Nevill, "The Akas," *Assam Census Report,* 1921, I. App. B. i.

AKALKOT, a native State of India, in the Deccan division of Bombay, ranking as one of the Satara Jagirs, in the Sholapur agency. It forms part of the Deccan table-land, and has a cool climate. Area 498sq.m.; pop. (1921) 81,250, a decrease of 9% in the decade, balanced by a similar increase in 1901–11. The tribute is £1,000. The State is under British management.

The town of Akalkot is situated near the Great Indian Peninsula railway, which traverses the State. Pop. (1921) 9,189.

AKAN, a Gold Coast tribe inhabiting the Koforidua district of the Accra hinterland, neighbours of the Fanti and Ashanti, with whom they probably share a common origin, their language being closely related to these two idioms, and their organization being the same.

See Sarbah, *Fanti Customary Law* (1904).

AKBAR, JELLALADIN MOHAMMED (1542–1602), the greatest and wisest of the Mogul emperors of India. He succeeded to the throne in 1556, but his position was not an enviable one. He was under the regency of Bairam Khan, a despotic Turkoman noble, until in 1560 he took the government into his own hands. The first seven years of his reign were entirely occupied by warfare; he established his authority in the Punjab and in the districts of Delhi and Agra. In 1567 he assaulted Chitor and conquered Ajmere, and three years later he obtained possession of Oudh and Gwalior. In 1572 he conquered Gujarat and made the province a Mogul viceroyalty; his generals drove the Afghans from Bengal, and six years later Orissa was annexed. By 1594 Akbar had further annexed Kabul, Kashmir, Sind and Kandahar. Having now a far greater part of India under his sway than had ever owed allegiance to one ruler, he did not rest, but attacked the Deccan, seizing Berar.

Great as he was as a conqueror, Akbar is chiefly remembered for his wonderful administrative ability. In order that taxation should be on a sound basis, he instituted accurate surveys and fought extortion. He developed commerce and invented a feudal organization, whereby tributary rajas took their places by the side

of his own Mogul nobles in military matters. He examined carefully all the religious beliefs of his varied subjects, and finally adopted for himself a pure deism which, so far from militating against individual creeds, embraced them all. He gained for himself the title "Guardian of Mankind" for his toleration and wide sympathies. A munificent patron of the arts, he established schools throughout the empire where, without discrimination, Hindus, Muslims and Parsis might study together. Abu'l Fazl (*q.v.*), one of the scholars surrounding Akbar at the court, wrote a splendid record of the emperor's reign (*Akbar Nameh*).

For the general history of his reign *see* INDIA, *History; see* also G. B. Malleson, *Akbar*, "Rulers of India" series (1890).

AKCHA, a town and khanate of Afghan Turkistan, 42m. W. of Balkh on the road to Andkhui. It is protected by a mud wall and a citadel. Estimated population 8,000, chiefly Uzbegs. The khanate is small, but well watered and populous. The rivers which rise in the southern mountains no longer reach the Oxus, but end near Akcha in vast swamps filled in flood time with débris of hillside plants.

AKEE, the West African name of a small tree (*Blighia sapida*) of the soapberry family (Sapindaceae), native to Guinea, and also of its important food fruit. Introduced in 1778 into Jamaica, which now exports the fruit, its cultivation has spread throughout most of tropical America. The shrub-like, stiff-branched tree, sometimes 20 ft. to 30 ft. high, bears handsome red or orange-coloured fruits, about 3 in. long, in small clusters at the tips of slender branches. The fruit, which is a soft-walled capsule, splits when ripe into three sections, from apex to base, displaying round, shining, black seeds, attached to the base by large whitish or yellowish fleshy arils. When cooked the arils resemble a fine omelette in taste and appearance; the Latin-American name *seso vegetal* (vegetable brain) being significant of their form.

AKEMAN STREET: *see* ROMAN ROADS.

AKEN, a town of Germany on the Elbe in the south-east of the district of Magdeburg, Prussian Saxony Pop. (1925) 9,493. Chemicals and oils are manufactured. There is considerable transit trade on the Elbe, and petrol storage.

AKENSIDE, MARK (1721–1770), English poet and physician, was born at Newcastle-on-Tyne. He was the son of a butcher, and was slightly lame all his life from a wound he received as a child from his father's cleaver. He was sent (1739) to Edinburgh to study theology with a view to becoming a minister, but in fact studied medicine, and seems to have drifted to a mild deism. His politics, says Dr. Johnson, were characterized by an "impetuous eagerness to subvert and confound, with very little care what shall be established," and he is caricatured in the republican doctor of Smollett's *Peregrine Pickle*. He had already acquired a considerable literary reputation when he came to London, about the end of 1743, and offered his *Pleasures of the Imagination* to Dodsley for £120. Dodsley thought the price exorbitant, and only accepted the terms after submitting the ms. to Pope, who assured him that this was "no everyday writer." The three books of this poem appeared in Jan. 1744. It was translated eventually into German, French and Italian, and gained a general success.

Akenside had taken a medical degree at Leyden and then tried to establish himself in medical practice at Hampstead. His lifelong friend, Jeremiah Dyson, took a house there, and did all he could to further his friend's interest in the neighbourhood; but Akenside's arrogance and pedantry frustrated these efforts, and Dyson then took a house for him in Bloomsbury square, making him independent of his profession by an allowance which enabled him to "keep a chariot," and to live "incomparably well." In 1746 he wrote his much-praised "Hymn to the Naiads," and began to contribute to Dodsley's *Museum, or Literary and Historical Register*. He was now 25 years old and began to devote himself almost exclusively to his profession. He was an acute and learned physician. In Jan. 1759 he was appointed assistant physician, and two months later principal physician to Christ's Hospital, but he was charged with harsh treatment of the poorer patients. At the accession of George III. both Dyson and Akenside changed their political opinions, and Akenside's conversion to Tory principles was rewarded by the appointment of physician to the queen. Dyson became secretary to the Treasury, lord of the Treasury, and in 1774 privy councillor and cofferer to the household.

Akenside died on June 23, 1770, at his house in Burlington street, where the last ten years of his life had been spent. He left all his effects and his literary remains to Dyson, who issued an edition of his *Poems* in 1772. This included the revised version of the *Pleasures of Imagination* on which the author was engaged at his death. The ideas embodied in this work were largely borrowed from Addison's essays on the imagination and from Lord Shaftesbury. Professor Dowden complains that "his tone is too high-pitched; his ideas are too much in the air; they do not nourish themselves in the common heart, the common life of man." Dr. Johnson praised the blank verse of the poems, but found fault with the long and complicated periods. The odes are dignified and often musical, while the few "inscriptions" are felicitous in the extreme.

See Dyce's *Life of Akenside* prefixed to his edition of the *Poetical Works* (1835); also Johnson's *Lives of the Poets*, and C. Bucke, *Life, Writings and Genius of Akenside* (1832).

AKHALTSIKH, a town in the Georgian S S R. It is situated in 41° 40′ N. and 42° 55′ E. at an altitude of 3,375ft. on a tributary of the Kura river. The new town is on the right bank, the old on the left Pop. (1926) about 15,000. It was the capital of Turkish Armenia from 1579 until it was captured by the Russians in 1828. There is trade in silk, honey and wax. Brown coal is found in the district. Its silver filigree work is famous. It is on the trade route to Turkey for caravans, but it has no railway communications.

AKHENATEN: *see* IKHNATUN.

AK-HISSAR (anc. THYATEIRA, the "town of Thya"), a town situated in a fertile plain on the Gürduk Chai (Lycus), in the Sarnkhan vilayet, 58m. N.E of Smyrna. Pop. (1927), 47,716. Thyateira was an ancient town re-peopled with Macedonians by Seleucus about 290 B.C. It became an important station on the Roman road from Pergamum to Laodicea, and one of the "Seven Churches" of Asia (Rev. ii. 18), but was never a *metropolis* or honoured with a neocorate, though made the centre of a *conventus* by Caracalla. The modern town is connected with Smyrna by railway, and exports cotton, wool, opium, cocoons and cereals. Cotton of excellent quality is grown in the neighbourhood, and the place is celebrated for its scarlet dyes.

See W. M. Ramsay, *Letters to the Seven Churches* (1904); M. Clerc, *De rebus Thyatirenorum* (1893).

AKHMIM, a town of Upper Egypt, on the right bank of the Nile, 67m by river south of Asyut, and 4m. above Suhag, on the opposite side of the river. It has several mosques and two Coptic churches, maintains a weekly market, and manufactures cotton goods, notably the blue shirts and check shawls with silk fringes worn by the poorer classes of Egypt. Outside the walls are the scanty ruins of two ancient temples. In Abulfeda's days (13th century A D) a very imposing temple still stood here. Akhmim was the Egyptian Apu or Khen-min, in Coptic Shmin, known to the Greeks as Chemmis or Panopolis, capital of the 9th or Chemmite nome of Upper Egypt. Herodotus mentions the temple dedicated to "Perseus" and asserts that Chemmis was remarkable for the celebration of games in honour of that hero, after the manner of the Greeks, at which prizes were given; but it is possible that he confused Coptos (*q.v.*) with Chemmis. Strabo mentions linen-weaving as an ancient industry of Panopolis, and it is not altogether a coincidence that the cemetery of Akhmim is one of the chief sources of the beautiful textiles of Roman and Coptic age that are brought from Egypt. Monasteries abounded in this neighbourhood from a very early date. Nonnus, the Greek poet, was born at Panopolis.

AKHTAL (ahch-tahl′) (GHIYATH IBN HARITH) (*c.* 640–710), Arabian poet of the Omayyad period, belonged to the tribe of Taghlib in Mesopotamia, and was, like his fellow tribesmen, a Christian, enjoying the freedom of his religion, while not taking its duty very seriously. Akhtal, Jarir and Ferazdaq form a trio celebrated among the Arabs, but as to relative superiority there is dispute. Abu 'Ubaida placed him highest of the three on

the ground that amongst his poems there were ten flawless *qasidas* ("elegies"), and ten more which were nearly so, and that this could not be said of the other two poets.

See *Diwan de Aḫṭal Reproduction photolithographique du manuscrit de Bagdad, avec préface et variantes* par le P. A. Salhani (Beirut, 1905); *Le Dîwân d'al-Aḫṭal reproduit par la photolithographie s'après un manuscrit trouvé au Yemen, avec préface, glossaires . . .* par le Dr. Eugenio Griffini (Beirut, 1907). A full account of the poet and his times is given in H. Lammens' *Le chantre des Omiades* (Paris, 1895) (a reprint from the *Journal Asiatique* for 1894).

AKHTYRKA, a town in the Ukrainian S.S.R. It is situated in 50° 20′ N. and 34° 52′ E. near the Vorskla river, on the railway from Kiev to Kharkov. Its beautiful cathedral, built in 1753, was designed by Rastrelli. It is a trade centre for fruit, sugar-beet, corn, cattle and domestic woollen industries. It was founded by Poles in 1642. Pop. (1926) 30,000.

AKKA (TIKKI-TIKKI), a race of African pygmies first seen by the traveller G. A. Schweinfurth in 1870, in the Mangbettu country, north-west of Albert Nyanza. The home of the Akka is the dense forest zone of the Aruwimi district of the Congo State. They form a branch of the primitive pygmy negroid race, and appear to be divided into groups, each with its own chief. The average height of the race would seem to be somewhat under 4ft. They are of the colour of coffee slightly roasted, with hair almost the same colour, woolly and tufted; they have very projecting jaws, flat noses and protruding lips. An abdominal protuberance makes all Akka look like pot-bellied children, and the spine hollows into a curve like an **S**. These characteristics tend to disappear. There is a tendency to steatopygia among the women. They are nomads, hunt game in the forests with poisoned arrows, with pitfalls and springs set everywhere, and with traps. They collect ivory and honey, manufacture poison, and exchange these for cereals, tobacco and iron weapons. In dress, weapons and utensils they are as the surrounding negroes. They build round huts of branches and leaves in the forest clearings.

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AKKAD (the country, for the town sometimes called Akkad; *see* under AGADE), northern Babylonia. The alluvial part of Mesopotamia was known in ancient times as Sumer and Akkad. Akkad was the narrow strip of land where the rivers approached one another most closely, and included the cities of Opis, Kish, Babylon, Sippar, Borsippa and Cutha. For details *see* MESOPOTAMIA: *Ancient Geography,* and under the cities named.

AKKADIAN: *see* ACCADIAN.

AKKERMAN, a town in Rumania (*see* CETATEA ALBA).

AKMOLINSK, a province of Kazak (Kirghiz) A.S.S.R. The boundaries are, north, the Ural area; east, Semipalatinsk; south, Syr Daria; west, Aktyubin and Kustanai provinces. Area 243,990 sq.km. Pop. (1926) 287,641; urban 12,770, rural and nomad 274,871. In the north the province is dotted with salt lakes, sloping south to a plateau (1,600ft.), to the east of which is a spur formed by the dying out of the Tarbagatai range containing gold, copper and coal. The Spassky copper mines are in the province and were re-started in 1925; near them are the Karagandinask coal beds, estimated at 6,000 million tons; the two are connected by rail, but are not yet linked to the main railway (1927). When this is done, the area will probably develop into an industrial centre. The south-east is a wide, waterless desert, the Bak-pak-dala or Hunger steppe. The climate is dry and continental, the rainfall (average 8–16in.) is mostly in heavy thunderstorms, moistening the surface only. Dry, strong north-east winds, dusty in summer, prevail all the year, in winter as the Buran gale, sweeping the snow away and exposing the ground to five months of frost. At Akmolinsk city (average temperature January 1·5° F., July 70° F.; yearly rainfall 9in.), south of latitude 50°, the steppe is salty soil, with sparse wormwood, blue grey grass, and plants with drought-resisting devices, hairs, pungent oils, thick leaves, etc., and animals such as suslik, hamster, jerboa and, rarely, saiga antelope. North of latitude 50° there is more moisture and better soil; in spring it is gay with tulips, irises, etc.; and in summer with white feather grass. The southern part of this area is inhabited by Kirghiz (in the Chu valley). The nomad Kara Kirghiz rear sheep, horses, camels, cattle and goats, following the pasture. Near the northern boundary of the province, wheat and barley are successfully grown, and the population consists mainly of Russian peasants. Petropavlovsk (*q.v.*) is the chief administrative centre, on the Ishym river. The town of Akmolinsk, on the Ishym river, is on the caravan routes from Tashkent and Bukhara to the north.

AKOLA, a town and district of India, in Berar, otherwise known as the Hyderabad Assigned Districts. The town is on the Murna tributary of the Purna river, Akola proper being on the west bank, and Tajnapeth, containing the Government buildings and European residences, on the east bank. It had a pop. (1921) of 37,864. It is walled, and has a citadel built in the early years of the 19th century. Akola is one of the chief centres of the cotton trade in Berar, and has numerous ginning factories and cotton presses. Among the educational establishments are a Government high school, and an industrial school supported by a Protestant mission.

The District of Akola as reconstituted in 1905 has an area of 4,110sq m., the population of this area in 1921 being 798,544. The surface of the country is generally flat, the greater part being situated in the central valley of Berar On the north it is bounded by the Melghat hills. By the addition of Basim and Mangrul *taluks* in 1905, the district includes the eastern part of the Ajanta hills, with peaks rising to 2,000ft., and the tableland of Basim. North of the Ajanta hills the country is drained eastward by the Purna affluent of the Tapti and its tributaries. The average temperature at the town of Akola in May for the 25 years ending 1901 was 94·4° F. But even during the hot season the nights are cool. The annual rainfall averages 34in. In the Purna valley the soil is everywhere a rich black loam particularly suitable to cotton, and nearly the whole of the land is cultivated. The history of Akola is not distinguished from that of the other portions of Berar.

AKRON, a city of Ohio, U.S.A., 35m. S.-by-E. of Cleveland, on the Little Cuyahoga river; the county seat of Summit county. It is about 1,000ft. above sea-level, on one of the highest spots in the State, whence its Greek name. The surrounding country is hilly and there are 20 lakes within 12m. of the city. On its northern boundary the Big Cuyahoga river flows through a gorge of great beauty, spanned by High Level bridge. The main approach from the north and east is by the North Hill viaduct, 135ft. high and 2,810ft. in length. Akron is served by the Baltimore and Ohio, the Erie, the Pennsylvania, and the Akron, Canton and Youngstown railways. A belt line encircles the industrial section. A municipal airport is projected. The Ohio canal, abandoned by commercial traffic, supplies water to some of the industries from lakes south of the city, and serves as a pleasure route to the Portage Lake State park near by. The city covers 25·3 sq. miles. Its population in 1920 was 208,435, of whom 5,580 were negroes and 38,021 foreign born; in 1926 a local census gave the population as 209,572.

The important period in Akron's history began about 1910. The town had been settled about 1825 and incorporated as a village in 1836; had become the county seat in 1842, and had been chartered as a city in 1865. Through the 19th century it had a normal gradual development, due at first to its position on the Ohio canal, later to the completion of the railway which is now the Erie, and still later to the manufacture of clay products and rolled oats. The pioneer rubber factory was established by Dr. B. F. Goodrich in 1869, and others came into existence with the extension of the uses of rubber for bicycle tyres, heels and soles, beltings for machinery, elastic stockings, insulated wire and many other purposes. By 1900 the population had increased to 42,728, and in 1910 it was 69,067.

Then began a phenomenal growth. Between 1910 and 1920 the population of the city tripled. The aggregate value of its manufactured products rose from $73,158,000 in 1909 to $558,962,000 in 1919; the average number of wage-earners in the factories

increased from 15,831 to 65,054. Postal receipts were quadrupled. All this was due chiefly to the demand for tires and other rubber products by the automobile industry. Akron's 20 rubber factories have 500ac. floor area and produce 30,000 articles, ranging from rubber bands to balloons and dirigibles, and including a daily output of 125,000 automobile tyres. They use about half of all the crude rubber imported into the United States, or nearly 40% of all produced in the world.

The older industries (oatmeal, matches and sewer-pipes) are still important. The town produces also puffed grains for breakfast foods, chemical stoneware, porcelain insulators, toy marbles and porcelain moulds for rubber articles. During the World War more than 1,000 air-craft were built by Akron companies, and the city is a centre for the production of the lighter-than-air variety. Fishing tackle, rubber-factory equipment, steel automobile rims, sewer-pipe and well-drilling machinery are other characteristic products. Salt and sulphur are refined, and zinc oxide is produced.

The abnormal growth was arrested by the general business depression of 1920–21, but by 1923 recovery was well under way. In 1925 the value of the factory products ($569,296,458) exceeded the high figure of 1919.

The rapid industrial development stimulated progress in other directions. Expenditures by the city for health and sanitation increased from $53,231 in 1910 to $444,865 in 1925; for education from $277,454 to $2,744,150. A municipal water system and a sewage-treatment plant were provided at a cost of $14,750,000, and an imposing municipal building was erected. Experts surveyed the public school system (1917) and prepared a city plan (1919). A city planning commission created in 1920 secured the adoption of a zoning ordinance in 1922. A large park and municipal golf links were presented to the city in 1924, bringing the total area in its 26 parks to 475 acres. From 1920 the charitable agencies were jointly financed by a "community chest" operated by the Better Akron Federation.

The University of Akron, which is a part of the free public-school system of the city, was created in 1913, when the city council accepted, as a nucleus, the plant and endowment of Buchtel college, which had been founded in 1870 and named after its chief benefactor, John R. Buchtel (1822–92), a business man of Akron. Fellowships for research in the chemistry of india-rubber have been established by the Goodyear and the Firestone Tire and Rubber Companies. In 1926–27 the enrolment in the university was about 2,000.

Because of the dominating industries Akron's population has a striking preponderance of men (138·9 males to 100 females in 1920, a higher ratio than in any other large city); a high proportion of skilled and semi-skilled labour; relatively high wages; and a high proportion of men engaged in gainful occupations. Of child labour and illiteracy there is little. The population was not congested, even after the period of rapid growth. Small detached or semi-detached dwellings are the rule. In 1920 45% of the homes were owned by their occupants.

A "home rule" charter went into effect Jan. 1 1920. Under it Akron adopted the city-manager form of government, but after four years this was discarded and the executive duties were transferred to a mayor elected at large. The old Portage Trail, used by the Indians in carrying their canoes from the Cuyahoga river to the Tuscarawas river in the journey from Lake Erie to the Ohio, runs through the city. It is marked at each end by commemorative tablets and bronze figures of Indians. A house once occupied by John Brown, the abolitionist, still stands in the western part of the city

AKSAKOV, SERGEI TIMOFEYEVICH (1791–1859), Russian writer, grandson of Sergei Aksakov, a country squire who founded a colony in the Bashkir steppe, was born at Ufa, Orenburg, on Sept. 20, 1791, and died in Moscow on April 30, 1859. He studied at the University of Kazan, and in 1808 entered the civil service in St. Petersburg (Leningrad). In 1815 he married and returned to the Urals to cultivate his estate. He dissipated his fortune after ten years of estate management, and found, through the influence of Shishkov, a place in the censorship at Moscow. There his house became a centre of Slavophilism. In 1832 he met Gogol, in whom he recognized a genius unspoiled, as he thought, by foreign influence. His friendship with Gogol led him to write himself, and, though that friendship was clouded in later years, it is to Gogol that Aksakov owed his inspiration. Aksakov draws on the history of his pioneer grandfather, a great figure of the family autocrat in a primitive community, wonderfully depicted, with the marriage of his own father and mother, and with his own schooldays. All these books are Russian classics. They give a picture of Russian rural life before the liberation of the Serfs remarkable in itself, and beautiful because of the author's keen, sensuous appreciation of nature, but interesting from the purely literary point of view in the development of the novel. Aksakov, to quote Prince Mirsky, "came nearer than any other Russian writer, even than Tolstoy in *War and Peace*, to a modern, evolutionary, continuous presentation of human life, as distinct from the dramatic and incidental presentation customary to the older novelists."

His best known works are: *Chronicles of a Russian Family* (1856, trans. by M. C. Beverley, 1924); *Recollections* (1856), trans by J. D. Duff under the title: *Autobiography of a Russian Schoolboy* (1917, repr. 1924); *Years of Childhood* (1858: trans. by J. D. Duff, 1916, repr. 1923). Aksakov's other important work is his *Recollections of Gogol*, which is the most important contemporary record of that great writer.

His elder son, KONSTANTIN SERGEYEVICH AKSAKOV (1817–1860), Slavophil author, was born at Moscow on April 10, 1817, and died in the Island of Zante in Greece on Dec. 19, 1860.

His younger son, IVAN SERGEYEVICH AKSAKOV (1823–1886), Russian Slavophil writer, was born at Nadezhdin in Ufa, on Sept. 26, 1823, and died at Moscow on Jan. 27, 1886. He studied law at St. Petersburg, and later entered the Moscow division of the Senate. At various periods he edited or established weekly and daily papers, the Moscow *Sbornik*, the *Den* (1861–65), the *Moskva* (1867), which was three times suppressed by the Government, and later, in 1880, the *Rus*, an organ of the Slavophil party. Between 1840 and 1860 Aksakov wrote numerous radical and political poems. His realistic poem *The Tramp* (1852), depicted the life of the Russian peasant. The height of Aksakov's activity as leader of the Panslavist movement was reached in 1876-78, when he warmly supported the cause of the liberation of the Balkan Slavs. In 1878 he was exiled from Moscow for a violent attack on the Treaty of Berlin in a speech delivered at the Slavic committee; but he was soon allowed to return, and continued to publish the *Rus* until his death.

AKSHAK, a city in northern Sumer in lat. 34° N., long. 44° E. There was a prehistoric Sumerian city on this site which lay on the Tigris at the mouth of the river Adhem (Physcus). It was the most northerly of the Sumerian cities and appears in the dynasty lists between Maer and the 4th dynasty of Kish. The site is usually identified with the Opis of Xenophon, who states that it was a large and populous city and that the Physcus was here spanned by a bridge, but Rawlinson identified Opis with another ancient site south of the Diyala, near Baghdad.

AK-SHEHR (anc. PHILOMELION), town, Konia vilayet, Asia Minor, at the edge of a fertile plain, on the north side of the Sultan Dagh. Philomelion was probably a Pergamenian foundation on the Graeco-Roman highway from Ephesus to the east, and to its townsmen the Smyrniotes wrote the letter that describes the martyrdom of Polycarp. Cicero, on his way to Cilicia, dated some of his extant correspondence there; and the place was important in frontier wars between Byzantine emperors and the sultanate of Rum. It became an important Seljuk town, and late in the 14th century passed into Ottoman hands. There Bayezid Yilderim is said by Ali of Yezd to have died after his defeat at Angora. The place still enjoys much repute among Turks as the burial place of Nasr-ed-din Hodja. The town has a station on the Anatolian railway, about 60m. from Afiun Qarahisar and 100m. from Konia. Pop. (in 1927), 46,057.

AKSU: *see* TURKISTAN.

AKSUM (previously AXUM), an ancient city in Tigré, Abyssinia, 14° 8′ N., 38° 31′ E., altitude 7,226ft., 12m. W. by S. of Aduwa. The old Abyssinian Book of Aksum contains the native legend of its foundation many thousands of years ago; the first

authoritative mention of it, however, is in the *Periplus Maris Erythraei* (*c.* A D. 67) where it is referred to as the seat of the Axumite Kingdom, the successor of the more ancient Punt and the forerunner of the modern Abyssinia. (*See* ETHIOPIA.)

It contains the ancient church where, according to tradition, the *Tobot* or Ark of the Covenant, brought from Jerusalem by the son of Solomon and the Queen of Sheba, was deposited and is still supposed to rest. The church was burned when Axum was sacked by Mohammed Gran the Muslim invader of Abyssinia in about 1535 and a new one was erected by the Portuguese shortly afterwards. It is famous for the ancient inscriptions in Minaco Sabaean, a Giz script of the 4th and 5th centuries and for its wonderful stone obelisks, many of which are still standing. They form a consecutive series from rude unhewn stones to highly finished obelisks, of which the tallest still erect is 60ft. in height, with 8ft. 7in. extreme front width; others that are fallen may have been taller. The highly finished monoliths are all representations of a many-storeyed castle, with an altar at the base of each. They appear to be connected with Semitic sun-worship and are assigned by Bent to the same period as the temple at Baalbek.

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AKTUBINSK, formerly part of the Turgai region, now a province in the Autonomous Kazak (Kirghiz) S.S.R. Area 457,479sq.km. The boundaries are, on the north, Orenburg and Kustanai; west, Adaev and Uralsk; south, Adaev, the Aral sea and Syr-Daria; east, Akmolinsk. It is divided for administrative purposes into Aktubinsk, pop. 238,059 (urban 20,504); Temirsk, pop. 77,799, (urban 4,000); Turgai, pop. 94,304, (urban 1,836); Chelkarsk, pop. 90,376 (urban 6,716). South of the east to west stretch of the Ural river, the Ural mountains continue as a plateau, the southward termination of which (the Mugojar hills) is deeply dissected by the streams of the craggy south-eastern slopes, a former shore line of the Aral sea. Beneath these slopes the streams lose themselves in the saline steppes that fringe the Aral sea and extend far northeast as part of the Turgai steppe. The climatic conditions are increasingly dry (av. rainfall 4 to 8in.), and the prevailing north-east winds bring sandstorms in summer and dry snow in winter, a season otherwise of cloudless skies and bitter cold, while the summer temperature averages 85° F. The numerous lakes are surrounded by reeds, the haunt of the wild boar, with grass patches in places; the stream shores are also grassy, especially in spring, and attract geese and cranes. The steppe includes black-earth areas carrying feather grass, clays bearing wormwood, salt clays with salsolaceae vegetation and bare shifting sand hills. Wild cherry and almond grow on the hill sides. The steppe fauna includes jerboa, marmot, steppe fox and saiga antelope. Famines are frequent for lack of irrigation and scientific crop rotation, though rye, wheat, oats, barley and potatoes are grown Nomadic herding of sheep, horses, camels and cattle is the chief occupation, and there is change of ground between the spring-and-summer grazing area of the Turgai steppe and the winter shelters in the Syr-Daria area. Cattle and hides are exported to Orenburg and camels are bred for the caravan transport between Bukhara, Khiva and Russian Turkistan. Sunflowerseed oil, flour and leather are produced for local use and salt is obtained from the lakes, while *koustar* (home) industries in felt products and carpets are widespread. The Emba river naphtha area extends into the south-west of the province and has its centre at Emba. In the north-west, near the Ulek river coal is mined. Aktubinsk, the chief town, is on the Orenburg-Tashkent railway.

AKYAB, a municipality and district in the Arakan division of Burma at the confluence of the large rivers Myu, Kaladan and Lemro. After the cession of Arakan to the British by the treaty of Yandaboo in 1826 the old capital of Myohaung was abandoned as the seat of government, and Akyab on the sea coast selected instead. Trade restrictions were removed and Akyab rapidly grew from a small fishing village into a leading port of Burma, with a population in 1921 of 36,569 (27,693 males and 8,876 females). The population has varied but slightly since the census of 1881. Out of the total population, 13,132 (13,062 males and 70 females) are "adventitious" Mohammedan and Hindu labourers. The settled civil population comprises 12,149 Buddhists (Arakanese and Burmese, 5,891 males and 6,258 females), 4,755 Hindus (4,353 males and 402 females) and 5,709 Mohammedans (3,860 males and 1,849 females).

It contains the usual public buildings and several large rice mills. The chief export is rice. The district lies along the north-eastern shores of the Bay of Bengal, with an area of 5,136sq.m. and a population in 1921 of 576,430. (*See* BURMA.)

ALA, one of the side recesses which almost universally opened off the atrium (*q.v.*) of a Roman house. There were usually two alae, one on each side, placed near the corners furthest from the entrance, and like the *tablinum* or official reception hall, their entire width was open to the atrium. In physiology, any wing-like process such as one of the lateral cartilages of the nose (Lat. *ala*, a wing). In botany, one of the side petals of a papilionaceous corolla, etc.

ALABAMA, called the "Cotton State" because of its chief agricultural product, a southern state of the U.S.A., is situated between 84° 51′ and 88° 31′ W. and about 30° 13′ and 35° N., and is bounded N. by Tennessee, E. by Georgia, S. by Florida and the Gulf of Mexico, and W. by Mississippi. Its total area is 51,998 sq. m., of which 719 are water surface.

Physical Features.—Northern Alabama is dominated by the Cumberland plateau, a diversified region varying from 400 to 1,800ft. in height and cut into blocks by the tributaries of the Tennessee river, which flows from east to west. In the north-east section of this region are precipitous mountains, while gentle rolling lowlands predominate in the west along the river. In the southern portion Little mountain, extending 80m. east and west between two valleys, rises 500ft. above them. To the south-east of the Cumberland plateau the Appalachian ("Coosa") valley region, occupying about 8,000sq.m. and running north-east and south-west forms the southern extremity of the Appalachian mountain system. Raccoon and Lookout are the most prominent flat-topped mountains in this limestone formation, being about 1,800ft. high at the Georgia border and lower to the south. South-east of the Appalachian valley region the gently undulating Piedmont plateau enters Alabama for a short distance. The remainder of the state is occupied by the coastal plain, which is crossed in the north by foot-hills and gradually slopes down to sea level in the south, with all rivers flowing south-west. Its rivers are the Tombigbee in the west, the Alabama in the central west, and in the east the Chattahoochee, which forms almost half of the Georgia boundary. The Tombigbee and the Alabama unite in the south-west; their waters then part to flow into Mobile bay as the Mobile and Tensas rivers. The valleys of the coastal plain are broad and in most cases rise in three successive terraces above the streams. The harbour of Mobile was formed by the drowning of the lower part of the valleys of the Alabama and the Tombigbee rivers.

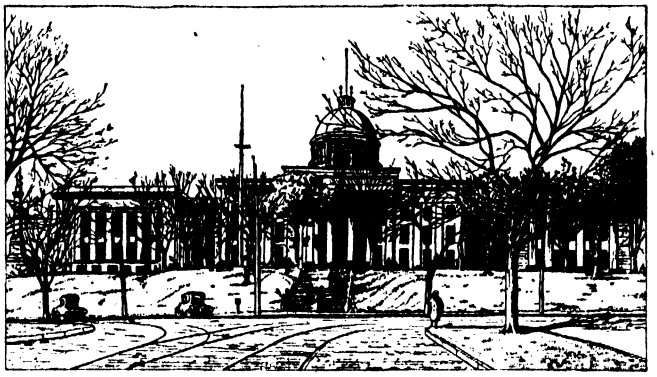


THE GREAT SEAL OF THE STATE OF ALABAMA, ADOPTED BY ACT OF THE GENERAL ASSEMBLY AND APPROVED ON DEC. 29, 1868

Climate and Soil.—Alabama has a temperate, uniform climate. The annual mean for the state is for the winter 46° and for the summer 79°. In the summer the temperature is kept moderate by the elevation in the northern districts and by winds from the Gulf of Mexico in the southern part. In the winter, on the average, 35 days are below the freezing point, and snow falls only once or twice a year. Rainfall is evenly distributed throughout the state, the average being rather high, 52in. Heavy fogs are rare, hail-storms few and innocuous, thunder-storms numerous in summer. The prevailing winds are from the south.

There are four different belts of soil. In the timber belt, along the coast, the soil is sandy and poor but responds to fertilization. North of this lies the black belt ("black prairie," "cotton belt"), which is 13,000sq.m. in extent and has black soil that is rich in limestone and marl formations, without sand or loam, and is especially adapted to the production of cotton. Between the cotton belt and the Tennessee valley lies the mineral belt, the soils of which are of varied fertility. North of the mineral belt is the cereal belt in the Tennessee valley, containing red clays and dark loams. North of the valley the soils are not so fertile.

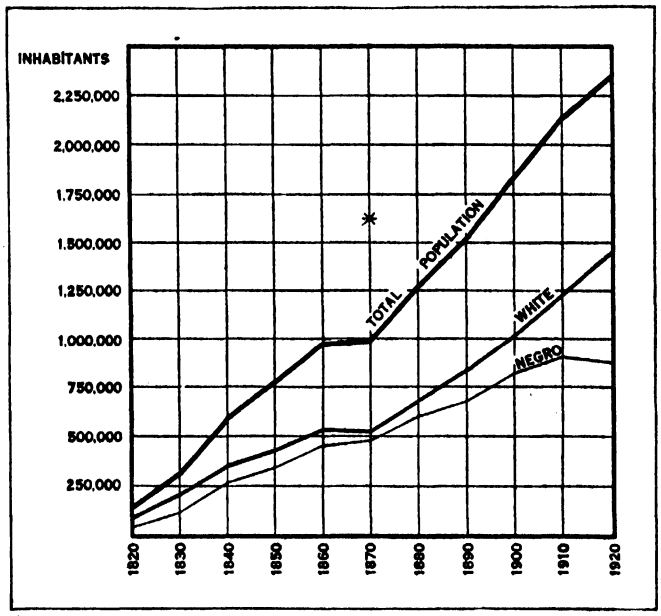
Government.—The form of government in Alabama has been altered five times. The original constitution was set up in 1819



THE STATE CAPITOL AT MONTGOMERY, ALABAMA
The capitol was the scene of important activities in the Civil War period. In its chambers was effected the organization of the Confederate States, and the president of the Confederacy took the oath of office on the front portico

and revised in 1865, 1868, and 1875; the present constitution was framed in 1901 and contains a number of notable provisions. It lengthened the term of executive and legislative officials from two to four years, made that of the judiciary six years, provided for quadrennial sessions of the legislature, and introduced the office of lieutenant-governor. The passage of local or special bills by the legislature was prohibited. A provision, intended to prevent lobbying, prohibits anyone except legislators and the representatives of the Press to be admitted to the floor of the house except by unanimous vote. No executive official may serve two consecutive terms in office, and the governor cannot be elected or appointed to the United States Senate or to any state office during his term as governor or within one year thereafter. Sheriffs whose prisoners suffer mob violence may be impeached. The constitution eliminated the negro from politics by a suffrage clause which came into effect in 1903. This restricts the right to vote to those who can read and write any article of the constitution of the United States, and have worked or been regularly engaged in some lawful employment, business or occupation, trade or calling for the greater part of the 12 months preceding the time they offer to register, unless prevented by physical disability from labour or ability to read and write, or who have paid taxes on property assessed at $300; but those who have served in the army or navy of the United States or of the Confederate States in time of war, their lawful descendants in every degree, and persons of good character "who understand the duties and obligations of citizenship under a republican form of government," are relieved from the operation of this law provided they registered prior to Dec. 20, 1902. The second of these exceptions is known as the "grandfather clause." No man may vote in any election who has not by Feb. 1 preceding that election paid all poll-taxes due from him to the state. In 1902, nine-tenths of the negroes in the state were disqualified from voting. The constitution of 1901 (like that of 1867) and special statutes require separate schools for white and negro children. A "Jim Crow" law was enacted in 1891. Buying, selling, or offering to buy or sell a vote has for penalty disfranchisement, and since 1891 the Australian ballot system has been used (*see* ELECTORAL SYSTEMS). The governor, auditor, and attorney-general are required to prepare and present to each legislature a general revenue bill; and the secretary of state and the two last named officers form a board of pardons which makes recommendations to the governor; he, however, is not bound by this advice in the exercise of his pardoning power. The constitution of 1901 exempted a homestead of 80 acres of farm land, or of a house and lot not exceeding $2,000 in value, from liability for any debt contracted since July 30, 1868, except for a mortgage on it to which the wife consented; personal property to the value of $1,000 is exempted. All amendments to the state constitution must be approved by a three-fifths vote of each house of the legislature and then ratified by the people. Under the civil code of 1897 the earnings of a wife are her separate property, and it is provided that "no woman, nor any boy under the age of 12 years, shall be employed to work or labour in or about any mine in this state." By acts of 1915 and 1919 restrictions were placed upon the employment of children. No child under 14 may be employed during school hours; no child under 14 may be employed in gainful occupations except agriculture and domestic service. No child under 16 may be employed on or near dangerous machinery; except in agriculture or domestic service, no child under 16 may be employed at night or over eight hours a day or six days a week. A firm that employs a child under 16 must furnish a certificate stating what work the child is to do, a statement from the superintendent of schools to show that the child has completed the fourth grade, and a certificate showing that the child is over 14 and in good physical condition. Any person or firm violating these restrictions may be fined $10 to $100 for the first offence and $100 to $500 for each subsequent offence. Alabama, however, leads all the other states of the Union in the number of children between 10 and 13 "gainfully occupied." According to the United States census of 1920 there were 47,596 children from 10 to 13 employed in the state; of these, 45,729 were employed in agriculture, forestry, and animal husbandry.

Population.—The first census of Alabama was in 1820, when the number of inhabitants was 127,901. The number was 771,623 in 1850; 1,262,505 in 1880; 1,513,401 in 1890; 1,828,697 in 1900; 2,138,093 in 1910; and 2,348,174 in 1920. The U.S. census esti-



GRAPH OF THE POPULATION INCREASE IN ALABAMA FROM 1820–1920
*The enumeration of 1870 was "generally deficient" in the Southern States

mate in 1927 was 2,549,000. Alabama is noted for its large proportion of negroes (38·4% in 1920) and its small proportion of foreigners (less than 1%). In 1920, there were 1,447,032 whites, an increase of 17·8% over 1910, and 900,652 negroes, a decrease of 0·8% from 1910, due to male negro migration to northern industrial centres. The negro population is unevenly distributed; in most of the counties of the black belt the negroes constitute over 75% of the population, whereas in the northern counties they are few in number. Although the proportion of urban population in 1920 was greater than in 1910, more than three-fourths of the population was still rural (1,838,857) and over one-half

lived on farms (1,335,885). In 1925 the number of people living on farms had decreased still further to 1,166,432. In church membership, Baptists and Methodists lead. The growth of the chief cities is shown in the following table:—

	1925	1920	1910
Birmingham	205,670	178,270	132,685
Mobile	65,955	60,151	51,521
Montgomery	46,481	43,464	38,136
Bessemer	21,975	18,674	10,864
Anniston	20,531	17,734	12,794
Gadsden	19,604	14,737	10,557
Tuscaloosa	18,000	11,996	8,000
Selma	16,987	15,607	13,649

Finance and Taxation.—One-half of the income of the state is derived from general taxes, the rest from licences, a special school tax, a poll-tax, and tonnage taxes in minerals. The state has neither inheritance nor income taxes; the constitution of 1901 limits the state property tax to 0·65% upon assessed values. Both real and personal property valuations for taxing purposes are fixed by law at 60% of a reasonable cash value. The framers of the constitution of 1901, thinking to avoid a repetition of the reckless borrowing of the reconstruction period, prohibited the increase of the state debt for any other purposes than the suppression of rebellion or resistance to invasion; but in 1922 two constitutional amendments authorized the state legislature to provide bond issues of $25,000,000 and $10,000,000 for highway and harbour improvements.



BY COURTESY OF THE U.S. BUREAU OF RECLAMATION

HOME OF A NEGRO FARM TENANT
Since the breaking up of large plantations there has been an increase in the number of farms operated by Negro cash renters

Education.—Public education, authorized for Mobile alone in 1826 and inaugurated there in 1852, was extended to the whole state in 1854. Its support was derived from public lands given to the state by the United States in 1819 and from special taxes fixed by each township. This system was demoralized by the Civil War; the one that replaced it in 1868 failed because of the attempt to teach whites and blacks in the same schools and because of corruption in the use of school funds. The constitution of 1875 made the support of the schools dependent upon the land grant of 1819, the poll-tax, and state appropriations; it established separate schools for blacks and whites. The constitution of 1901 makes obligatory a state tax of from 30 to 65 cents on each 100 dollars' worth of property to be expended on education. The legislature of 1907 voted an increase of $300,000 for the common school fund, granted state aid for the rural schools, and established a system of county high schools. Most of the counties have availed themselves of the privilege of levying a special school tax, granted by constitutional amendment. The expenditure for education has constantly increased until it amounted to $14,540,233 in 1923–24, of which $13,118,249 was used for schools for whites, and $1,421,984 for schools for negroes. Slow but steady progress in education is signified by the decrease in illiteracy, the percentage of illiterates declining from 50 in 1880 to 34 in 1900, and to 11·4 in 1920. Of the 278,082 illiterates in 1920, the negroes numbered 216,690, the native whites 65,394, and the foreign-born whites 1,893.

The present school code of Alabama was framed in 1919 as a result of the report by the U.S. Bureau of Education at the invitation of a state educational commission. One of the most important acts provided for a state council to co-ordinate the efforts of the institutions of higher education by assigning to each a special field of activity.

Elementary education is free between the ages of 6 and 21, and compulsory between the ages of 8 and 16, except for those who have completed the elementary school course and are lawfully employed, and those who live 2½m. or more away from a public school and are not furnished transportation. In the school year of 1924–25 the state had in the elementary schools 857,225 pupils and 14,911 teachers.

The chief institutions for higher education include the University of Alabama, at Tuscaloosa; the Alabama polytechnic institute, at Auburn; Alabama college, at Montevallo; Athens college (Methodist, for women), at Athens; Birmingham-Southern college (Methodist), at Birmingham; Howard college (Baptist), at Birmingham; Judson college (Baptist), at Marion; Spring Hill college (Roman Catholic), at Spring Hill; St. Bernard college (Roman Catholic), at St. Bernard; Woman's college of Alabama (Methodist), at Montgomery; Talladega college (Congregationalist, for negroes), at Talladega; Tuskegee normal and industrial institute for negroes, at Tuskegee (*q.v.*); agricultural and mechanical institute for negroes, at Normal; and the state normal schools at Daphne, Florence, Jacksonville, Livingston, Troy, and, for negroes, at Montgomery.

Charities and Houses of Correction.—Alabama supports various philanthropic and penal institutions: a home for Confederate veterans, at Mountain Creek; an institution for the deaf, an academy for the blind, and a school for the negro deaf, dumb and blind, all at Talladega; a hospital for the insane, opened in 1860, at Tuscaloosa; a penitentiary, established in 1839, at Wetumpka; a state industrial school for white boys, at East Lake (Birmingham); a state industrial school for white girls, at Montevallo; a child welfare department; a reform school for negroes; and a reform school for juvenile lawbreakers. These institutions are managed by trustees who are appointed by the governor. The convict lease system was abolished by the state legislature in 1927. Able-bodied convicts are now employed by the state in highway construction—all others are put to work in a variety of industries in the state prisons at Wetumpka, Speigner, and Montgomery. In 1901, a system of peonage that had grown up in the state attracted wide attention, and a Federal grand jury at a single term of court indicted a number of men for holding persons as peons. Many similar cases were found later in other southern states, but those in Alabama, being the first discovered, attracted the most attention. The system came into existence in isolated communities through the connivance of justices of the peace with white farmers. The justices have jurisdiction over petty offences, of which negroes are usually the guilty parties, and the fine imposed would sometimes be paid by a white farmer, who would thus save the accused from imprisonment, but at the same time would require him to sign a contract to repay by his labour the sum advanced. By various devices the labourer would then be kept constantly in debt to his employer, and be held in involuntary servitude for an indefinite time. The peons as a rule were negroes, but a few white ones were found; and in several instances negroes were found holding members of their own race in peonage. A law forbidding under severe penalties a labourer from hiring himself to a second employer without giving notice of a prior contract, and an employer from hiring a labourer known by him to be bound by such a contract, had aided in the development of the system, though it had been enacted for a different purpose. The Federal authorities, as soon as the existence of peonage became known, took active measures to stamp it out, and were supported by the Press and by the leading citizens of the state. Up to 1907 the state licensed the sale of liquor, and liquor licence fees were partly turned over to the public school fund; there was a dispensary system in some counties; and in 1907 one-third of the counties of the state (22 out of 67) were dry. In February of that year the Sherrod anti-shipping bill was enacted, forbidding the acceptance of liquors for shipment, transportation, or delivery to prohibition districts, and penalizing the soliciting of orders for liquor in dry districts with a punishment of $500 fine and six months' imprisonment with hard labour. In a special session of the legislature in Nov. 1907 a law was passed forbidding the sale of liquor within the state, this prohibition becoming effective on Jan. 1, 1909.

Agriculture.—Formerly most of the people of Alabama were dependent upon agriculture for a living; but in the last 20 years, according to the department of Agriculture, farm population has





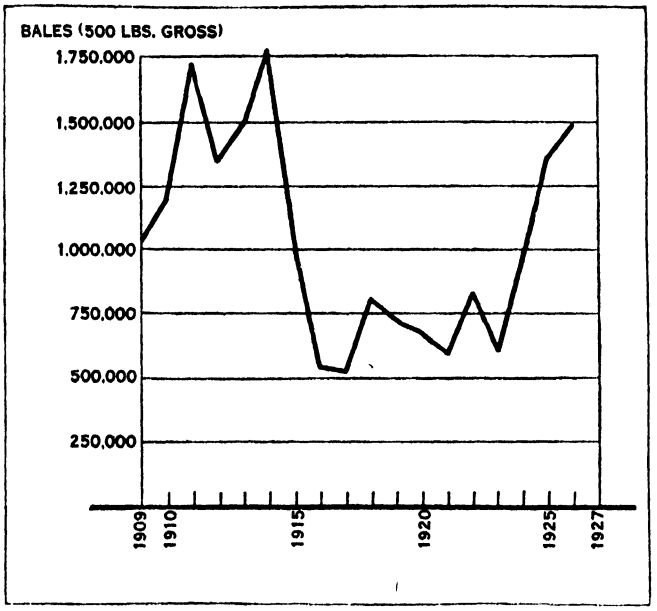
BY COURTESY OF (1) THE U.S. ARMY AIR SERVICE, (2) INTERNATIONAL NEWSREEL

BIRMINGHAM AND MONTGOMERY, LEADING INDUSTRIAL CITIES OF ALABAMA

1. Birmingham, chief industrial city of the Southern States since the development of the coal mining interests of Alabama, U.S.A.

2. Aerial view of Montgomery, capital of the State of Alabama, U.S.A., showing the bend in the Coosa river

decreased from 64·7% in 1910 to 56·8% in 1920 and still further to 47·3% in 1925. By actual count the farm population decreased 169,453 from 1920 to 1925. The cause of this is to be found in the migration of farmers to cities, especially of negro farmers to northern cities. Correspondingly, the number of farms decreased from 262,901 in 1910 to 256,099 in 1920, and then to 237,562 in 1925. In 1879 the value of all crops was $56,872,994, and in

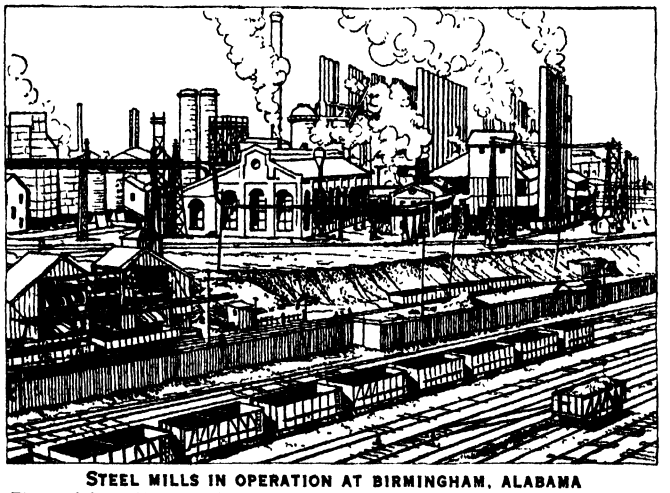


GRAPH SHOWING THE PRODUCTION OF COTTON BETWEEN 1909 AND 1926

1919, $304,348,638; then it fell off to $174,779,000 in 1926. Approximately one-third of the farms are managed by their owners, one-third by cash renters, and one-third by share tenants. Cotton has regularly been the chief agricultural product, though in some years the value of the corn (maize) crop has been higher. The output of cotton increased from 7,000 bales in 1818 to nearly 1,000,000 bales in 1860, but did not again reach that figure until 1924. In the years when the boll weevil ruined the crop of the cotton belt, the other counties of the state, stimulated by the high prices, began to grow more cotton. The result was an output of 1,357,000 bales in 1925. Of the other agricultural products corn (maize), hay, peanuts, oats, wheat, potatoes, syrups, and cottonseed are the most important. The value of the fertilizer for cotton growing increased from $9,521,000 in 1924 to $14,587,000 in 1926.

Minerals.—The chief feature of the industrial life of Alabama since 1880 has been the exploitation of her iron and coal resources. Bituminous coal, first mined near Tuscaloosa about 1827, was produced intensively after 1881; the output grew from 946 tons in 1840 and 13,200 short tons in 1870 to 420,000 tons in 1881 and 1,568,000 tons in 1883. In 1923, according to the bureau of mines, the output reached 20,457,649 short tons, with a value of $51,624,000, but declined in 1924 to 19,130,184 short tons with a value of $44,756,000. Most of the coal comes from Jefferson, Walker and Bibb counties, though the coal-bearing formations cover about 40% of the northern half of the state. It is estimated that the total available coal resources of Alabama amount to 66,711,378,260 short tons, enough to last 3,335 years at the present rate of extraction. The iron ore, which is primarily red haematite, is found chiefly in the region of which Birmingham is the centre. In 1905, Alabama produced 3,782,831 tons of iron ore; in 1923 there were shipped from mines 6,922,663 long tons, valued at $15,540,198; and in 1924, 6,557,596 long tons, valued at $13,927,551 (as reported by the bureau of mines). In 1924, Alabama stood third among the states of the Union in the production of iron ore. Gold, silver, lead, copper, tin, graphite and bauxite are also produced. In 1924, Alabama produced minerals to the value of $77,315,758, ranking 18th among the states, and producing 1·65% of the product of the whole Union. Coal, iron ore, cement and clay products were the chief mineral products of the state.

Manufactures.—The growth of manufactures in Alabama has been as remarkable as the revelation of mineral wealth. In 1880, the capital invested in manufactures was $9,668,008, little more than that in 1860; by 1890, it had increased to $46,122,571; in 1900, it amounted to $70,370,081; in 1909, to $173,180,038; and in 1919 to $455,592,733. On account of the proximity of coal, iron and limestone, the manufactures of iron and steel are the most extensive. The first blast furnace in Alabama was set up in 1818; from then until the Civil War numerous Catalan forges were in operation. In 1876, the first pig iron with coke for fuel was produced. In 1895, it was demonstrated that Alabama pig iron could be sent to Liverpool and sold cheaper than the English product, and Birmingham (Alabama) came consequently to rank next to Middlesbrough and Glasgow among the world centres of the pig iron trade. The pig iron produced in the state in 1860 was valued at $64,590; in 1880, at $1,405,536; in 1900, at $13,487,769; and in 1923, at $63,561,614. Manufacture of steel and steel products began in 1888, but was not successful until the Duplex process was used. On account of the irregular quantities of iron and phosphorus present in Alabama ores, this special process, representing a combination of the Bessemer and open-hearth processes, must be used. Recently Brazilian ores have been imported. Improvements in transportation facilities, such as railway, docks, and steamship lines, have enabled Alabama steel products to compete with those of the rest of the world in the South American market. By 1923, Alabama ranked seventh among the states in steel products, her output being worth $75,042,823. To meet the demand for coke from the iron and steel industries, the coke output rose to the value of $44,577,384 in 1923. The greater part of the pig-iron produced in Alabama and not used in the manufacture of steel is made into cast-iron pipe, mostly in the Birmingham district, the value of the 1923 output being $40,142,807, nearly half the entire output of the United States. Since 1910, there has been a remarkable development of the cement industry, due to the presence of practically inexhaustible deposits of limestone in the heart of rich coal fields, side by side with extensive areas of shale and clay, in a territory served by



STEEL MILLS IN OPERATION AT BIRMINGHAM, ALABAMA
The coal formation covering 40% of the State is responsible for the development of the steel and iron mills that make Birmingham the chief industrial centre of the South

adequate hydro-electric power. In 1924, the output of cement was 5,542,687 barrels, valued at $9,147,367.

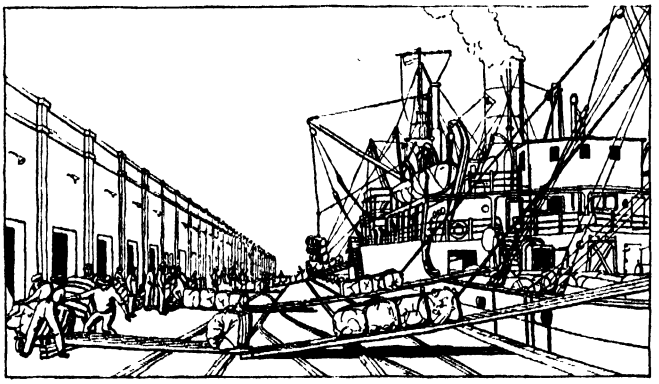
Lumber and naval stores are produced in great quantities. In 1923, the product of sawed lumber was valued at $52,792,121, of which yellow pine represented $46,289,706, oak $1,474,347, and poplar $1,307,823. From 1890 to 1924 the number of turpentine factories increased from 7 to 131; and the output of turpentine and rosin products was valued at $2,434,365 in 1905, and at $2,809,815 in 1923.

The manufacture of cotton goods has also developed rapidly. As late as 1890, there were only 13 cotton mills in Alabama, one

more than the number in 1850; in 1900, there were 31, with an annual product valued at $8,153,136, an increase of 272.2% over the product ($2,190,771) of 1890; by 1923, there were 61 establishments, employing 20,785 people, with products valued at $86,384,725, giving the state seventh place in the production of cotton goods.

In the 24 years from 1899 to 1923, the value of Alabama's manufactured products rose from $72,109,929 to $541,728,687. In 1923, Jefferson county, in which Bessemer and Birmingham are situated, produced 39.6% of the total for the whole state.

The use of hydro-electric power for the manufacturing establishments has recently been increased. Two great dams across the Coosa river and the U.S. Government dam at Muscle Shoals



BY COURTESY OF MOBILE CHAMBER OF COMMERCE

LOADING COTTON AT THE NEW STATE DOCKS IN MOBILE, ALABAMA

Mobile, the only seaport in Alabama, is the terminus of the road and waterway system that transports products for shipment from the inland plantations, mines and steel mills

(*q.v.*) on the Tennessee river are already completed; others are under construction.

Transportation.—Alabama rivers are navigable for a total distance of 2,000 miles, but obstructions often prevent the formation of a continuous route. The U.S. Government has spent millions of dollars on the elimination of these impediments, as well as on the improvement of Mobile harbour. National, state and city funds have been used to improve the facilities of the port of Mobile. During the closing months of 1920, the first vessel of a fleet of government-owned and operated self-propelling barges made its way down the Mississippi river to New Orleans and into the gulf, then to Mobile and up the rivers to Birmingham and Cordova in the heart of the Warrior coal fields. A balanced tonnage, up and down stream, is steadily being developed by the trans-shipment at Mobile of manganese ore from Brazil, for use in making high-grade steel in the Birmingham district, and by the establishment of an all-water freight rate from New York and other eastern points, via Mobile, to the various river ports.

An amendment to the state constitution having authorized the use of the credit of the state for the construction of a great system of docks at Mobile, an act of the legislature at its session of 1923–24 authorized the issue of $10,000,000 of bonds for that purpose and a commission was put in charge of the work. The commission thereupon acquired for the state approximately 400 acres of land, with a water frontage of two miles on the northern outskirts of the city.

As the streams in the mineral region are not navigable, the railways are the carriers of its products. Here all the large systems of the southern states find an entrance—the Mobile and Ohio, the Southern (Queen and Crescent route), the Louisville and Nashville, and the San Francisco system affording communication with the Mississippi and the west, and the Southern, the Seaboard air line, the Atlantic coast line, and the Central of Georgia forming connections with northern and Atlantic states. In 1922 the total mileage of steam railways in the state was 32,562.

HISTORY

The first Europeans to enter the limits of the present state of Alabama were Spaniards, who claimed this region as a part of Florida. The first fully authenticated visit was that of Hernando de Soto, who journeyed along the Coosa, Alabama, and Tombigbee rivers in 1539–40. The English, too, claimed the region north of the Gulf of Mexico, and the territory of modern Alabama was included in the province of Carolina by the charters of 1663 and 1665. English traders from Carolina were frequenting the valley of the Alabama river as early as 1687. Fort Condé, the germ of the present city of Mobile, and the first permanent white settlement in Alabama, was founded by the French in 1711. Later, on account of intrigues between English traders and the Indians, the French as a means of defence established several military posts. The grant of Georgia to Gen. J. E. Oglethorpe and his associates in 1732 included a portion of what is now northern Alabama, and in 1739 Oglethorpe himself visited the Creek Indians west of the Chattahoochee river and made a treaty with them. The treaty of Paris, in 1763, terminated the French occupation, and England came into undisputed possession of the region between the Chattahoochee and the Mississippi. The portion of Alabama below the 31st parallel then became a part of West Florida, and the portion north of this line a part of the "Illinois country," set apart, by royal proclamation, for the use of the Indians. In 1767 the province of West Florida was extended northward to 32° 28′ N., and a few years later, during the War of Independence, this region fell into the hands of Spain. By the treaty of Versailles, on Sept. 3, 1783, England ceded West Florida to Spain; but by the treaty of Paris, signed the same day, she ceded to the United States all of this province north of 31°, and thus laid the foundation for a long controversy By the treaty of Madrid, in 1795, Spain ceded to the United States her claims to the lands east of the Mississippi between 31° and 32° 28′; and three years later (1798) this district was organized by Congress as the Mississippi territory. A strip of land 12 or 14m. wide near the present northern boundary of Alabama and Mississippi was claimed by South Carolina; but in 1787 she ceded this claim to the general Government. Georgia claimed all the lands between the 31st and 35th parallels from its present western boundary to the Mississippi river, a claim not surrendered until 1802; two years later the boundaries of the Mississippi territory were extended so as to include all of the Georgia cession In 1812 Congress annexed to the Mississippi territory the Mobile district of West Florida, claiming that it was included in the Louisiana purchase; and in the following year Gen. J. Wilkinson occupied this district with a military force, the Spanish commandant offering no resistance. The whole area of the present state of Alabama then for the first time became subject to the jurisdiction of the United States. In 1817 the Mississippi territory was divided; the western portion became the state of Mississippi, and the eastern the territory of Alabama, with St. Stephens, on the Tombigbee river, as the temporary seat of government. In 1819 Alabama was admitted to the Union as a state.

Early Difficulties: Finance.—One of the first problems of the new commonwealth was that of finance. Since the amount of money in circulation was insufficient to meet the demands of the increasing population, a system of state banks was instituted. State bonds were issued and public lands sold to secure capital. The notes of the banks, loaned on security, became a medium of exchange. Prospects of an income from the banks led the legislature of 1836 to abolish all taxation for state purposes. This was hardly done, however, before the panic of 1837 wiped out a large portion of the banks' assets; next came revelations of careless and corrupt management, and in 1843 the banks were placed in liquidation. After disposing of all their available assets, the state assumed the remaining liabilities, for which it had pledged itself.

The Indian Problem.—The Indian problem was important. With the encroachment of the white settlers upon their hunting-grounds the Creek Indians grew restless, and the great Shawnee chief Tecumseh, who visited them in 1811, fomented their discontent. When the outbreak of the second war with Great Britain in 1812 gave the Creeks assurance of British aid they rose in arms, massacred several hundred settlers who had taken refuge in Fort Mims, near the junction of the Alabama and Tombigbee rivers, and soon no white family in the Creek country was safe outside

a palisade. The Chickasaw and Choctaw Indians, however, remained the faithful allies of the whites, and volunteers from Georgia, South Carolina and Tennessee, and later United States troops under Gen. Andrew Jackson, broke forever the power of the Creek confederacy. By the treaty of Fort Jackson (Aug. 9, 1814) the Creeks ceded their claims to about one-half of the present state; and cessions by the Cherokees, Chickasaws and Choctaws in 1816 left the Indians only about one-fourth of Alabama. In 1832 the national Government provided for the removal of the Creeks; but before the contract was effected, the state legislature formed the Indian lands into counties, and settlers flocked in. A disagreement ensued between Alabama and the United States authorities; although it was amicably settled, it engendered a feeling that the policy of the national Government might not be in harmony with the interests of the state—a feeling which, intensified by the slavery agitation, did much to cause secession in 1861.

Political History.—The political history of Alabama may be divided into three periods—that prior to 1860, from 1860 to 1876, and from 1876 onwards.

The first is the only period of altogether healthy political life. Until 1832 the democratic was the only party in the state, but the question of nullification caused a division that year into the (Jackson) democratic party and the States' rights (Calhoun democratic) party; about the same time, the whig party was formed chiefly in counties where slaves were most numerous and the freemen most aristocratic. For some time the whigs were nearly as numerous as the democrats, but they never controlled the state Government The States' Rights men were in a minority; nevertheless, under their active and persistent leader, W. L. Yancey (1814–1863), they prevailed upon the democrats in 1848 to adopt their most radical views.

The Alabama Platform.—During the agitation over the introduction of slavery into the territory acquired from Mexico, Yancey induced the democratic state convention of 1848 to adopt what is known as the "Alabama platform," which declared that neither Congress nor the government of a territory had the right to interfere with slavery in a territory, that those who held opposite views were not democrats, and that the democrats of Alabama would not support a candidate for the presidency if he did not agree with them on these questions. This platform was endorsed by conventions in Florida and Virginia and by the legislatures of Georgia and Alabama. Old party lines were broken by the compromise of 1850. The States' rights party, joined by many democrats, founded the southern rights party, which demanded the repeal of the compromise, advocated resistance to future encroachments, and prepared for secession, while the whigs, joined by the remaining democrats, formed the party known as the "unionists," which unwillingly accepted the compromise and denied the constitutional right of secession. The unionists were successful in the elections of 1851 and 1852, but the feeling of uncertainty engendered in the south by the passage of the Kansas-Nebraska bill and the course of the slavery agitation after 1852 led the state democratic convention of 1856 to revive the Alabama platform; and when the Alabama platform failed to secure the formal approval of the democratic national convention at Charleston, South Carolina, in 1860, the Alabama delegates, followed by those of the other cotton states, withdrew. Upon the election of Abraham Lincoln, Governor Andrew B. Moore, in obedience to previous instructions of the legislature, called a state convention on Jan. 7, 1861. After long debate it adopted on Jan. 11 an ordinance of secession, and Alabama became one of the Confederate states of America, whose government was organized at Montgomery Feb. 4, 1861. Yet many prominent men opposed secession, and in northern Alabama, where there were very few slaves, an attempt was made to organize a neutral state, Nickajack; but with President Lincoln's call to arms all opposition to secession ended.

The Civil War.—In the early part of the Civil War, Alabama was not the scene of military operations, yet the state contributed about 120,000 men to the Confederate service, practically all her white population capable of bearing arms; 39 of these attained the rank of general. In 1863 the Federal forces secured a foothold in northern Alabama in spite of the opposition of Gen. N. B. Forrest, one of the ablest Confederate cavalry leaders. In 1864 the defences of Mobile were taken by a Federal fleet, but the city held out until April 1865; in the same month Selma fell.

Reorganization After the Civil War.—According to the presidential plan of reorganization, a provisional governor for Alabama was appointed in June 1865; a state convention met in September and declared the ordinance of secession null and void and slavery abolished; a legislature and a governor were elected in November; the legislature was at once recognized by the national Government, and the inauguration of the governor-elect was permitted after the legislature had, in December, ratified the 13th amendment. But the passage, by the legislature, of vagrancy and apprenticeship laws designed to control the negroes flocking from the plantations to the cities, and its rejection of the 14th amendment, so intensified the congressional hostility to the presidential plan that the Alabama senators and representatives were denied their seats in Congress. In 1867 the congressional plan of reconstruction was completed and Alabama placed under military government. Negroes were now enrolled as voters and large numbers of white citizens disfranchised. A black man's party, composed of negroes and political adventurers known as "carpet-baggers," was formed, which co-operated with the republican party. A constitutional convention, controlled by this element, met in Nov. 1867 and framed a constitution which conferred suffrage on negroes and disfranchised a large class of whites. As the whites stayed away from the polls, thus preventing the required majority of legal voters, Congress enacted that a majority of the votes cast should be sufficient, and thus the constitution went into effect, the state was admitted to the Union in June 1868, and a new governor and legislature elected.

The next two years are notable for legislature extravagance and corruption. The state endorsed railway bonds at the rate of $12,000 and $16,000 a mile until the state debt had increased from $8,000,000 to $17,000,000, and similar corruption characterized local government. The native white people united, formed a conservative party, and elected a governor and a majority of the lower house of the legislature in 1870; but, as the new administration was largely a failure, in 1872 there was a reaction in favour of the radicals, as the republicans were locally known. Affairs went from bad to worse. In 1874, however, the power of the radicals was finally broken, the conservative democrats electing all state officials. A commission appointed to examine the state debt found it to be $25,503,000; by compromise it was reduced to $15,000,000. A new constitution was adopted in 1875, which omitted the guaranty of the previous constitution that no one should be denied suffrage on account of race, colour or previous condition of servitude, and forbade the state to engage in internal improvements or to give its credit to private enterprise.

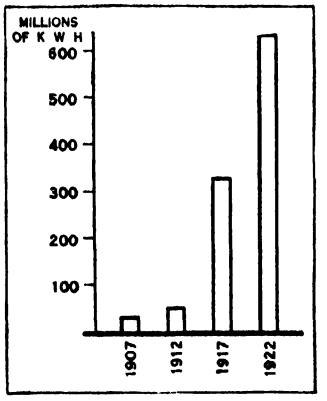
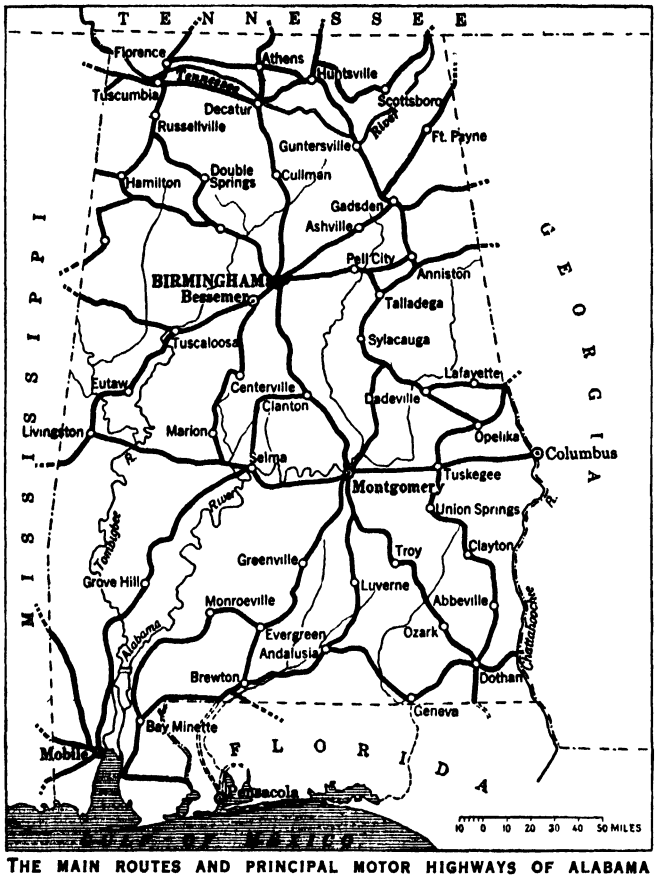


CHART SHOWING THE INCREASE IN ELECTRIC POWER GENERATED IN ALABAMA FROM 1907-1922

The Effects of Industrial Development.—Since 1874, the democratic party has controlled the state administration, the republicans failing to make nominations for office in 1878 and 1880, and endorsing the ticket of the greenback party in 1882. The development of mining and manufacturing was accompanied by economic distress among the farming classes, which found expression in the Jeffersonian democratic party, organized in 1892. The regular democratic ticket was elected and the new party merged with the populist party. In 1894 the republicans united with the populists, elected three congressional representatives, and secured control of many of the counties, but failed to carry the state and continued their opposition with less success

in the next campaigns. Partisanship became intense and charges of corruption of the negro electorate were made. Consequently, after division on the subject among the democrats themselves, as well as opposition from republicans and populists, a new constitution with restrictions on suffrage was adopted in 1901. The new restrictions resulted in the virtual elimination of the negro vote and therefore in a reduction of the republican vote. The



THE MAIN ROUTES AND PRINCIPAL MOTOR HIGHWAYS OF ALABAMA

republican party, which had polled 54,737 votes in the presidential election of 1896 and 55,634 votes in the election of 1900, polled only 22,472 votes in the election of 1904. Its vote remained at about that level until 1920, when the effects of economic changes began to appear in elections. In the presidential election of that year the republican vote was 74,690, or 31·9% of the vote cast—more than enough to secure the privilege of a primary for the nomination of candidates in the next election, at the expense of the state Government. The gains of the republican party were registered chiefly in the growing industrial districts, such as Chilton, DeKalb, St. Clair and Winston counties, in which the party polled majorities, and in Blount, Clay, Cullman, Jefferson, Marshall, Shelby and Walker counties, in which it polled strong minorities. Although its vote fell off to 45,005 in 1924, the striking increase in the republican vote from 1904 to 1924 and the appearance of a socialist vote are considered by many the normal result of industrial development and by some as a sign of the future break-up of the "solid south."

Two important amendments were added to the constitution of 1901: one provided for local option by counties and school districts as to increased taxation for public schools; the other authorized the issue of state bonds to the amount of $25,000,000 for the construction of a complete system of highways, thus securing for the state the national appropriations in aid of that policy, and in 1927 an additional $25,000,000 was authorized, for the continuance of the work. At its regular session in 1919 the legislature refused to ratify the 19th amendment to the constitution of the United States, providing for woman suffrage; but when the requisite number of states had made it a part of the constitution, a special session was called (1920) which promptly passed an act providing for the registration of women voters and for otherwise carrying into effect the provisions of the amendment. In 1921 a proposed amendment to the state constitution to provide additional qualifications for registering and voting was rejected by the people.

BIBLIOGRAPHY.—For an elaborate bibliography of Alabama, *see* T. M. Owen, *Annual Report of the American Historical Association* for 1897 (1898). Information regarding the resources, climate, population and industries of Alabama may be found in the reports of the United States Census; the publications of the United States Department of Agriculture and the United States Geological Survey; the bulletins of the Alabama Agricultural Experiment Station (published at Auburn, from 1888); the bulletins and reports of the Alabama Geological Survey (published at Tuscaloosa and Montgomery); and the following works: *Alabama Handbook: Agricultural and Industrial Resources and Opportunities* (Montgomery, 1919); R. M. Harper, *Resources of Southern Alabama* (1920). The history of the state may be found in J. A. Pickett, *A History of Alabama* (Charleston, 1851); W. R. Smith, *Debates in the Secession Convention of Alabama* (Montgomery, 1861); W. Brower, *Alabama* (Montgomery, 1872); W. Garrett, *Reminiscences of Public Men in Alabama* (Atlanta, 1872); P. J. Hamilton, *Colonial Mobile* (1897); *Publications of the Alabama Historical Society* (Montgomery); J. C. DeBose, *Alabama History* (Richmond, 1908); T. M. Owen, *History of Alabama and Dictionary of Alabama Biography* (1921), the first two volumes devoted to an exhaustive topical treatment of the history of the state and the last two to biography. *See* also W. L. Fleming, *Civil War and Reconstruction in Alabama* (1905); T. P. Abernethy, *The Formative Period in Alabama, 1815–1828* (Montgomery, 1922). *The biennial Alabama Official and Statistical Register* (Montgomery), published by the state department of archives and history, gives the names of all officials, the election statistics, etc. For government *see* H. L. McBain and J. W. Hill, *How We are Governed in Alabama and the Nation* (1914).

"ALABAMA" ARBITRATION. The facts of this case are as follows: In 1861 the Southern States of North America seceded and set up a separate government. Hostilities began with the capture of Fort Sumter by the Confederates on April 13, 1861. On the 19th President Lincoln declared a blockade of the southern ports. On May 14 the British government issued a proclamation of neutrality, by which the Confederates were recognized as belligerents. This example was followed shortly afterwards by France and other States. In June 1862 the vessel, the "Alabama," originally known as "No. 290," was being built by Messrs. Laird at Birkenhead. She was then nearly completed and was obviously intended for a man-of-war. On June 23 Mr. C. F. Adams forwarded to Earl Russell a letter from the United States consul at Liverpool giving certain particulars as to her character. This letter was laid before the law officers, who advised that, if these particulars were correct, the vessel ought to be detained. On July 21 sworn evidence, which was supplemented on July 23, was obtained and laid before the commissioners of customs (who were the proper authorities to enforce the provisions of the Foreign Enlistment Act of 1819), but they declined to move. On July 23, the same evidence was laid before the law officers, who advised that there was sufficient ground for detention. By some accident, the papers were not returned till July 29. Instructions were then issued to seize the vessel, but she had already sailed on the evening of the 28th. Although she remained for two days off the coast of Anglesey, there was no serious attempt at pursuit. She afterwards made her way to the Azores, where she received her armament, which was brought from Liverpool in two British ships. Captain Semmes there took command of her under a commission from the Confederate Government. After a most destructive career she was sunk off Cherbourg by the "Kearsarge" on June 19, 1864.

On these facts the United States Government alleged against Great Britain two grievances: first the recognition of the Southern States as belligerents and a general manifestation of unfriendliness in other ways; second, the breach of neutrality in allowing the "Alabama," the "Florida," the "Shenandoah" and other Confederate vessels to be built and equipped on British territory. Correspondence ensued extending over several years and in 1871 a commission was appointed to determine the mode in which the questions at issue might be settled. The British commissioners suggested that the "Alabama" should be submitted to arbitration. The American commissioners refused "unless the principles which should govern the arbitrators in the considera-

tion of the facts could be first agreed." Eventually it was agreed that the three following rules should apply: A neutral government is bound—(1) to use due diligence to prevent the fitting out, arming or equipping within its jurisdiction of any vessel, which it has reasonable ground to believe is intended to cruise or to carry on war against a power with which it is at peace, and also to use like diligence to prevent the departure from its jurisdiction of any vessel intended to cruise or carry on war as above, such vessel having been specially adapted, in whole or in part, within such jurisdiction, to warlike use; (2) not to permit or suffer either belligerent to make use of its ports or waters as the base of naval operations against the other, or for the purpose of the renewal, or augmentation of military supplies or arms or the recruitment of men; (3) to exercise due diligence in its own ports and waters and as to all persons within its jurisdiction to prevent any violation of the foregoing obligation and duties. These rules were embodied in the treaty of Washington (1871), which provided that the "Alabama" claims should be referred to a tribunal composed of five arbitrators, one to be named by each of the contracting parties and the remainder by three neutral powers. Art. 6 provided that the arbitrators should be governed by the three rules quoted above, and by such principles of international law not inconsistent therewith as the arbitrators should determine to be applicable to the case. By the same article the parties agreed to observe these rules as between themselves in future, and to bring them to the knowledge of other maritime powers. Art. 7 gave power to the arbitrators to award a sum in gross if Great Britain were adjudged in the wrong.

The treaty was, on the whole, welcomed in England. The United States appointed Mr C. F. Adams as arbitrator and Mr. J. C. Bancroft Davis as agent The British government appointed Sir Alexander Cockburn as arbitrator and Lord Tenterden as agent. The arbitrators appointed by the three neutral powers were Count Sclopis (Italy), M. Staempfli (Switzerland), Baron d'Itajuba (Brazil). The first meeting of the tribunal took place on Dec. 15, 1871, in Geneva. As soon as the cases had been formally presented, the tribunal adjourned till the following June. There followed immediately a controversy which threatened the collapse of the arbitration. The United States claimed damages not only for the property destroyed by the Confederate cruisers, but for such "indirect losses" as the transference of the American marine to the British flag, the enhanced payments of insurance, the expenses of pursuit and the prolongation of the war. They also revived the charges of "insincere neutrality" and "veiled hostility" which had figured in the diplomatic correspondence, and had been repudiated by Great Britain, and dwelt at length upon the premature recognition of belligerency, the unfriendly utterances of British politicians and the material assistance afforded to the Confederates by British traders. These claims for indirect losses, etc., caused great excitement in England. That they were within the treaty was disputed, and it was argued that, if they were, the treaty should be amended or denounced. In Oct. 1872 Lord Granville notified to General Schenck, the United States minister, that the British government did not consider that the indirect losses were within the submission, and in April the British counter-case was filed without prejudice to this contention. On June 15 the tribunal reassembled and the American argument was filed. To save the situation Mr. Adams persuaded his colleagues to make a spontaneous declaration that by the principles of international law the indirect claims ought to be excluded from their consideration. The discussion then turned mainly on the question of the measure of "due diligence." The United States contended that it must be a diligence commensurate with the emergency or with the magnitude of the results of negligence. The British government maintained that while the measure of care which a government is bound to use in such cases must be dependent more or less upon circumstances, it would be unreasonable to require that it should exceed that which the governments of civilized States were accustomed to employ in matters concerning their own security or that of their citizens.

The tribunal adopted the view suggested by the United States. It found that Great Britain was legally responsible for all the depredations of the "Alabama" and "Florida" and for those committed by the "Shenandoah" after she left Melbourne. In the case of the "Alabama" the court was unanimous; in the case of the "Florida" Sir A. Cockburn alone, in that of the "Shenandoah" he and Baron d'Itajuba, dissented from the majority. In the cases of the other vessels the judgment was in favour of Great Britain. The tribunal decided to award a sum in gross, and (Sir A. Cockburn again dissenting) fixed the damages at $15,500,000 in gold. On Sept. 14 the award was formally published, and signed by all the arbitrators except Sir A. Cockburn, who filed a lengthy statement of his reasons.

The first of the Washington Rules, with the substitution of the words "the means at its disposal" for the words "due diligence," was adopted by Art. 8 of the Hague Convention XIII., 1907.

See L. A. Atherley-Jones and H. H. L. Bellot, *Commerce in War* (1907). (H. H. L. B.)

ALABAMA CITY, a city of Etowah county, Alabama, U.S.A., 6om. N.E. of Birmingham; 2½m. N.W. of Gadsden. It is served by the Southern, the Louisville and Nashville, and the Nashville, Chattanooga and St. Louis railways. The population was 5,432 in 1920, and was estimated locally in 1927 at 8,500. It has large cotton mills and steel factories. Coal and iron are mined in the vicinity.

ALABAMA RIVER, a river of Alabama, U.S.A., formed by the Tallapoosa and Coosa rivers, which unite about 6m. above Montgomery. It flows west as far as Selma, then south-west until, about 45m. from Mobile, it unites with the Tombigbee to form the Mobile and Tensas rivers, which discharge into Mobile bay. The course of the Alabama is tortuous; its width varies from 600 to 900ft., its depth from 3 to 7ft.; its length by the United States Survey is 312m.; by steamboat measurement, 420m. The river crosses the richest agricultural and timber districts of the State, and railways connect it with the mineral regions of north central Alabama. The principal tributary of the Alabama is the Cahaba (about 200m. long), which enters it about 10m. below Selma. Of the rivers which form the Alabama, the Coosa crosses the mineral region of Alabama, and is navigable for light-draft boats from Rome, Georgia (where it is formed by the junction of the Oostenaula and Etowah rivers), to about 117m. above Wetumpka (about 192m. below Rome and 26m. below Greensport), and from Wetumpka to its junction with the Tallapoosa; the channel of the river has been considerably improved by the Federal government. The navigation of the Tallapoosa river (which has its source in Paulding county, Ga., and is 250m. long) is prevented by shoals and a 60ft. fall at Tallassee, a few miles north of its junction with the Coosa. The Alabama, which is navigable throughout the year, is an important carrier of cotton, cotton seed, fertilizer, cereals, lumber and naval stores.

ALABASTER or **ARBLASTIER, WILLIAM** (1567–1640), English Latin poet and scholar, was born at Hadleigh, Suffolk, and was educated at Westminster school and Trinity college, Cambridge. Alabaster served with the expedition of Robert Devereux, earl of Essex, to Cadiz in 1596, and embraced the Roman Catholic faith while he was in Spain. He was imprisoned in the Tower for his religious opinions in 1598 and 1599. His mystical writings brought him into conflict with the Inquisition, and he was imprisoned in Rome for a short time. He escaped, returned to England, abjured Catholicism and received a prebend in St. Paul's Cathedral, which he held until his death in April 1640.

Alabaster's Latin tragedy, *Roxana,* written while he was at Cambridge, is modelled on *La Dalida* of Luigi Groto, and was first published in 1632. Samuel Johnson praised it as the only Latin verse worthy of note written in England before Milton's *Elegies.* One book of an epic poem in praise of Elizabeth, entitled *Elisaeis, apotheosis poetica,* is preserved at Emmanuel college, Cambridge. It was admired by Edmund Spenser. "Who lives that can match that heroic song?" he says in "*Colin Clout's come home againe.*" Other works by Alabaster are mystical in character and owe much to his study of the Kabbala. They include *Apparatus in revelationem Jesu Christi* (Antwerp, 1607), *Ecce*

Sponsus venit (1633), *Lexicon Pentaglotton* (1637) and mystical commentaries on Revelations and the Pentateuch.

See T. Fuller, *Worthies of England* (ii. 343); Pierre Bayle, *Dictionary, Historical and Critical* (1734); J. P. Collier, *Bibl. and Crit. Account of the Rarest Books in the English Language* (vol. i. 1865); also the *Athenaeum* (Dec. 26, 1903), where Mr. Bertram Dobell describes a ms. in his possession containing 43 sonnets by Alabaster.

ALABASTER, a name applied to two different mineral substances. The alabaster of the ancients is mostly a granular aggregate of crystals of calcium carbonate—*i.e.*, it is really a marble (*q.v.*). The alabaster of modern times is a granular form of the mineral gypsum (*q.v.*). It is usually white, pink or yellowish in colour, often with darker streaks and patches, and is very soft (hardness 1·5 to 2) so that it can be scratched by the finger nail. It can be readily distinguished from marble by the fact that it does not effervesce with acid. Alabaster is found in beds interstratified with red sandstones and marls deposited in the beds of salt lakes during an arid period: in England, chiefly in the Keuper marls of the midlands, especially at Chellaston in Derbyshire, Fauld in Staffordshire, and near Newark, Nottinghamshire, also in the neighbourhood of Carlisle, near Watchet in Somerset and Penarth in Glamorgan, all in the Trias.

On the Continent the centre of the alabaster trade is Florence, where it is found in Miocene and Pliocene strata, and is extensively used for statuary work and carving of ornamental objects. The best kind is pure white and translucent, but by careful heating in nearly boiling water it can be made nearly opaque, resembling marble. This appears to be due to partial dehydration.

(R. H. Ra.)

ALABASTROS or **ALABASTOS,** a Greek vase, shaped like an urn The most common type of the alabastros stands on a base that balances, in appearance, its rather wide mouth. (*See* Potteries and Porcelains: *Greek Pottery.*)

ALACALUF, an Indian tribe, almost extinct, living in the west Patagonian channels, chiefly in the vicinity of Ración sound. Formerly they were much more numerous, and their canoes might be seen southward from the Gulf of Peñas to Brecknock peninsula in Tierra del Fuego, including the Straits of Magellan. Their culture in general closely resembles that of the other canoe-using tribe of Tierra del Fuego, the Yahgan (*q.v.*). The use of planked canoes by the Alacaluf has suggested the possibility of culture transference from Polynesia, but the Alacaluf planked canoe is demonstrably a local development.

See J. M. Cooper, "Analytical and Critical Bibliography . . . of Tierra del Fuego," in *Bureau of American Ethnology Bulletin 63* (1917). (S. K. L.)

ALACOQUE or **AL COQ, MARGUERITE MARIE** (1647–1690), French nun and founder of the devotion to the Sacred Heart of Jesus, was born at Lauthecourt on July 22, 1647, and died on Oct. 17, 1690. Having been cured of paralysis, as she believed by the intercession of the Blessed Virgin, in 1671 she entered the Visitation convent at Paray-le-Monial and in the following year made her final vows. After a long period of severe austerities she testified that Christ had revealed to her His heart burning with love for man, and bade her establish the Holy Hour, communion on the first Friday of the month and the feast of the Sacred Heart to be observed on the Friday after the octave of Corpus Christi. The devotion to the Sacred Heart spread rapidly throughout Christendom, and Marguerite Marie was pronounced venerable in 1824, blessed in 1864, and finally on May 13, 1920, was canonized

Her writings and autobiography are contained in *Vie et Oeuvres par les Contemporaines,* 2 vols. (Paris, 1901), her autobiography being published again at Paray-le-Monial in 1918. *See* also E. Bougaud, *Life of St. Margaret Mary Alacoque* (New York, 1920).

ALAGOAS, a maritime state of Brazil, bounded north and west by the State of Pernambuco, south and west by the State of Sergipe, and east by the Atlantic. It has an area of 22,584 square miles. A dry, semi-barren plateau, fit for grazing only, extends across the western part of the State, breaking down into long fertile valleys and wooded ridges towards the coast, giving the country a mountainous character. The coastal plain is filled with lakes (*lagoas*), in some cases formed by the blocking up of river outlets by beach sands. The valleys and slopes are highly fertile and produce sugar, cotton, tobacco, Indian corn, rice, mandioca and fruits. Hides and skins, mangabeira rubber, cabinet woods, castor beans and rum are also exported. Cattle-raising was formerly a prominent industry, but it has greatly declined. Manufactures have been developed to a limited extent only, though protective tariff laws have been adopted for their encouragement. The climate is hot and humid, and fevers are prevalent in the hot season. The capital, Maceio, is the chief commercial city of the State, and its port (Jaragua) has a large foreign and coastwise trade. The principal towns are Alagoas, formerly the capital, picturesquely situated on Lake Manguaba, 15m. south-west of Maceio, and Penedo, a small port on the lower São Francisco, 26m. above the river's mouth. Before 1817 Alagoas formed part of the capitania of Pernambuco, but in that year the district was rewarded with a separate government for refusing to join a revolution, and in 1823 became a province of the empire. The advent of the republic in 1889 changed the province into a State.

ALAIN DE LILLE (Alanus de Insulis) (*c.* 1128–1202), French theologian and Latinist, lived at Montpellier, and finally retired to the Abbey of Citeaux, where he remained until his death. His varied learning won for him the title of *Doctor universalis.* He was famed in his day for two of his Latin poems, *De planctu naturae,* a satire on human vices, and *Anticlaudianus,* a long verse treatise on the arts and on morals. Alain shared in the reaction against scholasticism, and laid stress on the share of faith in the apprehension of religious truth. He must be classed with the so-called Summists. But his *De arte seu de articulis catholicae fidei,* which was a "summa" of Christian theology, brings the principles of mathematical science to bear on Christian dogma He also wrote a treatise *contra haereticos.*

The works of Alain de Lille have been published by Migne, *Patrologia latina,* vol. ccx. A critical edition of the *Anticlaudianus* and of the *De planctu naturae* is given by Th. Wright in vol. ii. of the *Anglo-Latin Satirical Poets and Epigrammatists of the Twelfth Century* (London, 1872). *See* Hauréau, *Mémoire sur la vie et quelques oeuvres d'Alain de Lille* (Paris, 1885); M. Baumgartner, *Die Philosophie des Alanus de Insulis* (Münster, 1896).

ALAIS: *see* Ales

ALAJUELA, one of the four plateau cities containing most of the inhabitants of Costa Rica, Central America; the population in 1925 was 31,692. Alajuela is situated 14m. W. of San José on a branch line of the Costa Rica railway and is also accessible by highway. It lies on the slope of Poas volcano and is one of the chief centres of the coffee industry of Costa Rica. It is also the centre of the sugar trade of Costa Rica, this product coming from the adjoining country in the lower altitudes. A number of villages, ranging in population from 1,000 to 4,000, are tributary to Alajuela.

ALAMANNI or **ALLEMANNI,** a German people first mentioned by Dio Cassius. They dwelt in the basin of the Maine, to the south of the Chatti (*q.v.*). They were a conglomeration of various tribes. The Hermunduri formed the preponderating element, and there were among the others the Iuthungi, Bucinobantes and Lentienses. From the 4th century A.D. onwards we hear also of the Suebi (*q.v.*) or Suabi. The Hermunduri belonged to the Suebi, but reinforcements from new Suebic tribes now moved westward. In later times the names Alamanni and Suebi seem to be synonymous. They were continually engaged in conflicts with the Romans, the most famous encounter being that at Strassburg, in which they were defeated by Julian (A.D. 357). Early in the 5th century the Alamanni crossed the Rhine and conquered and settled Alsace and a large part of Switzerland. In A.D. 405 they were conquered by Clovis, from which time they formed part of the Frankish dominions. The Alamannic and Swabian dialects survive in Swiss dialects, and in parts of South Germany, particularly Baden and Württemburg and also parts of Alsace.

See Dio Cassius lxvii. et seq.; Ammianus Marcellinus, *passim;* Gregory of Tours, *Historia Francorum,* book ii.; O. Bremer in H. Paul, *Grundriss der germanischen Philologie* (2nd ed., Strasbourg, 1900), vol. iii. pp. 930 *et. seq.*

ALAMANNI or **ALEMANNI, LUIGI** (1495–1556), Italian statesman and poet, was born at Florence. Luigi joined with others in an unsuccessful conspiracy against Giulio de' Medici, afterwards Pope Clement VII. He was obliged to take refuge in Venice, and, on the accession of Clement, to flee to France. When Florence shook off the papal yoke in 1527, Alamanni returned, and took a prominent part in the management of the affairs of the republic. On the restoration of the Medici in 1530 he had again to take refuge in France, where he enjoyed the favour both of Francis I. and Henry II. He died at Amboise on April 18, 1556. His best work, *La Coltivazione* (Paris, 1546), is a didactic poem, written in imitation of Virgil's *Georgics*. His *Opere Toscane* (Lyons, 1532) consists of satirical pieces written in blank verse. An unfinished poem, *Avarchide*, in imitation of the *Iliad*, was the work of his old age and has little merit. It has been said by some that Alamanni was the first to use blank verse in Italian poetry, but the distinction belongs rather to his contemporary Giangiorgio Trissino. He also wrote a poetical romance, *Girone il Cortese* (Paris, 1548); a tragedy, *Antigone*; a comedy, *Flora*, and other poems. His works were published, with a biography, by P. Raffaelli, as *Versi e prose di Luigi Alamanni* (Florence, 1859).

BIBLIOGRAPHY.—*See* G. Naro, *Luigi Alamanni e la coltivazione* (Syracuse, 1897), and C. Corso, *Un decennio di patriottismo di Luigi Alamanni* (Palermo, 1898).

ALAMBAGH, the name of a large park or walled enclosure, containing the ruins of a country house of the old Oudh court, as well as a beautiful garden, situated about 4m. from Lucknow, near the Cawnpore road, in the United Provinces of India. It was converted into a fort by the mutineers in 1857, and after its capture by the British was of importance in connection with the military operations around Lucknow. Sir Henry Havelock was buried in the garden.

ALAMEDA, a residential city of Alameda county, California, U.S.A., on an artificial island on the continental side of San Francisco bay, opposite to and about 6m. from San Francisco, and directly south of Oakland, from which it is separated by an estuary spanned by three bridges. South of the city, but within its boundaries, is Bay Farm island, which is practically the city's vegetable garden. Alameda is served by the Southern Pacific railway, and by electric trains or ferries to all the cities around the bay, and there is a traffic tube to Oakland under the canal. An industrial belt line, constructed and owned by the city, is operated jointly by the transcontinental railways which serve the East Bay district (*see* ALBERT LEA). Population was 28,806 in 1920; and was estimated locally at over 35,000 in 1927. Alameda has 14 miles of waterfront, including long stretches of sandy beach used for recreation, besides the large tracts suitable for commercial and industrial purposes. It has 60 miles of paved streets, all lighted by electricity. It has a municipal light and power plant; a $1,250,000 high school; a municipal golf course; a community hotel; a city-planning commission; and an annual dahlia festival. The industries include large borax works and shipyards; a pottery and a lumber mill; and plants which make pencils, boxes, candy, engines and deep-well pumps. The fleet of a large salmon-packing association has its winter headquarters here. There are already large docks and warehouses, and the city has undertaken extensive developments on its western waterfront (estimated cost $10,000,000). There was a settlement here before the end of the Mexican period. The town was incorporated in 1854 and in 1885 it was chartered as a city. In 1870 it had a population of 1,557; in 1880, of 5,708. It operates under a freehold charter, and has had the city-manager form of government since 1917.

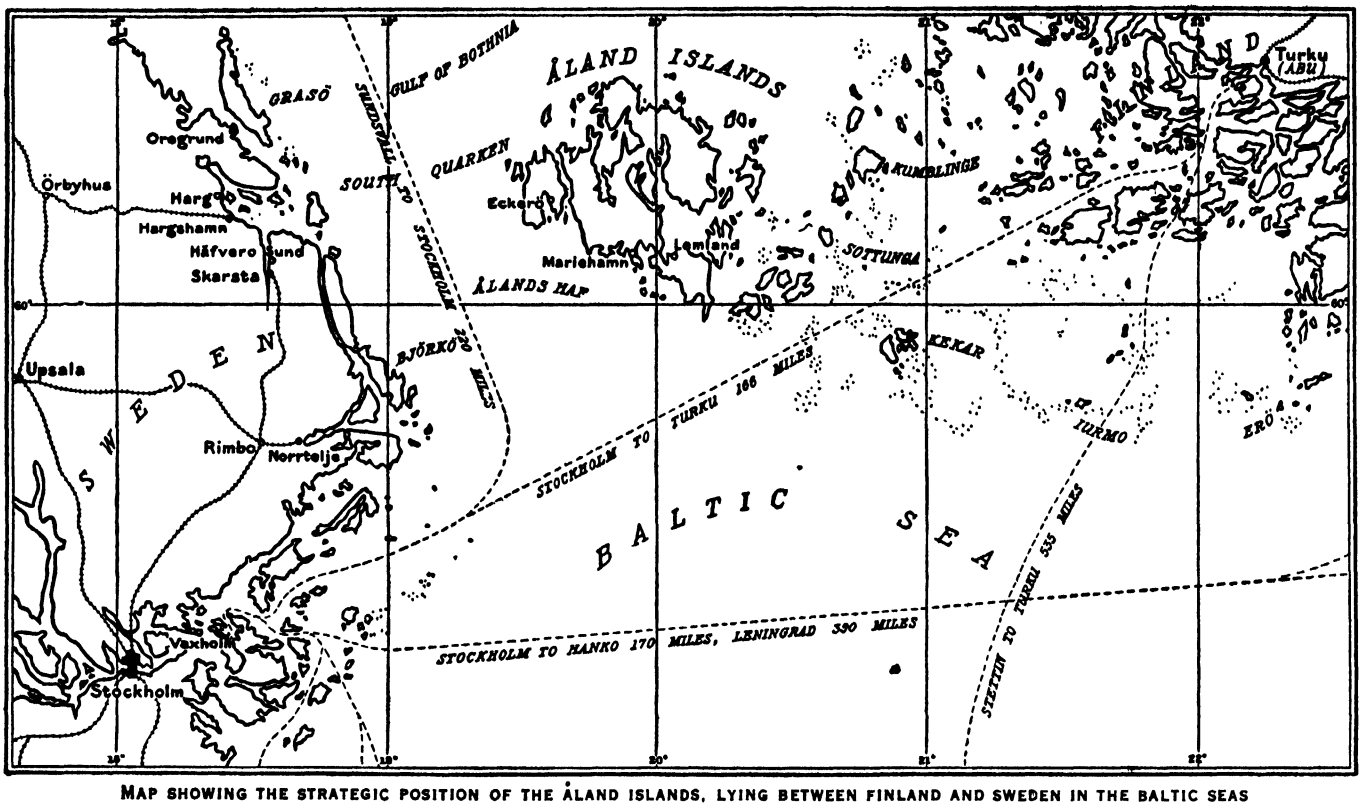
ALAMO, THE, an historic building in San Antonio, Texas, noted as the scene of an heroic defence in the war between Texas and Mexico. This building is the chapel of the Mission San Antonio de Valero, founded in 1718 by Franciscans, and commonly called the "Alamo Mission" from the grove of cottonwood (*alamo*) in which it stood. It originally consisted of the chapel, a convent yard about 100ft. square, a convent and hospital building, and a plaza about 2½ac. in extent, the whole being surrounded by a strong wall. Upon the disappearance of the Indians from the vicinity the mission was abandoned, and after 1793 it was sometimes used as a fort. In the war for Texan independence Cols. William B. Travis, James Bowie and Davy Crockett, with 180 men, were attacked here by 4,000 Mexicans commanded by Santa Anna. After a siege lasting 13 days, Feb 23–March 6, 1836, during which some 500 of the attacking force were killed, a breach was made in the walls. In a final assault the Mexicans overpowered and slaughtered the garrison in a hand-to-hand struggle in the chapel, the five survivors being subsequently killed in cold blood by order of Santa Anna. "Remember the Alamo" became the war-cry of the Texans, who, under Sam Houston, at San Jacinto, on April 21, 1836, defeated and captured Santa Anna. In 1883 the Alamo building was bought by the State and preserved as a public monument, and in 1913 the city of San Antonio began its restoration.

See A. M. Williams, *Sam Houston and the War of Independence in Texas* (Boston, 1893); Zavola, *Story of the Siege and Fall of the Alamo* (San Antonio, 1911).

ÅLAND ISLANDS, an archipelago at the entrance to the Gulf of Bothnia, about 25m. from the coast of Sweden, and 15m. from that of Finland. Area 551sq.m., with a population of 27,180 in 1925 The group which forms the Finnish department of Åland (Ahvenanmaa), consists of nearly 300 islands, of which about 80 are inhabited, the remainder being desolate rocks. These islands form a continuation of a dangerous granite reef extending along the south coast of Finland. They formerly belonged to Sweden, and in the neighbourhood the first victory of the Russian fleet over the Swedes was gained by Peter the Great in 1714. They were ceded to Russia in 1809, and remained Russian until 1917, when Finland was proclaimed an independent and sovereign State The population centres chiefly in the island of Åland, upon which is situated the small town of Mariehamn. The inhabitants, hardy seamen and fishermen, are mostly of Swedish descent. The surface of the islands is generally sandy, the soil thin and the climate keen; yet Scotch fir, spruce and birch are grown; and rye, barley, flax and vegetables are produced. Great numbers of cattle are reared; and cheese, butter and hides, as well as salted meat and fish, are exported. There are several excellent harbours (notably that of Ytternäs), which were of great importance to Russia from the fact that they are frozen up for a much briefer period than those on the coast of Finland.

History.—When, by an article of the Treaty of Fredrikshavn (Friedrichshamn), Sept. 5–17, 1809, the islands were ceded to Russia, together with the territories forming the grand-duchy of Finland on the mainland, the Swedes were unable to secure a provision that the islands, occupying a position of great strategic importance in relation to the entrance to Stockholm and to the Gulf of Bothnia, should not be fortified. The question was a vital one for Great Britain's trade as well. In 1854, accordingly, during the Crimean War, an Anglo-French force destroyed the fortress of Bomersund By the "Åland Convention," between Great Britain, France and Russia on March 30, 1856, it was stipulated that "the Åland islands shall not be fortified, and that no military or naval establishments shall be maintained or created on them." By the 33rd article of the Treaty of Paris (1856) this convention, annexed to the final act, was given "the same force and validity as if it formed part thereof." In 1906 it was asserted that Russia, under pretext of stopping the smuggling of arms into Finland, was massing considerable forces at the islands. The question of the Åland islands created discussion in 1907 and 1908 in connection with new North sea agreements, and Russia considered the 1856 convention rather humiliating. But it was plainly shown by other powers that they did not propose to regard it as open to question, and the point was not officially raised

Under the tsardom the islands were united with Finland until the latter country declared her independence in 1917. In Dec. 1917, the Åland islanders claimed the right of self-determination on their own account, and unofficial plebiscites showed a vote in favour of reunion with Sweden. Finland granted the islands autonomy on May 7, 1920, but refused to contemplate their secession. In June the leaders of the secession movement were



MAP SHOWING THE STRATEGIC POSITION OF THE ÅLAND ISLANDS, LYING BETWEEN FINLAND AND SWEDEN IN THE BALTIC SEAS

The Aland Islands, a self governing group within the Finnish body politic, were guarded by Russia for over a century because of their strategic position in the Baltic sea. They acquired the right of self determination after the World War and have been guaranteed neutralization by the Baltic powers. The majority of the inhabitants are Swedish

arrested for high treason, and Finnish troops were sent to the island. As this situation was producing a state of serious tension between Finland and Sweden, Great Britain drew the attention of the Council of the League of Nations to the movement on June 19, 1920.

With the consent of the two interested governments, the Council asked a special commission of jurists whether the question was international or the exclusive concern of Finland. This commission declared the question international, whereupon the Council despatched a special commission of inquiry to the spot. This commission reported against the claim of the islanders to secede from Finland, but declared that the islanders formed a distinct group within the Finnish body politic, and suggested that the maintenance of Finnish sovereignty ought to be made conditional upon the incorporation in the autonomy law of May 7, 1920, of five specific guarantees. The commission also reported in favour of a new convention, to be signed by all the Baltic powers, for the neutralization and demilitarization of the Åland Islands, to replace the earlier international convention of March 30, 1856.

This report was accepted by the Council and the two interested governments. An agreed text of the five guarantees was subsequently inserted in the Finnish law, and was placed under the supervision of the Council of the League. The new neutralization convention was negotiated at a conference held at Geneva from Oct. 10–20, 1921, and it came into force on April 6, 1922.

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ALANI, eastern division of the Sarmatians, half-caste Scyths, a wandering people resembling Mongols. First met with north of the Caspian, then (*c.* 1st century A.D.) spreading into the steppes of Russia, the Alani made incursions into both the Danubian and the Caucasian provinces of the Roman empire. By the Huns they were cut into two portions, of which the western joined the Germanic nations in their invasion of southern Europe, and, following the fortunes of the Vandals, disappeared in North Africa. Those of the eastern division, though dispersed about the steppes until late mediaeval times, were forced by fresh invading hordes into the Caucasus, where they remain as the Ossetes. (*See* SARMATAE and SCYTHIA.)

ALANINE, *α Alanine,* is a constituent, and decomposition product, of many proteins, soluble in water or alcohol, crystallizing in colourless, sharp rhombic prisms, and having marked physiological action. It has the formula of α amino-proprionic acid, $NH_2{\cdot}CHMe{\cdot}CO_2H$, and exists in the *d-*, *l-* and *r*-isomeric forms (*see* ISOMERISM).

ALANSI, a town in the inter-Andine province of Chimborazo, Ecuador, about 2° 15′ S. and 78° 50′ W. It is about 75m. inland on the Guayaguil and Quito railway. The town is situated in the plain of Alansi and on the river of the same name. Its chief resources are agricultural and pastoral. The population is estimated (1928) at approximately 7,000.

ALAPAEVSK, a town in Uralsk Area of Russian S.F.S.R. Its population was 12,151 (1926). Lat. 57° 49′ N. Long., 61° 40′ E. It was known for its copper as long ago as 1704, and is in the copper and iron mining area. Since it was linked by rail with Sverdlovsk and Nizhni-Tagil, its importance has greatly increased.

ALARCON, HERNANDO DE, Spanish navigator of the 16th century, was sent by the viceroy of New Spain in 1540 to give naval support to the expedition of Francisco Vasquez de Coronado in his search for the mythical seven cities of Mexico. The junction was never effected. Alarcon sailed up the Gulf of California, and determined with certainty that California was a peninsula, not an island. He surveyed the coast, ascended the Rio del Tizon or Rio de Buena Guia (Colorado) for 85 Spanish miles and planted a cross at the highest point he reached. Under the cross he buried a note afterwards found by Melchior Diaz.

See Herrera, Decade VI. book ix. ch. 15; vol. vi. fol. 212 of Madrid edition of 1730, and the report printed in Hakluyt's voyages.

ALARCON, JUAN RUIZ DE (*c.* 1581–1639), Spanish dramatist, was born about 1581 at Tlacho (Mexico), where his father was superintendent of mines, and died at Cordova on Aug. 4, 1639. Alarcon was educated in Spain, then, after a brief stay in

Mexico, returned to Spain and occupied a small post under the Council of the Indies. His plays were published in 1628 and 1634; the most famous of these is *La Verdad sospechosa,* which was adapted by Corneille as the *Menteur.* Alarcon was preoccupied with ethical aims, and his gift of dramatic presentation was as brilliant as his dialogue was natural and vivacious. It has been alleged that his foreign origin is noticeable in his plays, but in *El Tejedor de Segovia* he had produced a masterpiece of national art, national sentiment and national expression.

ALARCON, PEDRO ANTONIO (1833–1891), Spanish writer, was born at Guadix March 10 1833. He had a considerable reputation as a journalist and poet when his play, *El Hijo pródigo,* was hissed off the stage in 1857. The failure exasperated Alarcon so much that he enlisted under O'Donnell as a volunteer in the Moroccan campaign. The expedition provided the material for the brilliant *Diario de un testigo de la guerra de Africa* (1859), a masterpiece in its way as a description of campaigning life. On his return from Morocco, Alarcon did great service to the liberal cause as editor of *La Politica.* But in the years 1868–74 he ruined his political reputation by a series of rapid changes of front. His literary reputation steadily increased, however. *El sombrero de tres picos* (1874), a clever resetting of an old Spanish tale, lives for its malicious wit and minute observation. His other works include *Cuentos amatorios* (1881); *Historietas nacionales* (1881); *El Escandalo* (1875); *El Capitan Veneno* (1881). Alarcon died July 20, 1891.

ALARD, JEAN DELPHIN (1815–1888), famous French violinist and teacher, was professor at the Paris Conservatoire from 1843 to 1875. Sarasate was one of his pupils.

ALARIC (*c.* 370–410), Gothic conqueror, the first Teutonic leader who stood as a conqueror in the city of Rome, was probably born about 370 on an island named Peucè (the fir) at the mouth of the Danube. He was of noble descent, his father being a scion of the family of the Balthi or Bold-men, next in dignity among Gothic warriors to the Amals. He was a Goth and belonged to the western branch of that nation (sometimes called the Visigoths) who at the time of his birth were quartered in the region now known as Bulgaria, having taken refuge on the southern shore of the Danube from the pursuit of their enemies the Huns.

In the year 394 he served as a general of *foederati* (Gothic irregulars) under the Emperor Theodosius in the campaign in which he crushed the usurper Eugenius. As the battle which terminated this campaign, the battle of the Frigidus, was fought near the passes of the Julian Alps, Alaric probably learnt at this time the weakness of the natural defences of Italy on her north-eastern frontier.

In the shifting of offices which took place at the beginning of the reigns of Arcadius and Honorius, the sons of Theodosius, Alaric apparently hoped that he would receive one of the great war ministries of the empire, and thus instead of being a mere commander of irregulars would have under his orders a large part of the imperial legions. This, however, was denied him, and he remained an officer of *foederati.* His disappointed ambition prompted him to take the step for which his countrymen were longing, for they too were grumbling at the withdrawal of the "presents," in other words the veiled ransom-money, which for many years they had been accustomed to receive. They raised him on a shield and acclaimed him as a king; leader and followers both resolved (says Jordanes, the Gothic historian) "rather to seek new kingdoms by their own labour, than to slumber in peaceful subjection to the rule of others."

Alaric struck first at the eastern empire. He marched to the neighbourhood of Constantinople, but finding himself unable to undertake the siege of the city, he retraced his steps westward and marched southward through Thessaly and the unguarded pass of Thermopylae into Greece. Alaric's invasion of Greece lasted two years (395–96); he ravaged Attica but spared Athens, which at once capitulated to the conqueror, and penetrated into Peloponnesus, capturing its most famous cities, Corinth, Argos and Sparta, selling many of their inhabitants into slavery. Here, however, his victorious career ended. Stilicho, who had come a second time to the assistance of Arcadius, succeeded in shutting up the Goths in the mountains of Pholoe on the borders of Elis and Arcadia. Alaric escaped with difficulty, and not without some suspicion of connivance on the part of Stilicho. He crossed the Corinthian gulf and marched with the plunder of Greece northwards to Epirus.

Next came an astounding transformation. For some mysterious reason, probably connected with the increasing estrangement between the two sections of the empire, the ministers of Arcadius conferred upon Alaric the government of part of the important prefecture of Illyricum. Here, ruling the Danubian provinces, he was on the confines of the two empires, and, in the words of the poet Claudian, he "sold his alternate oaths to either throne," and made the imperial arsenals prepare the weapons with which to arm his Gothic followers for the next campaign. It was probably in the year 400 that Alaric made his first invasion of Italy, co-operating with another Gothic chieftain named Radagaisus. After spreading desolation through north Italy, and striking terror into the citizens of Rome, Alaric was met by Stilicho at Pollentia (a Roman municipality in what is now Piedmont). The battle (April 6, 402, Easter day) was a victory, though a costly one, for Rome and effectually barred the further progress of the barbarians. Alaric was an Arian Christian who trusted to the sanctity of Easter for immunity from attack, and the enemies of Stilicho reproached him for having gained his victory by taking an unfair advantage of the great Christian festival. The wife of Alaric is said to have been taken prisoner after this battle; and there is some reason to suppose that he was hampered in his movements by the presence with his forces of large numbers of women and children, having given to his invasion of Italy the character of a national migration. After another defeat before Verona, Alaric quitted Italy, probably in 403.

He had not indeed reached Rome, but his invasion of Italy had produced important results. It had caused the imperial residence to be transferred from Milan to Ravenna, it had necessitated the withdrawal of the 20th legion from Britain, and it had probably facilitated the great invasion of Vandals, Suevi, and Alani into Gaul, by which that province and Spain were lost to the empire. We next hear of Alaric as the friend and ally of his late opponent Stilicho. The estrangement between the eastern and western courts had in 407 become so bitter as to threaten civil war, and Stilicho was actually proposing to use the arms of Alaric in order to enforce the claims of Honorius to the prefecture of Illyricum. The death of Arcadius in May 408 caused milder counsels to prevail in the western cabinet, but Alaric, who had actually entered Epirus, demanded that if he were thus suddenly bidden to desist from war, he should be paid handsomely for what in modern language would be called the expenses of mobilization. The sum which he named was a large one. 4,000 pounds of gold (about £160,000 sterling), but under strong pressure from Stilicho the Roman senate consented to promise its payment.

Three months later Stilicho himself and the chief ministers of his party were treacherously slain in pursuance of an order extracted from the timid and jealous Honorius; and in the disturbances which followed the wives and children of the barbarian *foederati* throughout Italy were slain. The natural consequence was that these men to the number of 30,000 flocked to the camp of Alaric, clamouring to be led against their cowardly enemies. He accordingly crossed the Julian Alps, and in Sept. 408 stood before the walls of Rome (now with no capable general like Stilicho to defend her) and began a strict blockade.

No blood was shed this time; hunger was the weapon on which Alaric relied. When the ambassadors of the senate in treating for peace tried to terrify him with their hints of what the despairing citizens might accomplish, he gave with a laugh his celebrated answer, "The thicker the hay, the easier mowed!" After much bargaining, the famine-stricken citizens agreed to pay a ransom of more than a quarter of a million sterling, besides precious garments of silk and leather and three thousand pounds of pepper. Thus ended Alaric's first siege of Rome. At this time, and indeed throughout his career, the one dominant idea of Alaric was not to pull down the fabric of the empire but to secure for himself, by negotiation with its rulers, a regular and recognized position within its borders. His demands were certainly large—the concession of

a block of territory 200 m. long by 150 wide between the Danube and the Gulf of Venice (to be held probably on some terms of nominal dependence on the empire), and the title of commander-in-chief of the imperial army. As all attempts to conduct a satisfactory negotiation with this emperor failed, Alaric, after instituting a second siege and blockade of Rome in 409, came to terms with the senate, and with their consent set up a rival emperor and invested the prefect of the city, a Greek named Attalus, with the diadem and the purple robe. But Attalus rejected the advice of Alaric and lost in consequence the province of Africa, the granary of Rome, which was defended by the partisans of Honorius. The weapon of famine, formerly in the hand of Alaric, was thus turned against him, and loud in consequence were the murmurs of the Roman populace. Honorius was also greatly strengthened by the arrival of six legions sent from Constantinople to his assistance by his nephew Theodosius II. Alaric therefore cashiered his puppet emperor Attalus after 11 months of ineffectual rule, and once more tried to reopen negotiations with Honorius. These negotiations would probably have succeeded but for the malign influence of another Goth, Sarus, the hereditary enemy of Alaric and his house. When Alaric found himself once more outwitted, he marched southward and began in deadly earnest his third siege of Rome. No defence apparently was possible; there are hints, not well substantiated, of treachery; there is greater probability of surprise. However this may be (for our information at this point of the story is miserably meagre) on Aug. 24 410, Alaric and his Goths burst in by the Salarian Gate on the north-east of the city. The Goths showed themselves not absolutely ruthless conquerors, and there is no reason to attribute any extensive destruction of the buildings of the city to Alaric and his army. Contemporary ecclesiastics recorded with wonder many instances of their clemency: the Christian churches saved from ravage; protection granted to vast multitudes both of pagans and Christians who took refuge therein; vessels of gold and silver, which were found in a private dwelling, spared because they "belonged to St. Peter"; at least one case in which a beautiful Roman matron appealed, not in vain, to the better feelings of the Gothic soldier who had assailed her.

Alaric then marched southwards into Calabria. He desired to invade Africa, which on account of its corn crops was now the key of the position; but his ships were dashed to pieces by a storm in which many of his soldiers perished. He died soon after, probably of fever, and his body was buried under the river-bed of the Busento, the stream being temporarily turned aside from its course while the grave was dug wherein the Gothic chief and some of his most precious spoils were interred. When the work was finished the river was turned back into its usual channel, and the captives by whose hands the labour had been accomplished were put to death that none might learn their secret. He was succeeded in the command of the Gothic army by his brother-in-law, Ataulphus.

Our chief authorities for the career of Alaric are the historian Orosius and the poet Claudian, both strictly contemporary; Zosimus, a somewhat prejudiced heathen historian, who lived probably about half a century after the death of Alaric; and Jordanes, a Goth who wrote the history of his nation in the year 551, basing his work on the earlier history of Cassiodorus (now lost), which was written *c.* 520.

(T. H.; X.)

ALARIC II. (d. 507), eighth king of the Goths in Spain, succeeded his father Euric, or Evaric, on Dec. 28, 484. His dominions not only included the whole of Spain except its north-western corner, but also Aquitaine and the greater part of Provence. In religion Alaric was an Arian, but he greatly mitigated the persecuting policy of his father, Euric, towards the Catholics and authorized them to hold, in 506, the council of Agde. He appointed a commission to prepare an abstract of the Roman laws and imperial decrees, which should form the authoritative code for his Roman subjects. This is generally known as the *Breviarium Alaricianum*, or *Breviary of Alaric* (*q.v.*). Alaric endeavoured strictly to maintain the treaty which his father had concluded with the Franks, but Clovis found a pretext for war in the Arianism of Alaric. The two armies met in 507 at the Campus Vogladensis, near Poitiers, where the Goths were defeated, and their king, who took to flight, was overtaken and slain, it is said, by Clovis himself. This battle ended the rule of the Visigoths in Gaul.

ALA-SHEHR (anc. PHILADELPHIA), Aidin vilayet, Asia Minor, in the Kuzu Chai valley (*Cogamus*), at the foot of the Boz Dagh (Mt. Tmolus) 83 m. east of Smyrna (105 by railway). Pop. (1927) 32,801. Philadelphia was founded by Attalus II. of Pergamum about 150 B.C., became one of the "Seven Churches" of Asia, and was called "Little Athens" on account of its festivals and temples. It was subject to frequent earthquakes. Philadelphia was an independent neutral city, under the Latin Knights of Rhodes, when taken in 1390 by Sultan Bayezid I. and an auxiliary Christian force under the emperor, Manuel II., after a long resistance, when all other cities of Asia Minor had surrendered. Twelve years later it was captured by Timur, who built a wall with the corpses of his prisoners. A fragment of the ghastly structure is in the library of Lincoln cathedral. The town is connected by railway with Afiun Qarahisar and Smyrna. It is ill-built, but, as it stands above the wide fertile Hermus plain, the distant view is imposing. There are small industries and a fair trade. A mineral spring yields a heavily charged water, "Eau de Vals," in great request in Smyrna.

See W. M. Ramsay, *Letters to the Seven Churches* (1904).

ALAS, LEOPOLDO (1852–1901), Spanish novelist and critic, was born at Zamora. His reputation rests on his psychological novel, *La Regenta* (1884–85), whose scene is laid in Oviedo. The ruthless analysis of its characters gives it a place among the best novels of the period.

ALASKA, formerly called Russian America, is a Territory of the United States of America, occupying the extreme north-western part of North America and including the adjacent islands. The name is a corruption of a native word possibly meaning "mainland" or "peninsula." The Territory of Alaska comprises, first, all that part of the continent west of the 141st meridian; secondly, the eastern Diomede Island in Bering Strait, and all islands in Bering Sea and the Aleutian chain lying east of a line drawn from the Diomedes to pass midway between Copper Island, off Kamchatka, and Attu Island of the Aleutians; thirdly, a narrow strip of coast and adjacent islands north of a line drawn from Cape Muzon, in latitude 54° 40′ N., up Portland canal to its head, and thence, following the summit of the mountains situated parallel to the coast to the 141st meridian, provided that when the line runs more than ten marine leagues from the ocean the limit shall be formed by a line parallel to the windings of the coast and which shall never exceed the distance of ten marine leagues therefrom. Alaska is bounded on the north by the Arctic ocean, on the west by the Arctic ocean, Bering Sea and Bering Strait, on the south and south-west by the Gulf of Alaska and the Pacific ocean, and on the east by British Columbia and Yukon territory. The total area of Alaska is 590,884sq.m., an area equal to nearly one-fifth that of continental United States or more than twice the size of Texas, the largest State of the Union.



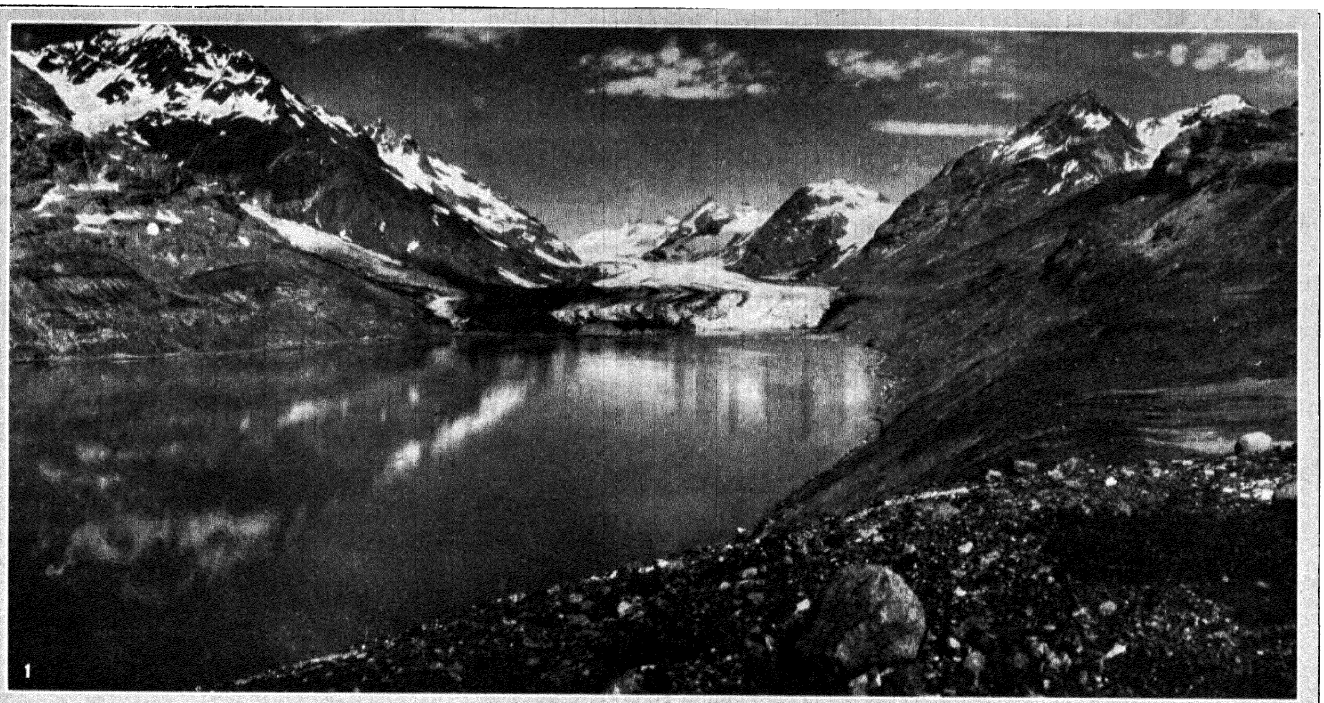
BY COURTESY OF AMERICAN MUSEUM OF NATURAL HISTORY

A RAVEN TOTEM POLE

Totem poles are erected by the Alaskan Indians to the animal from which they think their tribe has descended

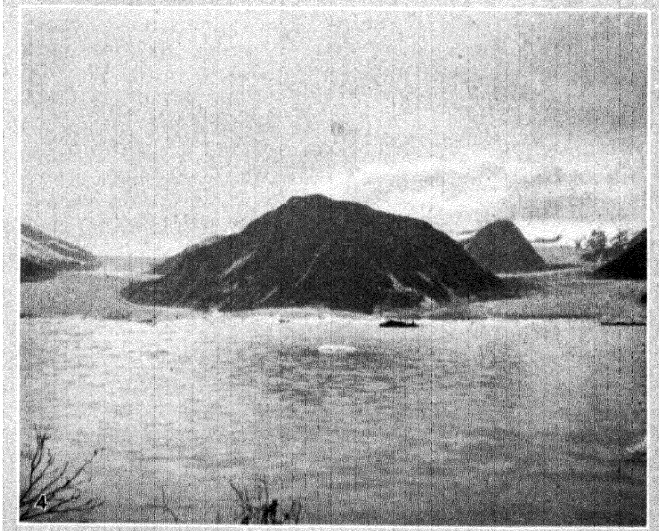
Principal Physical Features.—As indicated by the above boundaries, Alaska is of straggling, irregular shape, extending in longitude from about 130° W. to 193° W. or 167° E., as specified in the articles of cession and through more than 20° of latitude, 51° to 71° 25′ N. The southern limit lies far out in the Pacific as part of the Aleutian island chain, only 2° north of the boundary between the western half of the United States and Canada. Alaska consists of a compact central mass and two straggling appendages running from its south-western and south-eastern corners. These three parts will be referred to hereafter respectively, as continental Alaska, Aleutian Alaska, and the "Panhandle."

The general ocean coast-line is about 4,750m. and including the islands, bays, inlets and rivers to the head of tide water, is about











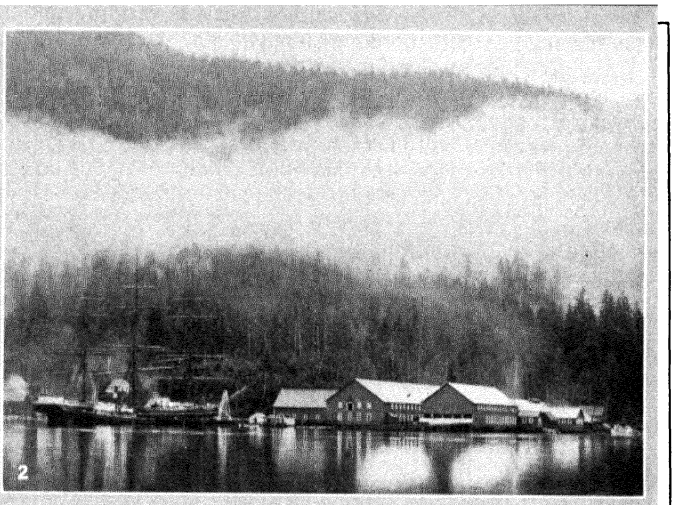
BY COURTESY OF (1, 2) U.S. GEOLOGICAL SURVEY (3, 4) THE CANADIAN NATIONAL RAILWAYS (5) PRODUCERS' DISTRIBUTING CO.

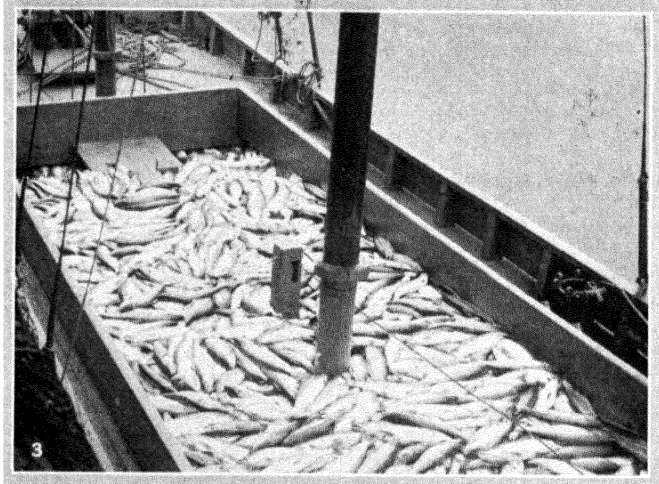
VIEWS IN GLACIER LAND AND THE MOUNTAINOUS REGIONS OF ALASKA

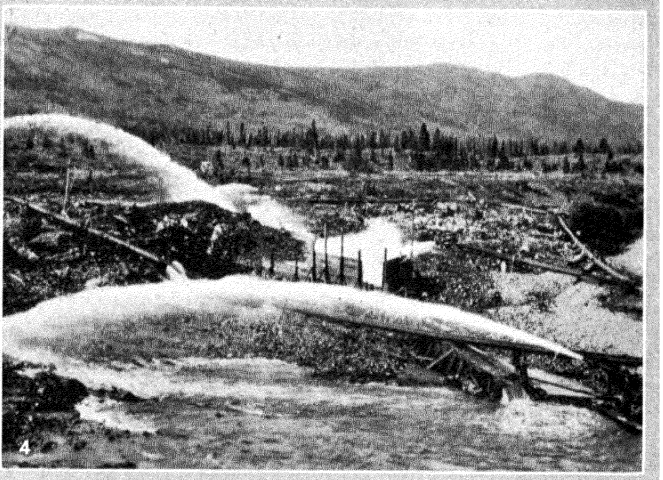
1. Rendu glacier, a large tidewater formation at the northern limit of Glacier Bay, southeastern Alaska
2. View of the Yukon river near Eagle, Alaska
3. General view of Wrangell, near the mouth of the Stikine river
4. Twin glacier, Taku river, which is one of the most accessible of the Alaskan glaciers
5. A typical scene in the mountainous regions of Alaska with campers' cooking outfit in the foreground

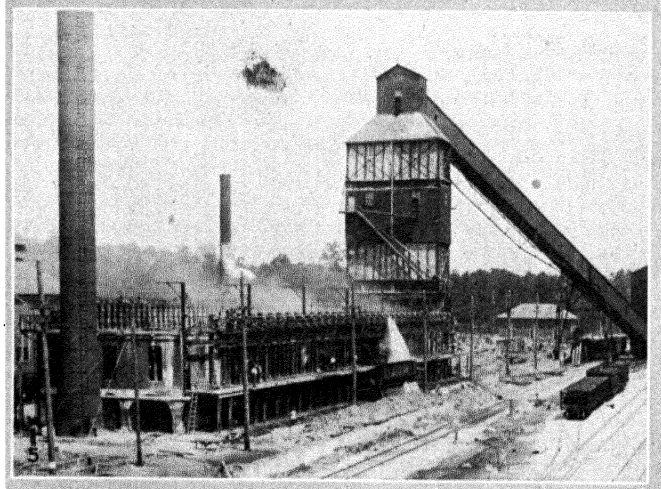
ALASKA

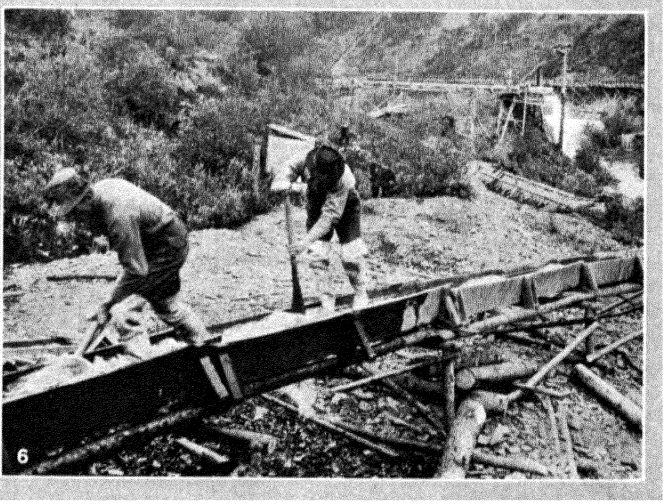












BY COURTESY OF (1, 2, 3) U.S. DEPT. OF COMMERCE, BUREAU OF FISHERIES, (4, 6) CANADIAN PACIFIC RAILWAY, (5) U.S. GEOLOGICAL SURVEY

FISHING AND MINING IN ALASKA

Salmon fishing ranks first among Alaskan industries to-day. Another interest that has attracted much capital to that part of the world is mining, developed rapidly during the last 25 years but leaving much territory still to be exploited, particularly in the coal districts. It is interesting to note that, whereas the United States purchase price of the Territory of Alaska in 1867 was $7,200,000, the estimated output of the fisheries and mines alone exceeded $1,205,000,000 in 1924

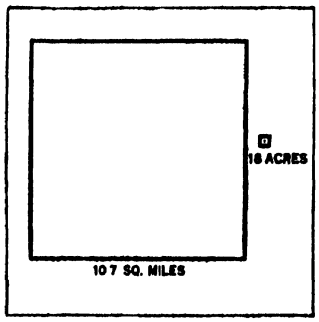
1. Beach seining for salmon at Karluk, Kodiak Island, Alaska
2. Alaskan salmon cannery
3. Delivery of red salmon at an Alaskan cannery
4. Alaska hydraulic mining, Pine Creek, Atlin, B.C., northeast of Juneau
5. By-product coke oven plant of 60 Koppers ovens, Woodward, Alaska
6. Washing gold at Spruce Creek

26,000m. in length. The entire southern coast is very precipitous, much indented by deep fiords, with only slight stretches of beach or plain. Its elevation gradually decreases as one travels west toward the Aleutians. A great submarine platform extends throughout a large part of Bering Sea. The western and northern coasts are regular in outline with long straight beaches; and shallows are common in the seas that wash them.

Of the vast number of islands within the boundaries of Alaska and constituting part of its territory, only a few of the more important can be mentioned in the scope of this article. At the south-eastern extremity and lying close inland, is the Alexander Archipelago (*q.v.*) consisting of some 1,100 islands, large and small. South-west of the Alaska Peninsula there are two groups. (1) Kodiak—the largest island, of the same name, is 40m. by 100m., and may be considered a continuation of the Kenai Peninsula. The group's western continuation consists of the Semidi, Shumagin and Sannak clusters. (2) The Aleutian islands (*q.v.*), sweeping 1,200m. or more west-south-west from the end of Alaska peninsula; west of the mainland in Bering Sea, the Pribilof islands, about 500m. south of cape Prince of Wales, the small Hall and St. Matthew Islands; to the north toward Bering Strait, the large St. Lawrence Island, with Nunivak near the coast to the south-east. Of the smaller islands, within Bering Sea, only the Pribilofs (home of the fur seal during breeding season) are of special interest or value.

Alaska has mountains, plateaux and lowlands on a grand scale. "In a broad way, the larger features of topography correspond with those of the western States. There is a Pacific mountain system, a central plateau region, a Rocky mountain system, and a Great plains region. These four divisions are well marked, and show the close geographic relation of this area to the southern part of the continent." The orographic features of the Pacific mountain system trend parallel to the coast-line of the Gulf of Alaska. The Pacific mountain system includes four ranges. The coast range of the Panhandle attains a width of 100m., but has no well-defined crest line. The range is characterized by the uniformity of summit levels between 5,000 and 6,000 feet. Continuing the coast range, with which it is closely associated—the Chilkat river lies between them—is the St. Elias Range (a term now used to include not only the mountains between Cross Sound and Mt. St. Elias but the Chugach, Wrangell and Nutzotin mountains), lying in the south-east of the main peninsula or continental Alaska. Among its principal peaks are: Mt. Crillon, Mt. Fairweather and Mt. Vancouver, all above 15,000ft. and Mt. Wrangell, 17,500ft. (an active volcano); in the Nutzotin mountains, Mt. St. Elias, 18,024ft., and in Canadian territory, Mt. Logan, 19,539 feet. The Aleutian range, of which crest the Aleutian islands are remnants, fills out the system near the coast. In the Aleutian range, near the base of the Alaska peninsula, there occurred in the early days of June 1912, one of the great volcanic eruptions of historic times. The top of Katmai, a mountain showing no evidence theretofore of volcanic action, was entirely blown off, and about the same time, there came into existence in the valley to the north-west, a vast number of tiny volcanic vents or fumaroles and since known as the valley of the "Ten Thousand Smokes." The mountain and valley have since been set apart by proclamation of the president (Sept. 24, 1918) as the "Katmai National Monument." The Alaska range, which lies south of the Yukon drainage system, connects with the Nutzotin and Skolai branches of the St. Elias Range. It is splendidly marked by many snowy peaks, including Mt. Foraker (17,000ft.) and Mt. McKinley (20,300ft.), the loftiest peak in North America. North of the Yukon are the Baird Mountains and the Endicott Range, an eastward extension of the Rocky mountains. Between the Pacific mountains and the last mentioned ranges lies the vast central plateau region or Yukon plateau. Finally, between the Endicott Range and the Arctic ocean is the Arctic slope region, a sloping plain corresponding somewhat to the interior plains of the United States.

The glaciers of the Panhandle and throughout the rest of the Pacific region are most remarkable—unusual, alike for their number and size. Thousands of Alpine glaciers from 1 to 15m. long fill the upper valleys and canyons of the mountains. Other glaciers are of the Piedmont type. The two most notable glaciers are the Malaspina, largest in the Territory, extending for 50m. along the seaward base of Mt. Elias; and the Muir, at the head of the icy straits. The Muir was much visited by tourists prior to the earthquake in 1899, which so shattered the glacier and increased the discharge of ice that steamers no longer find it safe to approach near the face. The condition of the glaciers of Alaska, generally speaking, appears at this time to be one of recession; many of them now have terminal moraines many miles back.



TWO SQUARES SHOWING THE RELATIVE AMOUNT OF SPACE AVAILABLE PER PERSON IN ALASKA (10·7 SQ.M.) AND IN CONTINENTAL UNITED STATES (18 ACRES)

Chief among the streams of Alaska is the Yukon, more than 2,000m. in length, which practically bisects the main peninsula. The principal feeders of this great river have their sources far away to the south-east in the coastal mountains along the boundary between Alaska, British Columbia and the Canadian Yukon territory. It flows in a general north-westerly direction for about one half its length, passing through a small section of British Columbia and through territory of the "Canadian Yukon" till it reaches the 141st meridian. Here it enters American territory and, continuing to the north-westward, passes within the Arctic Circle for a short distance in the vicinity of Ft. Yukon. It then turns south-westerly, gathering volume from many tributaries, the principal of which are the Tanana and the Koyukuk, and finally empties its flood into Bering Sea through many mouths and over a vast bar, in longitude (approx.) 164° W. and latitude 63° N. The ocean port for the river, where merchandise is transferred by lighterage from ocean vessels to river boats, is a bay on St. Michael island, lying about 60m. to the north-east of the Northern or Apoon mouth. River boats, drawing from three and a half to four feet can enter the Apoon mouth and proceed without difficulty, in ordinary stages of water, practically the whole length of the river to White Horse, connecting there with the White pass and Yukon railway to Skagway. The period of navigation on the Yukon is from four to four and a half months. The second largest river in Alaska is the Kuskokwim, with its sources in the mountains of the Alaska range south of the Yukon drainage basin, and emptying into the Bering Sea about 150m. south of the mouth of the Yukon. It is navigable for about 600 miles. Out of the Alaska and Nutzotin mountains two great rivers flow southward: the Copper, practically unnavigable except for small boats, because of its turbulence and the discharge of glaciers into its waters; and the Susitna, also practically unnavigable. Both of these rivers have their sources in lofty mountain masses, and are swift and powerful streams carrying with them much silt.

The Panhandle is remarkably picturesque. The maze of islands of the Alexander Archipelago, hundreds in number, are remnants of a submerged mountain system; the islands rise 3,000 to 5,000ft. above the sea, with luxuriantly wooded tops and bold, sheer sides scarred with marks of glacial action. Through the inner channels, sheltered from the Pacific by the island rampart, runs the "inland passage," the tourist route northward from Seattle, Wash. The inter-insular straits are carried up into the mainland shore as fiords heading in rivers and glaciers. Most remarkable are the inlets known as Portland canal and Lynn canal (continuing Chatham Strait). The first is very deep, with precipitous shores and bordering mountains 5,000 to 6,000ft. high; the second is a noble fiord 100m. long and on an average 6m. wide, with magnificent Alpine scenery.

Continental Alaska in the interior is essentially a vast plateau. "The traveller between the main drainage areas of the interior is struck by the uniform elevation. Rounded hills, level meads, and persistent flat-topped ridges, composed of rocks of varying

structure, rise to about the same level and give the impression that they are the remnants of a former continuous surface. In height it varies from about 5,000ft. close to the bases of the mountain systems to less than 3,000ft. in the vicinity of the main lines of drainage and slopes gradually toward the north."

Geology.—The outstanding features of Alaska are its mountain ranges, most of which consist of closely folded and contorted beds of sedimentary rock and underlying igneous masses, by intrusion of which the sedimentary beds were uplifted. A notable mountain chain is the Alaska range, which is nearly 600m. long and 50 to 80m. wide. This range, which was elevated to its present height late in Tertiary time, marks an old line of movement that has repeatedly been the site of folding and mountain building. In this range is the Mt. McKinley National Park, a reservation that contains 2,600sq.m. and includes the highest peak in North America, Mt. McKinley, which stands 20,300ft. above sea-level. Volcanic products, which were poured out at intervals during an immensely long time, form a part of some ranges and make up most of the mass of many peaks. Among these volcanic peaks are the Wrangell mountains and many of the mountains on Alaska peninsula and in the Aleutian chain of islands. On the other hand, Mt. McKinley and Mt. St Elias consist of masses of intruded granitic rock surrounded by sedimentary beds. The high relief of the larger mountain masses is due to their relatively recent elevation, the forces of erosion not yet having had time greatly to reduce their height.

The general outline of the mountain ranges in Alaska is a continuation of that seen in the region to the south, in Canada, but the course of the ranges in Alaska swings around from north-west to south-west, toward Asia, and the geologic history of the coastal ranges in both continents is doubtless similar. Far to the north lies Brooks range, from the northern base of which runs a series of gently folded beds that extend to the Arctic ocean

The details of the geological structure and of the petrology of Alaska are extremely complex, and the attempt to trace the geological history of the region is very difficult. The geological record indicates a long series of periods of uplift and depression, of erosion and deposition, of folding and faulting and metamorphism of the beds deposited, and of intermittent volcanism that produced great areas of lava and ashes, which, like all other deposits, were shifted here and there and at some places greatly altered.

The oldest sedimentary deposits are certain pre-Cambrian rocks that lie in a broad belt in the upper Yukon valley, especially in the region between the Yukon and the Tanana, where they include what is called the Birch Creek schist, the bed rock in that region. The conditions and events in early Cambrian time are unknown, but in late Cambrian and in parts of Ordovician time large areas in Alaska appear to have been submerged, for most of the beds formed during those periods are marine deposits. Evidences of emergence, however, are found at some places. In early Devonian time there was a period of elevation, deformation, and subsidence over large areas. Toward the end of the Carboniferous period, in late Pennsylvanian or early Permian time, marine deposition prevailed, perhaps intermittently, until beds of limestone that measured in the aggregate thousands of feet in thickness were laid down over parts of Alaska. The Palaeozoic beds include at many places accumulations of volcanic material, but the greatest eruptions in Palaeozoic time appear to have occurred intermittently near its end, during the Pennsylvanian and Permian epochs. Most of the products of these eruptions lie south of the Alaska range. In late Permian and early and middle Triassic time Alaska was a land surface undergoing erosion. In late Triassic time depression again brought the sea over a large part of Alaska. This submergence was followed by widely extended uplift, which included probably all of Alaska. In early Jurassic time the Pacific and Arctic coasts were submerged and along them were deposited beds of sandstone, shale and limestone. Middle Jurassic deposits cover a somewhat wider area along the Pacific coast. In Jurassic time there was a persistent shore line near the site of the Alaska range.

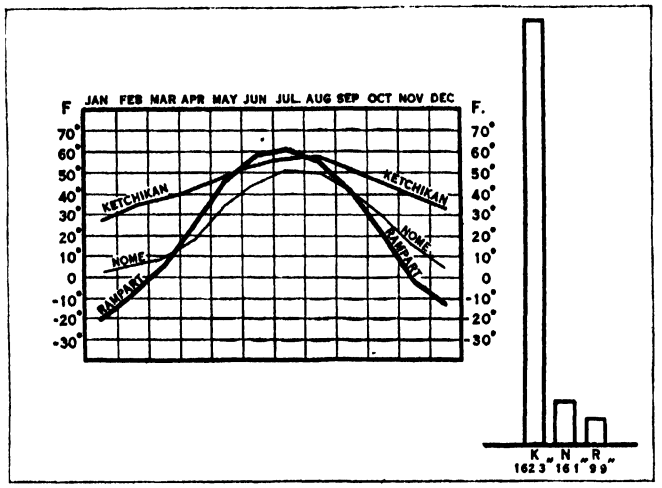
In early Cretaceous (lower Cretaceous) time renewed submergence brought the sea over much of Alaska, including parts of the Yukon valley, most of which had been above the sea since the end of Palaeozoic time. A large part of northern Alaska, which had been land since the end of the Triassic period, was also submerged. The deposits of this time include a basal conglomerate and overlying shale and limestone An uplift and a change in places of sedimentation followed, in later Cretaceous (upper Cretaceous) time, during which the larger topographic features of present Alaska were doubtless outlined. Marine deposits were laid down along the Arctic and Pacific coasts and in the lower and broader parts of the Yukon and probably other valleys. Terrestrial deposits were formed in embayments that stood on the sites of the larger river valleys. The submergence of the Yukon valley gradually increased and as gradually slackened, and swamps were formed in which plants grew and coal beds were laid down. The Cretaceous deposits in the Kuskokwim valley appears to be very similar to those in the lower Yukon valley. While sedimentation was in progress in the Yukon valley the rest of Alaska may have been land. During later Cretaceous time the sea invaded the sites of the Matanuska and Chitina valleys and parts of the southern coastal region. The deposits of this time in Alaska peninsula include marine shale, coal-bearing shale, conglomerate sandstone and shale, probably of mixed marine and terrestrial origin. The end of Cretaceous time on Alaska peninsula appears to have been marked by a period of mountain growth. The Cretaceous beds are greatly folded everywhere and many of them are cut by intrusive rocks and intrusive veins. Deposits of tuff laid down in early Tertiary (Eocene) time show that the diastrophic movements which began late in Cretaceous time culminated in volcanic eruptions. Among the earliest post-Cretaceous deposits are the Tertiary coal-bearing beds Two groups of coal beds that lie near the Alaska range are reached by the Alaska Railroad, one in the valley of Matanuska river, in lat. 61° 45′, the other along and east of the Nenana river, about lat. 64°. Most of the coal mined is used on the railroad. Beds of lignitic coal are exposed at many places around Cook Inlet and in the lower part of the valley of the Susitna river. The coal-bearing beds, which have been at some places greatly tilted and folded, generally consist of poorly consolidated sand, clay and gravel, and at some places contain abundant remains of plants. Many of the Tertiary rocks, however, consist of hard conglomerate and shale, and include basaltic lava and other volcanic material, as well as intrusive dikes and sills.

By early Quaternary time the great mountain-building movements in the south of the Alaska range had apparently ceased and the larger topographic features of this region, including the Kenai-Chugatch range, the Talkeetna Mountains and the Yukon-Tanana upland, had assumed nearly their present form, although the details of the drainage may have been different, for the climate was milder than it is now. A colder age followed, in which enormous glaciers were formed in the mountains. The Quaternary beds, which include glacial deposits, are widespread. In the Alaska range and in the region south of it such deposits constitute a large part of the unconsolidated surface material. The glaciers abraded the rocks of the highlands and carried down into the lowlands immense quantities of gravel, sand, silt and till, modifying the forms of the higher valleys and leaving thick deposits over large areas. The bluffs along Copper river, for example, consist of glacial deposits more than 500ft. thick; and moraines, outwash gravel and thick delta fans made up of glacial material cover large areas. The glaciers now appear to be receding, but the deposition of outwash from glaciers is still in active progress at many places, and the great glaciers in the Alaska range and the Wrangell mountains, and especially the glaciers of Kenai Peninsula, Prince William Sound and the coast farther south, are conspicuous features. The higher parts of the Alaska range are the gathering grounds for some of the largest valley glaciers. Five or more of these great tongues of ice are from 2 to 4m. wide and 30 to 50m. long. The present surface form of the mountains of this range has been produced in large part by the erosive action of these glaciers and of their much larger predecessors.

Great changes in the climate of north-western North America are indicated by the fossil plants. The flora of Alaska was at times evidently that of a temperate or a warmer region.

The uplifts in Alaska apparently established land connection between North America and Asia at several periods. Across this body of land in Tertiary time horses of early types passed to Asia from the central plains of North America, which appear to have been the first habitat of the horse. Early elephants, or elephant-like creatures, on the other hand, found their way from Asia to America, where their remains have been discovered at many places.

Climate.—Alaska is one of the "ends of the earth" and as such presents many interesting extremes, none more than in its climatic features. Enclosed on the north and west by Arctic waters, and from the Alaska peninsula down the long coast to the south-eastward by north Pacific waters, with their tempering currents drifting eastward encompassing the islands of the Aleutian group and those farther south, there results a great variation in temperature and precipitation. The climate of the Aleutians is oceanic, with moderate and fairly uniform temperatures, much rain and almost constant fogs. The summers are cooler than along the coast to the east and southward, and the winters milder, with much less snow, never going as low as zero. Clouds laden with moisture from the warm Pacific currents, being swept in upon the mountains and the many glaciers by the prevailing winds, produce a heavy precipitation of rain in summer and snow in winter. Crossing the coast range to the interior, one encounters an entirely different climate. Here the precipitation is comparatively light, both of rain and snow, except upon the high mountain ranges. Low temperatures occur in winter—occasionally as low as −75° or −80° F—with short, hot summers. In this part of Alaska, the ground is permanently frozen to great depth in most of the valleys, but on the drier hillside slopes, it frequently happens that but little frost is found. The tempering influence of the ocean currents practically disappears north of the line of the Pribilof islands, or about the middle of Bering Sea, and the regions to the northward and eastward of this are for the most part barren, windswept and inhospitable. Arctic conditions prevail, especially beyond Bering Strait. Point Barrow, farthest north (71° plus), is ice-locked for about ten months of the year.



GRAPH CONTRASTING THE CLIMATIC CONDITIONS OF ALASKA
The curves show the monthly mean temperatures at Ketchikan, on the south-east coast, Nome, on Bering Sea, and Rampart, in the interior on the Yukon river. The columns show the normal annual precipitation at these three places

Fauna and Flora.—The fauna of Alaska is very rich and surprisingly varied. The lists of insects, birds and mammals are especially noteworthy. Of these three classes, and of other than purely zoological interest, are mosquitoes, which swarm in summer in the interior in vast numbers; sea fowl, which are remarkably abundant near the Aleutians; moose, and especially caribou, which in the past were very numerous in the interior and of extreme economic importance to the natives. The destruction of the wild caribou threatened to expose the Indians to wholesale starvation, hence the effort which the United States Government made to stock the country with domestic reindeer from Siberia. It is, however, the fish and fur-bearing animals of its rivers and surrounding seas that are economically most distinctive of and important to Alaska. The fishing grounds extend along the coast from the extreme south-east past the Aleutians into Bristol Bay.

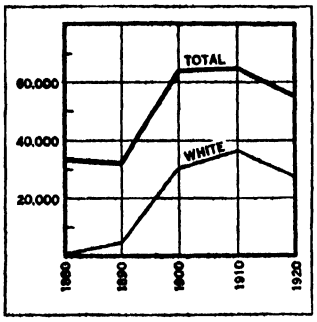
Herring, cod and salmon abound in almost incredible numbers. Of marine mammals, whales are hunted far to the north in Bering Sea and the Arctic ocean, but are much less common than formerly as are also the walrus, the sea-otter and the fur seal. There are half a dozen species of hair seals and sea-lions. The number of fur-bearing land animals is equally large. Sable, ermine, wolverines, minks, land-otters, beavers and musk-rats have always been important items in the fur trade. There are black, grizzly and polar bears, and also two exclusively Alaskan species, the Kodiak and the glacier bear. The grey wolf is common; it is the basal stock of the Alaskan sledge-dog. The red fox is widely distributed, and the white or Arctic fox is very common along the eastern coast of Bering Sea. A blue fox, once wild, is now domesticated on Kodiak and the Aleutians, and on the southern continental coast, and a black fox, very rare, occurs in south-eastern Alaska. The silver fox is very rare.

The Alaskan flora is less varied than the fauna. The forests of the coastal region eastward from Cook Inlet, and particularly in south-eastern Alaska, are of fair variety and of great richness and value. The balsam fir and in the south the red cedar occur in scant quantities; more widely distributed, but growing only under marked local conditions, is the yellow or Alaska cedar, a very hard and durable wood of fine grain and pleasant odour. Far the most abundant are coast and Alpine hemlocks and the tide-land or Sitka spruce. The spruce is not confined to this part of Alaska, but is the characteristic and universal tree. The separation of the coast and interior flora is almost complete; only along the mountain passes and river valleys, and rarely there, is there any change of species. Timber, however, is fairly abundant along the entire course of the Yukon above Anvik (about 400m. from the mouth), along the great tributaries of the Yukon and along every stream in central Alaska. The woods of the interior consist almost entirely of spruce. On the Yukon flats it grows in a vast forest impenetrably dense. The timber line, which in the Panhandle and along the southern coast of the continental mass runs from 1,800 to 2,400ft., frequently rises in the interior plateau even to 4,000 feet. Next in importance after spruce, in the interior, is birch and then balsam poplar. Thickets of alders and willows in wet places and new-made land, aspens and large cottonwoods west of the characteristic spruce area (as on Seward Peninsula), are also common. Toward the Arctic Circle, the timber becomes, of course, sparse, low, gnarled and distorted. The willows in the Arctic drainage basin shrink to shrubs scarcely knee-high. Grasses grow luxuriantly in the river bottom and wherever the tundra moss is destroyed to give them footing. Most distinctive is the ubiquitous carpeting of mosses, varying in colours from the pure white and cream of the reindeer moss to the deep green and brown of the peat moss, all conspicuously spangled in the brief summer with bright flowers of the higher orders, heavy blossoms on stunted stalks.

Sedges available for forage grow in the tundra. In August berries are fairly abundant over the interior; one of them, the salmon or cloud berry, preserved in seal oil for the winter, is an important food of the natives. The western timber limit is on Kodiak island. The Aleutian islands are almost destitute of trees, but are covered with a luxuriant growth of herbage. Climatic differences cannot account for the treeless condition of the country west of this point, and the true explanation lies probably in the fact that in winter, when the seeds of the coastal forests ripen and are released, the prevalent winds west of Kodiak are damp and blow from the south and south-west, while the spread of the seeds requires dry winds blowing from the north and north-west. Such favourable conditions occur only rarely.

Population.—The population in 1867, at the time of the cession from Russia, was estimated at 30,000, of which two-thirds were Eskimos and other natives. The population at the various decennial censuses was as follows: 33,426 in 1880; 32,052 in 1890; 63,592 in 1900, of whom approximately 48% were whites, 46% natives and 6% Japanese and Chinese; 64,356 in 1910; and

55,036 in 1920, a decrease of 14·5% since 1910. The whites numbered 29,000, the Indians and Eskimos 25,000; the balance represented Mongolian and other races. The white population of Alaska steadily increased until 1915, when it exceeded 40,000. Subsequent losses were due to: (1) enrolment in military service of about 3,500 men, few of whom returned; (2) high wages in the United States; and (3) the decrease in the gold-mining industry. The upward curve in population was not restored until 1924. In that year the number of people arriving in the Territory exceeded the number departing by 577. In addition to the permanent residents of Alaska, between 25,000 and 30,000 men annually visit the Territory to find employment in fishing and mining. The permanent or stabilized white population is found mostly in towns or larger mining and industrial camps. Of the 18 incorporated towns, two had dwindled in population (1920) to small villages of less than 100 inhabitants. The total population of the other 16 averaged slightly more than 1,000, and, with the exception of Sitka (*q.v.*) the whites were in preponderance. Juneau, the capital and an important mining centre, was the largest town, with a population (1920) of 3,058. These towns are centres of business and social activities, as well as of Government agencies, covering considerable tributary areas, and scattered over a vast frontier region. They have, therefore, a dignity and importance in excess of that usually attached to towns of similar size in more populous regions. All have electric lights, telephones and other modern conveniences, and, with one or two exceptions, have modern water supply systems.



POPULATION OF ALASKA, TOTAL AND WHITE, AS ENUMERATED AT EACH CENSUS, 1880 TO 1920

The natives of Alaska have been considered to fall under four ethnologic races: the Eskimo or Innuit—of these the Aleuts are an offshoot; the Haidas or Kaigani, found principally on Prince of Wales island and thereabouts; the Thlinkits, rather widely distributed in the Panhandle; and the Tinnehs or Athapascans, the stock race of the great interior country. Later studies by ethnologists have resulted in classifying all these except the Eskimos as remote offshoots of the North American Indian stock. The natives have adopted many customs of white civilization, their children attend Government schools, and on the Aleutians, in coastal Alaska, and in scattered regions in the interior acknowledge Christianity under the forms of the Orthodox Greek or other churches.

Government.—The District of Alaska was terminated and the Territory of Alaska created by an Act of Congress in 1912. The Organic Act under which Alaska became a Territory serves as its Constitution. The legislative authority was vested in a bicameral body, the upper chamber or senate, consisting of two senators from each of the four judicial divisions serving four years. Sixteen representatives form the lower chamber, or house of representatives, four elected for two years from each judicial division. This equal representation gives the less populated areas of the interior an unjust preponderance in the legislature and has not always worked for the best interest of the Territory as a whole. Under the Constitutional Act, Congress expressly retained the right of repealing all laws enacted by the Alaska legislature. Furthermore, the Territory was denied the right to enact laws relating to the excise, to game, fish, fur-bearing animals or to the existing Federal licence tax. Acts of the legislature are subject to veto by the governor as well as by Congress, but a measure may be passed over the governor's veto by a two-thirds vote of the members elected to each house. The executive and administrative authority is vested in a governor and a Territorial secretary, each appointed by the President for a term of four years; an attorney general elected by the voters of Alaska, for a term of four years; a Territorial treasurer, appointed by the governor with the consent of the Territorial senate, for four years; a commissioner of education appointed by the board of education for two years; and a commissioner of health appointed by the governor for two years. Each of the four judicial divisions has a judge, an attorney and a U.S. marshal, all appointed by the President for four years. The judges hold both the U.S. and Territorial courts. Each judicial division has a number of U S commissioners who are ex-officio justices of the peace, probate judges, coroner and recorders. Each town is permitted to have a municipal court By an Act of Congress approved on June 6, 1900, towns were allowed to become incorporated municipalities. Up to 1927, 18 municipalities had been formed under this Act. Alaska is still hampered by divided control. The various departments and bureaux of the National Government and the Territorial Government often have overlapping duties and conflicting interests.

Finances.—The governmental expenses of Alaska are met in part by the Territorial Government and in part by the Federal Government. The chief sources of Territorial revenue are: a tax on the salmon fishing industry, a fur tax, professional and occupation licences, corporation fees, an insurance premium tax, 25% of the receipts of the National forests, an inheritance tax and a railway income tax. Of the disbursements about 46% were for education, the remainder being expended for roads, trails and air-ports, for charitable purposes and for official salaries and expenses. The total receipts for the biennium ending Dec. 31, 1926 were $2,791,545. The disbursements for the same period were $2,444,650.

There were 13 Territorial and four National banks operating in Alaska on Dec. 31, 1926. The combined resources of the 17 banks were $13,018,634. The deposits subject to check were $6,907,380 and time certificates and savings were $4,315,073.

Education and Charities.—By an amendment passed to the Organic Act in 1917, Alaska became responsible for the education of its white population. The Alaska division of the national bureau of education is required to provide for the education of the natives, to train them in industry and to furnish them medical relief. The enrolment in the Territorial schools for the session 1925–26 was 4,352 pupils and 211 teachers. Of the total enrolment 581 were in high schools and 3,771 in elementary schools. The school term in incorporated towns ranged from nine to ten months and for rural districts from seven to nine months. During the fiscal year 1925 there were 3,912 natives enrolled in the schools supported by the Federal Government and 325 enrolled in three mission schools. The average length of term in the Government supported schools was 137 days. The only institution of higher education is the "land grant" Agricultural College and


BY COURTESY OF THE AMERICAN MUSEUM OF NATURAL HISTORY

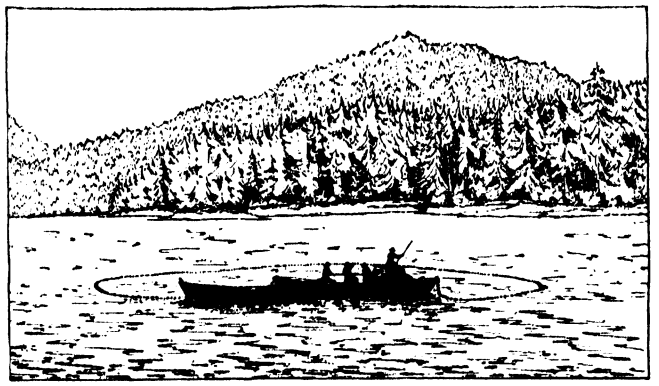
A DUG-OUT CANOE OF THE THLINKIT INDIAN, A MEMBER OF ONE OF THE FOUR ETHNOLOGICAL RACES IN ALASKA. THE THLINKITS ARE SKILLED FISHERMEN AND HUNTERS, WHO FASHION THEIR CANOES FROM CEDAR LOGS. THE CRAFT VARY IN SIZE AND SHAPE ACCORDING TO PURPOSE. THE TYPE ABOVE IS USED ON INTERIOR WATERS

School of Mines opened at Fairbanks in 1922. Its enrolment for the session 1925–26 was 94 men and 70 women.

The burden of charitable relief falls on both the Territorial and Federal Governments. The Territorial Government during the biennium 1924–26 expended $308,400 or about 15% of the total revenue for the support of eleemosynary institutions, the care of the indigent, of children and the relief of the destitute. The insane of Alaska are cared for at Federal expense in a private institution.

Fisheries.—The product of the fisheries is about equal to the sum-total of all other Alaskan products. The total value of fish

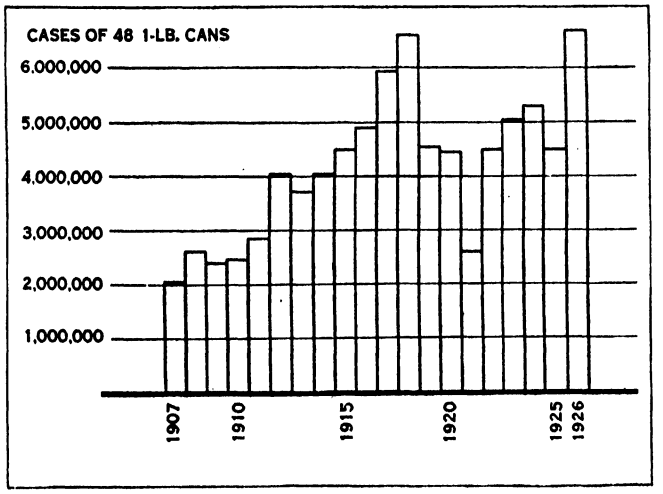
marketed between 1867 and 1926 was about $688,000,000. In 1925, according to the governor's report, the capital invested in Alaskan fisheries was $67,077,495 and the value of the product was $40,038,745. Salmon represents about four-fifths of the product. During the World War the salmon catch assumed such proportions that there was grave danger to the industry, but in 1924 Congress authorized the secretary of commerce to impose suitable



BY COURTESY OF THE BUREAU OF FISHERIES, DEPT. OF COMMERCE

FISHING WITH SALMON PURSE SEINES IN SOUTH-EASTERN ALASKA
The purse seine, largely employed by salmon fishermen on river or sea shoals, is one of the modern methods that has aided the growth of Alaska's extensive fishing industry

restrictions. Since 1924 certain districts have been closed and others restricted in the interest of preserving the supply. The halibut fisheries were also being rapidly depleted, but in 1924 Congress ratified a treaty with Canada and Great Britain for the preservation of the halibut fishing of the northern Pacific; the value of the Alaskan catch in 1924 was $1,619,443. Extensive cod-fishing banks from 22 to 90 fathoms deep are found in Bering sea and east of the Alaska peninsula. The number of cod on the Alaska banks is enormous, but as yet they have been but little



ALASKA'S OUTPUT OF CANNED SALMON FROM 1907 TO 1926
The output in 1926, 6,652,882 cases, was even higher than in 1918 and was nearly eight times as much as the output of the States of Washington, Oregon and California

exploited. Herring are also abundant and their catch has increased rapidly within recent years. Herring are used for bait, in the production of oil and fertilizer, and a limited quantity of the young fish are packed as "sardines." Whale fishing, once a very important industry, has practically ceased.

Agriculture and Live Stock.—In 1924 the best developed farming area was in the neighbourhood of Fairbanks, where hardy varieties of wheat were matured and a small flour-mill operated. There is an abundance of good grazing land in the interior, but the period of winter feeding is about eight months. The Matanuska valley has proved particularly adapted for breeding dairy cattle. The domesticated reindeer herds in 1924 were 350,000, valued at $8,750,000. In 1927 the herd had grown to 675,000. It is estimated that Alaska contains 120,000,000ac. suitable for grazing of reindeer and capable of supporting 4,000,000 deer. This industry promises to be a very profitable one for the future of Alaska.

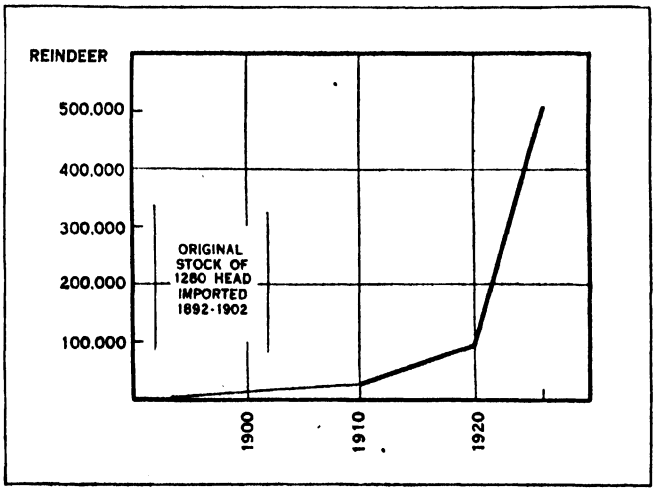
Furs.—Between 1867 and 1925 Alaska produced furs to the value of about $107,000,000, of which about 55% represented sealskins taken on the Pribilof islands. Up to 1910 the Government leased the seal-catching privileges on these islands to private corporations, which killed 2,320,028 seals and paid the Government $9,474,000 in royalties. The land killing of seal was re-



BY COURTESY OF THE BUREAU OF FISHERIES, DEPT. OF COMMERCE

FUR SEALS UNDER GOVERNMENT PROTECTION ON PRIBILOF ISLANDS
Guarded by the United States Federal Government from unlicensed hunters since 1910, the fur seal has been increasing in number yearly, and is no longer in danger of extermination

stricted, but pelagic sealing, which was becoming very destructive, could not be controlled by the American Government; a treaty was therefore signed in 1911 between the United States, Great Britain, Russia and Japan, abolishing it and providing that the United States was to pay to both Great Britain and Japan 15% of the value of the catch made on the islands. Since 1910 killing has been prohibited on the Pribilof islands, except by U. S. agents. Thanks to these provisions the seal herd increased from 215,000 in 1912 to 723,050 in 1925. In that year 19,860 sealskins were taken from the herd. The annual production of fur, other than seal, was valued at approximately $2,000,000 in 1925. Most

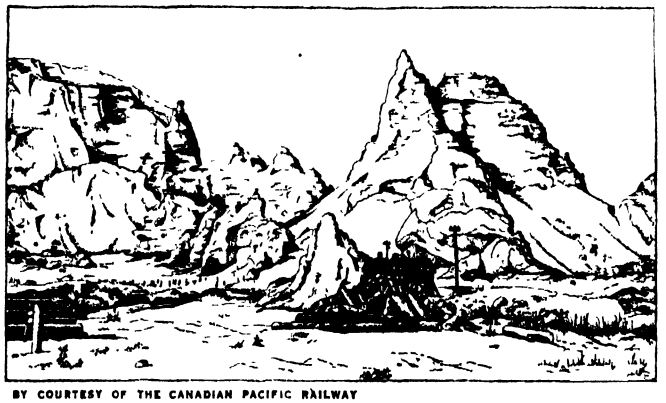


THE ORIGINAL STOCK OF 1280 REINDEER BROUGHT INTO ALASKA FROM SIBERIA IN 1892–1902 INCREASED TO ABOUT 500,000 HEAD IN 1926, OF WHICH 235,000 WERE OWNED BY THE NATIVES

of this was due to the rapid increase of fox-farming, about 400 fur farms being in operation. Two companies were engaged in sheep-grazing in the Aleutian islands.

Minerals.—As early as 1861 gold discoveries were made on the Stikine river; repeated discoveries, culminating in the Cassiar district "boom," were made in British Columbia from 1857 to 1874; colourings along the Yukon were reported in 1866-67 and systematic prospecting of the upper river began about 1873. Juneau was founded in 1880; the same year the opposition of the

Indians, which prevented the crossing of the mountain passes to the interior, was withdrawn, and after 1880 repeated and scattered discoveries were made on the Lewes, Pelly, Stewart and other streams of the Upper Yukon country in Canada. As early as 1883–85 there was a considerable mining excitement due to these discoveries, and a much greater one in 1887 after the discovery of coarse gold on Forty Mile Creek in American territory; but these were as nothing to the picturesque and feverish rush that



BY COURTESY OF THE CANADIAN PACIFIC RAILWAY

LOVETT'S GULCH ON BONANZE CREEK IN THE KLONDIKE, YUKON, A SPOT FAMOUS IN THE HISTORY OF THE GOLD RUSH OF 1898

followed the location of the first Klondike claim in Canadian territory in Aug. 1896.

The total value of the mineral output of the Territory from 1880 through 1927, was $586,000,000. Of this $365,700,000 was for gold, $196,172,878 for copper and $11,183,588 for silver. Alaska also produces coal, lead, tin, platinum, palladium, antimony, tungsten, natural gas, petroleum, marble, gypsum, graphite, barite and sulphur. Copper mining, begun in 1901, was in 1927 the chief mineral industry. For a decade copper has annually exceeded in value the output of all other minerals. Copper ores are widely distributed, but most of the deposits are as yet inaccessible. The output has been largely that of the Kennecott mines in the Chitina district. Coal, both bituminous and anthracite, occurs in the Bering River, and the Matanuska fields, which lie within reach of the Government railway. The Territory, also, contains an abundant supply of sub-bituminous and lignite coals, which are very widely distributed. The production up to 1925 was about 670,000 tons. The transportation problem for districts distant from the railway is still a drawback to the industry.

Important oil seepages have been found at five places on the Pacific seaboard, and at two places in the Naval Petroleum Reserve No. 4 on the North Arctic coast. The withdrawal of all oil lands from entry in 1911 stopped development until 1919, when an oil-leasing law was passed and operations begun in several localities; up to 1925 the production of petroleum had been confined to the Katalla field. About 12,700,0000z. of silver and 7,000 tons of lead have been produced. Almost all the tin output of North America comes from Alaska, chiefly from the New district in the Seward Peninsula; over 1,000 tons had been mined between 1900 (when operations began) and 1925. The mining of platinum and related minerals began in 1916, and about 1,6000z. had been produced by 1925. Quicksilver mining has been carried on in a small way for many years. In south-eastern Alaska extensive deposits of high-grade marble have been quarried on a large scale.

Timber Production.—The commercial timber of Alaska is contained in the two great national forests, the Tongass in south-eastern Alaska and the Chugach on Prince William Sound. They had, in 1925, a total area of 21,334,274ac., and were estimated to contain 84,760,000,000 board ft., of saw timber, of which 74% was western hemlock and 20% Sitka spruce. The remainder was largely western red cedar and Alaskan cedar. Saw-mills are developing rapidly, the lumber cut of the national forests in 1925 being 57,500,000 board ft., or an increase of 500,000 board ft. over the 1924 production. The total cut since 1909 was estimated at 639,500,000 board ft., but this production is still far under the natural increase. In 1925 a pulp-wood industry was being developed under the encouragement of the forest service.

Communication and Transportation.—Transportation facilities have greatly improved since 1900. All the important centres of population have regular mails, cable, telegraph or wireless communication, with the United States, and steamer connection the year around with all coast towns except Nome. Aeroplane service also is being rapidly developed In 1900 there were only 22m. of railway in Alaska but by 1910 there were 390m. in operation. This mileage included 20m. of the White Pass railway (narrow gauge) which ran inland from Skagway across the international boundary to White Horse in the Canadian Yukon (110m.). While primarily serving Canadian territory, this line gives access, during the open season of navigation, to the settlements on the lower Yukon. The Copper river and North-western railway, extending from Cordova on the coast to the Chitina copper belt (196m.), was completed in 1910. In 1912 Congress authorized a special commission to report upon the Alaskan railway situation. This commission recommended the construction of two lines: one from Cordova to Fairbanks, the other from Seward to the navigable waters of the Kuskokwim. The estimated cost, $35,000,000 was appropriated by Congress in 1914, but in the following year the Administration announced the selection of a railway route from Seward to Fairbanks, a far more expensive undertaking. Construction on the Alaska Railroad was begun in 1915 and finished in June 1923, at a total initial cost of $56,000,000. Appropriations since that date bring the total cost up to near $70,000,000. This system, with its branch lines to Matanuska and Chickaloon coal-fields, has a total length of 540 miles. The governor of Alaska, in his annual report for 1926, stated that excellent progress had been made in the construction and maintenance of roads and trails by the Alaska road commission and the bureau of public roads working in co-operation with the Territory. In 1925 the legislature authorized the territorial road board to divert from the 1925 road appropriation sums necessary for the construction of aviation fields. By July 1, 1926, 23 such fields had been constructed and there were two aviation companies operating from Fairbanks.

In 1924 minerals, furs, fish, etc., were exported to the value of $61,015,062, and the value of imports was $32,580,057. During that year 2,802 vessels entered Alaskan ports and 2,675 vessels were cleared. Coastal Alaska was served by three regular passenger and freight steamship lines which during 1924 operated 12 steamers. A boat service was furnished on the Tanana and Yukon rivers by the Alaska Railroad.

Exploration and Early History.—In the early explorations of the north-west coast of America, Spain was first in the field, but there is little evidence to prove that any Spanish navigator sailed as far north as Alaska. Later, and during the period of active Russian exploration, a number of expeditions were sent north from Mexico and at one time Spain claimed the sole right to navigate the waters of the northern Pacific and issued a prohibition against other nations trading in those waters. Many Spanish names of places along the coast remain to-day to attest the extent of these explorations. Spain does not appear to have pressed her claims, however, and gradually ceased her efforts in this direction. This may have been due to disputes on her hands in other parts of the world or to the wide extent at that time of the Spanish claims in the western hemisphere or possibly, in part, to the fact that the climatic conditions of this northern region did not appeal strongly to a people whose life and activities had been spent in warmer climes. To the Russian, on the other hand, these regions were as home. During the latter half of the 17th century, the Russians had been pushing their explorations across Siberia and along the eastern and northern shores of Asia. In 1728 Vitus Bering passed through the strait named after him and Girosdeff sighted the American coast in 1731. Bering's second expedition, in company with Chirikov, sailed from the Siberian coast in 1741. The mainland of America was located and numerous islands visited. This expedition is commonly accepted as fixing the date of the discovery of Alaska. Bering's ship was

wrecked in early November on what is now called Bering Island. The crew made such provision as was possible against the cold of the approaching winter, but the privations and hardships were very great. "It was under such circumstances that Vitus Bering died—on this cold, forbidding isle, under the sky of an Arctic winter, December 8, 1741." During the 30 or 35 years following, the Russians were active in exploring the coast and islands and in establishing a trade with the natives.

About the time the American colonies were making their struggle for separation from the mother country, England was beginning her part of the exploration of this north-west coast. Three names stand high in the record of these explorations: Cook, Vancouver and Mackenzie. Cook's expedition sailed from England in July, 1776. In the personnel of his expedition were men from the American colonies, and Vancouver, then a midshipman, was of the party. The work begun by Cook was continued by Vancouver during the years 1791 to 1794. Dall expressed the view generally held concerning Vancouver's work in the statement that: "The explorations which he carried out have not been excelled by any other navigator and were faithfully and thoroughly performed." The Hudson's Bay Company was meanwhile advancing its trade and extending its influence westward from the interior of Canada. In 1793 Alexander Mackenzie crossed the continent by land to the Gulf of Georgia, returning by the same route. This expedition, although little known, may well be compared with that of Lewis and Clark, in respect both of the difficulties encountered and of its value to his company and Government.



BY COURTESY OF AMERICAN MUSEUM OF NATURAL HISTORY

CARVED WOODEN SPOON USED BY THE INDIANS OF ALASKA

The excesses committed by private traders and companies, who robbed, massacred and hideously abused the native Indians, caused the Russian Government in 1799 to confine the trade and regulation of its American possessions to a semi-official corporation called the Russian-American Company for a term of 20 years, afterwards twice renewed for similar periods. Alexander Baranof, chief resident director of the American companies (1790–1819), and one of the administrators of the new company, became famous through the success he achieved as governor. He founded Sitka (*q.v.*) in 1804 after the massacre by the natives of the inhabitants of an earlier settlement (1799) at an adjacent point. The headquarters of the company were at Kodiak until 1805, and thereafter at Sitka. In 1821 Russia attempted by *ukase* to exclude navigators from Bering Sea and the Pacific coast of her possessions. This led to immediate protest from the United States and Great Britain. The outcome was a treaty with the United States in 1824 and one with Great Britain in 1825, by which the excessive demands of Russia were relinquished and the boundaries of the Russian possessions were established. In the convention with Great Britain, it was agreed that Russia should have the narrow strip of coast north of 54° 40′ and the peninsula and islands westward of the 141st meridian.

The last charter of the Russian-American Company expired on Dec. 31, 1861, and Prince Maksutov, an imperial governor, was appointed to administer the affairs of the territory. Authority was granted to an American company in 1864 to make explorations for a proposed Russo-American company's telegraph line overland from the Amur river in Siberia to Bering Strait, and through Alaska to British Columbia. Work was begun on this scheme in 1865 and continued for nearly three years, when the success of the Atlantic cable rendered the construction of the line unnecessary and it was given up, but not until important explorations had been made. Much of this information was made public in 1870 by W. H. Dall in his book *Alaska and its Resources*.

The first official overtures by the United States for the purchase of Russian America were made by Senator Gwin of California (1859) during the presidency of James Buchanan. This movement, however, was checked temporarily by the Civil War, which soon followed. The fishing interests of north-western United States were next to manifest an interest in the territory to the northward. In 1866 a memorial was adopted by the legislature of the Washington Territory, "in reference to the cod and other fisheries," and delivered to President Johnson. By a treaty signed on March 30, 1867, the purchase was consummated for the sum of $7,200,000, and on Oct. 18, 1867, the formal transfer of the territory was made at Sitka.

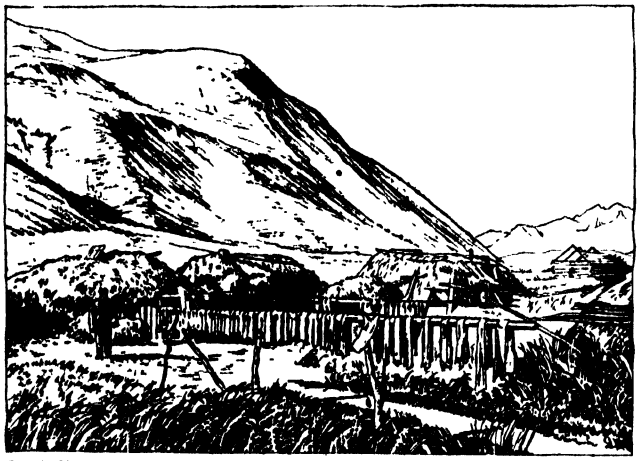
Later History.—Since its acquisition by the United States, the history of Alaska has been mainly that of the evolution of its administrative system and the varying fortunes of its gold-fields, fisheries and sealing industries. Alaska was an unorganized Territory from 1867 until May 1884. From 1867-77 the Government was in the hands of the Department of War, although the customs were from the beginning collected by the Treasury, with which the control rested from 1877 until the passage of the so-called Organic Act of May 17, 1884. This Act extended over Alaska the laws of the State of Oregon so far as they should be applicable, created a judicial district and a land district, put in force the mining laws of the United States, and in general gave the administrative system the organization it retained up to the reforms of 1899 and 1900. The history of government and political agitation then centred in the demand for general land legislation and for an adequate civil and criminal law, in protest against the enforcement of a liquor prohibition Act, and in agitation for an efficiently centralized administration. After partial and inadequate legislation from 1891 to 1898, the regular system of land surveys was made applicable to Alaska in 1899, and a generous homestead law was provided in 1903. The liberal land policy was completely reversed as a result of the conservation movement inaugurated under President Roosevelt. The original aim of the movement was to prevent waste of natural resources, but this gradually veered to a protest against corporate control of lands and resources. An important result of the conservation movement was the increase of reservations in Alaska, some 40,000sq.m. being set aside for various purposes, exclusive of mineral and forest withdrawals. For many years, however, the conservation issue remained unsettled and industry languished; with an abundant supply of fuel close at hand, Alaska was forced to import petroleum and coal at great cost; her pulp wood was rotting in the forests; her water-power was undeveloped Only gold and copper mining and salmon fishing increased. Finally during the Wilson Administration, a leasing policy for coal and oil lands and water-power was established by law. It was also during this period that the Government began the Alaska railway which was completed in 1923. The shortage of print paper after the war had a liberalizing influence on the regulations regarding the sale of timber from the national forests and the contracts governing pulp mills.

The struggle of Alaska to attain representation at Washington resulted in 1906 in the authorization of an elected delegate to Congress. At each biennial election which followed, home rule was the only important issue, until in 1912 an Act was passed granting a limited Territorial government. The first Territorial legislature was convened at Juneau on March 3, 1913, and the first law passed gave the franchise to women. Since that date the most important legislation has related to mining, hours of labour, workmen's compensation, banking and education.

The agitation over prohibition dated from 1868; the Act of that year organizing a customs district forbade the importation and sale of fire-arms, ammunition and distilled spirits; the Organic Act of 1884 extended this prohibition to all intoxicating liquors. Smuggling flourished; juries steadily refused to convict offenders and treasury officials regularly collected revenue from saloons existing in defiance of law. In 1900 the sale of liquors was authorized under what was known as the high license law. In 1916 the legislature authorized a plebiscite on the prohibition of the sale, transportation and manufacture of all alcoholic beverages. The vote was in the affirmative by 7,958 to 4,431; as the legislature had no power to change the excise law, a petition

was submitted to Congress which passed a dry law for Alaska in 1917.

Two events of international interest growing out of Alaska were the Fur Seal Arbitration of 1893 (*see* BERING SEA ARBITRATION), and the Alaskan-Canadian boundary dispute, previously mentioned, settled by an international tribunal of British and American jurists in London in 1903. The boundary dispute involved the interpretation of the words in the treaties of 1825 and 1867 defining the boundary of the Russian (later American) possessions, and also the determining ownership of the Portland canal and the question whether the coastal girdle should cross or pass around the heads of the fiords of the coast. The award of the tribunal made in Oct. 1903 was arrived at by the favourable vote of the three commissioners of the United States and of Lord Alverstone, whose action was bitterly resented by the two Canadian commissioners; it sustained in the main the claims of the United States.



BY COURTESY OF THE BUREAU OF FISHERIES, DEPT OF COMMERCE

NATIVE METHOD OF DRYING SALMON EMPLOYED IN WESTERN ALASKA
In summer the Alaskan Indian catches great quantities of salmon, which is hung over poles to dry and then stored for the winter months

Very little was known about the interior of Alaska previous to 1896, when the gold discoveries in the Klondike stimulated public interest regarding it. Since 1895, however, the exploration of the United States geological survey and the Department of War, as well as those of individuals, have established the main features of its physiography and a rather accurate knowledge of its resources. The highest peak of Mt. McKinley (20,300ft.) was conquered in 1912 by Hudson Stuck and Harry P. Karstens. Alaska was chosen as the objective of the Amundsen polar expedition on the journey from Spitsbergen over the North Pole in 1926. The Wilkins expedition selected Point Barrow as a base for its aeroplane explorations during 1926, 1927 and 1928; and it was from this point that Wilkins and Eielson made their successful aeroplane flight across the Arctic region to Spitsbergen in April 1928. These exploits demonstrated that transportation over air routes, even during the winter months, is possible.

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(G. McL. Wo.; W. P. R.)

ALASTOR, in early Greek mythology, the spirit of revenge, that prompts the members of a family to commit fresh crimes to obtain satisfaction. Further acts of vengeance transmit the curse from generation to generation. The word is also used for a man's evil genius which drives him to sin; a man so driven is sometimes called *Alastor*. The epithet is applied to the Furies (Erinyes) as the deities of revenge, and to Zeus when he is invoked as the "Avenger."

ALA-TAU (variegated mountains) is the name given to the following ranges in Asiatic Russia: (1) Terskei, (2) Kunghei and (3) Trans-ili, all three linking the Tian Shan and the Alexander range. (1) Lies south, and (2) and (3) north of and parallel to Lake Issyk-Kul Average height 6,000–7,000ft. (Mt. Talgar 15,000ft.) Snow-line 11,000–11,700ft. (4) Also called Talastau, west by south from the Alexander range. (5) Dzungarian Alatau, a range bordering the Dzungarian gate, north of the Tian-shan, average height 6,250ft., max. 11,000ft (6) Kuznetsk-Alatau, between the upper Ob and the upper Yenisei, west of the Abakan mountains. Average height 6,000–7,000ft. For No 6 *see* KUZNETSK.

ALATYR, a town in Chuvash, A S S R. Pop. (1926) 22,374. It is situated in latitude 54° 53′ N and longitude 46° 30′ E., at the junction of the Alatyr and Sura rivers. It has a grain elevator and an extensive grain trade, also flour mills and starch factories.

ALAUNA, ALAUNUS, the Celtic names of two rivers, etc, in Roman Britain. Hence the modern Allan Water, river Alyn, etc.

ALAVA, DON MIGUEL RICARDO DE (1770–1843), Spanish general and statesman, was a member of the assembly at Bayonne in 1808 which accepted Joseph Bonaparte as king of Spain, but shortly afterwards joined the national independent party which was fighting in alliance with the English.

He was Spanish commissary at Wellington's headquarters, and before the end of the campaign had risen to the rank of brigadier-general. In 1815 he was ambassador at The Hague, and was present at the battle of Waterloo He had served at Trafalgar on the flagship of his uncle, Admiral Alava, and was said to be the only man to have been present at both Trafalgar and Waterloo. He was a deputy to the Cortes in 1820, and in 1822 fought in the militia to support the authority of the Cortes against the rebels.

Alava took part in the negotiations for the restoration of Ferdinand, but was soon driven into exile. Returning to Spain after Ferdinand's death, he supported Maria Christina against Don Carlos, and was again sent abroad as ambassador, first to London (1834) and then to Paris (1835). He refused to take the oath to the Constitution of 1837, and died in exile at Barèges, France, in 1843.

Alava's name is repeatedly mentioned in the Duke of Wellington's correspondence.

ÁLAVA, one of the Basque Provinces of northern Spain. Pop. (1920) 98,668; area, 1,176sq.m.; density per sq.m., 83·9. The countship of Treviño (190sq.m.) in S. Álava belongs to the province of Burgos. Álava (Basque *araiiar*, country set among mountains) is in the west and north-west of a district of mountain and valley, drained by the rivers Boyas and Nervión. The centre of the province is the large, fertile plain of Vitoria which continues to the west the structural trough separating the Sierra de Aralar, on the north, from the Sierra de Andia, on the south. The

Montes de Vitoria separate this plain from the lower plain of Treviño, a dried-up lake basin running east from the Ebro at Miranda and bounded on the south by the Sierras de Toloño and de Cantabria. South of these sierras lies the lowest of the three plains of the province, the Alavese Rioja, with a water-frontage on the Ebro between Haro and Logroño.

Formerly a lordship, governed by an elective *señor*, Álava was incorporated in Castile in 1332 at the request of the electoral corporation of clergy and nobility, who celebrated with Alfonso XI. of Castile the Convention of Arriaga defining administrative relations between the lordship and Castile. The modern province is in many respects transitional between the Basque country and Castile. Castilian is the ordinary language except in the north.

Rainfall is fairly regular, except in the Alavese Rioja. About 27% of the soil of the province is cultivated, producing wheat (64% of the cereal area, 1924), barley, oats and sugar-beet; maize is grown on the Bizcayan and Guipuzcoan border only. Agricultural methods are, for Spain, progressive, owing to the educative effect of sugar-beet cultivation, and artificial fertilizers and modern ploughs are in general use. The wine of the province is renowned, especially that of the Alavese Rioja; attacks of phylloxera have diminished the area devoted to viticulture, but more than 11,000 acres (1924) have been replanted with American stocks. Forests of chestnut, oak and beech, controlled by the provincial authority, and rough pastures occupy 46% of the province. Livestock in 1925 included 32,042 horned cattle, 90,075 sheep, 32,891 goats and 31,136 swine. Goats and sheep are exported to Barcelona, cattle to the market of Bilbao. Irrigation is not in use except for horticulture, but the streams are harnessed to supply electric power and light. Salt and asphalt are worked; lignite, important in the war-time shortage of coal, is no longer profitable. Steel, pig-iron and puddled iron are produced (total value, 1923, 2,867,289 pesetas); and there are manufactures of beds, furniture, railway carriages, matches, paper, sweets and woollen and cotton goods. Bread-stuffs, colonial products and machinery are largely imported. In Álava the rate of illiteracy is only 16·24%; there are secondary schools at Vitoria, the capital (pop. 1920, 34,785), which is the only town of more than 3,500 inhabitants, and good normal schools for teachers of both sexes. (*See* BASQUES and BASQUE PROVINCES)

BIBLIOGRAPHY.—M. Risco, in vol. 33 of *Hispania Sagrada* by H Florez and others (1754–1879); A. A. Salazar, *Catálogo de las obras referentes a las provincias deÁlava y Navarra* (1887, bibl.).

ALB, a liturgical vestment of the Catholic Church. It is a sack-like tunic of white linen (Lat. *alba,* white) with narrow sleeves, and a hole for the head to pass through, and when secured round the waist by the girdle (*cingulum*) just clears the ground. Albs were originally plain, but about the 10th century the custom arose of ornamenting the borders and the cuffs of the sleeves with strips of embroidery, and this became common in the 12th century. These at first encircled the whole border; but soon it became customary to substitute for them square patches of embroidery or precious fabrics. These "parures," "apparels" or "orphreys" (Lat. *parurae, grammata, aurifrisia,* etc.) were usually four in number, one being sewn on the back and another on the front of the vestment just above the lower hem, and one on each cuff. A fifth was occasionally added just below the neck opening. In the 16th century the parures began to go out of use, and broad bands of lace soon afterwards replaced them, as in a magnificent specimen preserved at South Kensington. Apparelled albs are now only in regular use at Milan (Ambrosian Rite), and, partially in certain churches in Spain; but attempts have been made, especially in England, to revive their use.

The alb is worn by bishops, priests, deacons and subdeacons under the other eucharistic vestments at mass and at functions connected with it. It is sometimes also worn by clerics in minor orders, whose proper vestment is, however, the surplice—itself a modification of the alb. (*See* SURPLICE.) The alb is supposed to symbolize purity, and the priest, when putting it on, prays: "Make me white, O Lord," etc. In the middle ages the parures were taken to symbolize the wounds of Christ; and at Toledo the singers of the Passion on Good Friday still wear apparelled albs.

In England at the Reformation the alb went out of use with the other "Mass vestments," but was reintroduced in the ritual revival of the 19th century. It is now worn in many churches not only by the clergy but by acolytes and servers at the Communion. Where the ritual is a revival of pre-Reformation uses, these albs are frequently apparelled. (For the question of its legality *see* VESTMENTS.)

Both the alb and its name are derived from the *tunica alba,* the white tunic, which formed part of the ordinary dress of Roman citizens under the empire. The date of its definite adoption as a liturgical vestment is uncertain; at Rome—where until the 13th century it was known as the *linea* or *camisia* (*cf.* the modern Italian *camice* for alb)—it seems to have been thus used as early as the 5th century. But as late as the 9th and 10th centuries the *alba* is still an everyday as well as a liturgical garment, and we find bishops and synods forbidding priests to sing mass in the *alba* worn by them in ordinary life. (*See* Braun, p. 62.) In mediaeval inventories are sometimes found *albae,* described as red, blue or black; it is clear, however, from the descriptions of these vestments that in some cases they were actually tunicles, the confusion of terms arising from the similarity of shape (*see* DALMATIC); in other cases the colour applied to the parures, not to the albs as a whole. Silk albs appear in the inventories, but only very exceptionally.

The equivalent of the alb in the Eastern Churches is the sticharion (στιχάριον) of the Orthodox Church (Armenian, *shapik;* Syrian, *Kutina,* Coptic, *stoicharion* or *tuniah*). It is worn girdled by bishops and priests in all rites, by subdeacons in the Greek and Coptic rites; ungirdled, by deacons and lectors in all the rites. It is usually white for bishops and priests; for the other orders all colours, except black, may be used. Its material may be linen, wool, cotton or silk; but silk only is the rule for deacons. In the Armenian and Coptic rites the vestment is often elaborately embroidered; in the other rites the only ornament is a cross high at the back, save for bishops of the Orthodox Church, whose sticharia have two vertical red stripes (πόταμοι, "rivers"). As in the West, the vestment is specially associated with the Eucharist. The whole subject is exhaustively treated by Father Joseph Braun in *Die liturgische Gewandung* (Freiburg im Breisgau, 1907). (*See* also bibliography to the article VESTMENTS)

ALBA, town and episcopal see, province of Cuneo, Piedmont, Italy, 42m. S E. of Turin by rail. Pop. (1921) 8,904 (town), 14,213 (commune). The fine cathedral, with Gothic façade, was rebuilt in 1486. *Alba Pompeia* was probably founded by Pompeius Strabo (consul 89 B.C.) when he constructed the road from Aquae Statiellae (Acqui) to Augusta Taurinorum (Turin). The emperor Pertinax was born here. It became an episcopal see dependent on Milan in the 4th century. It is the centre of a wine-growing district.

ALBACETE, inland province, south-east Spain, formed in 1833 out of the northern half of Murcia. Pop. (1920), 291,833; area, 5,471sq.m.; density per sq.m. 50·8. A somewhat featureless province; except for the Sierra de Alcaraz in the west, Albacete continues south-east of the monotonous arid steppe land of La Mancha. Lying in the south-eastern corner of the central plateau, where the border of the plateau is less clearly marked by mountains than elsewhere, the province is crossed by the main routes from Madrid both to the Valencian plain and to the south-east. The drainage is almost entirely to the Mediterranean by the rivers Júcar and Segura, but the rainfall is low and the province contributes little to the volume of these rivers except from the western sierras. In these sierras the snow lies for several months; elsewhere the climate is mild and healthy. About 55% of the province is cultivated land, of which cereals—wheat, barley, oats, rye and maize in order of importance occupy nearly half. Albacete is a stock-raising province, but the acreage devoted to wheat shows a steady rise, with much breaking-up of natural pastures and a corresponding decline in live stock. Of these, sheep, belonging to the large Manchigan breed with its all-round production, are now the most important (1924, 369,627); sheep and wool are exported to Barcelona and Valencia, and cheeses to all parts of Spain. The vine has suffered much from repeated attacks of

phylloxera, and replacement with local stocks has been unsuccessful; olives are cultivated; the peaches of the Cabriel and Júcar valleys supply canning factories in Valencia. Saffron and esparto (wild) are exported, and employ much labour. There are important pine forests. Manufactures are almost confined to the spinning of hemp and the making of coarse cloth, porcelain, earthenware and cutlery. Brandy is distilled, and there is some trade in wood. Albacete, the capital (pop. 1920, 31,960), and the other important towns, Almansa and Hellin, are described separately. The railroad from Madrid to Albacete passes southwest to Chinchilla, where it bifurcates, one line going to Murcia and the other to Alicante. A large part of the province is accessible only by road. In respect of elementary education, Albacete is one of the seven most backward provinces, with 65·89% of the population returned as illiterate.

ALBACETE, capital of a Spanish province is in a fertile plain where the Balazote unites with the canal of María Cristina, which flows into the Júcar, 16m. to the north. Pop. (1920) 31,960. Albacete comprises the picturesque old upper and lower town mostly erected after the city became a provincial capital in 1833. Chiefly a market-town for saffron and other agricultural produce and for live-stock, it also manufactures matches. Albacete formerly had an extensive trade in cutlery, from which it was named the Sheffield of Spain, and its daggers are still held in high repute by Spaniards.

ALBACORE, a large West Indian fish allied to the tunny (*q.v.*). The name is also applied to an allied species in the Pacific.

ALBA FUCENS (mod. *Albe*), an ancient Italian town on a lofty site (3,347ft.) at the foot of Monte Velino, 4m. N. of Avezzano. Originally a town of the Aequi, on the frontier of the Marsi, it was occupied by a Roman colony and its fortifications (*c.* 300 B.C.) persist. It lay on a hill just to the north of the Via Valeria, which was probably prolonged beyond Tibur at this very period. Later it became a regular place of detention for important State prisoners, such as Syphax of Numidia, Perseus of Macedonia, Bituitus, king of the Arverni. Its strong position made it important in the civil wars. The external walls, a circuit of about 2m., are of polygonal masonry; carefully jointed, with faces smoothed. The gates as a rule come at the end of a long, straight stretch of wall, and are placed so as to expose the right side of an attacking force. On the north there is, for a length of about 150yds, a triple line of defences of later date, possibly added by the Roman colonists, inasmuch as both the city wall proper and the double wall thrown out in front of it are partly constructed of concrete and faced with finer polygonal masonry.

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ALBA IULIA, a town of Transylvania, Rumania (Ger. *Karlsburg*, Hung. *Gyula-Fehérvár*), situated on the Mureș, 73m. S. of Cluj by rail. Pop. (1924) 13,400. Alba Iulia, which consists of an upper town or citadel, and a lower town, is the seat of a Roman Catholic bishop and has a fine cathedral in 11th century Romanesque, rebuilt in 1443 by John Hunyady in Gothic style. It contains among other tombs that of John Hunyady. Near the cathedral are the episcopal palace and the Batthyaneum, founded by Bishop Count Batthyány in 1794, containing a valuable library with many incunabula and old manuscripts, amongst which is one of the *Nibelungenlied*, an observatory, a collection of antiquities and of minerals. The citadel was built in 1716–35 by the emperor Charles VI. Alba Iulia occupies the site of the Roman colony *Apulum*, and many Roman relics are in the museum. The bishopric was founded in the 11th century by King Ladislaus I. (1078–95). In the 16th century the town became the residence of the independent Transylvanian princes. From this period dates the castle and also the buildings of the university, founded by Gabriel Bethlen and now used as barracks. Alba Iulia with Cluj was the traditional centre of the Rumanian national movement in Transylvania; it was here that Michael the Brave proclaimed himself prince of Transylvania, Wallachia and Moldavia; here the union of Transylvania with Rumania was proclaimed in 1918 and King Ferdinand of Rumania was crowned in 1922. A peasant congress assembled at Alba Iulia in the spring of 1928, to protest against the Bratiano policies, but was without result.

AL-BALADHURI (Aḥmad ibn Yaḥya) (d. 892), native of Baghdad; one of the earliest Arab historians and the best authority for the period of the formation of the Arab empire. His chief work, *Futûh al-Buldân*, gives an account of the conquest of Arabia, Syria, Mesopotamia, Armenia, Egypt and north Africa, Spain, the Mediterranean islands, Nubia, Persia, and Media. It has been translated into English by P. K. Hitti under the title *The Origins of the Islamic State* in the *Studies in History, Economics and Public Law* series of Columbia university (1916). A second work, *Ansâb al-Ashrâf* (Lineage of Nobles), was edited by Flügel (Leipzig 1835).

ALBA LONGA, an ancient city in Latium, on the western edge of the Albanus Lacus, about 12m. S E. of Rome. Ascanius is the traditional founder and said to be the oldest of Latin cities, destroyed by its daughter city of Rome, under Tullus Hostilius, to which passed the hegemony of the Latin league. It has by many topographers been placed between the Albanus Mons and the Albanus Lacus, according to the indications of Dionysius, at the monastery of Palazzolo; but the position is quite unsuitable and does not answer to Livy's description, *ab situ porrectae in dorso urbis Alba longa apellata* (it was called Alba[1] Longa because it stretched along a narrow ridge); and its site is probably on the west side of the lake, where the modern Castel Gandolfo stands. Confirmation of this may be found in Cicero's description (*Pro Milone*, 85) of the destruction of the shrines and sacred groves of Alba by the construction of Clodius's villa, in the local application of the adjective *Albanus*, and in the position of Castel Gandolfo itself. Only the necropolis remains are preserved; the earliest tombs are Villanovan (about 1100 B.C.). Later ones are 7th and 6th centuries B.C. None was found, as has been alleged, buried by a subsequent eruption of the Alban volcano. The name *Albanum*, from about 150 B.C. till the time of Constantine, meant a villa in the Alban territory. The emperors formed a single estate out of a considerable part of this district, including apparently the whole of the lake, and Domitian was especially fond of it. The imperial villa occupied the site of the present Villa Barberini at Castel Gandolfo, and considerable remains still exist. To the south a camp, with baths, an amphitheatre, a large water reservoir, etc., was constructed for the Second Parthian legion, as his bodyguard, by Septimius Severus. The camp was given up in the time of Constantine, when the *Civitas Albanensis* arose.

The lapis Albanus is a green grey volcanic stone with black and white grains in it (hence the modern name, peperino), much used for building material in Rome and its neighbourhood.

For detailed accounts *see* T. Ashby, *Jour. Phil.* xxvii. 37 (1901); G. Lugli, *Ball. Comm.* (1917–20) and *Ausonia*, ix. 211; x. 210. MacIver, *Villanovans and Early Etruscans* (Oxford, 1924); *Italy in the Iron Age* (Oxford, 1927).

ALBAN, SAINT, the first martyr of Britain, is said to have been born at Verulamium (St. Albans, Hertfordshire) and to have served for seven years in Rome in the army. On his return to Britain he is said by Gildas to have been put to death as a Christian during the persecution of Diocletian (*c.* 286–303), according to Bede, at St Albans. As there is no certainty that the persecution of Diocletian extended to Britain it is possible that his martyrdom should be ascribed to that under Decius (250–251) or that of Valerian (259–260). A church was built on the place of his martyrdom, *c.* 793. A monastery was subsequently added, and around it the present town of St. Albans gradually grew up. Pope Adrian IV., who was born in the neighbourhood, conferred on the abbot of St. Alban's precedence over his fellow abbots, a right hitherto attached to the abbey of Glastonbury. St. Alban is commemorated in Catholic martyrology on June 22 and in the Church of England on June 17.

See U. Chevalier, *Répertoire des sources historiques* (1905), i. 95; D. Hardy, *Descriptive Catalogue* (1862), I. i. 3–34, ii. 688.

ALBANI, DAME EMMA, *née* LAJEUNESSE (1852–) celebrated Canadian singer, who was born in Chambly, Quebec,

[1]Whether Alba means "white" is very doubtful: it is more probably derived from the root Alp.

on Sept. 27, 1852. She made her first public appearance in Montreal, at the age of seven, and after studying at Milan with Lamperti (on whose advice she adopted for stage purposes the name of Albani, after that of an extinct Italian family) she made her European début there in Bellini's *La Sonnambula*, achieving an immediate success, which was repeated when two years later, on April 2, 1872, she made her first appearance at Covent Garden in the same opera. Thenceforward for a long period of years she enjoyed, alike in opera and oratorio, the widest fame and popularity, being not less esteemed as a woman than admired for her art. She married in 1878 Ernest Gye, the operatic impresario, who died in 1925, and in the same year she was accorded the D.B.E.

See her *Forty Years of Song* (1911).

ALBANI or **ALBANO, FRANCESCO** (1578–1660), Italian painter, was born at Bologna. His first master was Denis Calvert, with whom Guido Reni was at the same time a pupil. He was soon left by Calvert entirely to the care of Guido whom he followed to the school of the Caracci. Albani opened an academy in Rome, where he resided for many years. Here he painted, after the designs of Annibal Caracci, the whole of the frescoes in the chapel of San Diego in the church of San Giacomo degli Spagnuoli. His best frescoes are those on mythological subjects, of which there is a large number in the Verospi, now Torlonia Palace. A number of his works are at Bologna, and others at Florence, the Louvre, Dresden and Leningrad.

ALBANIA, an independent republic lying on the west coast of the Balkan peninsula, between Greece and Yugoslavia, with an area variously estimated at 17,000 and 11,000sq.m., and an estimated population of about 832,000, formed out of the earlier Turkish provinces of Scutari and Yannina, with parts of the vilayets of Kossovo and Monastir. Though the Albanian republic may be said to date only from the year 1920, when a national assembly was convoked, and the national boundaries were not demarcated till 1925, the state displays a certain individuality, distinguishing it from its two larger neighbours.

The Albanian lands lie athwart the mountain chain of the Dinaric Alps, but, as contrasted with Dalmatia to the north and Greece to the south, these here stand back from the sea, from which they are separated by a marshy and malarious lowland, crossed by several important rivers. The actual coast is generally low, and the shore waters are rendered turbid by the silt carried down by the rivers, thus contrasting markedly with the clear blue tint off the limestone country further north. Equally marked is the general absence of the coastal settlements so characteristic of most parts of the Mediterranean. Southwards, in the region near the port of Valona, the coastal lowland disappears, and limestone hills again approach the water's edge. In this, the region anciently called Epirus, the Greek mode of life becomes possible, though Greek penetration was always limited. The Albanians have been in the past and still are mainly mountain folk, occupying the hilly interior rather than the coastal lowland. The continuity of the mountain belt gives them a certain cultural unity, while at the same time the fact that it is broken up into a series of small natural regions, more or less isolated from each other, has made the growth of a national spirit a slow process. The country has thus three essential features which go far to explain the history and characteristics of its people: because of the littoral plains it marks a definite break in the otherwise mountainous west coast of the peninsula; its elevated hinterland forms a natural refuge between the seaway to the west and the north-to-south land routes of the interior of the peninsula; within the mountain belt lie valleys and basins of considerable productivity, capable of supporting fairly dense populations. The aloofness both of the land as a whole, and of its centres of settlement, has led to Albania being one of the least known parts of Europe, and within the post-war republic the primitive and the ultra-modern jostle one another. Thus there is a regular aeroplane service between the capital Tirana and the town of Koritsa, but over most of the country there are no roads, and the simple wooden plough, which scarcely does more than scratch the ground, is of archaic type. The language of the country is practically unknown beyond its own borders.

Structure and Relief.—Starting from this simple conception of Albania as consisting of a marginal lowland, crossed by powerful perennial streams, and a complex mountainous hinterland enclosing small fertile basins, the details of the picture may be filled in. To the north the Albanian Alps, built largely of massive limestones, form the outstanding feature. They have a general west-to-east direction, roughly parallel to the course of the Lower Drin, below the junction of the two streams of the Black and White Drin. The Black Drin is the effluent of Lake Okhrida, and flows northwards, draining a large part of eastern Albania, while the White Drin enters the country from Yugoslavia, flowing in a southerly direction. Below the confluence the river swings round at a sharp angle to cut through wild mountainous country, in a series of inaccessible gorges, on its way to the Adriatic. It receives a number of swift tributaries from the Albanian Alps, these also flowing in deep, steep-sided gorges, for the southern slopes of the mountains are remarkably abrupt and rocky. The result is that the actual valley of the Lower Drin is not, as one might suppose, a line of access to the interior, the only practicable route from the coast to the confluence of the two headstreams running well south of the river in the hilly Merdita region. No bridge crosses the Drin in its gorge section, and as it is too deep to be forded, the inhabitants usually cross it by swimming, supported by inflated skins. The fact is interesting as suggesting what is meant by difficulties of communication in Albania.

The Albanian Alps rise to heights of 6,500–8,500ft. above sea-level, and to the north-west, where limestones predominate, they are practically a continuation of the high karst of Montenegro. To the north-east, however, other rocks, particularly Palaeozoic schists, appear and the scenery is of a different type. The steep lower slopes are thickly wooded, for the region has one of the highest mean annual rainfalls in Europe At the higher levels, however, where considerable plateau tracts occur, there are wide summer pastures. Though in the strict sense there is no permanent snow, patches linger throughout the summer, and a very slight change in the climate would give the chain a snowcap. It was heavily glaciated during the Ice Age, and the effects of ice erosion have been to accentuate its inaccessibility and high relief. Except on their margins the mountains are virtually devoid of permanent habitations, and thus at first sight they would appear to form an admirable boundary zone. But, as has been noted by travellers, parts of the higher levels swarm with herdsmen and their flocks during the summer season, and these mountain pastures are an economic necessity to the inhabitants of the lower grounds. Great difficulties have consequently arisen in demarcating frontiers, for the line of the water-parting, so often chosen as a basis, may separate a group from its pastures and thus inflict great hardship. In limestone regions, also, the water-parting may be very difficult to trace.

Westwards the Albanian Alps cease abruptly some 30m. from the Adriatic coast, giving place to quite a different type of country. Though much of it lies below 600ft., it is not a uniform plain, and there is a considerable belt of hills between Lake Scutari and the sea. The structure is, however, perfectly clear and simple. Low limestone hills indicate that the coastal chains of Dalmatia are continued here, but two separate facts introduce a new note. The first is that depression has taken place on a much greater scale than further north, and the second is that very extensive silting has occurred, so that the sunken hill-ridges are largely submerged beneath a mantle of recent deposits. Lake Scutari itself represents an area of depression in which the filling has been incomplete. The Drin, on emerging from its gorge, swollen by the water from the Albanian Alps, has great difficulty in finding its way through the maze of its own deposits and those of its tributary the Kiri. Up to the year 1858 it turned southward past Alessio (Lesh) and discharged its waters by a swampy, wooded delta just south of the port called by the Italians San Giovanni de Medua, and by the Albanians Shën Gjin. In that year, during a period of high flood, it broke through to the Boyana, the effluent of Lake Scutari, and most of its water now follows this course, the older one carrying but a small part. This caused a rise in the level of Lake Scutari, with a flooding of parts of its margins,

and also obstructed the channel of the Boyana, formerly navigable, by the silt thus poured into it. As in all such changes of river course, deserted channels and pools were left to become breeding places of mosquitoes, and thus form foci of malaria.

South of this frontier zone of coastal lowland and inland mountain belt the conditions are much more complicated, both as regards geological structure and relief. The mere fact that the Drin, after a lengthy course as the Black Drin in the interior, should cut its way through the mountains in a gorge more than 3,000ft. deep, and over 30m. long, is sufficient to suggest that there have been earth movements on a considerable scale here. So far as geographical effects are concerned, however, the matter may be simply put. The course of the Lower Drin marks a change in the direction of the mountain folds, associated with changes in their characters. The outer or coastal folds have sunk, and at the same time rocks from the west have been thrust over them. The inner folds have been elevated, and as a result their surface rocks, including tertiary sandstones and Cretaceous limestones, have been for the most part worn off, exposing the deeper beds, mainly serpentines, below. These serpentines give rise to rounded land-forms, far less repellent than massive limestones, even though the elevation is considerable, a number of crests rising above 6,500ft. with a maximum of nearly 9,000ft. The region has also been cut up by river action so that it is by no means uniformly high, but encloses small plains whose floors in some cases sink to only some 650ft. above sea-level.

South of the Semeni the low ridges rise to greater heights and the limestones reappear beneath the sandstones. Still further south, beyond the River Viossa, the elevation increases to over 6,000ft., the limestones are fully developed, the sandstone covering disappears from the crests, though it remains in the intervening furrows, and the lowland gives place to the mountainous Epirus region, continued beyond the frontier into Greece. The vegetation undergoes a corresponding change, woods tend to disappear, and the summits are clothed with scanty herbage, again forming summer pasturages. This type of country is continued southward into Greece, and frontier lines are difficult to draw, for the whole tract is the natural home of wandering shepherds. No notable difference of elevation separates this littoral Epirus area from the mountain zone of interior Albania, but it is still possible to distinguish between the two because of the great simplicity of structure of the western folds.

From the western shores of Lake Okhrida towards the Lower Drin there extends northwards a mountain belt consisting of a series of blocks separated by mountain passes. This forms a central backbone repelling settlement to its margins. It is highest to the south where also it forms a single chain, and becomes lower towards the north where it tends to consist of rows of hills rather than of a single ridge. Finally it merges into the complex hilly country of the Merdita, south of the Lower Drin, where settlement becomes possible on the flanks of the hills as well as in the intervening valleys. Except in the extreme south, most of this central hill belt is heavily wooded, especially with beech. Above the tree limit occur the usual high pastures.

At either side of this chain lie long furrows, each consisting of a succession of basins and gorges, and forming one of the most characteristic features of the country. The eastern furrow is traversed by the Black Drin, and is bounded by another mountain belt on its eastern side. It might be supposed, therefore, that this mountain belt would form the eastern frontier of Albania with Yugoslavia. But this is only the case to a limited extent, for south of the town of Dibra, on the Black Drin, the Yugoslav frontier is pushed westwards, and includes that town, a part of the river and the greater part of Lake Okhrida. This is but another illustration of the difficulty of drawing satisfactory frontiers in the Balkan peninsula. The difficulty here depends on the peculiar topography which is itself a result of recent earth movements. It is a characteristic feature of Macedonia that large depressed basins occur which, even when they are strung along the same river system, are separated physically from one another by mountain sills, cut through by the river in gorges. Because of these sills it happens frequently that basins belonging to separate river systems are in closer touch with one another than those linked by a single river. The Black Drin shows very markedly this feature of successive basins and gorges, the basins being largest to the south, and smaller towards the north. The largest is that which is mainly submerged beneath the waters of Lake Okhrida. It is a general rule in Albania that, as compared with Macedonia, the basins are small, and thus only moderately productive, and not capable of supporting a dense population. At the same time the intervening gorges tend to be longer and more forbidding, and the possibility of linking effectively successive series of basins by transverse routes is much less notable. These differences have had a cumulative effect on the inhabitants of the two areas, and the present frontier, which assigns the greater part of the larger southern basins to Yugoslavia, the power which holds the adjacent section of Macedonia here, and the smaller, more northerly ones to Albania, is drawn mainly on an ethnic basis, racial distribution here being a reflection of the topography.

Some of the basins on the course of the Black Drin may be noted. The largest, as just stated, is occupied by Lake Okhrida, of which only the south-western corner falls in Albania. Here lies the settlement of Pogradec. Still further south there lies a large basin containing the town of Koritsa, but this is best considered with the western furrow rather than with that of the Black Drin. On emerging from the lake that river passes through a heavily wooded gorge to emerge at the basin of Dibra. Though most of this basin lies in Yugoslavia, its Albanian side is also capable of settlement. A low ridge separates this basin from that of Pehskëpi, further north, and the alternation of basin and sill is continued to and even beyond the confluence of the Black and White Drin. In each basin there tends to be a market centre, but the point of importance is that the floor of the whole basin is capable of yielding cereals, especially maize and wheat, so that each forms a centre of settlement, more or less isolated from its neighbours, and necessarily self-sufficing.

To the west of the central mountain belt lies the second furrow, differing in several respects from that of the Drin. Though bounded on the west by the hill belt which forms the inner margin of the coastal lowland, it lacks the continuity given to its easterly counterpart by the Black Drin. A belt of highland forming the water-parting between the Upper Mati and a right-bank tributary of the Shkumbi divides it into a northern and a southern section, drained respectively by the Upper Mati and the Upper Shkumbi. North and south of this wooded and impassable highland passes permit communication with the Black Drin furrow, downstream from Dibra on the one hand, and in the Lake Okhrida area on the other. The latter line is particularly important as it was followed by the Roman Via Egnatia which passed from Durazzo to Elbasan, placed where the Shkumbi emerges from the hill country, and then by way of the basin traversed by that river to the shores of Lake Okhrida, which was rounded to the north. The existence of this route shows that the Shkumbi furrow is much less isolated than parts of the Drin furrow.

The headstream of the Shkumbi approaches very closely the valley of the Devoli, one of the two feeders of the River Semeni. The Devoli drains the basin of Koritsa, to the south of Lake Okhrida, and may be said to mark the region of convergence of the two furrows, the eastern and the western. Koritsa is a fairly important route centre, being connected southwards through Albanian Epirus with Yannina in Greek Epirus, eastward with Kastoria in Greek Macedonia, and also by the Devoli valley with the coastal lowland as with Durazzo via Elbasan and with Valona. To the south-west of the Koritsa basin lies the smaller one of Kolonja, traversed by the Osum river, the other feeder of the Semeni.

Climate and Natural Vegetation.—The climate of Albania may be briefly dismissed. The coastal lowland, together with the littoral part of the Epirus region, has the typical Mediterranean climate, with summer drought accentuated by high summer temperatures. But this type has a limited distribution. Even in the Epirus region the elevation brings changes, diminishing the heat of summer and slightly increasing its rainfall. The southern part of inner Albania, at least in the basins, shows the modified

Mediterranean or Macedonian type. The summers are hot, apparently even hotter than in the lowland, but winter frosts occur.

The natural vegetation reflects these climatic conditions. Near the coast the characteristic Mediterranean scrub or *maquis* occurs, though this has been largely cleared. It had always a somewhat limited distribution, and the most widely distributed plant association in the south is oak wood, or rather oak scrub-forest. The oaks are of the evergreen, drought-resisting type, and in addition to their value as sources of fuel are important in the low grounds as furnishing in their leaves and shoots supplementary winter fodder. Even cattle and horses eat oak leaves in Albania. To the north, with the heavier rainfall, the oak woods give place to luxuriant mixed forest, with beech as a predominant element, mingled with pines and firs.

People.—The inhabitants are mainly Albanians, with a certain admixture of Vlachs, especially in the Epirus region, and of Serbs and Bulgars in the interior. But not all the Albanians live within the confines of the country. A number estimated at 87,000 live in southern Italy and Sicily, whither their forefathers fled from the Turks in the 15th and 16th centuries. Some 50,000 are found in the United States, many emigrants leaving Epirus, a region of poverty. As in other parts of the peninsula, emigration is often temporary, the travellers returning when they have amassed a certain amount of money. In addition considerable numbers of Albanians live in Greek Epirus and in Macedonia, outside the frontier.

The Albanians have retained their original language, and, though dialects occur, the differences are said not to be so marked as to make mutual comprehension impossible. They are divided into Ghegs to the north of the Shkumbi line and Tosks to the south, the latter being apparently the more advanced. Some 71% of the total are Muslims, this being an effect of Turkish rule; monogamy is, however, the rule, and the status of women is higher than in most Muslim countries. About 10%, mostly living in the north, are Roman Catholics, while 19%, mostly in the south, belong to the Albanian orthodox church. According to travellers, however, religious distinctions count for comparatively little, at least in the remoter regions.

From the psychological standpoint the Albanians, about whose characteristics much has been written, may be said broadly to show the features common to isolated mountain folk. As is frequently the case with such stocks their virtues are apt to be more highly estimated by strangers than by those with whom they come in daily contact. Theft and cold-blooded murder are not crimes, either in the estimation of the individual or of his fellows, but a breach of the plighted word or a violation of the duties of hospitality cuts a man off from his family group, and adultery is uncommon. The blood-feud or vendetta, almost inevitable in a country of such loose organization, has been in the past a scourge, and there are said to be still, at least among the Ghegs, groups which hold that the death, even the accidental death, of a kinsman can only be wiped off by the murder of the guilty person or one of his relatives. Associated with this is the strength of the *bessa* or pledge, which protects its holder absolutely. All women are protected by the bessa, and so also is any man accompanied by a woman. Boys under 16 years of age, ecclesiastics, and generally all those incapable of bearing arms, are also protected, while certain places, or routes, some occupations, such as irrigation works, and certain periods, confer similar rights.



BY COURTESY OF AMERICAN WOMEN'S HOSPITAL

A TOSK OF ALBANIA IN THE NATIVE COSTUME, THE DISTINGUISHING FEATURE OF WHICH IS THE WHITE PLAITED PETTICOAT

Occupations.—The Albanians are almost entirely dependent on the land, carrying on a characteristic combination of pastoral and agricultural occupations. Sheep form the major part of the flocks, and yield cheese, which forms an important part of the diet, and is exported on a considerable scale, as well as wool and skins. Goats are also reared, but the cattle are of poor breeds, yielding little milk. Oxen, with buffaloes in the swampy plains, are the plough animals. Religion excludes the thrifty pig, save among the Christian tribes, and meat of any kind is a luxury. Even the ewe's-milk cheese is too valuable to be used extensively, and the Albanians are mainly vegetarians, depending on maize bread with vegetables and whey. Horses, donkeys and mules are reared for riding and as pack animals.

It is calculated that only 7–9% of the surface is arable, but of this total only a small part, particularly in the north, is actually utilized. In the lower grounds all the characteristic Mediterranean fruit-trees, including olive, orange, lemon, fig, etc., can be grown, but the Albanian shows little aptitude for the more delicate operations of arboriculture. The vine is grown on a fairly large scale, especially in the south of interior Albania, and wine is made, but of a quality only fit for local use. Brandy is distilled from a variety of fruits, including mulberries, and alcoholism is said to be one of the curses of the country. Despite the presence of the mulberry, silkworm-rearing is only carried on on a small scale. Rice is produced in the swampy parts of the lowland, and tobacco is fairly widespread, and forms an article of export.

Towns.—Koritsa is the largest town, with some 24,000 inhabitants, and the surrounding basin is well-cultivated and prosperous. Tirana is only about half the size, but its selection as a capital is due largely to the necessity of keeping touch with both the Ghegs and the Tosks, the more backward north and the better-developed south. Its population is said to be increasing rapidly, while that of Scutari, a town comparable in population to Koritsa, is decreasing.

See Bourcart, *L'Albanie et les Albanais* (1921); Louis, *Albanien* (1927, bibl.); J. and C. Gordon, *Two Vagabonds in Albania* (1927).

(M. I. N.)

Defence.—The liability of all Albanians, without exception, for military service begins at the age of 18 years and ends, for service in the active army, at the age of 50. After that age, they pass into the reserve. Under these conditions, statistics about the numbers which could take the field in war are difficult to obtain. According to the latest available figures the total peace strength of the army may be put at about 7,600, including about 350 officers. There is also, for maintaining internal order, a small force of *gendarmerie* and special troops, numbering about 3,100 (160 officers); grand total about 10,700. Albania also has a small air force with a personnel of about 40.

See also the League of Nations *Armaments Year-Book, 1928.*

(X.)

SOCIAL AND ECONOMIC CONDITIONS

According to whether they live north or south of the River Shkumbi, the Albanians are called Ghegs and Tosks, the latter having attained a more advanced state of civilization. The social organization of Albania, with its clans and tribes, recalls that of feudal Europe. The cohesion of the Albanian family is very remarkable.

Albania is divided into nine prefectures, called after the principal centres of population:—Argyrokastron, Berat, Dibra, Durazzo, Elbasan, Koritsa (Korça), Kosovo, Scutari (Shkodra), Valona. In 1923, 562,010 of the population were Muslims; 169,000 Orthodox Greek; and 85,600 Catholic. The Muslims, who represent 69% of the population, are in the majority in all prefectures, except in that of Argyrokastron, where the majority is Orthodox, and in that of Scutari, where Catholicism is predominant. Orthodox Christians are numerous in the regions of Koritsa, Berat and Valona, while the prefectures of Dibra, Durazzo, Elbasan and Kosovo are almost entirely Muslim.

The principal towns, in order of importance, are: Koritsa, 25,598 inhabitants; Scutari, 21,580; Argyrokastron, 12,400; Tirana, the capital, 10,845; Elbasan, 10,400; Berat, 8,000; Kavaja, 6,307; Valona, 5,942; and Durazzo, 4,785.

Religion.—The Albanians are extremely tolerant in religious matters. In 1923, the Muslim Congress at Tirana broke with the Caliphate, and proclaimed the religious autonomy of Albanian Muslims. After the Congress of Berat in 1922, the Albanian Orthodox Church constituted itself an independent Church, with the consent of the Patriarch of Constantinople. This Church has four metropolitans, at Durazzo, Berat, Argyrokastron and Koritsa. At Scutari the Catholics have an apostolic delegate and an archbishop. The country is divided into five Catholic bishoprics.



BY COURTESY OF AMERICAN WOMEN'S HOSPITAL

A CORNER OF ELBASAN. A TOWN OF 13,000 INHABITANTS IN ALBANIA ON THE ANCIENT ROMAN ROAD BETWEEN DURAZZO AND OCHRIDA

Education.—Under the Turkish domination, which prohibited teaching in the Albanian language, the Albanians remained in ignorance. The new State has succeeded in creating public instruction of all degrees. There are now in Albania 440 primary schools; 14 continuation schools; a teacher's training college at Elbasan; a school of agriculture at Lushna; a technical school at Tirana; an Albanian college at Scutari; and a French college at Koritsa.

Finance.—Albania is economically a backward country, and the State revenues, about 23,000,000 gold francs in 1927, are hardly sufficient to meet the cost of administration and the still rudimentary organization of public services. Its economical development was only possible with the aid of foreign capital. The Albanian Government met this need by entrusting in March 1925 to an Italian financial group the foundation of the National Bank of Albania and of the Corporation for the Economic Development of Albania.

Production.—Albania is a primitive country. Almost the whole population is engaged in agriculture and cattle-raising. Each household attempts to produce all the necessaries of life for its own purposes, including flax, wool and leather, for clothing.

Albania is a mountainous country, a great part of its area being over 3,000ft. above sea-level, the north and south offering vast districts unfit for cultivation. But the central region, the littoral, the shores of the great lakes, together with many wide valleys and high plateaus in the mountain districts, can be cultivated. The coast region is indeed very fertile, but it is for the greater part uncultivated, and indeed uninhabited, on account of the marsh-fever arising from the undrained marshes. In northern and central Albania, only about one-tenth of the arable land is under crops. In the northern mountains, land is held in common by families, the pastures being the collective property of the tribes. In the centre are found the large estates of the Albanian beys. The State moreover possesses a vast stretch of land in this region. South Albania is the best cultivated region.

Albania possesses vast forests of oak, walnut, chestnut, elm and plane trees, and in the high regions forests of beech, pine and fir. These forests are almost exclusively owned by the communes and by the State. In 1923 the Germans began a timber industry in the forest of Mamuras, north of Durazzo. Later on the Forestry Concern of the Italian State Railways was authorized to survey and to utilize the forest resources of the country.

Mines.—The mineral wealth of Albania, thought to be considerable, is not yet exactly known, no geological survey having yet been made. The results of the investigations made by the Austrians during the War have not been published. Almost the whole strip of coastline, about 40m. wide, shows indications of the presence of hydro-carbons. Asphalt and bitumen are worked at Selenitza, near Valona, by a formerly French, now Italian, company. Petroleum concessions were granted to the Anglo-Persian Oil Co., to the Italian State Railways connected with the Standard Oil Co., and to the French Crédit Général des Pétroles. Coal seams exist in the regions of Tepeleni, Koritsa and Tirana; and there is iron in the basin of the Fani, near Scutari, and in the Tepeleni district.

Communications.—The ports of San Giovanni di Medua, Durazzo and Valona are good natural harbours, but they have not been developed. With the exception of the Bojana, which is the outlet of the lake of Scutari to the Adriatic, there are no navigable rivers. Since the recovery of her independence, Albania has begun to construct much-needed roads. In 1925 there were about 720m. available for motor traffic. There are no railways of normal gauge, though during the War the Austrians constructed "Decauville" lines from Scutari to Durazzo, Lushna and Berat, with branches to Tirana, Elbasan and Fieri. These lines still exist for the most part, but need repair. The line from Durazzo to Tirana is used for the carriage of materials needed for the repair of that route. Early in 1925 a German, now Italian, aeroplane service was started between Scutari, Tirana, Koritsa and Valona.

The Corporation for the Economic Development of Albania, supported by the Italian Government, has given Albania a 40 years loan of 50 million gold francs, guaranteed by the receipts of the Albanian customs and monopolies of salt, matches, cigarette paper and playing cards. The Italian Government has guaranteed the corporation the payment of the annuities of the loan. The money is to be used for important public works, as roads, bridges, harbour works at Durazzo, public buildings, and later on for the drainage of the large swampy malarious areas on the coast.

Trade.—The trade balance has much improved in recent years. While in 1920 the imports amounted to 17·5 million gold francs and the exports to 1·5 million only, the figures of 1926 reached 24·8 million (imports) and 12 million (exports). The imports, which consist principally of textiles, cereals, groceries and metals, come chiefly from Italy (67%) and Greece (12%). The greater part of the exports, consisting chiefly of live animals and animal food, cereals, raw hides and wood, go to Italy (45·8%), Greece (32·8%) and America (16·7%). The heavy trade deficit has been compensated to a large extent by remittances from Albanian emigrants in the United States.

The maritime communications consist of two Italian steamship lines.

Currency.—Till 1926 Albania had neither metallic nor paper money of her own. The unit was the gold franc, but payments were made in napoleons (20-franc gold pieces and 8-florin Austrian gold pieces) and in crowns (silver Austrian money). In Sept. 1925 there was formed the National Bank of Albania, with a capital of 12·5 million gold francs, of which 51% was subscribed by an Italian group. The National Bank created a gold currency with the Albanian or gold franc as a unit, and has issued bank-notes (whose circulation amounted in 1927 to nearly 3 million gold francs), exchangeable for gold, and gold, silver, nickel and bronze coins. The Bank has also established general warehouses for credit purposes for the import and export trade.

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MEDIAEVAL AND MODERN HISTORY

After the division of the Roman empire, northern and southern Albania became the Byzantine provinces of Dyrrachium and Nikopolis. Overrun by the Goths in the 4th and 5th centuries, they were reconquered by Justinian in 535. In 640 northern Albania was invaded by the Serbs. In 861 the Bulgarians conquered southern Albania, defeated the Serbs (893–927) and established themselves (976–1014) in the greater part of the peninsula; but in 1014 the emperor Basil II. reconquered southern Albania, which remained under Byzantine rule until 1204, when Michael Comnenus, of the imperial family, founded the independent *Despotate* of Epirus, which included southern Albania, Acarnania, and Aetolia. In 1318 the Despotate passed to the princes of the house of Orsini, who ruled it until 1358. Meanwhile the Sicilian kings acquired and held central Albania (1271–1368). In 1180 the Serbs had re-installed themselves in the provinces of Scutari and Prizren, and Stefan *Dushan* (1331–58) included all Albania in his ephemeral empire. Large numbers of Albanians under Jin Bua Spata and Peter Liosha emigrated southward before *Dushan's*

hordes, took Yannina and Arta, and penetrated as far as Acarnania and Aetolia (1358), while colonies were established in the Morea, Attica and Boeotia.

After the death of *Dushan* Albania fell under the rule of native chieftains; but a Norman knight named Balsha, who had served under *Dushan,* established a dynasty at Scutari (1366) and induced the chieftains to co-operate under his leadership against the Serbs and Bulgarians. The power of the Balshas was, however, short-lived. At the close of the 14th century the Venetians established themselves at Durazzo, Scutari, and Antivari, and in 1421 the dynasty came to an end.

Period of Turkish Rule.—The advance of the Turks, who captured Yannina in 1431, reunited the Albanian chieftains (1444–66) under the immortal George Kastriota of Kroia (*see* SKANDERBEG), and thereafter under the Venetians. But in 1478 Kroia surrendered Scutari in 1479, Durazzo in 1502, and in 1571 Antivari and Dulcigno, the last Venetian possessions in Albania. Many Albanians fled with their Venetian allies to Dalmatia and Italy. Although more than half the Albanian race abandoned Christianity —in the lowlands that it might enjoy equality with the Turks, and in the north-eastern highlands that it might obtain their support against its hereditary foes, the Slavs—Ottoman sovereignty was never effectively established, and against it the Albanians intermittently revolted. In about 1760 Mehmed Bushati, pasha of Scutari, rallied the northern clansmen and threw off Turkish suzerainty. His son, Mahmoud, *the Black,* routed three Turkish armies, but with the defeat of his grandson Mustafa, in 1831, the power of the Bushati was broken. Meanwhile, in southern Albania, the able Ali Pasha of Tepelen (b. about 1750), by a combination of cunning and brutality, established a virtually independent state with Yannina as its capital, and maintained direct relations with foreign Powers, but was overthrown by a Turkish army in 1822.

The revival of nationalism in Greece, Bulgaria and Serbia, coupled with the decline of the Turkish empire, induced the Albanians to prepare for and to seek autonomy within the empire while availing themselves of its protection until they were prepared for independence. In 1879 the Porte sought to turn Albanian nationalism to its advantage by encouraging the formation at Prizren of the *Albanian League,* which opposed with some success the cession of Albanian territory, as provided for by the Treaty of Berlin, to Montenegro and Greece. Once the *League* had fulfilled its purpose the Porte suppressed it, although not without much bloodshed. But Albanians at home and abroad continued to work clandestinely in the national cause. In 1908 they threw in their lot with the Young Turks—whose success was due largely to their support—in the hope that in consequence they would obtain autonomy and educational liberty. The new régime proved, however, infinitely worse than previous conditions, and the Albanians rose in revolt against Ottomanization. Throughout 1910–11 they struggled unsuccessfully, but in 1912 a general rising was successful; the vilayet of Kosovo was liberated, Monastir threatened, and in August the Turks were obliged to grant autonomy to Albania, which was to include the vilayets of Scutari, Kosovo, Yannina and Monastir. But the Balkan States had envisaged the partition of Albania between them and hastened to precipitate war with Turkey. The Albanians, wishing neither to be classed as Turks and share their fate, nor to facilitate the overthrow of their protectors, and without any central administration to guide them, remained neutral except at Yannina and Scutari which were vital to their national existence. On Nov. 28, 1912, Ismail Kemal Vlora, diplomatically supported by Austria-Hungary and Italy, who were opposed to the access of any third Power to the Adriatic, proclaimed Albanian independence at Valona. But Russia and France supported the Balkan allies, and a general European war was perhaps only averted by British arbitration. The solution of the problem was entrusted to a Conference of Ambassadors in London, which acknowledged the principle of Albanian autonomy on Dec. 20, and on July 29, 1913, declared Albania an independent sovereign State; but its boundaries included less than half the Albanian race.

The Albanian State.—Prince William of Wied, selected by the Powers to rule Albania, landed at Durazzo on March 7, 1914; but the machinations and the intrigues of various neighbouring States rendered his position untenable. Unable to extend his authority into the interior, he left Albania on Sept. 3, although he did not abdicate. Meanwhile, to resist the incorporation of southern Albania in the new State, Greece instigated during February the constitution of a "Provisional Government of Autonomous Epirus" supported by Greeks masquerading as insurgents The international situation prevented the Powers from interfering, and anarchy continued until Greece was authorized officially to re-occupy southern Albania in the autumn. Italian troops occupied Valona in Dec. 1914, and in 1916 the whole of southern Albania, except the Korçha region, which was occupied from Salonika by the French, who established an autonomous administration. Early in 1915, the Serbs and Montenegrins occupied northern and central Albania after severe fighting, but after their defeat by the Austro-Bulgarian armies these regions were occupied by the latter in 1916. Albania had no central government, although Essad Pasha posed as its president, and local policies were pursued. On June 3, 1917, General Ferrero proclaimed the independence of the whole of Albania under Italian protection, thereby repudiating those clauses of the Pact of London (1915) which provided for its partition.

Albania after the War.—After the Armistice the Italians occupied most of the country, the French remained at Korçha until June 1920, the Yugoslavs occupied north-eastern Albania, and at Scutari an inter-allied administration, the successor of the international administration temporarily established in 1914, governed until Feb. 1920. In Dec. 1918 a National Assembly at Durazzo elected a provisional government and delegation to the Peace Conference. In Feb. 1920 the Albanians, exasperated by Italy's apparent intention to remain in occupation, her readiness to sacrifice Albanian territory to Greece and Yugoslavia for advantages elsewhere, and the refusal of the Yugoslavs to withdraw while the Italians remained, formed a fresh government at Lushnja with a mandate to obtain the restoration of independence, elected a council of regency composed of a representative of each of the four religious sects, and selected Tirana as the capital. In June the Albanians drove the Italians into Valona. The latter, appreciating the folly of defeating their own ends by alienating Albanian good will, thereupon recognized the Albanian Government (Aug. 2, 1920) and evacuated the country. The Yugoslavs, now in turn asked to withdraw, advanced on Tirana; but the Powers intimated their displeasure, and the Yugoslavs thereupon withdrew to their original positions. While ostentatiously declaring for the re-establishment of Albania as delimited in 1913 that they might not prejudice their case against Italy in the Adriatic dispute which was settled by the Rapallo Treaty (Nov. 1920), the Yugoslavs worked surreptitiously to acquire north-eastern Albania for strategic reasons. A "Mirdite Republic," proclaimed at Prizren (June 1921), was unsupported outside Yugoslavia; and a serious invasion of Albania, with the intention to detach the north and confront Europe with an accomplished fact, was frustrated by the intervention of the British Government (Nov. 7), which convened a meeting of the Council of the League of Nations, of which Albania had become a member on Dec. 17, 1920. Meanwhile the Conference of Ambassadors finally overruled all claims to Albanian territory by confirming (Nov. 9, 1921) the 1913 frontier with the exception of minor rectifications, at the same time declaring that the integrity of Albania's frontiers was necessary to the strategic security of Italy. The frontier question was finally closed on Aug. 2, 1926, by the signature in Paris of a protocol, and in the meantime the rectifications caused much tension between Albania and its neighbours.

Internal Politics.—On Dec. 25, 1921, Albania's sixth post-war cabinet took office; it included Djafer Ypi (Premier), Fan Noli (Foreign Affairs), and Ahmed Zogu (Interior). With the exception of an irredentist insurrectionary movement in March, 1922, perfect tranquillity reigned throughout the country until June 1924. Zogu became premier in a reconstituted cabinet in Dec. 1922, and with the assistance of foreign advisers much progress was made towards consolidation and development. But Albania was hopelessly handicapped financially, not being supported, as

other Balkan States had been, by a foreign Power; and rumours of disturbances deliberately spread by interested parties discouraged foreign private enterprise. Late in 1923 Zogu was accused by the Democratic Party of obstructing, in the interests of the land-owning classes, various progressive and agrarian reforms, and by the irredentists of pro-Yugoslav tendencies because he turned his back upon irredentist dreams. His resignation in Feb. 1924 did not pacify his opponents, who contended that his influence remained. During June northern and southern Albania rose against him and his colleagues, who were compelled to seek refuge abroad. Mgr. Noli's revolutionary Government succeeded in balancing the budget, due to the ability of M. Gurakuchi (Finance), but otherwise accomplished little. Meanwhile, Zogu, who had retired to Belgrade, organized with Yugoslav assistance a well-equipped force, with which he returned to Albania and expelled Noli.

The Albanian Republic.—On Jan. 22, 1925, a National Assembly voted the proclamation of a republic, and on Feb. 1, Zogu was elected president for seven years, the regency being abolished By a generous attitude towards political opponents, Zogu consolidated his position, at the same time making it clear that, although grateful for Yugoslav support, he did not intend to become Yugoslavia's vassal. During Sept. 1923 negotiations with Italy for a loan were concluded and a national bank established, an Italian financial group being the principal shareholder. Relations with Greece, strained over the Turko-Greek exchange of populations, in which Greece sought to include the Muslim Albanians of Epirus, were improved through the mediation of the League; and a conciliatory policy towards Yugoslavia improved relations with that country, although proposals for the conclusion of a pact of friendship and security were received unfavourably in Belgrade as had been previous proposals Zogu, although anxious to consolidate his position by obtaining support from a neighbouring Power without sacrificing independence, and although doubtful of the competence of the League—which had failed in his predecessor's case—to prevent his overthrow by bands from across the border, hesitated to turn to Italy, which had acquired already a commercial foothold in the country. But an insurrection in northern Albania in Nov. 1926, sustained from Yugoslavia, forced his hand. By the Treaty of Tirana, concluded on Nov. 27, Italy and Albania recognized that any disturbance directed against the *status quo* of Albania is opposed to their reciprocal political interests, and to safeguard it undertook to give their mutual support and cordial collaboration. This treaty, which was registered at Geneva on Feb. 8, 1927, with a supplementary letter explaining that Italy could not interfere in the external or internal affairs of Albania except at the latter's request, precluded further unsolicited interference from across the border and raised a storm of protest in Yugoslavia. Preparations in Yugoslavia to overthrow Zogu were reported by Italy during April 1927 to the Powers, and a grave international crisis was only averted by the pressure which they brought to bear. The arrest at Durazzo on May 22 of Djurashkovitch, an Albanian subject alleged to have been engaged in espionage for Yugoslavia, provoked a further crisis. The Yugoslav Legation maintained that it employed him as dragoman, and in an offensive note, to which Albania took exception, the Chargé d'Affaires demanded his immediate release. The Albanian Government refused to comply unless the offending note was modified. Thereupon the Yugoslav representative was withdrawn and diplomatic relations broken off, but through the intervention of the Powers the matter was settled by the simultaneous release of Djurashkovitch and modification of the note. In reply, it would seem, to the treaty of friendship signed by France and Yugoslavia on Nov. 11, 1927, a defensive alliance between Italy and Albania for 20 years was concluded at Tirana on Nov. 22, 1927. On Sept. 1, 1928, Ahmed Zogu (*q.v.*) was proclaimed king.

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ALBANIA, the ancient name of a district in the eastern Caucasus, consisting, according to Strabo (xi. 4. 1–8), of the valley of the Cyrus (Kur) and the land lying between it and the Caucasus range from Iberia to the Caspian sea. The Albani inhabited also the mountain valleys and the land to the north. (Pliny vi. 39). Dionysius of Halicarnassus quotes a tradition that the name arose because the people were the descendants of emigrants from Alba in Italy. Strabo describes them as tall, well made, and in character simple and honest. They worshipped the sun and, more particularly, the moon, the latter being perhaps identical with the great Nature Goddess of Asia Minor (*see* GREAT MOTHER OF THE GODS). Old age was held in high honour, but it was sacrilege to speak, or even to think, of the dead. The people were nomadic and lived on the abundant natural fruits of the land. In Strabo's time they appear to have been ruled by a single king. The Albani became known to the Romans during Pompey's pursuit of Mithridates the Great (65 B.C.), against which they are said to have opposed a force of 60,000 foot and 20,000 cavalry. Pompey exacted from them a nominal submission, but their independence was not seriously affected by the Romans. In the reign of Hadrian their territory was invaded by the Alani (Th Mommsen, *Provinces of the Roman Empire,* Eng. trans. 1886), and later they fell under the Sassanid rule. They were driven finally into Armenia by the Khazars and ceased to exist as a separate people. The district subsequently suffered under the successive invasions of Huns, Varangians (who captured the chief town Barda in the 10th century), and Mongols. (*See* CAUCASIA, *History;* ARMENIA)

ALBANIAN LANGUAGE. This Indo-European language is spoken in the mountainous region north of Epirus, south of Montenegro, on the eastern side of the Adriatic, by rather less than a million persons, who have kept to their ancient speech as to their ancient ways.

Apart from a few fragments of the 15th century, the oldest texts belong to the 16th and 17th centuries so that all we have is a modern version not very remote from present day speech. It is therefore difficult to construct an accurate history of the language From what period Albanian was spoken in its present area and whence it came, cannot be stated with certainty. There is no reason for holding that it came from Thrace and it probably is the continuation of a language which from early times was spoken in this area.

Albanian preserves a number of peculiarities indicating its Indo-European origin, such as the personal pronouns, *ty,* thou; *na,* we; *ju,* you; and verbal forms as *thom,* I say; *thote,* he says; *thomi,* we say; *thonë,* they say.

It is now modern in type. The article follows the noun The future is expressed by a periphrasis. I will work is *do të punoj,* literally, there is a will that I should work; or *kam me punue* = I have to work, as in the French, *travaillerai.*

A few indigenous words come directly from the Indo-European stock such as, in the northern dialect (called Guègue) *dîmen* = winter, plural *dîmna;* and *êmën* = name, plural *êmna.* In Tosk, the southern dialect, these nouns vary in form because *n* between vowels becomes *r,* thus *dimër, dimèra* and *emër, êmera.*

The bulk of the vocabulary consists of words borrowed from foreign languages, Albanian being thus a typical Balkan speech in which words have passed from one tongue to another so that we may speak correctly of a Balkan vocabulary despite the fundamental diversity of the individual languages.

Hardly any words can be definitely traced to ancient Greek, whose influence barely reached Albania in classical days. Latin, however, has had a strong influence even from early times and Romance scholars find Latin as well as Romance loan-words. Numerals like *pes* = five, and *dhet* = ten, have an indigenous appearance; but *katrë* = four, and *qind* = one hundred, are evidently from Latin. The Latin *amicus* is *mik, canis* (dog) is *qen. Këndoj,* to recite or read comes from *canto;* as *livroj* = work, comes from *laboro;* and *kujtoj* = think, from *cogito.* Without words taken from Latin, the language would be seriously inadequate. It is a language of interest to the student, for we have a country reached by Roman civilization under the empire where the non-urban population preserved its own speech. The vocabulary is

full of Latin words while the grammar and pronunciation have remained constant to indigenous forms.

Many other influences have been at work on Albanian. Mediaeval and modern Greek have furnished many words, often by indirect routes. Other words are of Slav origin. Thus the word *lypset*="it is necessary," was borrowed from Serbian, which in turn borrowed it from Greek.

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ALBANUS LACUS (LAGO DI ALBO), a lake 12m. S.E. of Rome. It is at the bottom of an extinct crater, itself on the margin of the great crater of Albanus Mons (*q.v.*). Fed by subterranean springs, it is 560ft. deep and the banks 400ft. over water-level. An outlet was made in 398-397 B.C., because the Delphic Oracle said Veii could be taken only when the waters reached the sea; it is still in use and is rock-hewn, 1m. long, 6ft. high and 4ft. broad with vertical shafts and a sluice chamber. (*See* ALBA LONGA.)

ALBANUS MONS (mod. *Monte Cavo*), the highest point of the volcanic Alban hills, about 13m. S E. of Rome, 3,115ft. above sea-level It is on the inner crater rim, while Tusculum and Algidus Mons are on the earlier outer crater, about 7m. wide. Upon the Mons Albanus stood the temple of Jupiter Latiaris, where the annual festival of the Latin League was held.

Little was left of it even in the 17th century, and the charge generally brought against Cardinal York of having destroyed it to build the monastery on the summit cannot be maintained. It is very probable that it was not a large temple (of which indeed no traces have been found) but a precinct containing a number of small shrines. On the other hand, a little below the summit 16 large drums of columns, some four feet in diameter, were found, and probably belonged to some other temple. The road which ascended to the temple is still well preserved for the greater part of the way from Aricia, where it began. It was called Via Triumphalis, because minor triumphs were held on the Mons Albanus.

ALBANY, DUKES OF. The territorial designation of Albany was formerly given to those parts of Scotland to the north of the firths of Clyde and Forth. The title of duke of Albany was first bestowed in 1308 by King Robert III. on his brother, Robert Stewart, earl of Fife (*see* I. below); but in 1425 it became extinct. The dukedom was re-created, *c.* 1458, in favour of Alexander Stewart, "lord of Annandale and earl of March" (*see* II below), whose son and successor (*see* III. below) left no legitimate heir. The title of duke of Albany was next bestowed upon Henry Stuart, commonly known as Lord Darnley, by Mary, queen of Scots, in 1565. From him the title passed to his son, James VI of Scotland and I. of England. The title was by him given, at his birth, to Charles, his second son, afterwards King Charles I. By Charles II. it was again bestowed, in 1660, on James, duke of York, afterwards King James II. On July 5, 1716, Ernest Augustus, bishop of Osnaburgh (Osnabrück) (1674–1728), youngest brother of King George I., was created duke of York and Albany, the title becoming extinct on his death without heirs in 1728. On April 1, 1760, Prince Edward Augustus, younger brother of King George III., was created duke of York and Albany; he died without heirs on Sept. 17, 1767. On Nov. 29, 1784, the title of duke of York and Albany was again created in favour of Frederick, second son of George III., who died without heirs on Jan. 5, 1827. On May 24, 1881, Prince Leopold, youngest son of Queen Victoria, was made duke of Albany (*see* IV. below).

I. ROBERT STEWART (*c.* 1345–1420), duke of Albany, regent of Scotland, was a natural son of King Robert II. He was made high chamberlain of Scotland in 1382, and gained military reputation by leading several plundering expeditions into England. In 1389 he was chosen governor of Scotland by the estates; and he retained the control of affairs after his brother John became king as Robert III. in 1390. In April 1398 he was created duke of Albany; but in the following year his nephew David, duke of Rothesay, the heir to the crown, succeeded him as governor, although the duke himself was a prominent member of the advising council. Uncle and nephew soon differed, and in March 1402 the latter died in prison at Falkland. It is not certain that Albany was responsible for the imprisonment and death of Rothesay, whom the parliament declared to have died from natural causes; but the scanty evidence points in the direction of his guilt. Restored to the office of governor, the duke was chosen regent of the kingdom after the death of Robert III. in 1406, as the new king, James I., was a prisoner in London; and he took vigorous steps to prosecute the war with England, which had been renewed a few years before. He suppressed a formidable revolt led by Donald Macdonald, second lord of the isles, who claimed the earldom of Ross and was in alliance with Henry IV. of England. The duke died at Stirling Castle in Sept. 1420, and was buried in Dunfermline abbey. His son, Murdac (or Murdoch) Stewart, succeeded him as duke of Albany and regent, but the dukedom became extinct at his execution in 1425.

See John of Fordun, *Scotichronicon,* continued by Walter Bower, edited by T Hearne (1722), Andrew of Wyntoun, *The Orygynale Cronykil of Scotland,* edited by D. Laing (1872–79), and P. F. Tytler, *History of Scotland* (1850). *See* also Sir W. Scott's *Fair Maid of Perth.*

II. ALEXANDER STEWART (*c.* 1454–1485), duke of Albany, was the second son of James II., king of Scotland, by his wife, Mary, daughter of Arnold, duke of Gelderland. Created duke of Albany before 1458, he also received the lordship of the Isle of Man, and was afterwards captured by an English ship when journeying to Gelderland in 1468. He was soon released, and as he grew to manhood began to take part in the government and defence of Scotland, being appointed in quick succession high admiral, warden of the marches, governor of Berwick and lieutenant of the kingdom. He quarrelled with his brother, king James III, and carried on a series of intrigues with the English, who supported his pretensions to the Scottish crown. He was sentenced to death in 1483 during his absence in England. He died in France two years later.

III JOHN STEWART (*c* 1481–1536), duke of Albany, regent of Scotland, was born about 1481. In 1515, at the request of the Scottish Parliament, Albany came to Scotland, was inaugurated regent in July, and proceeded to organize resistance to the influence of England and of Margaret Tudor, the queen dowager, sister of Henry VIII. In August he seized the latter and her children at Stirling, and subsequently was occupied in suppressing the rebellion of the Homes, Angus (the second husband of Margaret), and James Hamilton, earl of Arran; Alexander, third lord Home, being beheaded in Oct. 1516. Albany was declared on Nov. 12 heir to the throne, and on June 6, 1517, he returned to France. In August he concluded the treaty of Rouen, by which the alliance between France and Scotland was renewed, and a daughter of Francis I. was to marry James V. Meanwhile disorders had broken out owing to the rivalry between Angus and Arran. Francis I had secretly engaged himself to Henry VIII. not to allow Albany's departure from France, but he returned at the close of 1521 and immediately became the object of Henry VIII.'s and Wolsey's attacks. He reconciled himself temporarily with Margaret, supported her divorce from Angus, and was now accused by the English Government of harbouring schemes of marrying her himself. This was denied by the Scots, and Henry's demand for the regent's dismissal refused. War broke out in 1522, and in Sept. Albany advanced to within four miles of Carlisle with a large army. The Scots, however, showed unwillingness to fight outside their own frontiers, and Albany disbanded his troops and departed to France, leaving the borders exposed to the enemy. On Sept. 25, 1523, he once more landed in Scotland, bringing with him supplies from France and a considerable body of troops, and on Nov. 3, after an unsuccessful attack on Wark, retreated hastily, and quitted Scotland finally on May 20, 1524. On July 30 his regency was terminated by the declaration of James V as king. Between 1530 and 1535 he acted as French ambassador in Rome, conducted Catherine de' Medici, his wife's niece, to Paris on her marriage to Henry (afterwards Henry II.) in 1534, and negotiated the marriage of James V.

The regent Albany was a singularly unfortunate commander in the field, but a successful ruler and administrator, and the Scottish court of session owed to him its institution. But he regarded himself more the subject of the king of France than of the king of Scotland, subordinated the interests of the latter state to the former, and disliked his official duties in Scotland.

IV. Leopold George Duncan Albert (1853–1884), duke of Albany, youngest son of Queen Victoria, was born on April 7, 1853 He matriculated at Christ Church, Oxford, in Nov. 1872, and pursued his favourite studies of science, art, and the modern languages. In 1876 he left the university with the honorary degree of D.C.L. On coming of age in 1874, he had been made a privy councillor and granted an annuity of £15,000. He travelled on the continent, and in 1880 visited the United States and Canada. He was a trustee of the British Museum, a bencher of Lincoln's Inn, and continued to take an active part in the promotion of education and knowledge generally. On May 24, 1881, he was created duke of Albany, earl of Clarence, and Baron Arklow. On April 27, 1882, he married Hélène Frederica Augusta, princess of Waldeck-Pyrmont, and his income was raised by parliament to £25,000. His death at Cannes on March 28, 1884, was universally regretted. He left a daughter, born in Feb. 1883, and a posthumous son, Arthur Charles Edward, born on July 19, 1884, who succeeded to the dukedom of Albany, and who, on July 30, 1900, became duke of Saxe-Coburg on the death of his uncle. He abdicated on Oct. 22, 1920.

ALBANY, LOUISE MAXIMILIENNE CAROLINE, Countess of (1752–1824), eldest daughter of Prince Gustavus Adolphus of Stolberg-Gedern, was born at Mons on Sept. 20, 1752. In her youth she was a canoness of Ste. Wandru at Mons, but in her twentieth year she was affianced, at the instigation of the Duke of Berwick and with the secret connivance of the French court, to Prince Charles Edward Stuart, "the Young Pretender," self-styled Count of Albany. They were married at Macerata, near Ancona, on Good Friday 1774, and went to live in the old Stuart palace at Rome and later on in Florence.

The marriage was an unhappy one, and in Dec. 1780 Louise fled to a neighbouring convent and threw herself on the protection of her brother-in-law, Henry Stuart, Cardinal York. She had already in Florence formed the acquaintance of the poet Vittorio Alfieri, who now followed her to Rome. In 1784 a legal separation between the Count and Countess of Albany was arranged, and by Charles's death in 1788 Louise found herself free. In company with Alfieri (to whom rumour said she had been secretly married) she now visited Paris and London, and was cordially received at the English court, George III. granting her an annual pension of £1,600 from the privy purse. Returning to Italy, Alfieri and the countess settled at Florence, where the poet died on Oct. 9, 1803 and was buried in the church of Santa Croce beneath Canova's vast monument erected at Louise's expense. The countess continued to reside in the house on the Lung' Arno at Florence, where she held a salon frequented by scientists and men of letters. She died on Jan. 29, 1824 and was buried in Santa Croce.

The countess bequeathed all her property to the companion of her old age, the French painter, François Xavier Fabre, who ultimately gave the greater part of his legacy to the museum of his native town of Montpellier. Two excellent portraits of the Countess of Albany and of Alfieri, painted by this artist, now hang in the Uffizi Gallery at Florence.

Bibliography.—*See* Vernon Lee, *The Countess of Albany* (1884); Marchesa Vitelleschi, *A Court in Exile.*

ALBANY, a municipal town in the county of Plantagenet, on Princess Royal harbour, itself an interior basin of King George sound, on the most southerly stretch of the coast, and towards the south-west corner of West Australia. The coast-line, here largely composed of granite, has sunk in recent geological times, giving rise to magnificent inlets which, however, wave action has to some extent already modified by erosion and the deposition of sand. First occupied in 1826, it was later (1889) connected by rail with the existing West Australian railway system and ultimately became the southern terminus of the Great Southern railway. Albany is 352m. distant from Perth by rail. Its fine and equable climate (mean annual temp.: 58·6°; mean annual rainfall: *c.* 30″) and its scenery brought it into prominence as a summer and health resort, and for long it was the port of arrival and departure for the mail steamers. A coaling station, importing Newcastle (N.S.W.) coal was established; and industries began to rise and flourish. The development of the ports of Fremantle and Bunbury; the substitution of locally mined (Collie) coal for imported coal; the loss of economic hinterland through the development of the State railway system, and the loss of passenger traffic owing to the completion of the west-east trans-continental line have severely affected Albany which is at present suffering a decline; but with the development of the promising south-western region of the State it can hardly fail to progress.

ALBANY, a city of Georgia, U.S.A., 150m. S.S E. of Atlanta, on an elevated plateau at the head of navigation on the Flint river; the county seat of Dougherty county. It is served by the Atlantic Coast Line, the Seaboard Air Line, the Central of Georgia, the Georgia Northern, and the Georgia Southwestern and Gulf railways. The population in 1920 was 11,555, of whom 6,144 were negroes. It is the commercial and social centre of a region which formerly was devoted to cotton raised by negro tenants on large plantations, but, since the boll weevil reached it about 1915, the region has been in process of transformation into small farms with diversified crops. Cotton is still a profitable crop, when the new intensive methods are applied, but other products are increasing rapidly in importance, especially pecans, bright leaf tobacco, peaches, peanuts, sweet potatoes, water-melons and cantaloups, hogs, poultry, berries and vegetables. There were over 70,000 acres planted in paper-shell pecans in 1927.

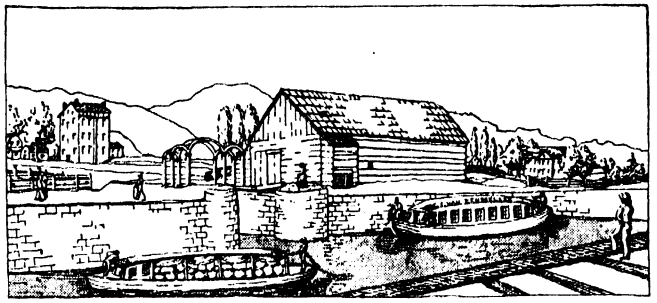
The city has railway repair shops, cotton gins, tobacco warehouses and several co-operative marketing associations. The State Normal and Agricultural college for coloured students is here. Four miles south are mineral springs with a high percentage of radioactivity.

Albany was settled in 1836; planned in 1837 by Nelson Tift, from Connecticut; and incorporated in 1838. The commission form of government was adopted in 1924.

ALBANY, the capital of the State of New York, U.S A., a city, a port of entry, and the county-seat of Albany county; on the west bank of the Hudson river, below the mouth of the Mohawk, 145m. N. of New York city; at the cross-roads between Boston and Buffalo, and between Montreal and New York. It is served by the New York Central, the Delaware and Hudson, the West Shore, and Boston and Albany railways; by the steamboat lines on the Hudson, and is a terminus of the State barge canal system. The area is 191 sq. m. The population in 1920 was 113,344, of whom 87,779 (an unusually large proportion) were natives of the state, and 17,695 were foreign-born; in 1925 it was 117,820, according to the state census.

Albany lies picturesquely, on a series of hills rising sharply from the river. Fine specimens of the Dutch and later colonial architecture are still standing. The Schuyler mansion (built 1761) was dedicated in 1917 as a State historical monument. The Van Rensselaer manor-house (1765) was moved in 1893 to the campus of Williams college, Williamstown (Mass.). On a commanding site of 7 84 ac. stands the State Capitol (300 by 400 ft.) of Maine granite, which was built (1867–98) at a cost of $25,000,000. Across the square is the beautiful colonnaded State education building, which also houses not only the State Department of Education, but also the State library (established 1818) of 630,000 vols. and the State museum, which has a fine collection of Indian relics. The present city hall (erected 1882), the fifth which the city has used, is a French Gothic structure of pink granite. A large State office building has recently been erected (1927). Many of the schools, banks, hotels, clubs, and churches have architectural beauty and dignity. The New York State National Bank (1803) is probably the oldest building in America continuously used for banking purposes. There are 20 parks, of which Washington and Lincoln are the largest. A zoning ordinance was adopted in 1924 as a foundation for a comprehensive programme of building and improvement. The assessed valuation of property in 1926 was $187,331,711. Con-

verging railways, water routes, and highways, together with a population of 30,000,000 within a radius of 200m. make Albany an important distributing point. As a transfer point for railway express it ranks second in the country; for mail, third. Traffic facilities were greatly improved by the New York Central's construction of the "Castleton cut-off" (opened 1924), which diverts rail traffic from the steep grades and congested trackage at Albany across a new bridge 10m. below the city. The same company has also built a vast terminal classification yard at



A FREIGHT AND A PASSENGER BOAT AT THE ENTRANCE OF THE ERIE CANAL INTO THE HUDSON RIVER AT ALBANY, N.Y., AFTER A PRINT PUBLISHED IN 1825, AT THE TIME OF THE COMPLETION OF THE CANAL

Selkirk, west of the river, which eventually will have a capacity for 20,000 cars. Albany has a municipal airport, the Quentin Roosevelt field; and the deepening of the Hudson (authorized 1925), to give a 27 ft. channel from New York city, will make it virtually a seaport. The Albany port district, embracing the city of Albany, the city of Rensselaer, and adjacent lands and water in the Hudson river, is in charge of a commission appointed by the governor. Ground was broken for port development in 1926.

Albany has many and diverse industries. It had 223 factories in 1925, with an aggregate output valued at $52,177,926, and products ranging from such staples as stoves, chemicals, textiles, and paper, to billiard balls, checkers, and dominoes, axle-grease, paper towels, college caps and gowns, and college pins. About 1,100 men are employed in printing plants. Albany is an important educational centre. The public school system includes 27 elementary schools, vocational schools for boys and girls, junior high and high schools. The Catholic system consists of 18 parish schools (including four high schools), two academies, and two institutions of college grade. There are several private academies. The State college for teachers (opened 1844) had an enrolment of 2,275 in 1926–27. The professional schools of Union university, which has its undergraduate college in Schenectady, are situated here: viz., the Albany college of pharmacy (established 1881); the Albany law school (1851); and the Albany medical school (1839). The Dudley observatory, founded in 1853 as the result of an abortive attempt to establish a national university in Albany, is also affiliated with Union university. Training schools for nurses are maintained by four hospitals. The State library school, the first ever established for the professional training of librarians, was opened in 1887 at Columbia university, and in 1889 was transferred to Albany as an adjunct of the State library. There are three daily papers; the *Knickerbocker Press* (1842); the *News and Journal* (1922), and the *Times-Union* (1853).

Albany was probably the second permanent settlement within the borders of the 13 colonies. Its authentic history dates from 1614, when the agents of the United New Netherland company built a small fort on Castle (now Westerlo) island, which they occupied for three years as a trading post. In 1624 colonization was begun by the newly-organized Dutch West Indian company. Eighteen families of Dutch Walloons arrived; Fort Orange was built on a hill near the present site of the Capitol; and the little settlement around it became known as Beverwyck. In 1629 the Dutch Government granted to Kiliaen van Rensselaer, a diamond merchant of Amsterdam, a large tract of land (ultimately 1,093 sq. m.) on both sides of the river, centring at Fort Orange, for a patroonship. His grant was named Rensselaerswyck. The colonists he sent over were capable and industrious, and the settlement prospered. In 1652 Peter Stuyvesant, after a lengthy controversy with the director of Rensselaerswyck, established Beverwyck as an independent village. When Fort Orange was surrendered to the English (Sept. 24, 1664) Beverwyck was named Albany, one of the titles of the duke of York (afterward James II.). In 1673–74 Albany again came under Dutch control for about a year, during which time it was called Willemstadt. Meanwhile the van Rensselaer family in Holland was trying to obtain from the duke of York a patent for the colony which would restore to them the ownership of the former village of Beverwyck. The application came finally to Governor Dongan, who declined to grant it because he "did not think it convenient that the second town in the government should be in the hands of private men." The van Rensselaers thereupon relinquished their claims to Albany, and received a patent (1685) which erected the colony of Rensselaerswyck into an English manor. On July 22 1686, Governor Dongan granted to Albany a city charter, by which all vacant and unappropriated lands within its limits were vested in the mayor, aldermen, and commonalty of the city, thus ending the jurisdictional disputes. The first mayor, appointed by the governor, was Peter Schuyler (1657–1724). In 1643, according to Father Jogues, the settlement consisted of 25 or 30 houses, built along the river; in 1695 the Rev. John Miller found 200 houses; at the first federal census (1790) the population was 3,498; by 1850 it had reached 50,763, and in 1910, 100,253. As late as 1750 a Swedish naturalist, Peter Kahn, who wrote a vivid description of the city, found the language and manners still Dutch, though the dress was in English style. Albany became the permanent state capital in 1797.

Its strategic position at the gateway of the Iroquois country and at the head of navigation on the Hudson made Albany highly important throughout the colonial period. In 1689 the first intercolonial convention was held here, when delegates from Massachusetts bay, Plymouth, Connecticut, and New York met to treat with representatives of the five nations and to plan a system of defence. The Albany Congress of 1754 was a similar and more important gathering, including commissioners also from New Hampshire, Rhode Island, Pennsylvania, and Maryland, which met in anticipation of renewed hostilities with the French. It secured from the Indians assurances of their continued support, and adopted a plan (proposed by Benjamin Franklin) for "one general government" of the English colonies for purposes of common defence. The "Albany plan," though disapproved both by the home Government and by the colonies, paved the way for the congress of 1765 and the Continental congress of 1774. During the Revolution the British looked upon Albany as "a capital object to be subdued," and it was the objective of Burgoyne's expedition which ended with the battle of Saratoga. In 1839 it became the centre of the "Anti-Rent War," which was precipitated by the death of the last patroon and the attempt of his heirs to collect overdue rents, and was not entirely settled until 1847.

The first newspaper, the *Gazette*, was founded in 1771. The *Argus*, founded in 1813, was long the organ of the coterie of New York politicians known as the "Albany regency," and was one of the most influential Democratic papers in the country. The *Evening Journal*, founded in 1830, and edited for 35 years by Thurlow Weed, was equally influential as an organ of the Whig, and later of the Republican party.

See J. Munsell, *The Annals of Albany* (Albany, 1850–59); E. B. O'Callaghan, *Documentary History of the State of New York*, vol. iii. (Albany, 1850); William Barnes, *The Settlement and Early History of Albany* (Albany, 1851); *Collections on the History of Albany* (1865–71); G. R. Howell and J. Tenney, *Bi-Centennial History of Albany* (1866); A. J. Weise, *History of the City of Albany* (Albany, 1884); Amasa J. Parker, *Landmarks of Albany County* (Syracuse, 1897); Cuyler Reynolds, *Albany Chronicles* (Albany, 1906); John Boyd Thacher 2nd, and others, *Albany's Tercentenary* (Albany, 1924).

ALBANY, a city of Oregon, U.S.A., on the Willamette river, about 80 m. S. of Portland; the county seat of Linn county. It is on the Pacific highway, and is served by the Southern Pacific, and the Oregon Electric railways. The population was 4,840 in 1920 and about 7,000 in 1927.

Albany is an important railway centre. It manufactures chairs, boxes, garage doors, saddles and harness, condensed and powdered milk; and has a cannery, a flour mill, a meat-packing plant, a foundry and machine shop, a creamery, and a number of smaller industries. It is the seat of Albany college (established 1866), which guarantees to students an opportunity to earn part of their expenses. Albany was settled in 1846 and incorporated as a city in 1865.

ALBANY, a river of Canada, rises in Lake St. Joseph in 91° 25′ W. and 50° 55′ N., and flows east-north-east into James Bay; length, over 400m.; navigable for nearly half its length, to Martin's Falls. There are four Hudson Bay Company's posts on its banks, including Fort Albany at its mouth. The Ogoki and Kenogami rivers are the principal tributaries.

ALBANY CONGRESS, a gathering of delegates from several American colonies important for the plan which it devised for colonial union. In accordance with instructions from the British Board of Trade (Sept. 18, 1753), 25 delegates, representing the four New England colonies, New York, Pennsylvania and Maryland, met at Albany, N. Y., on June 19, 1754, for the express purpose of formulating a concerted Indian policy. It was early apparent to the delegates that the question of colonial union was of even greater importance than a common Indian policy, so a committee was appointed to prepare a plan. The plan reported was chiefly the work of Benjamin Franklin and was unanimously adopted. It provided for a president-general to be appointed by the Crown, and for a grand council to be elected by the colonial assemblies. This grand council was empowered to raise and pay soldiers, to build forts, and to equip vessels to guard the coasts. The necessary funds were to be raised by the grand council, which was to have power to levy taxes and impose general duties. In this grant of power is seen the first suggestion of the important Federal principle which underlies the entire Federal structure in the United States—the right of the General Government to operate directly upon individuals. The plan was too comprehensive to suit the various Colonial Governments, which either rejected or failed to ratify it. It was never formally presented to the British Government. As a result of this unfavourable action by the Colonial Governments the Albany congress failed to solve either the question of colonial union or of joint Indian policy.

See R. Frothingham, *Rise of the Republic of the U.S.* (1881); G. L. Beer, *British Colonial Policy, 1754–1765* (1907); E. B. Greene, *Foundations of American Nationality* (1922); J. T. Adams, *Revolutionary New England* (1923). (C. C. Ta.)

ALBANY REGENCY, the name given to a coterie of politicians who from about 1820 to 1854 largely controlled the machinery of the Democratic Party in the State of New York. The members of this group constituted the first highly effective American political machine. They derived their power chiefly from their great personal influence and political sagacity. On the whole they actively opposed political corruption, though they always acted on the principle, first stated in 1833 by one of their ablest leaders (Marcy), that "to the victors belong the spoils." Among the members of this unofficial body, whose headquarters were at Albany, were Martin Van Buren, W. L. Marcy, Silas Wright and John A. Dix. About 1848 the opponents of the group began to adopt similar tactics, soon dividing the Democratic Party into irreconcilable factions, and thereafter the prestige of the "regency" rapidly waned.

ALBATEGNIUS (Mohammed ben Gebir al Batani, commonly called Albategnices) (*c.* 850–929), an Arab prince and astronomer, was born at Batan in Mesopotamia. From his observations at Aracte and Damascus, where he died, he was able to correct some of Ptolemy's results, previously taken on trust. He compiled new tables of the sun and moon, long accepted as authoritative, discovered the movement of the sun's apogee, and assigned to annual precession the improved value of 55″. Perhaps independently of Aryabhatta (born at Pataliputra on the Ganges A.D. 476), he introduced the use of sines in calculation, and partially that of tangents. His principal work, *De Motu Stellarum,* was published at Nuremberg in 1537 by Melanchthon, in a blundering Latin translation by Plato Tiburtinus (*c.* 1116), annotated by Regiomontanus. A reprint appeared at Bologna in 1645. The original manuscript is preserved at the Vatican; and the Escorial library possesses in manuscript a treatise of some value by him on astronomical chronology.

See Houzeau, *Bibliographie astronomique,* i. 467; M. Marie, *Histoire des sciences,* ii. 113; R. Wolf, *Geschichte der Astronomie,* p. 67; Delambre, *Hist. de l'astr. au moyen âge,* ch. ii.; *Phil. Trans.,* 1693 (913), where E. Halley supplies corrections to some of the observations recorded in *De Motu Stellarum.*

ALBATROSS. A sea bird of the family *Diomedeidae,* related to the petrel. The large, strong beak ends in a hook. The webbed feet lack the hind toe. *Diomedea exulans* of the Pacific is the best known. It is the largest sea bird, attaining a length of 4 ft, a weight of 25 lb., and the unique wing-spread of 17 ft.; it is remarkable for its soaring flight. It feeds upon fish and offal, and when gorged may be unable to fly. Both sexes are white, streaked with dark bands on the back and with dark wings. The bird lays one white egg, 4 in. long, on the ground; it nests on Tristan da Cunha and similar islands. The joint courtship dance is remarkable. About 20 species are known. The black-footed albatross (*D. nigripes*) and short-tailed albatrosses (*D. albatrus*) are found in the north Pacific from California to Alaska. The yellow-nosed albatross and sooty albatross, of related species, are casual visitors as far north as Oregon.

See also Mallemuck.

ALBAY, a municipality (with administrational center and 32 barrios or districts) and the capital of the province of Albay, Luzon, P.I., near an inlet on the west shore of the Gulf of Albay, about 200 m. by road S.E. of Manila. Pop. (1918) 52,756, of whom 25,992 were males and 115 whites of both sexes; literacy (based on ages from 10 years up, 1918) 62·9%. The district of Legaspi (merged with Albay in Oct. 1907) is the port for the municipality. Albay is one of the most important municipalities in the Philippines. It lies on level ground near the south base of Mount Mayon, 7,500 ft. high, and with the most perfect volcanic cone known, from which it is sheltered by the Linguin hills. Good motor roads connect it with all parts of the province and with Manila, and it has railway and steamboat connections with various places as well. It has no pronounced dry season but the climate is excellent. The surrounding country is one of the most important *abacá* (Manila hemp) producing regions in the archipelago. *Sinamay* and *pinolpog* (sinamay with its fibres flattened by beating) are woven extensively and much *abacá* is shipped to Manila. Copra, sugar, rice, corn, sweet-potatoes and tobacco are among the other products of the region. In 1918 there were 21 manufacturing establishments of all kinds with a capital of 162,400 pesos and a total product valued at 240,800 pesos. The language is Bicol. Formally created in 1636, Albay had a population in 1649 of about 1,200, a church, a fortified house and part of a wall. In February 1815, an exceptionally violent eruption of the volcano destroyed much of the site and of the nearby district, killing about 1,200 people; and the eruption of 1897 also did some damage. In 1900, Albay was partially destroyed by the insurgents, but in 1901 civil Government was established by the United States. Since then there has been considerable rebuilding under American direction and the municipality is steadily growing in importance. It has a high school and forty-three other schools of all kinds.

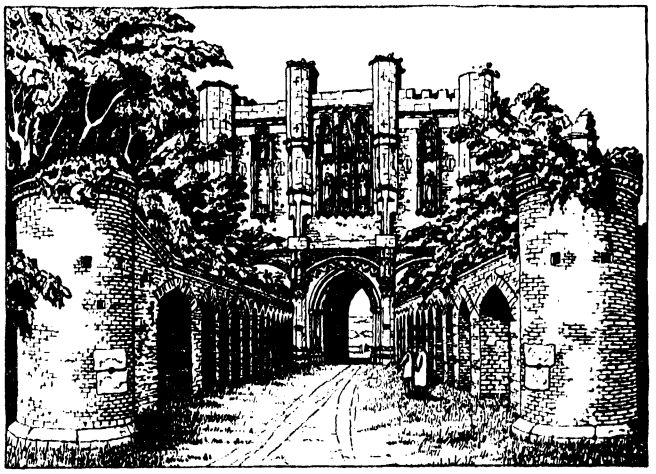
ALBEDO (from Lat. *albus,* white), "whiteness," a word used principally in astronomy for the measure of reflecting power. A body shining by reflected light is said to have albedo ½ if it reflects (or scatters outwards) half the light incident on it. The albedo for visual light of the cloud-covered planets (Venus, Jupiter, Saturn, Uranus, Neptune) ranges from 0·56 to 0·73; of the earth 0·44; Mars 0·15; Moon 0·07. (*See* H. N. Russell, *Astrophysical Journal,* vol. xliii. p. 173.)

ALBEMARLE, WILLIAM DE FORS or **DE FORTIBUS,** Earl of (d. 1242), was a great-grandson of King Stephen and a son-in-law of William of Blois. He is described by Bishop Stubbs as a "feudal adventurer of the worst type." He was one of the executors of Magna Carta, but frequently changed sides in the civil war that followed, his general aim being to revive the power of the feudal barons. In 1221, 1222 and 1223 he was

in revolt, although in each case he was compelled to submit, and was twice excommunicated. He died at sea on his way to the Holy Land on March 26, 1242.

ALBEMARLE, GEORGE MONK or MONCK, 1st duke of. *See* MONK.

ALBEMARLE, ARNOLD JOOST VAN KEPPEL, 1st earl of (1669–1718), was born in Holland, and accompanied William III. to England in 1688. He was created earl of Albemarle in 1697.



THORNTON ABBEY IN LINCOLNSHIRE, FOUNDED BY WILLIAM OF BLOIS AN ANCESTOR OF THE ALBEMARLE FAMILY

The confidant of the king, he returned to Holland at his death, and became a general of horse in the Dutch army. He joined the allied forces in 1703, fought at Ramillies, Oudenarde, and the siege of Lille. He led Marlborough's second line in 1711.

ALBEMARLE, GEORGE THOMAS KEPPEL, 6th earl of (1799–1891), British general, served in the campaign of Waterloo. He was aide-de-camp to the marquess of Hastings in India, returning home in 1823 by way of Persia and St. Petersburg (now Leningrad). He wrote a narrative of the journey, *Journey from India to England* (1825). Gen. Keppel sat in the first reformed parliament as a member for East Norfolk (1832–35) and for Lymington (1847–49). He succeeded to the title in 1851.

See his *Fifty Years of My Life* (1875).

ALBEMARLE AND CHESAPEAKE CANAL, in the United States, connecting Norfolk, Va., with Currituck Sound, N.C., is a portion of the inland navigation between New York, Philadelphia, Baltimore and North Carolina and is connected with the Chesapeake and Delaware and Raritan canals. It is 11·2m. long, 8oft. wide, 12ft. in depth and has one lock. Its capacity is steamers of approximately 800 tons, drawing 11ft. of water. The canal was opened in 1860, and the cost of construction was $1,641,363.

ALBEMARLE SOUND, a large inlet on the Atlantic coast of North Carolina, U.S.A. It has an east and west direction extending along the 36th parallel of north latitude, a length of about 50m., and a breadth of from 5 to 15 miles. The depth varies from a few feet to 20ft. or more. Albemarle is separated from the Atlantic by a long narrow barrier beach. From the north-east end of the Albemarle the long, narrow arm called Currituck sound extends northward about 40m. to and beyond the Virginia border. On the south-east Albemarle is connected with Pamlico sound by Croatan sound, and also by a narrower channel, Roanoke sound, separated from the former by Roanoke Island. From Albemarle sound project many bay-like arms, commonly called rivers, because they serve as the mouths of streams; but they are true bays, having a breadth of several miles and a depth about equal to that of the sound. Roanoke river (*q.v.*) is the most important stream emptying into it. Albemarle is connected with Norfolk, Va., harbour partly by natural and partly by artificial waterways (Dismal Swamp canal and the Albemarle and Chesapeake canal), thus forming an important link in the great inland waterway extending from Massachusetts to Beaufort, North Carolina.

ALBENGA, town and episcopal see, province of Liguria, Italy, on the north-west coast of the Gulf of Genoa, 52½m. S.W. of Genoa by rail. Pop. (1921), 4,578 (town), 7,557 (commune). Albenga is the ancient *Album Ingaunum* or *Albingaunum,* the chief town of the Ingauni, whose territory reached as far as Genoa. An inscription records the restoration of the walls, forum, harbour, etc., by Constantius A.D. 354. To the east is a well-preserved Roman bridge, Ponte Lungo, nearly 500ft. long and 11½ft. wide, with 10 arches, each with a span of 37ft. To the south is a conspicuous rectangular pillar, 27ft. high, probably marking a tomb. A good brick Gothic cathedral has an interesting octagonal baptistery (8th or 9th century).

ALBENIZ, ISAAC (1860–1909), Spanish pianist and prolific composer, who only towards the close of his career found his true métier and wrote the works which give him his chief claim to remembrance. These were his brilliant and fascinating pianoforte pieces, such as the suite *Iberia,* reproducing the rhythms and other characteristic features of Spanish popular music. He wrote also a number of works for the stage, including a comic opera, *The Magic Opal,* produced in London, and a more ambitious work, *Pepita Jiménez,* but these were of less account.

ALBERONI, GIULIO (1664–1752), Spanish-Italian cardinal and statesman, the son of a gardener, born near Piacenza, probably at the village of Fiorenzuola. He took priest's orders, and found his way to Rome in attendance on the son of a bishop. During the War of the Spanish Succession Alberoni rendered substantial services to the Duke of Vendôme, commander of the French forces in Italy, and in 1711 he followed him into Spain as his secretary. Two years later Alberoni was appointed consular agent for Parma at the court of Philip V. of Spain, and helped to arrange the king's marriage with Elizabeth Farnese of Parma, by whose influence he was made a member of the king's council, bishop of Malaga, and in 1715 prime minister. Alberoni's foreign policy was to undo the work of the Treaty of Utrecht. He desired to gain the succession of Elizabeth to Parma and Piacenza, then in the hands of Austria. To this end he made hurried attempts to reform the administration and the military and financial organization of Spain. But the impatience of Elizabeth left him no time to mature his plans. In 1718 Alberoni equipped a small expedition to help the Scottish Jacobites against George II., but the fleet was wrecked on its way from Cadiz. The Spanish ambitions in Italy led to the Quadruple Alliance of England, France, Austria and Holland, all of which needed a long period of peace for recovery from the last war, and after the landing in 1718 of Spanish troops at Palermo, French armies and English ships invaded Spain. After the Spanish collapse Alberoni was exiled, and went to Italy, where he took refuge in the Apennines, Pope Clement XI., who was his bitter enemy, having ordered his arrest. On the latter's death Alberoni appeared at the Conclave and took part in the election of Innocent XIII. (1721), after which he was imprisoned for a time by the Pope, at Spain's demand. At the next election, he was himself proposed for the papal chair, and secured 10 votes at the Conclave which elected Benedict XIII. He died on June 16, 1752. Alberoni left a number of manuscripts, but the genuineness of the *Political Testament* published under his name at Lausanne in 1753 has been questioned.

An *Histoire du Cardinal Alberoni* up to 1719 was published by Jean Rousset de Missy at The Hague in 1719. A laudatory life, *Storia del Cardinale Giulio Alberoni,* was published by Stefano Bersani, a priest educated at his college, at Piacenza, in 1861. *Giulio Alberoni e il suo secolo,* by Giovanni Bianchi (1901), is briefer and more critical. *See* also *Lettres intimes de J. Alberoni,* edited by M. E. Bourgeois (1892).

ALBERT I. (1875–), king of the Belgians, was born at Brussels, April 8, 1875, the younger son of Philip, count of Flanders (1837–1905), who was a brother of Leopold II., and Princess Marie of Hohenzollern. The other children of this marriage were Baldwin (b. 1869), Henriette, afterwards duchess of Vendôme (b. 1870), a daughter who died in infancy, and Josephine, afterwards Princess Charles of Hohenzollern (b. 1872).

The premature death of Prince Leopold, only son of Leopold II., on June 22, 1869, made Prince Baldwin heir presumptive to the Belgian crown, but on his death on Jan. 23, 1891, Prince Albert

became next in the line of succession. He was carefully educated, and showed a marked taste for engineering and mechanics, studying both naval and aerial construction. He received his training in military matters at the École Militaire under Gen Jungblut, and also became a thorough sportsman, taking much interest in mountaineering and later in aviation. He served as an officer in the Grenadier regiment. On Oct. 2, 1900 he was married at Munich to Elisabeth (b. July 25, 1876), second daughter of Duke Charles Theodore of Bavaria. Three children were born of this marriage: Leopold, duke of Brabant (b. Nov. 3, 1901); Charles, count of Flanders (b. Oct. 10, 1903) and Marie José (b. Aug. 4, 1906).

Prince Albert also travelled widely, paying a visit to America in 1898, and in 1908 visiting England in order to study naval construction. In April 1909 he went to the Belgian Congo. Starting from the Cape, he visited the Cape province and the Transvaal, going from there to Elisabethville. Thence he traversed the Katanga mineral region and followed the course of the Congo to its mouth. He returned to Belgium in August, and three months later King Leopold died

On Dec. 1, 1909 Prince Albert took the oath of fidelity to the Belgian constitution, and became king under the name of Albert I. In his speech from the throne, the king emphasized his care for the people's welfare in the words: "Our prosperity depends upon the prosperity of the masses." He occupied himself more especially with the organization of the army, and in May 1913 gave his assent to the law which was designed to secure for Belgium an army of 350,000 men. He also interested himself in various social and legal reforms, while his scientific tastes did not prevent him becoming a friend of art and literature. The economist Waxweiler, the poet Verhaeren and the painter Laermans were on friendly terms with the royal family, the latter receiving personal attention from the queen when he was threatened with the loss of his sight.

Albert was anxious to preserve friendly relations with neighbouring States, and after 1910 paid official visits both to Berlin and Paris. On Nov. 5 and 6, 1913, the king, who had been appointed honorary colonel of the regiment of Hanover Dragoons, visited Germany for the second time. At a reception in Potsdam, the Emperor William II. and Gen von Moltke informed him that they considered war with France imminent. The king gave warning of this to the French ambassador in Berlin through his own minister plenipotentiary, Baron Beyens. On July 31, 1914, when the European crisis came to a head, the king wrote a personal letter to the German emperor, reminding him of the respect due to Belgian neutrality. Germany replied by the ultimatum of Aug. 2, which in turn was answered by a *fin de non recevoir* and hostilities began. The king took command of the troops and established his headquarters first at Louvain and afterwards at Antwerp. He directed in person the first advance from Antwerp towards Louvain, which was intended to relieve the French and British armies engaged with the forces of Kluck and Bülow. After the fall of Antwerp, the king and queen sent their children to England, while they themselves accompanied the retreating army; when it came to a halt on the Yser they took up their residence at Furnes. From Oct. 17 to 24 the Belgian army, under the king's command, withstood the German invasion without any Allied assistance. During the whole of the war he remained with the troops, having his headquarters at La Panne, where he was exposed to the risk of enemy bombardments. He made continual visits to the front-line trenches, and even surveyed the enemy's lines from an aeroplane. The queen remained with him, acting as a nurse in the Hôpital de l'Océan at La Panne. She also interested herself deeply in the welfare of the soldiers in the trenches, and superintended the establishment of canteens and aid posts. Prince Leopold, King Albert's elder son, lived by his father's wish, the life of a simple soldier in the 12th Regiment.

When the general offensive of Oct. 1918 was undertaken, Albert was appointed commander of the northern army groups, consisting of both Belgians and French, which captured the forest of Houthulst, "the Flandernstellung," Thourout, Ostend and Bruges, and forced the passage of the Lys. On Nov. 11, 1918 the king and queen made their entry into Ghent, and on Nov. 22 into Brussels, being received with enormous enthusiasm. Even before the signing of the Armistice the king had summoned at Lophem a number of politicians and had arranged a new government containing representatives of the three more important Belgian political parties. After a triumphant reception by parliament, the king made a speech from the throne, in which he urged that all parties should work together for national reconstruction, while, addressing himself to the Allies, he asked for the abolition of Belgian neutrality and of the treaties of 1839 which had left Belgium open to invasion. After the Armistice, King Albert declined the augmentation of his civil list. He occupied himself actively with the improvement of conditions in his country, visiting the devastated areas, and contributing considerable sums to "King Albert's Fund," which was devoted to providing temporary shelter for sufferers from the war.

The king in person presided at the Colonial Congresses of 1920 and 1926 and made important speeches on those occasions He was actively interested in the development of the Belgian mercantile marine. As before the war, he continued to support the intellectual development of his country. After the war he made official visits to the State universities of Ghent and Liége. In Jan. 1926 King Albert, who had been given honorary degrees by many universities, was elected a member of the *Institut de France*. His solicitude for the welfare of his people was unfailing and, during the floods which ravaged Belgium in Dec. 1925, he and his queen lost no time in succouring the distressed inhabitants of the inundated districts. (*See* BELGIUM)

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ALBERT I. (*c.* 1250–1308), German king and duke of Austria, eldest son of King Rudolph I., was invested with the duchies of Austria and Styria in 1282. On Rudolph's death in 1291 Albert was obliged to acquiesce in the election of Adolf of Nassau as German king, but in 1298 he mustered sufficient allies to enable him to defeat Adolf at Gollheim, near Worms, was elected king at Frankfort on July 27, and crowned at Aix on Aug. 24. Pope Boniface VIII. declined to recognize him until 1303 when Albert admitted the right of the pope to bestow the imperial crown and promised that none of his sons should be elected king without papal consent. In 1306 he secured the crown of Bohemia for his son Rudolph, but tried in vain to impose his own claims on Thuringia in 1307. His action in abolishing all tolls established on the Rhine since 1250, led to the formation of a league against him by the Rhenish archbishops and the count palatine of the Rhine; but aided by the towns, he soon crushed the rising He was on the way to suppress a revolt in Suabia when he was murdered on May 1, 1308, at Windisch on the Reuss, by his nephew John, afterwards called the "Parricide," whom he had deprived of his inheritance.

Although a hard, stern man, he had a keen sense of justice when his selfish interests were not involved, and few of the German kings possessed so practical an intelligence. He encouraged the cities, and not content with issuing proclamations against private war, formed alliances with the princes in order to enforce his decrees. The serfs, whose wrongs seldom attracted notice in an age indifferent to the claims of common humanity, found a friend in this severe monarch, and he protected even the despised and persecuted Jews. The stories of his cruelty and oppression in the Swiss cantons first appear in the 16th century, and are now regarded as legendary.

See A. L. J. Michelsen, *Die Landgrafschaft Thüringen unter den Königen Adolf, Albrecht, und Heinrich VII.* (Jena, 1860); G. Droysen, *Albrechts I. Bemühungen um die Nachfolge im Reich* (Leipzig, 1862); J. F. A. Mücke, *Albrecht I. von Habsburg* (Gotha, 1866).

ALBERT II. (1397–1439), German king, king of Bohemia and Hungary, and (as Albert V.) duke of Austria, was born on Aug. 10, 1397, the son of Albert IV. of Habsburg, duke of Austria.

He succeeded to the duchy of Austria on his father's death in 1404, and in 1438 succeeded his father-in-law, Sigismund, as German king, though he does not appear to have sought election.

He was crowned king of Hungary and of Bohemia but was unable to obtain possession of the latter country. His reign, which lasted less than two years, was spent in the defence of Hungary against the Turks. He died at Langendorf on Oct. 27, 1439. Albert was an energetic and warlike prince, whose short reign gave great promise of usefulness for Germany.

See W. Altmann, *Die Wahl Albrecht II. zum römischen Könige* (1886).

ALBERT, FREDERICK AUGUSTUS (1828–1902), king of Saxony, was born April 23, 1828, being the eldest son of Prince John, who succeeded to the throne in 1854. In 1849 he served as a captain in the campaign of Schleswig-Holstein against the Danes. When the war of 1866 broke out, the crown prince was placed in command of the Saxon forces opposing the Prussian army of Prince Frederick Charles. No attempt was made to defend Saxony; the Saxons fell back into Bohemia and effected a junction with the Austrians. They took a prominent part in the battles by which the Prussians forced the line of the Iser and in the battle of Gitchin. The crown prince, however, succeeded in effecting the retreat in good order, and in the decisive battle of Koeniggraetz (*see* SEVEN WEEKS' WAR) he held the extreme left of the Austrian position with great tenacity. After peace was made and Saxony had entered the North German confederation, he was placed in command of the Saxon army, which had now become the XII. Army Corps of the North German army. He was a firm adherent of the Prussian alliance.

On the outbreak of war in 1870 he again commanded the Saxons, who formed the extreme left of the German army, at Gravelotte, and with the Prussian Guard carried out the attack on St. Privat, the final and decisive action in the battle In the march towards Paris the crown prince was given a separate command over the 4th army (army of the Meuse) consisting of the Saxons, the Prussian Guard corps, and the 4th (Prussian Saxony) corps. He took a leading part in the operations which preceded the battle of Sedan, the 4th army being the pivot on which the whole army wheeled round in pursuit of MacMahon; and the actions of Buzancy and Beaumont on Aug. 29 and 30 were fought under his direction; in the battle of Sedan itself, with the troops under his orders, he carried out the envelopment of the French on the east and north Albert had won the complete confidence of the army, and during the siege of Paris his troops formed the north-east section of the investing force. After the armistice he was left in command of the German army of occupation, a position which he held till the fall of the Commune.

On the conclusion of peace he was made an inspector-general of the army and field-marshal. On the death of his father on Oct. 29, 1873, he succeeded to the throne. The king devoted himself mainly to military affairs, in which his advice and experience were of the greatest value to the German army in general. In 1897 he was appointed arbitrator between the claimants for the principality of Lippe. King Albert married in 1853 Carola, daughter of Prince Gustavus of Vasa, and granddaughter of the last king of Sweden of the house of Holstein. He died June 10, 1902.

ALBERT (1522–1557), prince of Bayreuth, surnamed THE WARLIKE, and also ALCIBIADES, was a member of the Franconian branch of the Hohenzollern family. His restless and turbulent nature marked him out for a military career; and having collected a small band of soldiers, he assisted the emperor Charles V. in his war with France in 1543. Sharing in the attack on the Saxon electorate, Albert was taken prisoner at Rochlitz in March 1547 by John Frederick, elector of Saxony, but was released as a result of the emperor's victory at Mühlberg in the succeeding April. He then followed the fortunes of his friend Maurice, the new elector of Saxony, deserted Charles, and joined the league which proposed to overthrow the emperor by an alliance with Henry II. of France. Having extorted a large sum of money from the burghers of Nuremberg, he quarrelled with his supporter, the French king, and offered his services to the emperor. Charles, anxious to secure such a famous fighter, gladly assented to Albert's demands and gave the imperial sanction to his possession of the lands taken from the bishops of Würzburg and Bamberg. After Albert had been placed under the imperial ban in Dec. 1553 on account of his depredations in Franconia, he was defeated by Henry II., duke of Brunswick, and compelled to fly to France. He there entered the service of Henry II, and had undertaken a campaign to regain his lands when he died at Pforzheim Jan. 8, 1557.

See J. Voigt, *Markgraf Albrecht Alcibiades von Brandenburg-Kulmbach* (Berlin, 1852).

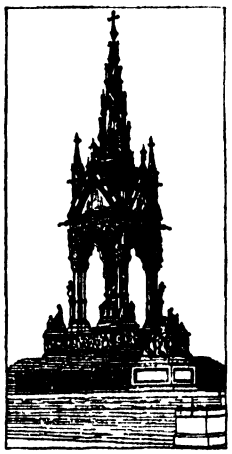
ALBERT, PRINCE CONSORT OF ENGLAND (1819–1861), b. at Rosenau Aug. 26, 1819. Francis Charles Augustus Albert Emmanuel was the second son of the hereditary duke of Saxe-Coburg-Gotha (belonging to the Ernestine or elder branch of the royal family of Saxony) by his first wife, the Princess Louise of Saxe-Gotha-Altenburg (d. 1831), from whom the duke was separated in 1824. His father's sister married the duke of Kent, and her daughter, afterwards Queen Victoria of England, was thus his first cousin. They were born in the same year. Albert and his elder brother, Ernest, were educated privately and at the University of Bonn. There Prince Albert studied natural science, political economy, and philosophy; he diligently cultivated music and painting, and excelled in gymnastic exercises, especially in fencing.

The idea of a marriage between him and his cousin Victoria had always been cherished by their uncle, King Leopold I. of Belgium, and in May 1836 the duke of Saxe-Coburg-Gotha and his two sons paid a visit to the duchess of Kent and her daughter at Kensington Palace The visit was by no means to the taste of King William IV., who disapproved of the match and favoured Prince Alexander of Orange But Leopold's plan was known to Princess Victoria, and William's objections were fruitless. Princess Victoria, writing to her uncle Leopold (May 23, 1836) said that Albert was "extremely handsome," and (June 7) thanked him for the "prospect of great happiness you have contributed to give me in the person of dear Albert. He possesses every quality that could be desired to render me perfectly happy." In the winter of 1838–39 the prince travelled in Italy, accompanied by Baron Stockmar, the Queen's confidential adviser, formerly Leopold's doctor and private secretary. On Oct 10, 1839, he and Ernest went again to England to visit the Queen, with the object of finally settling the marriage The betrothal took place on Oct. 15, and on Feb 10, 1840 the marriage was celebrated at the chapel-royal, St. James's.

The public life of the Prince Consort cannot be separated from that of the Queen, and it is unnecessary here to repeat such details as are given in the article (*see* VICTORIA, ALEXANDRINA). The prejudice against him, on account of what was regarded as his undue influence in politics, was never fully dissipated till after his death. His co-operation with the Queen in dealing with the political responsibilities which devolved upon the sovereign represented an amount of conscientious and self-sacrificing labour which cannot easily be exaggerated; and his wisdom in council could only be realized, outside a very small circle, when in later years the materials for the history of that time became accessible. He was indeed a man of cultured and liberal ideas, well qualified to take the lead in many reforms which the England of that day sorely needed. He was specially interested in endeavours to secure the more perfect application of science and art to manufacturing industry

The Great Exhibition of 1851 originated in a suggestion he made at a meeting of the Society of Arts, and owed the greater part of its success to his intelligent and unwearied efforts. He had to work for its realization against an extraordinary outburst of angry expostulations. Every stage in his project was combated. In the House of Peers, Lord Brougham denied the right of the Crown to hold the exhibition in Hyde Park; in the Commons, Colonel Sibthorp prophesied that England would be overrun with foreign rogues and revolutionists, who would subvert the morals of the people, filch their trade secrets from them, and destroy their faith and loyalty towards their religion and their sovereign.

Prince Albert was president of the exhibition commission, and every post brought him abusive letters, accusing him, as a foreigner, of being intent upon the corruption of England. He was not the man to be balked by talk of this kind, but quietly persevered, looking always to the probability that the manufacturing power of Great Britain would be quickened by bringing the best manufactured products of foreign countries under the eyes of the mechanics and artisans. The exhibition was opened by the Queen on May 1, 1851, and was a colossal success; and the realized surplus of £150,000 went to establish and endow the South Kensington Museum (afterwards renamed "Victoria and Albert") and to purchase land in that neighbourhood.



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THE ALBERT MEMORIAL ERECTED 1872–1876 IN LONDON IN MEMORY OF ALBERT, PRINCE CONSORT OF ENGLAND

Similar institutions, on a smaller scale but with a kindred aim, always found in him warm advocacy and substantial support. It was chiefly at meetings in connection with these that he found occasion for the delivery of addresses characterized by profound thought and comprehensiveness of view, a collection of which was published in 1857. One of his best speeches is the inaugural address which he delivered as president of the British Association for the Advancement of Science when it met at Aberdeen in 1859. The education of his family and the management of his domestic affairs furnished the Prince with another very important sphere of action, in which he employed himself with conscientious devotion.

As the Prince became better known, public mistrust began to give way. In 1847, but only after a significantly keen contest with Earl Powis, he was elected chancellor of Cambridge University; and he was soon afterwards appointed master of Trinity House. In June 1857 the formal title of Prince Consort was conferred upon him by letters patent, in order to settle certain difficulties as to precedence that had been raised at foreign courts.

But in the full career of his usefulness he was cut off. During the autumn of 1861 he was busy with the arrangements for the projected international exhibition, and it was just after returning from one of the meetings in connection with it that he was seized with his last illness. Beginning at the end of November with what appeared to be influenza, it proved to be an attack of typhoid fever, and, congestion of the lungs supervening, he died on Dec. 14. The grief of the Queen was overwhelming and the sympathy of the whole nation marked a revulsion of feeling about the Prince himself which was not devoid of compunction for earlier want of appreciation. The magnificent mausoleum at Frogmore, in which his remains were finally deposited, was erected at the expense of the Queen and the Royal Family; and many public monuments to "Albert the Good" were erected all over the country, the most notable being the Albert Hall (1867) and the Albert Memorial (1876) in London. His name was also commemorated in the Queen's institution of the Albert medal (1866) in reward for gallantry in saving life, and of the order of Victoria and Albert (1862).

BIBLIOGRAPHY.—By the Queen's authority, her secretary, General Grey, compiled *The Early Days of the Prince Consort*, published in 1867; and *The Life and Letters of the Prince Consort* (1st vol., 1874; 2nd, 1880) was similarly edited by Sir Theodore Martin. A volume of the *Principal Speeches and Addresses of Prince Albert*, with an introduction by Sir Arthur Helps, was published in 1862. *See* also C. F. von Stockmar, *Memoirs* (1872); the *Letters of Queen Victoria* (1907); and Lytton Strachey, *Queen Victoria* (1921). (H. C.)

ALBERT (1490–1568), last grand master of the Teutonic Order, and first duke of Prussia, was born at Ansbach, May 16, 1490, the third son of Frederick of Hohenzollern, prince of Ansbach and Bayreuth, and Sophia, daughter of Casimir IV., king of Poland. In 1511 Albert was made grand master of the Teutonic Order, which had held East Prussia under Polish suzerainty since 1466. In 1519 Albert was at war with his Polish suzerain, and though a truce was made in 1521 the dispute, which was referred to the emperor, remained unsettled. Albert was then converted to Protestantism, and, supported by the advice of Martin Luther, determined to make Prussia a hereditary duchy, though he was at the same time assuring Pope Adrian VI. that he intended to reform the Order and repress Lutheranism among the knights. Eventually in 1525 a treaty was signed at Cracow by Sigismund I. of Poland, agreeing to the creation of a duchy, provided it were held as a Polish fief, and Albert was formally invested on Feb. 10.

The new duke proceeded to further Protestantism in East Prussia. He was deposed from the grand mastership, but the Teutonic knights were unable to recover Prussia, and, although he was placed under the ban of the empire, it was never enforced. In imperial politics Albert was fairly active. Joining the league of Torgau in 1526, he acted in unison with the Protestants, and was among the princes who banded themselves together to overthrow Charles V. after the issue of the *Interim* in May 1548. The early years of Albert's rule in Prussia were fairly prosperous. Although he had some trouble with the peasantry, the lands and treasures of the church enabled him to propitiate the nobles and for a time to provide for the expenses of the court. He did something for the furtherance of learning by establishing schools in every town and by giving privileges to serfs who adopted a scholastic life. In 1544, in spite of some opposition, he founded a university at Königsberg, where he appointed his friend Osiander to a professorship in 1549. But Osiander's divergence from Luther's doctrine of justification by faith involved him in a violent quarrel with Melanchthon, who had adherents in Königsberg, and these theological disputes soon created an uproar in the town. The duke strenuously supported Osiander, and the area of the quarrel soon broadened. After Osiander's death in 1552, a preacher named John Funck, with an adventurer named Paul Scalich, exercised great influence over him. The state of turmoil caused by these religious and political disputes compelled the duke to consent to a condemnation of the teaching of Osiander, and in 1566 the estates appealed to Sigismund II., king of Poland, who sent a commission to Königsberg. Scalich saved his life by flight, but Funck was executed; the question of the regency was settled; and a strict form of Lutheranism was declared binding on all teachers and preachers. The duke, a disappointed man, lived for two years longer, and died at Tapiau on March 20, 1568.

See J. Voigt, *Briefwechsel der beruhmtesten Gelehrten des Zeitalters der Reformation mit Herzog Albrecht von Preussen* (Konigsberg, 1841); K. Lohmeyer, *Herzog Albrecht von Preussen* (Danzig, 1890); E. Joachim, *Die Politik des letzten Hochmeisters in Preussen, Albrecht von Brandenburg* (Leipzig, 1892).

ALBERT III. (1443–1500), duke of Saxony, surnamed ANIMOSUS or THE COURAGEOUS, younger son of Frederick II., the Mild, elector and duke of Saxony, was born Jan. 27, 1443, and, after escaping from the hands of Kunz von Kaufungen, who had abducted him and his brother Ernest, passed some time at the court of the Emperor Frederick III. in Vienna. After the death of the Elector Frederick in 1464, Albert and Ernest ruled their lands together, but in 1485 a division was made by the Treaty of Leipzig, and Albert received Meissen, together with some adjoining districts, and founded the Albertine branch of the family of Wettin.

In 1475, Albert took a prominent part in the imperial campaign against Charles the Bold, duke of Burgundy, and in 1487 led an expedition against Matthias Corvinus, king of Hungary, which failed owing to lack of support on the part of the emperor. In 1488 he marched with the imperial forces to free the Roman king Maximilian from his imprisonment at Bruges, and after the king returned to Germany in 1489, Albert restored the authority of Maximilian in Holland, Flanders and Brabant. In 1498 Maximilian bestowed upon him the title of hereditary governor (potestat) of Friesland, but he had to make good his claim by force of arms. He was engaged in repressing a rising in Friesland when he died at Emden, Sept. 12, 1500. Albert, who was a man of great strength and considerable skill in feats of arms, delighted in tournaments and knightly exercises. His rule was a period of prosperity in Saxony in spite of the large sums which he spent campaigning in the emperor's service.

See F. A. von Langenn, *Herzog Albrecht der Beherzte, Stammvater des königlichen Hauses Sachsen* (Leipzig, 1838); O. Sperling, *Herzog Albrecht der Beherzte von Sachsen als Gubernator Frieslands* (Leipzig, 1892).

ALBERT, DUKE OF WÜRTTEMBERG (1865–), German general, the son of Duke Philip of Württemberg, was born in Vienna on Dec. 23, 1865. As the king and queen of Württemberg had no male heir, he was the heir presumptive to the Württemberg throne. He passed through the different grades of a military career and was appointed general in command of the XI. Army Corps at Cassel in 1906, and in 1908 was entrusted with the command of the Württemberg Army Corps. In 1913 he was advanced to the rank of generaloberst (colonel-general, immediately below field-marshal) and was appointed inspector-general of the VI. Army inspection. At the outbreak of the World War he took over the leadership of the IV. Army on the western front, was advanced to the rank of field-marshal-general in 1916 and appointed chief-in-command of the group of armies on the front in Alsace-Lorraine, which fought under his leadership until the end of the war. Since then he has lived as a private citizen on his Württemberg estates. He married in 1893 the late Archduchess Margarete Sophie of Austria (d. 1902), the sister of the Archduke Francis Ferdinand, who was assassinated at Sarajevo.

ALBERT I. (*c.* 1100–1170), margrave of Brandenburg, surnamed "the Bear," was the only son of Otto the Rich, count of Ballenstädt, and Eilika, daughter of Magnus Billung, duke of Saxony. He inherited the valuable Saxon estates of his father in 1123, and on his mother's death in 1142 succeeded to one-half of the lands of the Billungs. About 1123 he received from Lothair, duke of Saxony, the margraviate of Lusatia. In 1128 his brother-in-law, Henry II., margrave of the Saxon north mark, died, and Albert, disappointed at not receiving this fief, attacked Udo, the succeeding margrave, and was consequently deprived of Lusatia by Lothair. His services in Italy in 1132 were rewarded in 1134 by the investiture of the north mark, which was again without a ruler. For three years he was occupied in campaigns against the Wends, and by an arrangement made with Pribislaus, duke of Brandenburg, Albert secured this district when the duke died in 1150.

Taking the title margrave of Brandenburg, he pressed the warfare against the Wends, extended the area of his mark, did much for the spread of Christianity and civilization therein, and so became the founder of the margraviate of Brandenburg. In 1137 his cousin, Henry the Proud, had been deprived by King Conrad III. of his Saxon duchy, which was given to Albert. But he was driven from Saxony and also from his mark by Henry, and compelled to take refuge in South Germany, and when peace was made in 1142 he renounced the Saxon dukedom and received the counties of Weimar and Orlamünde.

It was possibly at this time that Albert was made arch-chamberlain of the empire, an office which afterwards gave the margraves of Brandenburg the rights of an elector. In 1162 Albert accompanied the Emperor Frederick I. to Italy, and distinguished himself at the storming of Milan. In 1164 he joined a league of princes formed against Henry the Lion, and peace being made in 1169, Albert divided his territories among his six sons. He died Nov. 13, 1170, and was buried at Ballenstädt. His personal qualities won for him the surname of "the Bear," and he is also called by later writers "the Handsome."

See L. von Heinemann, *Albrecht der Bär* (Darmstadt, 1864).

ALBERT III. (1414–86), elector of Brandenburg, surnamed ACHILLES because of his relentless energy and physical strength, and his combination of shrewdness and knight-errantry, was the third son of Frederick I. of Hohenzollern, elector of Brandenburg. Albert was born at Tangermünde on Nov. 9, 1414, and died at Frankfurt on March 11, 1486. On the division of territory which followed his father's death in 1440 he received the principality of Ansbach; on the death of his brother John in 1464 he inherited Bayreuth; and in 1470, on the abdication of his brother Frederick II., he became elector of Brandenburg. His main object was family aggrandizement, and he became as powerful among the northern as the elector of the Palatinate among the southern princes. He saw that division of inheritance weakened the family power, and he devised the famous *Dispositio Achillea* of 1473, which decreed that the mark of Brandenburg should descend intact to the eldest son, the younger son receiving the Franconian possessions of the Hohenzollerns. Both sections of the family lands were to descend thenceforward by primogeniture, a new principle in the succession of the German princely houses. He married his daughter Barbara to Henry VI. of Glogau, and after her husband's death secured a part of his Pomeranian lands for his daughter in 1482. The power of Brandenburg declined with his death. It is said that the old warrior, who had spent the greater part of his life either in fighting against the towns which desired to maintain their independence, or the princes who sought reforms, or in purely dynastic struggles, realized at the end of his life that military strength was useless so long as Germany had no sound peace, no good system of law and no general currency.

See *Das kaiserliche Buch des Markgrafen Albrecht Achilles, Vorkurfürstliche Periode, 1440–70*, ed. by C. Hoefler (Bayreuth, 1850); *Kurfurstliche Periode*, ed. by J. von Minutoli (1850); *Quellensammlung zur Geschichte des Hauses Hohenzollern*, Band I., ed. by C. A. H. Burkhardt (Jena, 1857); O. Franklin, *Albrecht Achilles und die Nuremberger, 1449–53* (1866); *Politische Korrespondenz des Kurfürsten Albrecht Achilles, 1470–86*, ed. by F. Priebatsch (Leipzig, 1894–98); J. G. Droysen, *Geschichte der preussischen Politik* (1855–86).

ALBERT (1490–1545), elector and archbishop of Mainz, and archbishop of Magdeburg, was the younger son of John Cicero, elector of Brandenburg, and was born June 28, 1490, and died at Aschaffenburg Sept. 24, 1545. In 1513 he became archbishop of Magdeburg and administrator of the diocese of Halberstadt. In 1514 he obtained the electorate of Mainz, and in 1518 was made a cardinal.

Meanwhile to pay for the pallium of the see of Mainz and to discharge the other expenses of his elevation, Albert had borrowed a large sum of money from the Fuggers, and had obtained permission from Pope Leo X. to conduct the sale of indulgences in his diocese to obtain funds to repay this loan. For this work he procured the services of John Tetzel, and so indirectly exercised a potent influence on the course of the Reformation. When the imperial election of 1519 drew near, the elector's vote was eagerly solicited both by the partisans of Charles (afterwards the Emperor Charles V.) and of Francis I., king of France, and he appears to have received a large amount of money for the vote which he cast eventually for Charles. Albert's large and liberal ideas, his friendship with Ulrich von Hutten, and his political ambitions, appear to have raised hopes that he would be won over to the reformed faith; but after the peasants' war of 1525 he ranged himself definitely among the supporters of Catholicism. He was nevertheless compelled to grant religious liberty to the inhabitants of Magdeburg in return for 500,000 florins.

During his latter years indeed he showed more intolerance towards the Protestants. Albert adorned the *Stiftskirche* at Halle and the cathedral at Mainz in sumptuous fashion, and took as his motto the words *Domine, dilexi decorum domus tuae*. A generous patron of art and learning, he counted Erasmus among his friends.

See J. H. Hennes, *Albrecht von Brandenburg, Erzbischof von Mainz und Magdeburg* (Mainz, 1858); J. May, *Der Kurfurst, Kardinal, und Erzbischof Albrecht II. von Mainz und Magdeburg* (Munich, 1865–75); W. Schum, *Kardinal Albrecht von Mainz und die Erfurten Kirchenreformation* (Halle, 1878); P. Redlich, *Kardinal Albrecht von Brandenburg, und das neue Stift zu Halle* (Mainz, 1900).

ALBERT (FRIEDRICH RUDOLF ALBRECHT), ARCHDUKE (1817–1895), Austrian field-marshal, the eldest son of the Archduke Charles (Karl Friedrich), was born Aug. 3, 1817, in Vienna. After having been educated under the careful superintendence of his father, he entered the Austrian army as a colonel of infantry in 1837, and was transferred to the cavalry arm in 1839, and became a lieutenant-field-marshal in 1843. He learned the art of war from Radetzky. At this time the Austrian generals and staff officers had committed themselves blindly to the strategical method of the Archduke Charles, the tradition of whose practical soldiership survived only in Radetzky and a few others. Albert chose to follow Radetzky, and was thus saved from the

pseudo-scientific pedantry which brought defeat to the Austrian arms in 1859 and in 1866.

He fought under Radetzky as a volunteer throughout the campaign of 1848, having been present at the action of Pastrengo and the battles of Santa Lucia and Custozza. In the following campaign he applied for and obtained the command of a division in the 2nd corps (under d'Aspre), though his previous grade had been that of commander-in-chief. The splendid fighting of the corps at Novara was decisive, and Radetzky named d'Aspre, Count Thurn, and the archduke as the general officers worthy of the greatest rewards. In 1850 he became a general of cavalry, and in 1851 military and civil governor of Hungary, a position which he retained until 1860, when he was relieved at his own request.

Soon afterwards he was appointed to succeed Radetzky as commander-in-chief in Italy, and in 1863 he was promoted to the rank of field-marshal. When war became imminent in 1866, the archduke took command of the field army in Italy. For the story of the campaign of 1866 in Italy, *see* ITALIAN WARS (1848–70). The operations of the archduke, who disposed of considerably inferior forces, were crowned with success in the brilliant victory of Custozza (June 23), and his reputation as a general-in-chief was firmly established during only eight days of field operations, though it is possible that his chief of staff, Lieutenant-Field-marshal von John, contributed not a little to the success of the Austrian arms.

The result of Custozza was the retreat and complete immobilization of the whole Italian army, so that Albert was able to dispatch the greater part of his troops to reinforce the Bohemian army, when, after having been defeated by the Prussians, it fell back on Vienna. On July 10 the archduke was summoned to Vienna to take supreme command of the forces which were being collected to defend the capital, but peace was made before further hostilities took place. From this time, under various titles, he acted as inspector-general of the army.

Like his father, and with better fortune, he was called upon to reorganize the military system of his country on an entirely new plan, learned, as before, by defeat. The principle of universal short service, and the theory of the armed nation, were necessarily the groundwork of the reforms, and the consequent preparation of all the national resources for their task in war, by the superintendence of peace administration, by the skilful conduct of manoeuvres, was thenceforward the task of his lifetime. In 1870 he conducted the military negotiations preparatory to an alliance with France, which, however, was not concluded He retained personal control of the army until his last illness, which he contracted at the funeral of his nephew Francis, ex-king of Naples. His only remaining brother, the Archduke Wilhelm, had died a few months before, as the result of an accident. He himself died Feb. 18, 1895. His only son died in childhood, and his nephew Archduke Frederick (born 1856) inherited his great possessions, including the Albertina, a famous collection of books, manuscripts, engravings and maps, founded by Duke Albert of Saxe-Teschen.

Among the military works of the Archduke Albert, *Über die Verantwortlichkeit im Kriege* created a sensation, and was translated into English and French. He also wrote *Gedanken uber dem Militärgeist; Über die höhere Leitung im Kriege;* and *Kritische Betrachtungen über den Feldzug 1866 in Italien.* He was the principal editor of the military works of his father.

See Mathes v. Bilabrueck, "Gedenkrede auf Weiland Sr. K. u. K. H. Erzh. Albrecht," *Mil.-Wissenschaftl. Verein* (1895); Teuber, *F. M. Erzh. Albrecht, ein Lebensbild* (Vienna, 1895); Duncker, *F. M. Erzherzog Albrecht* (Vienna and Prague, 1897).

ALBERT, also named ALEXANDRE MARTIN (1815–1895), the first industrial workingman to enter a government, was a member of the French Provisional Republican Government in Feb. 1848. He signed all decrees "ALBERT, *ouvrier,*" and followed implicitly the guidance of Louis Blanc (*q.v.*). He was sentenced to ten years' deportation on political grounds in 1849. On his release he secured employment as a gasworker.

ALBERT, MADAME (*c.* 1805–1846), French actress, whose maiden name was Thérèse Vernet, was born of a family of players. Her grace, beauty, and distinction of manner made her the idol of Paris, and her circle of admirers was widened by long tours of the provinces and abroad.

ALBERT, LAKE (A. NYANZA), Uganda, situated in 1° 9′ to 2° 17′ S., and 30° 30′ to 31° 35′ E. Its greatest length is 100m., its greatest breadth 22m., and its greatest depth 55ft. The area is approximately 1,640sq m.; *i.e.,* about the size of Lancashire. The height of the lake surface above sea-level is given as 2,037ft., but this is liable to seasonal and other fluctuations.

The lake lies on the floor of the western branch of the Rift valley. Thermal springs occur at Kibiro, and again between the Murchison falls, on the Victoria Nile, and Wadelai. At Kibiro salt springs are exposed on the strand in the dry season, and give rise to a native trade in salt. At the southern end of Albert Nyanza is a wide plain, traversed by the Semliki river, which enters the lake through a swamp of tall weeds, chiefly ambach and papyrus. On both the eastern and western sides the walls of the Rift valley are close to the lake, the water in many cases washing the base of the cliffs. Elsewhere the narrow foreshore is thickly wooded. The ascent to the plateaux is generally by a series of abrupt steps. On the western side the mountains present many pointed and conical summits, some of which may be nearly 8,000 feet above the lake; on the eastern side the cliffs rise sharply for 1,000 to 2,000 feet. On either coast wild ravines, densely wooded, break the outline of the mountains. Through these gorges and over the plateau-edge fall magnificent cascades. Towards the north the hills recede from the coast and on both sides flats extend for distances varying from 5m. to 15m. On the eastern side, 92m. from the southern end of the Nyanza, the Victoria Nile enters the lake, here not more than 6m. across, through a wilderness of woods, the delta of the Nile extending over 4m. The mouth of the main stream is obstructed by a bar of its own formation; the current is sluggish; there are many side channels, and the appearance of the lake gives no hint that a great river has joined its waters. For 5m. or 6m. north of the junction of the Victoria Nile the lake suffers no material diminution in width. Then, however, the eastern and western shores approach each other, and a current is perceptible flowing north. The lake has become the Bahr-el-Jebel, or Mountain river, as this section of the Nile is called. Albert Nyanza is shallow; at its southern end the water for a considerable distance is not more than 3ft. deep. The deepest soundings give only 50ft. to 55ft., the average depth being 30 to 40 feet.

The Albertine Basin of the Nile.—Albert Nyanza receives the whole of the drainage of Edward Nyanza and the Semliki river, and with them forms the "Albertine" Nile system. Its waters, as stated above, mingle with those of the Victoria Nile. There is evidence of very considerable shrinkage in the size of these lakes. Within human times the level of Albert Nyanza appears to have been 1,000ft. higher than it is at present. The causes of this fall have not been fully explained. Both tectonic and climatic agencies may be involved. River erosion is probably also a complicating factor. In recent geological times the valley to the north of Edward Nyanza, then much larger than now, was blocked. The removal of the block led to the shrinkage of the lake and the formation of the Semliki, which found its way to the more northern lake—Albert Nyanza. Gradually the Semliki eroded its bed, and consequently the level of Edward Nyanza continued to fall. The process continues but is checked by the existence of the rock barrier which stretches across the Semliki. This stream leaves Edward Nyanza at its north-west end in 0° 8′ 30″ S., and after a course of about 160m. enters Albert Nyanza in 1° 9′ N. In its upper and in its lower course the river flows either through high alluvial plains, in which it has scored a deep channel, or across swamp land. In the middle section, which has a length of some 75m., the river runs in a deep narrow valley covered with the densest forest. On the west this valley is bounded by the Congo mountains, which form the wall of the Rift valley, on the east by the mighty range of Ruwenzori, whose heights tower over 16,000ft. above sea-level. In this length of 75m. the river falls in cataracts and rapids over 800 feet.

Albert Nyanza, on the other hand, is threatened in the distant future with destruction from another cause—the filling of its

bed by the alluvium poured into it by the Semliki, the Victoria Nile and other streams. The Semliki receives directly or indirectly the whole of the drainage of Ruwenzori, and also that of the eastern face of the Congo mountains as well as the drainage basin of Edward Nyanza. The Semliki, as it emerges from the region of forest and cataracts, and deposits much of its burden, becomes sluggish as its slope flattens out. This process has formed a large plain at the south end of Albert Nyanza, which has seriously encroached upon the lake. At the northern end of the lake the sediment brought down by the Victoria Nile is producing a similar effect. Nyamsasi, which was an island at the south-west end in 1889, has become a peninsula Islands which in 1876 were on the east coast no longer exist; they now form part of the foreshore. On the other hand, the shrinkage of the lake level caused the appearance in 1885 of an island where in 1879 there had been an expanse of shallow water. It seems probable that, in a period geologically not very remote, the "Albertine" system will consist of one great river, extending from the northern slopes of the Kivu range, where the Ruchuru has its rise, to the existing junction of the Victoria Nile with Albert Nyanza.

The combined drainage area, including the water surface of Edward Nyanza, the Semliki and Albert Nyanza, is some 16,600 sq m Throughout this area the rainfall is heavy (40in. to 60in or more per annum), the volume of the Semliki in flood being not less than 700cu m. per second. Of the water received by Albert Nyanza annually (omitting the Victoria Nile from the calculation) between 50% and 60% is lost by evaporation, whilst 24,265,000,000cu m. are annually withdrawn by the Bahr-el-Jebel. The "Albertine" system plays a comparatively insignificant part in the annual flood rise of the White Nile, but to its waters are due the maintenance of a constant supply to this river throughout the year.

Discovery and Exploration.—Albert Nyanza was first reached by Samuel Baker on March 14, 1864, near Vacovia, a small village of fishermen and salt-makers on the east coast. Albert Nyanza was entered on his map as a vast lake extending about 38om. But the circumnavigation of the lake by Gessi Pasha (1876), and by Emin Pasha in 1884, showed that Baker had been deceived as to the size of the lake. The lake forms part of the (British) Uganda Protectorate, but the north-west shores were leased in 1894 to the Congo Free State Of this leased area a strip 15m. wide, giving the Congo State a passageway to the lake, was to remain in its possession after the determination of the lease (*See* also NILE.)

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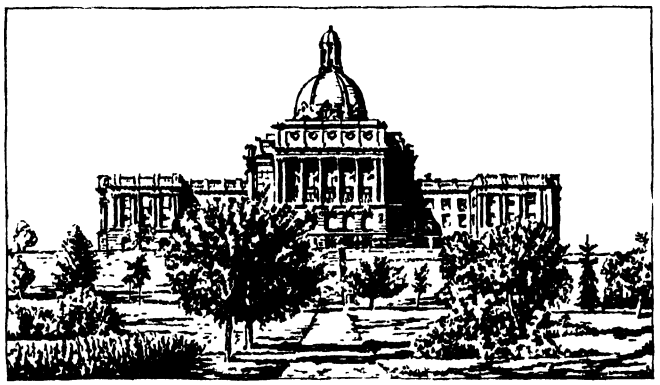
ALBERT OF AIX (fl. *c.* A.D. 1100), historian of the first crusade, was canon and *custos* of the church of Aix-la-Chapelle. He wrote a *Historia Hierosolymitanae expeditionis* or *Chronicon Hierosolymitanum de bello sacro,* a work in 12 books, between 1125 and 1150. This book gives the history of the first crusade and of the Latin Kingdom of Jerusalem down to 1121. It was well known during the middle ages, and was largely used by William, archbishop of Tyre, for the first six books of his *Belli sacri historia.* The first edition of the history was published at Helmstadt in 1584, and a good edition is in the *Recueil des historiens des croisades,* tome iv. (Paris, 1841–87)

See M. Pigeonneau, *Le Cycle de la croisade et de la famille de Boullon* (1877); F. Krebs, *Zur Kritik Alberts von Aachen* (Muenster, 1881); H. von Sybel, *Geschichte des ersten Kreuzzuses* (Leipzig, 1881); B. Kugler, *Albert von Aachen* (Stuttgart, 1885); F. Vercruysse, *Essai critique sur la chronique d'Albert d'Aix* (Liége, 1889).

ALBERTA, the most westerly of the three prairie provinces of Canada and the most recently developed, is bounded on the south by the U.S. along the 49° N. lat., on the east by Saskatchewan along the 110° W. long., on the north by lat. 60° and on the west by British Columbia along the Rocky mountains water-parting to lat. 54° and thence long 120° W. It contains portions of three physiographical provinces, viz., that of the Rocky mountains and foothill region, where the country is mountainous and rugged, and the strata much disturbed; that of the great plains, where the land forms are tabular and lower, and the strata are usually flat lying; and lastly, a small area of the Laurentian shield in the extreme north-east about Lake Athabasca. The true foothill country occupies a narrow belt in the south-west wholly more than 4,500ft. above sea-level, and characterized by sharp, parallel north-west to south-east ridges from 5,000 to 7,000ft. in height. The front range of the Rockies in Alberta has an average height of 8,000 to 9,000ft., with many peaks over 10,000 feet. All the rest of Alberta is a land of plains and plateaux In general this land sinks to the north and east from a general level in the south-west of about 3,500ft. to 600ft about the Slave river in the extreme north-east. This descent is not gradual, however, but takes place chiefly between a high plateau developed on Cretaceous and Tertiary rocks (2,000 to 3,000ft.), which cover most of the province, and a lowland (600ft.) developed on Palaeozoic and Archaean rocks, in the extreme north-east. The zone of rapid



BY COURTESY OF THE CANADIAN PACIFIC RAILWAY

THE PARLIAMENT BUILDINGS AT EDMONTON, WHERE THE LOCAL GOVERNMENT OF ALBERTA IS CARRIED ON BY A PROVINCIAL LEGISLATURE SIMILAR TO THAT OF THE OTHER CANADIAN PROVINCES

descent runs diagonally from about Fort MacMurray on the Slave river, lat. 56° 45′, to about where the Hay river leaves the province in the north. The Athabasca and Peace rivers make great embayments into this upland, the flanks of which are known as the Cutknife (2,400ft), Caribou (3,300ft) and Birch (2,500ft.) mountains (*i.e.,* plateaux). Near the head of these embayments the Hay, Peace and Athabasca rivers are interrupted by rapids. South of this scarp line of the extreme north, the general surface level of the rest of Alberta is about 2,000 to 2,500ft. but is studded with residual plateaux a few hundred feet higher, developed on Tertiary rocks. Such are the Swan hills and Hand hills, and in the extreme south, the Milk River ridge and Cypress hills —the last mentioned rising to 4,500ft. with particularly rough topography. The developed prairie portion of the province lying between Edmonton and Lethbridge drains eastward by the north and south Saskatchewan river system The larger, forested and undeveloped northern portion drains north by the Athabasca and Peace river systems. On the main plateaux, the river flood-plains are enclosed by precipitous walls, often several hundred feet high. Apart from the dissected edges of the residual plateaux, and the sharp trenches of the rivers, the prevailing relief is flat to gently rolling. In the drier southern parts of the province the plateaux and river scarps develop a bad-land topography.

The larger part of Alberta is forested, chiefly with conifers, but most settlement has taken place in the southern prairie area. The forest line runs west of the Edmonton-Calgary-Macleod line, and the northern boundary is about the line of the North Saskatchewan eastward from Edmonton. On the inner side of these limits the prairie is invaded by a varying width of grove country, with scattered and usually small wood belts, chiefly of poplar and birch. Within this again lies the true prairie. Prairie and grove form less than one quarter of the province, but they are the scene of most of its development.

Climate.—The extreme continental type prevails. The winters are very severe, but weeks of very low temperature are frequently interrupted by startling increases. This is due some-

CLIMATIC STATISTICS

	Ht. above sea-level.		Lat.N.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.	Jan. mean daily max. and min.		July mean daily max. and min.	
Ft. Chipewyan	714 ft	T.	58° 46′	−11·9	−9·1	5·0	28·5	44·5	54·0	61·5	58·1	45·2	33·7	11·0	2·0	26·9	−3·5	−20·4	71·0	51·9
		ppt.		0·9	0·58	0·58	0·64	0·81	1·57	2·64	1·64	1·57	0·75	0·91	0·92	13·5				
Edmonton	2,158 ft.	T.	53° 35′	5·9	10·6	23·4	40·8	51·2	57·3	61·2	59·0	50·4	41·7	24·5	16·0	36·9	15·6	−3·8	73·7	48·8
		ppt.		0·76	0·67	0·67	0·80	1·86	3·26	3·56	2·47	1·40	0·74	0·73	0·75	17·67				
Medicine Hat	2,144 ft.	T.	50° 2′	11·2	12·8	26·7	45·1	54·7	62·5	68·4	66·0	56·5	45·8	29·3	21·1	41·7	21·6	0·7	82·7	54·1
		ppt.		0·01	0·61	0 61	0 61	1·75	2·57	1·73	1·51	0·92	0 62	0·72	0·53	12·79				

times to warm southerly winds; sometimes to a Chinook effect with westerly winds. The summers show rather higher average shade temperatures than those obtaining in the same latitudes of western Europe. Actually the air is clearer, the sun temperature higher, the daily range greater, and the tendency to heat wave greater. The precipitation is everywhere small but rises to over 20in. at the borders of the foothills. Elsewhere it varies from 11-in. to 16in. over most of the province, the driest areas occurring in a broad belt of prairie land to the east of Calgary and Lethbridge. This is also in general the area of highest summer temperature and longest growing seasons. Fortunately more than 65% of the precipitation is between May and September. Snowfall is light and is frequently rapidly cleared by the Chinook in the south

Topography.—The whole of Alberta was glaciated, with the usual results of a rearranged river system, a ground-till thinning out somewhat on the plateau levels, some areas of rough morainal topography, and many irregularly scattered lakes. Of these last some in the south-eastern dry belt are alkaline. The soils developed on the glacial till over most of the prairie area, under the influence of the climate and natural vegetation, are dark brown loams of great fertility. There are scattered areas of poor land, especially in the rough topography of the Milk River ridge and Cypress hills, and in the south, about the borders of Saskatchewan; but the greater part of the prairie and grove areas is exceedingly fertile. The Porcupine hills and Bow river plateaux just east of the foothills, together with some of the Milk river plateau, are important ranch lands. The grass sun-cures *in situ*, but to ensure good results some winter feed in addition must be forthcoming. This (among other crops) is provided by the great Alberta irrigation works which have been made in the dry belt east of Calgary and Lethbridge. These works tap the Bow, Old Man, and St. Mary rivers where they emerge from the foothills (and at additional points lower down) and render irrigable an enormous area in a district where the average rainfall is less than 14in. and very variable. About 20% only of the land which existing works have rendered irrigable is actually irrigated. The percentage is highest in the Lethbridge area, where there is a long growing season and diversified irrigated crops. The western Canadian Pacific railway irrigation system is only on the verge of the arid belt, and the farmers, if conditions look promising, frequently do not irrigate but trust to the rainfall for their wheat crop. In the northern grove belt, and in the area of cleared bush, north and west of Edmonton, mixed farming predominates. In the centre and south of the developed area purely wheat farming is still the rule. Alberta, the last of the prairie provinces to be developed, has made enormous strides in the last few years in farm production. On the middle Peace river in northern Alberta some rich open prairie forms a kind of oasis in the surrounding forests. The growing season, too, is longer (120 days) than in surrounding areas, and the soils are good Recent settlement has been attracted to this country, which is now connected up by rail with Edmonton. This is the most northerly area (lat. 56°) of considerable farming settlement on the continent. Excellent grain and dairy produce is obtained. An outlet is to be sought across the Rockies to join the Prince Rupert line. There is a growing tendency for wheat shipment to take place via Vancouver instead of Winnipeg.

At three horizons in the Cretaceous sands and shales, coal-bearing formations occur; viz., in the Edmonton, Belly river, and Kootenay formations. The Kootenay (lower Cretaceous coals) are accessible only when brought to the surface in the Rocky mountains and foothill belt in elongated, detached basins, which run parallel to the Rockies. These coals are bituminous and sometimes anthracitic. The structure however is disturbed and the topography difficult. Eastward of the Rockies the rocks are little disturbed, though a major syncline and anticline determine the accessibility of coal seams in the Belly river and Edmonton formations. The seams are thick and persistent over large areas, and little disturbed. The coals pass from sub-bituminous in the west to lignite in the east. Along the belts of accessible coal, mining occurs where there are railway connections. The reserves are enormous, and the present market is for the railways, for power stations in the larger towns, and for domestic fuel. Coal is sent over the border to Saskatchewan, and if freights can be brought low enough may eventually come into competition with American coals in populous southern Ontario. The chief mining areas at present are the Crow's Nest, Drumheller, Lethbridge, Edmonton and Mountain Park fields. Nearly six million tons were mined in 1925. Natural gas is piped to Edmonton, Calgary and Medicine Hat from the Viking, Bow Island, and Medicine Hat fields respectively. There are promising oil developments in the Turner Valley field in the foothills south-west of Calgary. Alberta has 475,000h p. water power resources (calculated at ordinary minimum flow) of which 34,000h p is developed.

STATISTICS OF PRINCIPAL CROPS

	1920.		1926.		1927 (est only).	
	Area. 000 ac.	Yield. 000 bush.	Area. 000 ac.	Yield. 000 bush.	Area. 000 ac.	Yield. 000 bush.
Wheat	4,079	58,196	6,114	113,120	6,251	178,519
Oats	2,720	83,362	1,907	57,210	2,248	115,233
Barley	365	8,830	405	8,910	400	14,273
Rye	125	1,922	112	1,344	157	3,951
Flax (seed)	108	489	12	82	13	176

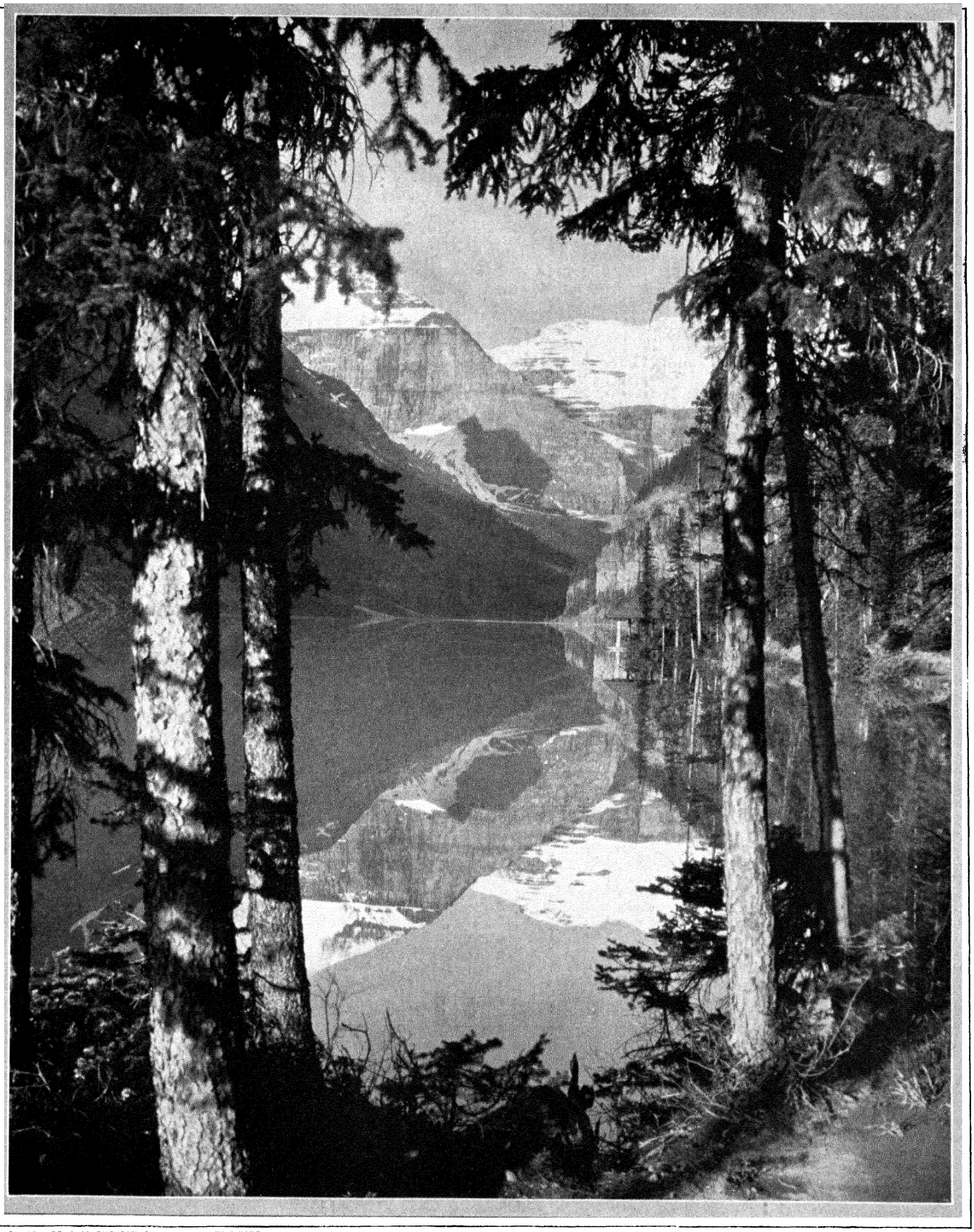
Transport.—There is an extensive development of railway now in the prairie and grove region, and the Rockies are crossed at three points, viz., the Yellow Head pass (C.N.R.), Kicking Horse pass (C.P.R.) and Crow's Nest (C.P.R.). The first two are through routes to Vancouver, and have, in addition to their normal traffic, a heavy summer tourist traffic. The last leads, by combined lake and rail routes, to the British Columbia southern mining and fruit growing valleys. The chief cities are Edmonton (capital, pop., 1926, 65,163); Calgary (65,291); Medicine Hat (9,536) and Lethbridge (10,735).

POPULATION AND RACIAL ORIGIN (1926)

British	350,086	Ukranian	35,819
German	47,114	French	31,582
Scandinavian	47,013	Others	95,985
Total	607,599		

History.—Alberta was administered as a part of the North-west Territories after 1870 and received provincial status in 1905. Until the coming of the railway in 1883 there was little settlement, though the neighbourhood of Edmonton had acquired some importance from the collecting and furnishing of fur company stores situated on the navigable Saskatchewan near this point.

Administration.—Alberta sends a quota of senators (six nominated for life) and 12 members of the House of Commons, to the Dominion Government; but has as well, like the other prov-

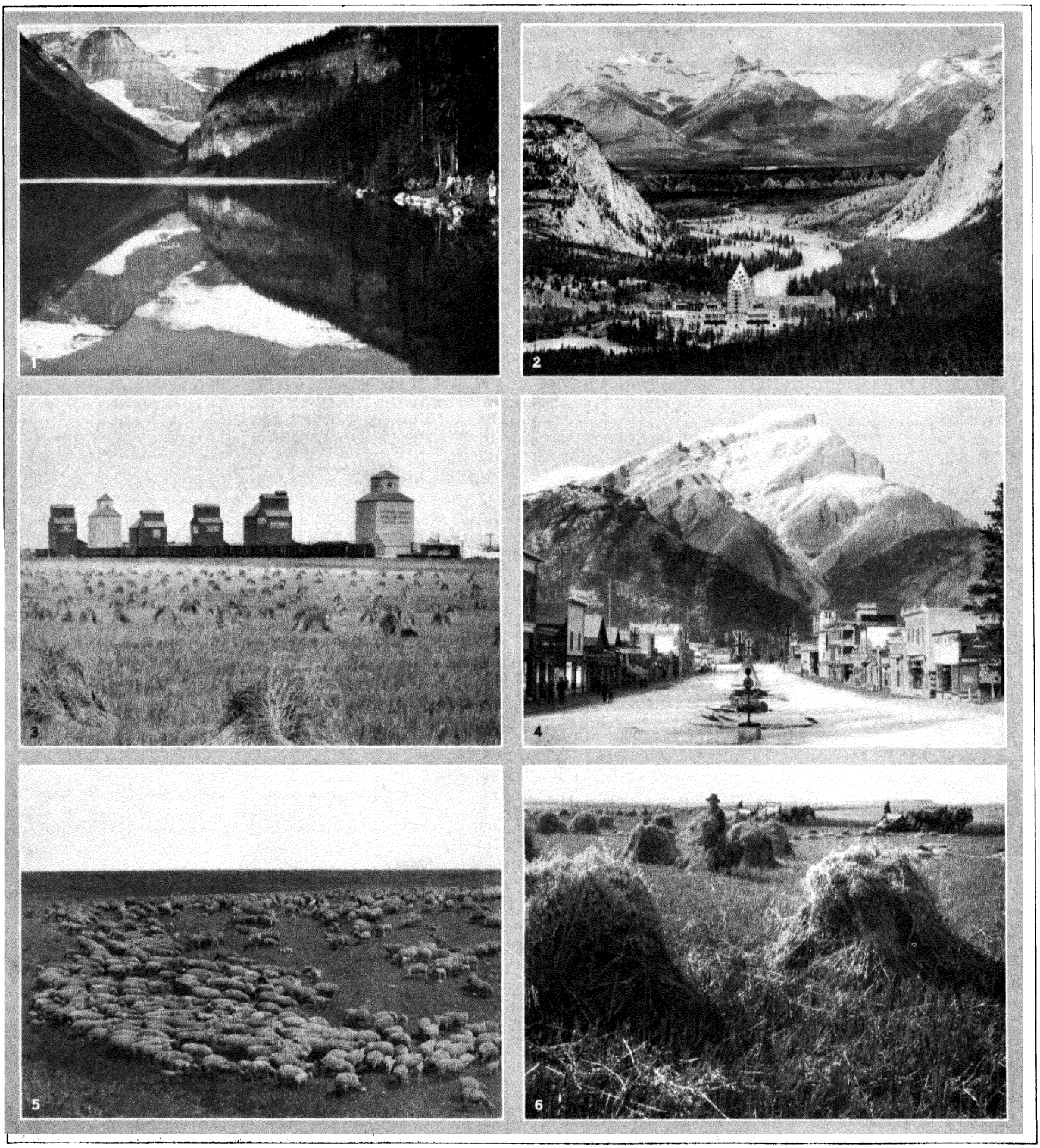


BY COURTESY OF THE CANADIAN PACIFIC RAILWAYS

VIEW OF LAKE LOUISE IN THE CANADIAN PACIFIC ROCKIES

Lake Louise, viewed from a trail along the edge of the water looking toward Mt. Lefroy on the left, and Mt. Victoria in the centre, both crowned with glaciers. The shadows of these mountains are cast about six miles and in the early morning perfect pictures of the glaciers are mirrored in the depths of the blue and green shaded waters

ALBERTA



BY COURTESY OF (1, 2, 3, 5, 6) CANADIAN PACIFIC RAILWAY, (4) INTERNATIONAL NEWSREEL

MOUNTAIN AND PRAIRIE VIEWS IN ALBERTA, CANADA

1. Lake Louise, 5,044 feet above sea level, mirroring the surrounding forests and cliffs with glimpses of the glaciers capping Mt. Lefroy on the left and Mt. Victoria in the centre of the background
2. Banff hotel encircled by lofty, snow covered mountains as it is seen from Bow River Valley
3. Elevators in the wheat belt of Alberta erected to hold the grain yield during harvest
4. Main street of Banff, Alberta, taken on a winter day when there was less snow than usual
5. Flock of sheep near Calgary, in the foothills of the Canadian Rockies, where large herds of cattle and sheep feed
6. Oat crop on a farm near Aldersyde, Alberta, in the midst of the great grain producing district

inces, its own separate parliament and administration with a lieutenant-governor, appointed by the governor-general, at the head of the executive. Alberta has one legislative assembly consisting of 60 directly elected members and an executive council. Woman suffrage is established in the province. Among the matters assigned exclusively to provincial legislators are: the amendment of the provincial constitution, direct taxation for revenue, borrowing, education, local works and undertakings, etc. Edmonton is the seat of government. The provincial government controls education. Primary and secondary education is free and non-sectarian, though in certain circumstances minority elementary schools are established. There is a university at Edmonton and normal schools at Calgary and Camrose. (H. R. J.)

See John Blue, *Alberta* (1924).

ALBERT EDWARD NYANZA: *see* EDWARD, LAKE.

ALBERTI, DOMENICO (*c.* 1710–1740), Italian musician, achieved unawares something like immortality in musical history as the writer of dozens of sonatas in which the melody is supported from beginning to end by an extremely familiar, but nowadays little-esteemed, formula of arpeggio accompaniment, consequently known as the Alberti bass.

ALBERTI, LEONE BATTISTA (1404–1472), Italian painter, poet, philosopher, musician and architect, was born in Venice on Feb. 18, 1404. He was so skilled in Latin verse that a comedy he wrote in his twentieth year, entitled *Philodoxius*, deceived the younger Aldus, who edited and published it as the genuine work of Lepidus. In music he was reputed one of the first organists of the age. At Rome he was employed by Pope Nicholas V. in the restoration of the papal palace and of the foundation of Acqua Vergine, and in the ornamentation of the magnificent fountain of Trevi. At Mantua he designed the church of Sant' Andrea, at Rimini the Church of San Francesco, which is generally esteemed his finest work, and in Florence the principal façade of the church of Santa Maria Novella, as well as the palace now known as the Palazzo Strozzi His most important treatise is that on architecture, *De Re Aedificatoria*, which was translated into Italian, French, Spanish and English

See Passerini, *Gli Alberti di Firenze* (1869–70); Mancini, *Vita di Alberti* (Firenze, 1882); V. Hoffmann, *Studien zu Leon Battista Alberti's zehn Büchern: De Re Aedificatoria* (Frankenberg, 1883).

ALBERTINELLI, MARIOTTO (1474–1515), Italian painter, was born in Florence, and was a fellow-pupil and partner of Fra Bartolommeo, with whom he painted many works. His chief paintings are in Florence, notably his masterpiece, the "Visitation of the Virgin" (1503) at the Uffizi

ALBERTINI, LUIGI (1871–), Italian journalist and politician, was born at Ancona Oct. 19, 1871, and after graduating in law took to journalism. In 1896 he joined the staff of the Milan newspaper, *Il Corriere della Sera*, and in 1909 became editor and chief proprietor. Under his guidance *Il Corriere* became the foremost journal in Italy. In 1914 Albertini was nominated senator and showed himself a convinced interventionist. After the War *Il Corriere* was steadily anti-Socialist. Albertini at first sympathized with Fascism, but when the movement began to aspire to seize power by violence he opposed it. When the Black Shirt *squadre* occupied Milan they forced *Il Corriere* to suspend publication, but Mussolini afterwards revoked the suspension. In parliament Albertini made several important speeches against the government and, after the Matteotti affair, against Mussolini in particular. His paper was frequently confiscated under a decree restricting the liberty of the press. In Nov. 1920, owing to the difficult position of *Il Corriere*, the company was dissolved, Albertini bought out, and a new director appointed.

ALBERTITE, a pyrobitumen (*see* BITUMEN) so named from the type occurrence in Albert county, New Brunswick. It is jet black in colour, has a brilliant lustre and a conchoidal to hackly fracture. It occurs typically in veins up to many feet in thickness and is a derivative of petroleum. (J. R.)

ALBERT LEA, a city of Minnesota, U.S.A., about 97 m. S. of St. Paul; the county seat of Freeborn county. It is on the Jefferson highway, Blackhills Trail, is the northern terminus of the Illinois Central Railroad, and is served also by the Rock Island, the Chicago, Milwaukee and St. Paul, and the Minneapolis and St. Louis railways. It is pleasantly situated between Lake Albert Lea and Fountain lake. The population was 8,056 in 1920, of whom 1,271 were foreign-born white, chiefly Scandinavians.

The manufactures include road-building machines, sprayers for fruits and vegetables, tools, camp stoves, and barn equipment. Thousands of chickens, hatched in electrically controlled incubators, are shipped to all parts of the country. Butter is the leading product of the surrounding country, and the Minnesota State Experimental Creamery was established in Albert Lea in 1911. The two lakes and 16,000 ac. of surrounding territory have been placed in a game refuge, where hunting is forbidden.

The city and the lake owe their names to Lieut. Albert Miller Lea (1808–91), a West Point graduate (1831), who was the topographer of a U S. Government exploring party. His report was published in 1836. The first post office was established here in 1855, and the city received its charter in 1878.

ALBERT MEDAL, a British decoration instituted in 1866 as an award for signal acts of bravery in saving life at sea, and extended in 1877 to acts of bravery on land. The conditions governing the award were amended in 1905. There are two classes, each with two divisions. The medal, which is in gold for the 1st class and bronze for the 2nd, is oval, and bears the monogram V.A. The ribbon consists of crimson and white vertical stripes.

ALBERT PIKE HIGHWAY, a western thoroughfare, running from Hot Springs, Arkansas, through the Ozark mountains to Colorado Springs, Colorado. In 1928 it was graded and improved throughout most of its 1,000-mile length, but had little pavement. Ft. Smith, Muskogee, Tulsa, Dodge City, La Junta and Pueblo are some of the cities that lie along its path. It was named after Albert Pike, American author, soldier and explorer who first passed over the route in an expedition to Santa Fé.

ALBERTUS MAGNUS, ALBERT OF COLOGNE (?1206–1280), scholastic philosopher called *doctor universalis*. Albert was born of the family of the counts of Bollstädt, at Lauingen, in Suabia. In 1223 he joined the Dominican order, and after teaching in turn at Cologne, Hildesheim, Freiburg, Ratisbon, Strasbourg, and again at Cologne, was sent to Paris from 1245–48, and there acquired great fame. (Roger Bacon, who was by no means friendly towards Albert, speaks of him as "the most noted of Christian scholars.") When he returned to Cologne in 1248 to organize the *studium generale*, Thomas Aquinas, who had been under his direction at Paris, went with him. From 1254–57 he was provincial of the German province, during which time he defended the Mendicants against the University of Paris and its spokesman, William of St. Amour. From 1260–62 he held the bishopric of Ratisbon. From that date to 1270, when he returned to Cologne as a *lector*, he seems to have been travelling about preaching a crusade in Germany and Bohemia, and undertaking various other ecclesiastical missions in Wurzburg and Strasbourg. In 1277 he returned to Paris to defend the doctrines of Aquinas against the condemnations of Bishop Tempier. Albert's works, which were mostly completed before 1256, were published in 21 folio volumes by Jammy at Lyons in 1651, and reprinted in 36 volumes by Borguet (Paris, 1890). They include paraphrases of all of Aristotle's works, a commentary on the *Sentences* of Peter Lombard, an incomplete *Summa Theologiae*, a treatise against Averroes, and the curious *De Causis et Processu Universitatis*—a work of Neoplatonic colouring.

Albert has a remarkable affinity with the early Franciscan philosophers of Oxford; thus, his love of experimental science, and his knowledge of geography, astronomy, medicine, zoology and botany, are strongly reminiscent of Grosseteste and Bacon, while his interweaving of Aristotelian, Arabian, Jewish, Neoplatonic and Augustinian elements bears a close resemblance to the system of Thomas of York. However, as far as his Dominican successors are concerned, Albert's chief influence seems to lie in his successful propagation of an esteem for Aristotle. Hence his project of "adapting Aristotle to the use of the Latin races" was fulfilled in spite of the intense distrust of Aristotle that had been

aroused by the Paris condemnations of his works on natural science and metaphysics in 1210, 1215, 1231 and 1245.

See J. Sighart, *Albertus Magnus, sein Leben und seine Wissenschaft* (1876); Paget Toynbee, "Some Obligations of Dante to Albertus Magnus" in *Romania* (1895); E. Michael, *Geschichte d. deutschen Volkes vom 13 Jahrh.* (1903) v. iii. p. 445 *seq.* (for Albert's scientific interests); A. Schneider, *Die Psychologie Alberts d. Gr.* (1906); C. Baeumker, *Witelo* (1908) (for Albert's Neoplatonism); H. Lauer, *Die Moraltheologie Alberts d. Gr.* (1911); P. Mandonnet, *Siger de Brabant* (1911); L. Gaul, *Alberts des Grossen Verhaltnis zu Plato* (1913); G. von Hertling, *Albertus Magnus, Beiträge zu seiner Würdigung* (1914).

ALBERUS, ERASMUS (*c.* 1500–1553), German humanist and poet, was born at Sprendlingen, near Frankfort, and died at Neubrandenburg on May 5, 1553. He was almost the only member of Luther's party who commanded an effective weapon of satire. He ridiculed the Franciscan order in his *Barfüsser Mönche Eulenspiegel und Alkoran* (1542, preface by Luther), and gave his views on church and state in a collection of fables entitled *Buch von der Tugend und Weisheit* (1550). Some of his hymns are used in the Lutheran hymnal.

BIBLIOGRAPHY.—*Das Buch von der Tugend und Weisheit* has been edited by W. Braune (1892); the 16 *Geistliche Lieder* by C. W. Stromberger (1857). Alberus's prose writings have not been reprinted in recent times. *See* F. Schnorr von Carolsfeld, *Erasmus Alberus* (1894).

ALBI, a city of south-west France, in the department of Tarn, 48m. N.E. of Toulouse, on a branch line of the Southern railway. Pop. (1926) 21,994. It occupies a commanding position on the left bank of the Tarn, where its valley broadens as it emerges from the high *Plateau Central* towards the plain of Toulouse; a bridge crosses to La Madeleine (a suburb).

Albi (*Albiga*) was capital of the Gallo-Roman Albigenses, and later of the viscounty of Albigeois, a fief of the counts of Toulouse. From the 12th century onwards its bishops encroached on the authority of the viscounts and, after the Albigensian War, lost their estates, which passed ultimately to the Crown. By a convention (1264), the chief temporal power was granted to the bishops. A nucleus of narrow, winding streets is surrounded by boulevards, beyond which lie modern quarters. The cathedral of Sainte Cécile, a fine Gothic fortress-church built in 1277–1512, is without transepts or aisles; the rood-screen and the choir-enclosures (about 1500) are masterpieces. The 14th-century archbishop's palace to the north-east is fortified

The church of St. Salvi belongs to the 13th and 15th centuries. There are dye-works, cement-works, coal-mines, glass-works and important flour-mills. Hats, cloth fabrics, umbrellas, artificial silk and agricultural implements are also made. Trade is in wheat, wine, and prunes. Albi is the seat of an archbishop (1678), a prefect, and a court of assizes. It has tribunals of first instance and of commerce, a board of trade arbitrators and a chamber of commerce.

ALBIA, a city of Iowa, U.S.A., 68m. S E. of Des Moines, in a fertile farming and stock-raising district and in the Albia coal-field; the county-seat of Monroe county. It is a junction point of the Burlington, the Wabash, and the Minneapolis and St. Louis railways, and is the northern terminus of the Iowa Southern Utilities Company. It has several industrial plants, and is an important distributing centre for the coal and agricultural products of the region. The population in 1920 was 5,067; in 1925 (State census) 5,166.

ALBIGENSES, the usual designation of the heretics—and more especially the Catharist heretics—of the south of France in the 12th and 13th centuries. This name appears to have been given to them at the end of the 12th century, but the designation is hardly exact, for the centre of the movement was at Toulouse and in the neighbouring districts rather than at Albi (the ancient *Albiga*). The heresy, which had penetrated into these regions probably by trade routes, came originally from eastern Europe. The name of Bulgarians (*Bougres*) was often applied to the Albigenses, and they always kept up intercourse with the Bogomil sectaries of Thrace. Their dualist doctrines, as described by controversialists, present numerous resemblances to those of the Bogomils (*q.v.*), and still more to those of the Paulicians, with whom they are sometimes connected. It is exceedingly difficult, however, to form any very precise idea of the Albigensian doctrines, as our knowledge of them is derived from their opponents, and the very rare texts which have come down to us, emanating from the Albigenses (*e.g.*, the *Rituel cathare de Lyon,* ed. by Cunitz, Jena, 1852, and the *Nouveau Testament en provençal,* ed. by Clédat, Paris, 1887), contain very inadequate information concerning their metaphysical principles and moral practice. What is certain is that, above all, they formed an anti-sacerdotal party in permanent opposition to the Roman Church, and raised a continued protest against the corruption of the clergy of their time. The Albigensian theologians and ascetics, the Cathari or *perfecti,* known in the south of France as *bons hommes* or *bons chrétiens,* were few in number; the mass of believers (*credentes*) were perhaps not initiated into the Catharist doctrine; at all events they were free from all moral prohibition and all religious obligation, on condition that they promised by an act called *convenenza* to become "hereticized" by receiving the *consolamentum,* the baptism of the Spirit, before their death or even *in extremis.*

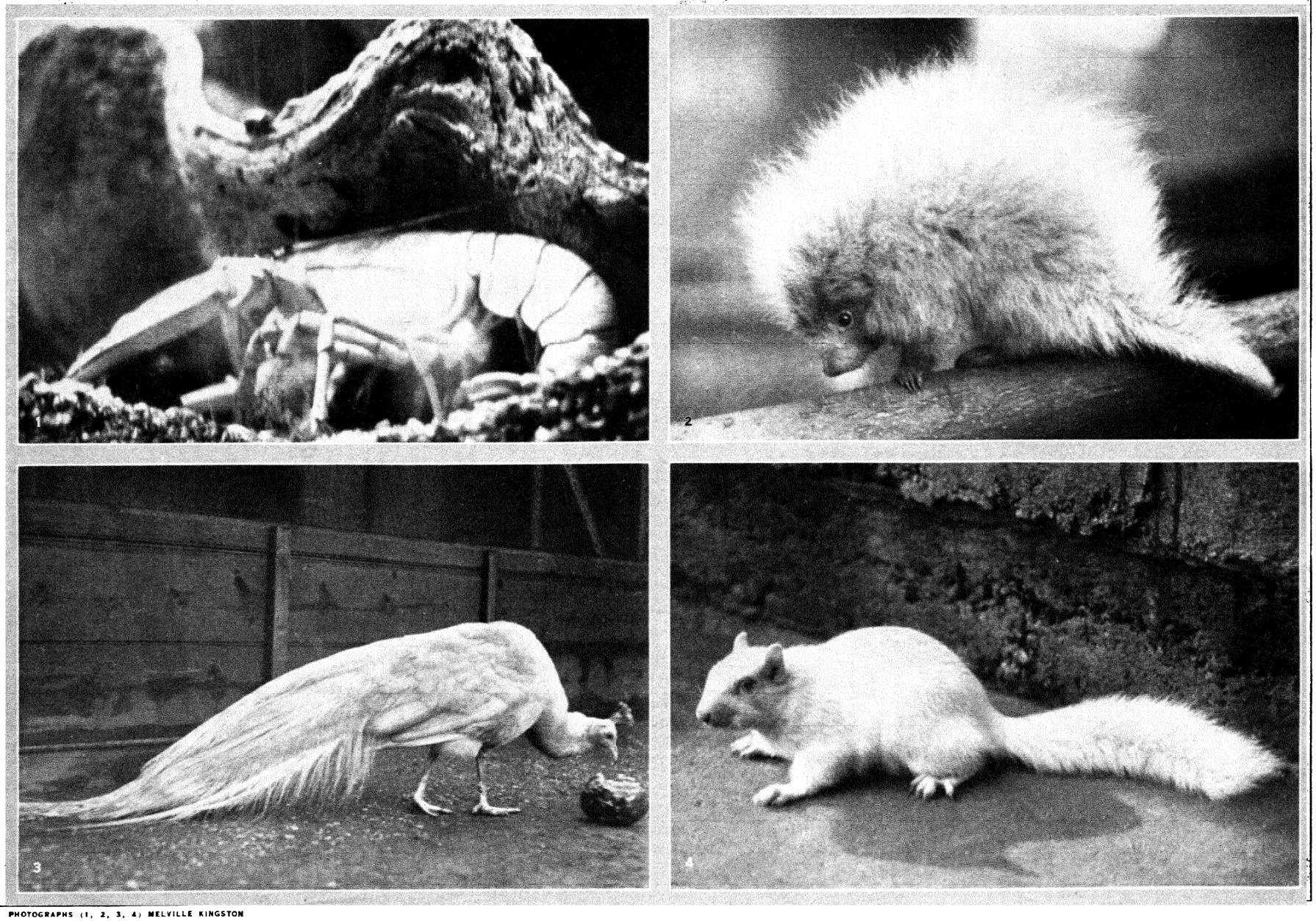
The first Catharist heretics appeared in Limousin between 1012 and 1020. Protected by William IX., duke of Aquitaine, and soon by a great part of the southern nobility, the movement gained ground in the south, and in 1119 the Council of Toulouse in vain ordered the secular powers to assist the ecclesiastical authority in quelling the heresy. The people were attached to the *bons hommes,* whose asceticism and anti-sacerdotal preaching impressed the masses, and the movement maintained vigorous activity for another hundred years, until Innocent III. ascended the papal throne. At first he tried pacific conversion; but his envoys had to contend not only with the heretics, the nobles who protected them and the people who listened to them and venerated them, but also with the bishops of the district, who rejected the extraordinary authority which the pope had conferred upon his legates. At last (1209) the pope ordered the Cistercians to preach the crusade against the Albigenses. This implacable war, which threw the whole of the nobility of the north of France against that of the south, and destroyed the brilliant Provençal civilization, ended, politically, in the Treaty of Paris (1229), which destroyed the independence of the princes of the south, but did not extinguish the heresy, in spite of the wholesale massacres of heretics during the war. The Inquisition, however, operating unremittingly in the south at Toulouse, Albi and other towns during the whole of the 13th century and a great part of the 14th, succeeded in crushing it. There were indeed some outbursts of rebellion, some fomented by the nobles of Languedoc (1240–42) and others emanating from the people of the towns, who were embittered by confiscations and religious persecutions, but the repressive measures were terrible. In 1245, the royal officers assisting the Inquisition seized the heretical citadel of Montségur, and 200 Cathari were burned in one day. Moreover, the Church decreed severe chastisement against all laymen suspected of sympathy with the heretics (Council of Narbonne, 1235; Bull *Ad extirpanda,* 1252).

Hunted down by the Inquisition and now abandoned by the nobles of the district, the Albigenses became more and more scattered, hiding in the forests and mountains, and only meeting surreptitiously. The sect, moreover, was exhausted and could find no more adepts in a district which, by fair means or foul, had arrived at a state of peace and political and religious unity.

BIBLIOGRAPHY.—*See* C. Schmidt's *Histoire de la secte des Cathares ou Albigeois* (1849), which is still the most important work on the subject. On the ethics of the Catharists, *see* Jean Guiraud, *Questions d'histoire et d'archéologie chrétienne* (1906); and P. Alphandéry, *Les idées morales chez les hétérodoxes latins au début du XIIIe siècle* (1903). *See* also under CATHARS.

ALBINISM: *see* PIGMENTATION.

ALBINO, a biological term (Lat. *albus,* white) for a pigmentless individual of a pigmented race. Pigmentation depends upon the presence and interaction in the tissues of colour-bases, chromogens, colourless in themselves, and ferments or enzymes which, acting upon the colour-bases, yield coloured products. If, therefore, either of these ingredients of pigmentation is absent from the constitution of an individual, it must perforce remain pigmentless, albinotic, even though in the environment in which it



PHOTOGRAPHS (1, 2, 3, 4) MELVILLE KINGSTON

ALBINOS: VARIATIONS OCCURRING IN CRUSTACEAN, RODENT AND BIRD FAMILIES

1. Lobster with the normal blue pigment almost entirely lacking
2. Tree porcupine, American rodent in which albinism is rather common
3. White peacock whose tail is like watered silk in appropriate light
4. Albino squirrel caught in Sussex, England, uncommon in the wild state

lives there are agents, such as sunlight, which are known to stimulate the production of pigment in the tissues of animals and plants exposed to their action. An albino is an individual whose tissues lack the power to elaborate either the ferments or the colour-bases.

In man the general colour of the skin ranges from the fair, almost pigmentless, condition of the Scandinavian to the almost ebony blackness of the natives of certain parts of Africa. These differences have been employed in the classification of races into white, yellow, red, brown, and black. The colour of the skin proper is creamy white. To this is added a tinge of yellow due to the presence of a yellow pigment in the skin. A further ingredient is black, due to the presence of minute granules of melanin, itself sepia in colour but, in masses, so completely absorbing the light that it appears black. Lastly, the red colour of the blood circulating in the minute vessels of the skin adds its tint. It is possible, by using a spinning top with a combination of these colours, white, yellow, red, and black in different proportions, to match any particular skin colour, and it is found, when this is done, that in all pigmented skins all these four colours can be identified, and that different proportions of the yellow and the black in combination correspond to different racial skin colorations. The relative proportions of these two pigments vary greatly in different individuals and in different regions of the body of one and the same individual.

Albinism is the condition, as estimated by this test, in which the black pigment is absent and in which the yellow is present only in relatively small amount.

The eyes of the albino are pink, this colour being the red of the blood circulating in the retinal blood vessels, as seen through the transparent tissues in front. The eyes are extremely sensitive to light and so the eyelids are kept partially closed, while blinking and a general wrinkling of the skin around the eyes are associated conditions which give to the albinotic individual a characteristic appearance. The hair on all parts is white, and all tissues, such as the brain and spinal cord, which in the normal individual are more or less pigmented, are in the albino completely devoid of this melanin

In the normal individual this black pigment would seem to serve a useful purpose In the case of the pigmented eye, the intensity of the light falling upon the retina is adequately diminished by the absorbing power of the retinal pigment, and this same melanin in the skin and hair, it is assumed with reason, protects the individual from the rays of the sun in tropical climes. The albino is seriously embarrassed in consequence of its deficiency, the albino animal much less so than the plant, however. Commonly in the breeding of corn or sorghum, when the self-fertilized seeds from an apparently normal green plant are sown, it is found that amongst the seedlings a number of spindling white plants make their appearance only to wither They die because they lack the pigment chlorophyll, so essential in the manufacture of food, and therefore in the life of the plant. When the seeds of such an albino-producing plant are carefully sown and the number of chlorophyll-possessing and chlorophyll-lacking seedlings are counted, it is found that the greens outnumber the albinos by about three to one. From this it is known that the parent plant was heterozygous for its character green, that albinism in plants as in animals behaves in inheritance as a simple Mendelian recessive, and that in the case of these plants this character in the homozygous condition (*see* MENDELISM) is lethal, since in the absence of chlorophyll the plant cannot assimilate its food.

Albinism has been recorded in the great majority of the species, breeds, and varieties of domesticated animals and of cultivated plants. There are many records of instances of the condition among wild mammals and birds. In the case of mankind it has been observed in most races and probably occurs in all. Its frequency is not known, but it is estimated at perhaps one in 10,000. To-day it is possibly most frequent among the Indians of Arizona and Mexico. Whatever may be the exact frequency of the albinotic in a species, it is certain, since the condition behaves as a Mendelian recessive, that there are far more "carriers" than affected individuals in any race in which albinos appear, and that though originally the condition made its appearance as a "sport" or mutation, resulting from some definite change in the hereditary material of some one individual, since that time its reappearance in the stock is the result of the shuffling and reshuffling of the hereditary factors in their transmission from generation to generation and of the matings of apparently normal individuals who, however, are heterozygous for this particular character, not showing the taint but carrying it and transmitting it to their progeny.

The differently coloured races of a species all have albinotic strains and these may each possess the colour-bases or the ferments of the particular race to which it belongs. Albinos are all alike in that they are unpigmented, but they differ remarkably in respect of their unexpressed pigmentation. Properly planned breeding experimentation reveals the hidden. Pigmented races are not coloured uniformly: there is always some suggestion of a differential regional distribution of pigment, some indication of a pattern, and breeding experimentation has shown that the hereditary factors for the different patterns are transmitted from one generation to another quite independently of those which relate to the actual colour of the skin or coat. Thus it is that an albino that cannot exhibit a pattern because it has no colour can possess in its hereditary constitution factors for one or other of the various patterns. It is known, for example, that when a pure-bred self-coloured mouse is mated with an albino, the pattern of the coats of the offspring is determined by hereditary factors that are known to be absent from the self-coloured stock and to be present in the stock out of which the albino was derived.

So far, complete albinism only has been discussed. Partial albinism is also known, and a study of this condition reveals the fact that the interaction of colour-base and colour-developer is conditioned by such agencies as temperature. The Himalayan rabbit is an excellent example of partial albinism. In this breed the eye is pink and the fur of the body is unpigmented, but the ears, legs, tail, and nose are black. It has been shown that if an area of the white-furred body is shaved and the animal kept in the cold (5–9°C) the new fur that grows is black, whereas if the animal is kept in a warmed room, the new fur is white as before. The baby coat of the Himalayan is all white and the pattern develops after a few weeks when the young are moving freely about. But if the naked baby rabbit is taken from the rest for about ten minutes on two successive days and exposed to a temperature of about 17°C, and especially if it is sponged with cold water, the fur when it is developed later is black all over the body. It follows that the essential ingredients for pigmentation are present in all parts of the skin but that ordinarily the pigment is elaborated only in certain well-defined areas. The Himalayan is a self-coloured race, but the power to elaborate pigment at ordinary temperatures differs in different regions of the body, certain areas being albinotic because normally the temperature of these parts is not that at which the enzyme and colour-base which are undoubtedly present can in their interaction yield pigment.

In certain animals such as the arctic fox, the stoat, ermine, and several hares, and in certain birds, the ptarmigan for example, the pigmented pelage or plumage of the summer and autumn is replaced in the winter by a white one. In the case of the hare, it is held by some that the autumn coat is moulted completely and that the winter coat is a new growth; others hold that there is no moulting but that the autumn coat itself becomes unpigmented; still others are of the opinion that both processes are involved, a whitening of the old fibres and a new growth of non-pigmented fibres. In the ptarmigan the pigmented feathers certainly become white. It is probable that in the hare and similar forms the whiteness is due to the presence of air in the pigmented fibres and consequently to the irregular reflection of the light from the surfaces of these air bubbles. In the case of the ptarmigan it is possible that the whiteness of the winter plumage is due to a seasonal increase in the activity of the thyroid gland, for it is established that if the active principle of the thyroid gland is administered to pigmented domestic fowls, the new feathers as they grow tend to be non-pigmented. It has not yet been shown conclusively that

this seasonal change from the pigmented to the non-pigmented condition is to be regarded as an instance of seasonal albinism.

Occasionally albinotic frogs or axolotls are recorded, but it is doubtful whether all these cases are true examples of albinism. It is more probable that they are individuals in which the pituitary gland or hypophysis at the base of the brain is abnormal; for experiment has shown that if this gland is removed from these animals, the pigment cells in their skin no longer expand and that therefore the animals must preforce remain very pale in colour. An injection of the active principle of the gland, pituitrin, turns them coal-black almost at once.

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(F. A. E. C.)

ALBINOVANUS PEDO, Roman poet, flourished during the Augustan age. He wrote a Theseis, referred to in a letter from his friend Ovid (*Ex Ponto*, iv. 10), epigrams which are commended by Martial (ii. 77, v. 5) and an epic poem (*cf.* Quintilian x. i. 90) on the exploits of Germanicus under whom he probably served (Tac. *Ann.*, i. 60). This may have been used as a source by Tacitus. All that remains of his works is a beautiful fragment, preserved in the *Suasoriae* (i. 15) of Seneca, describing the voyage of Germanicus (A.D. 16) through the river Ems to the Northern Ocean.

Three elegies were formerly attributed to Pedo by Scaliger; two on the death of Maecenas (*In Obitum Maecenatis* and *De Verbis Maecenatis moribundi*), and one addressed to Livia (*Consolatio ad Liviam de Morte Drusi* or *Epicēdion Drusi*, usually printed with Ovid's works); but it is now generally agreed that they are not by Pedo. The *Consolatio* has been put down as the work of a 15th century Italian imitator, there being no mss. and no trace of the poem before the publication of the *editio princeps* of Ovid in 1471. There is an English verse translation of the elegies by Plumptre (1907).

See Haupt, *Opuscula*, i. (1875); Bährens, *Poetae Latini Minores* (1879) and *Fragmenta Poetarum Latinorum* (1886); Haube, *Beitrag zur Kenntnis des Albinovanus Pedo* (1880).

ALBINUS, BERNARD SIEGFRIED (1697–1770), was born at Frankfurt-on-the-Oder, and from 1718 to his death on Sept. 9, 1770, occupied the chair of anatomy, surgery and medicine at Leyden. He was the first to show by injections the connection of the vascular systems of the mother and the foetus. He also edited with Boerhaave the works of Vesalius and of Harvey. But he is chiefly famed for the excellent drawings in his *Tabula sceleti et musculorum corporis humani* (Leyden, 1747). His *De ossibus corporis humani ad auditores suos libellus* appeared at Leyden, 1726.

ALBION, the most ancient name of the British Isles, generally restricted to England (in Ptolemy Ἀλουίων; Lat. *Albion*, Pliny 4, 16 [30], 102). The name is perhaps Celtic but the Romans connected it with *albus*, white, in reference to the chalk-cliffs of Dover, and A. Holder (*Alt-Keltischer Sprachschatz*, 1896) translates it *Weissland*, "white-land." The early writer (6th century B.C.) whose *Periplus* is translated by Avienus (end of 4th century A.D.) does not use the name Britannia; he speaks of *νῆσος Ἰέρνων καὶ Ἀλβιόνων* ("island of the Ierni and the Albiones"). So Pytheas of Massilia (4th century B.C.) speaks of Ἄλβιον and Ἰέρνη.

ALBION, a city of Calhoun county, Michigan, U.S.A., on the Kalamazoo river, 18 m. W. of Jackson. It is on the Michigan Central and the New York Central railways, and is connected by trolley with cities as far north as Grand Rapids and Owosso. The population was 8,354 in 1920 and was estimated locally at 9,400 in 1927. It has 16 factories. On a commanding site in the east part of the city is Albion college (Methodist Episcopal; co-educational), which had an enrolment of 765 students in 1926–27. Albion was settled in 1831, incorporated as a village in 1866, and chartered as a city in 1885. The city-manager form of government was adopted in 1915.

ALBION, a village in the north-western part of New York, U.S.A., about 10m. S. of Lake Ontario and 30m. W.N.W. of Rochester; the county-seat of Orleans county. It is served by the New York Central and an electric railway. The population was 5,206 in 1925 (State census). Albion is an important fruit-shipping point and has fruit and vegetable canning factories. It is the centre of the Medina sandstone quarries. The Albion State training school, a reformatory for women, was established in 1890. The village was settled in 1812, incorporated in 1823, and became the county-seat in 1825.

ALBITE, a mineral of the felspar group and forming the sodic end member of the plagioclases (*q.v.*) (from the Lat. *albus*, in allusion to the white colour of its crystals). Albite crystallizes in the triclinic system and has the chemical composition $NaAlSi_3O_8$. In petrology the name is not restricted to the pure sodium compound but is arbitrarily adopted for mixtures containing up to 10% of the anorthite ($CaAlSi_2O_8$) molecule, with which it forms solid solutions. Albite forms an essential constituent of many acid and alkaline igneous rocks, in granite, syenite, porphyry, trachyte, etc., whilst in the crystalline schists it is not infrequent as a metamorphic mineral.

ALBO-CARBON or **WHITE CARBON:** *see* NAPHTHALENE.

ALBOIN, d. 573, king of the Lombards and barbarian conqueror of northern Italy, succeeded his father Audoin about 565. The Lombards at that time occupied Noricum and Pannonia, and were engaged in constant war with the Gepidae. Alboin obtained the alliance of the Avars, and with their help destroyed the Gepidae, slew their king, Cunimund, in battle and married his daughter, Rosamund. On April 1, 568, Alboin had assembled his people with a great number of allies, among them 20,000 Saxons, to cross the Alps and form a new settlement in Italy. There appears to be no truth in the legend that the Lombards were invited to attack Italy by the Byzantine general, Narses. This was in effect a migration rather than a mere invasion. The Roman defences were overrun, Milan was occupied (Sept. 4, 569), and Pavia was invested. Lombard rule was established in northern Italy. But Alboin was murdered in 573 at the instigation of Rosamund, whom Alboin had insulted, so the story goes, by making her drink wine from her father's skull.

The authorities for the history of Alboin are Procopius, Paulus Diaconus and Agnellus (in his history of the Church of Ravenna).

See Hodgkin, *Italy and her Invaders*, vol. v.

ALBONI, MARIETTA (1823–1894), Italian opera-singer, was born at Cesena, Romagna, and studied at Bologna, where she became a pupil of Rossini. She had a magnificent contralto voice, and made her first appearance at La Scala, Milan, in 1843. In England her reputation was established by her appearance at Covent Garden in 1847, and she had brilliant success both in Europe and in the United States. She lived in Paris from 1866 onwards, and died at Ville d'Avray in 1894.

ALBORADA (*Span.*) signifies strictly a sunrise song or morning serenade akin to the French aubade (*q.v.*) but is now applied to a particular kind of instrumental music of a popular type to be heard in certain parts of Spain, the instruments employed being generally the bagpipes and side drum.

ALBORNOZ, GIL ALVAREZ DE, Spanish cardinal, was born at Cuenca early in the 14th century and died at Viterbo in 1367. He was made archbishop of Toledo in 1337 and cardinal in 1350. In 1353 Innocent VI. sent him from Avignon as legate into Italy with a mission to secure the restoration of the papal authority in the States of the Church. By 1362 he had paved the way for the return of Urban V. to Rome. As legate, Albornoz showed himself to be an astute manager of men and an effective fighter. He began by making use of Rienzi, whose release from prison at Avignon he secured. After the murder of the tribune in 1354 Albornoz pursued his task of restoring the Pope's authority by intrigue and force. A work by Albornoz on the constitution of the Church of Rome, first printed at Jesi in 1473, is now very rare.

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ALBRECHT, the German form of Albert (*q.v.*).

ALBRECHTSBERGER, JOHANN GEORG (1736–1809), famous Austrian musical theorist and teacher, was born at Kloster-Neuburg, and died in Vienna. He studied composition under the court organist, Mann, and became one of the most learned and skilful contrapuntists of his age. In 1772 he was appointed organist to the court of Vienna, and in 1792 *Kapellmeister* of St. Stephen's cathedral. His fame attracted a large number of pupils, among whom were Beethoven, Hummel and Moscheles. His compositions, consisting of preludes, fugues and sonatas for the piano and organ, string quartets, etc., are of small importance, and most of them exist only in manuscript, being preserved in the library of the Vienna *Gesellschaft der Musikfreunde*. In 1790 he published at Leipzig his *Gründliche Anweisung zur Komposition*. A collection of his writings on harmony, in three volumes, was published under the care of his pupil Ignaz von Seyfried (1776–1841) in 1826 (English version 1855).

ALBRET. The lordship (seigneurie) of Albret (Labrit, Lebret), situated in the Landes, gave its name to a powerful French family. Arnaud Amanieu, lord of Albret, helped to take Guienne from the English. His son Charles became constable of France, and was killed at the battle of Agincourt in 1415. Alain the Great, lord of Albret (d. 1522), wished to marry Anne of Brittany, and to that end fought against Charles VIII.; but on the betrothal of Anne to Maximilian of Austria, he surrendered Nantes to the French in 1486.

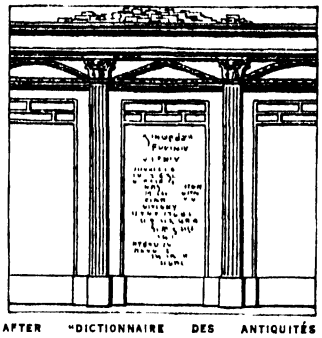
John of Albret, son of Alain, became king of Navarre by his marriage with Catherine of Foix. Their son Henry, king of Navarre, was created duke of Albret and peer of France in 1550. By his wife Margaret, sister of the French king, Francis I, he had a daughter, Jeanne d'Albret, queen of Navarre, who married Anthony de Bourbon, duke of Vendôme, and became the mother of Henry IV., king of France.

ALBUERA, LA (or ALBUHERA), a small village of Spain, in the province of Badajoz, 13m. S E. of the town of that name, insignificant in itself but celebrated on account of the victory gained there on May 16, 1811, by the British, Portuguese and Spaniards, under Marshal Beresford, over the French army commanded by Marshal Soult.

After Portugal had been cleared of the French invading army under Masséna, Wellington sought to secure his position by recovering the frontier fortresses. He himself invested Almeida while Beresford was sent with 10,000 Spaniards, 9,000 Portuguese and 9,000 British only, to lay siege to Badajoz. But the latter was hardly in position before Soult moved upon him from the south with 27,000 veterans. Beresford took up a covering position at Albuera, astride the road to Badajoz, but his dispositions were faulty and Masséna, feinting at a direct thrust down the road, made a concealed manoeuvre round the allied right flank. Here the Spanish were cut to pieces or dispersed, a British brigade, hurrying to their aid, was annihilated by the French cavalry, and only a thin line of 1,800 British "red-coats" strung out on a ridge intervened between the French mass of manoeuvre and complete victory. Thin as it was, being a line, it overlapped the front of the massed French columns, and thus gained full value from its fire. For half an hour both sides poured a heavy musketry fire into each other's ranks at point-blank range, and then the nerves of the French snapped under the exorbitant toll, and their columns rolled back down the slopes, gaining momentum as they went until their retirement became a rout. The French losses were some 8,000, and those of the British 4,000 in all, while the Spaniards lost 1,400. Strategically, Beresford's decision to fight was a mistake, for the siege had already been abandoned on Soult's approach; it exposed him to disaster when isolated, and even as it was the losses grievously impaired Wellington's strength. But morally, it had a vital influence on subsequent encounters.

ALBUFERA DE VALENCIA, lagoon, 7m. south of Valencia in Spain, about 12m. long, 14m. broad and 12ft. deep (max.), with a narrow outlet to sea under control. It is crown property and rich in fish and wild fowl, and rice is grown around it. Napoleon made Marshal Suchet duke of Albufera (1812) after the conquest of Valencia. After the battle of Vittoria (1813) he lost the domain but kept the title. Later, the Spanish nation gave the revenues of Albufera to the duke of Wellington.

ALBULA PASS, the principal route form the north to the Upper Engadine in the Grisons. It was used in the 13th century and a carriage road (highest point, 7,505ft.) was made across it in 1865, but for a long time it was not as much used as the easier and more direct Julier pass (7,504ft.). The opening of the railway in 1903, however, vastly increased its importance Starting from Coire the railway follows the Rhine to Reichenau (6¼m), and then the Hinter Rhine to Thusis (10½m). It then runs through the grand Schyn gorge (cut by the Albula torrent) to Tiefenkastell (7½m.), where it leaves the Julier road on the right (south), and continues to follow the course of the Albula past Filisur and Bergün (12½m.) to the mouth (5,879ft.) of the tunnel (3¾m. in length; highest point, 5,987ft.) which has been pierced below the pass. The railway descends through the Bevers glen to Bevers (2½m.), in the Upper Engadine, about 5m. below St. Moritz, which is 56m. from Coire by this route.



AFTER "DICTIONNAIRE DES ANTIQUITÉS GRECQUES ET ROMAINES"

AN ALBUM FOUND IN POMPEII, ITALY, AT THE ENTRANCE OF ONE OF THE STREETS LEADING TO THE FORUM

ALBUM, in ancient Rome, a board chalked or painted white, on which public notices were inscribed in black. The *Annales Maximi* of the Pontifex Maximus, the annual edicts of the praetor, the lists of senators and jurors, the *Acta Diurna*, etc., were exhibited in this manner In modern times *album* denotes a book of blank pages in which autographs, sketches, or the like, are collected. It is also applied to the official list of matriculated students in a university, and to the roll in which a bishop inscribes the names of his clergy. In law, the word is the equivalent of *mailles blanches*, for rent paid in silver ("white") money.

ALBUMAZAR or properly **ABU-MAASCHOR** (805–885), Arab astronomer, was born at Balkh, flourished at Baghdad and died at Wasid in Central Asia. His principal works were translated into Latin. *De Magnis Conjunctionibus* (Augsburg, 1489); *Introductorium in Astronomiam* (Venice, 1506) and *Flores Astrologici* (Augsburg, 1488). He maintained in the first that the world, created when the seven planets were in conjunction in the first degree of Aries, will come to an end at a like conjunction in the last degree of Pisces. Albumazar's name is used for the subject of *L'Astrologo* by Gian Battista del Porta (1606), a play which was adapted in *Albumazar* by John Tomkis, played before James I. in 1614, revived by Dryden in 1748.

See *Biog Universelle* (Jourdain); Lalande, *Bibliographie Astronomique;* Poggendorff, *Biog. literarisches Handworterbuch;* Houzeau, *Bibl. Astronomique.*

ALBUMIN or **ALBUMEN** was originally used to denote the main constituent of the white of eggs. It was then applied to any of the substances of similar properties and composition found in vegetable and animal cells and also in milk and eggs. These substances are now known as proteins, and the albumins are regarded as a particular group of this very complex class. The special properties of the albumins are described in the article on proteins (*q.v.*).

ALBUMINOIDS: *see* PROTEINS

ALBUMINS: *see* PROTEINS.

ALBUMINURIA, a general name for conditions in which the urine contains proteid matter. Normally the secreting and conducting parts of the urinary system hold back in the blood, out of which the urine is formed, all protein. But when the kidney is diseased (*see* KIDNEY, DISEASES OF), whether primarily or secondarily, its efficiency as a filter is impaired and albumin

appears in the urine. As a rule this is in the form of serum-albumin and serum-globulin, but occasionally it occurs as albumoses (albumosuria). Under certain conditions the urine may contain albumin in individuals apparently quite healthy (physiological albuminuria). The most common cause is strenuous muscular exertion, but in some individuals there occurs, intermittently, an albuminuria (paroxysmal albuminuria) which appears without obvious cause beyond perhaps a trivial exposure to cold. Cases in which the urine contains blood (haematuria) or its colouring matter (haemoglobinuria), both of which are proteins, are not included under albuminuria. Owing to its importance as a symptom, its existence in a candidate for life assurance is usually regarded by the company as a complete bar to acceptance of the risk. In inflammatory conditions of the bladder and urethra, albumin is often present in the urine, in a sense as an accident.

(W. S. L.-B.)

ALBUQUERQUE, ALPHONSO D' (in old Portuguese AFFONSO D'ALBOQUERQUE) (1453–1515), surnamed THE GREAT, and THE PORTUGUESE MARS, was born in 1453 at Alexandria, near Lisbon, and educated at the court of Alphonso V. In 1503 he set out on his first expedition to the East. He sailed round the Cape of Good Hope to India, where he obtained from the king of Cochin permission to build a Portuguese fort. He returned home in July 1504, and King Emmanuel gave him the command of a squadron of five vessels in the fleet of 16 which sailed for India in 1506 under Tristan da Cunha. After a series of attacks on the Arab cities on the east coast of Africa, Albuquerque separated from Da Cunha, and captured (Sept. 1507) the island of Ormuz, in the Persian Gulf, which was then one of the chief centres of commerce in the East. He was unable long to maintain his position.

With his squadron increased by three vessels, he reached the Malabar coast at the close of 1508, and produced a commission from the king empowering him to supersede the governor Francisco de Almeida. The governor's reply was imprisonment, from which Albuquerque was only released on the arrival of the grand marshal of Portugal with a large fleet. An unsuccessful attack upon Calicut in Jan. 1510 was immediately followed by the investment and capture of Goa Albuquerque abandoned the town in August, to return with the reinforcements in November, when he obtained undisputed possession. He next directed his forces against Malacca, which he subdued after a severe struggle. He remained in the town nearly a year to consolidate the position. In 1512 he sailed for the coast of Malabar On the voyage, Albuquerque's vessel, the "Flor de la Mar," which carried the treasure he had amassed in his conquests, was wrecked, and he himself barely escaped with his life In September of the same year he arrived at Goa, where he quickly suppressed a serious revolt headed by Idalcan.

Albuquerque had been for some time under orders from the home Government to undertake an expedition to the Red Sea, in order to secure that channel of communication exclusively to Portugal. He accordingly laid siege to Aden in 1513, but was repulsed; and a voyage into the Red Sea, the first ever made by a European fleet, led to no substantial results. His last success was the recapture in 1515 of the island of Ormuz, which remained in the possession of the Portuguese until 1622. Albuquerque had several enemies at the Portuguese court, and on his return from Ormuz, at the entrance of the harbour of Goa, he met a vessel from Europe bearing despatches announcing that he was superseded by his personal enemy, Soarez. He died at sea on Dec. 16, 1515. Before his death he wrote a letter to the king in dignified and affecting terms, vindicating his conduct and claiming for his son the honours and rewards due to himself.

His body was buried at Goa, and it is, perhaps, the most convincing proof possible of the justice of his administration that, many years after, Mussulmans and Hindus used to go to his tomb to invoke protection against the injustice of his successors. His natural son Affonso published a selection from his father's papers under the title *Commentarios do Grande Affonso d'Alboquerque.*

BIBLIOGRAPHY.—*See* the *Cartas de Albuquerque,* published by the Lisbon Academy (vol. i., 1884); also Morse Stephens's *Life of Albuquerque* in the "Rulers of India" series; an article in the *Bolitim* of the Lisbon Geographical Society (Jan. to June 1902) on "O antigo Imperialismo portuguez, etc.," has especial reference to Albuquerque.

ALBUQUERQUE, MATHIAS DE (d. 1647), Portuguese general, was governor of Pernambuco in 1624 and, after the Dutch captured Bahia, governor-general of North Brazil. As governor in Pernambuco again, in 1629, he had to meet the Dutch invasion of that province, and in 1630 was forced to surrender Olinda and the forts of the Recif. Sent back to Portugal in disgrace in 1635, he took part, later, in the Portuguese War of Liberation, defeating the Spaniards under Mölingen at Montijo, on May 26, 1644, and thereby earning the title of Count of Allegrete. He died at Lisbon June 9, 1647.

ALBUQUERQUE, the largest city of New Mexico, U.S.A., near the centre of the state, in a fertile strip of land on the east bank of the Rio Grande; on the National Old Trails road, and at the junction of two main lines of the Santa Fé railway system. It is the county-seat of Bernalillo county. Between 1900 and 1920 the population increased from 6,238 to 15,157; in 1925 it was estimated by the United States Census Bureau at 21,000.

The city lies at an altitude of 4,954ft., and the average annual precipitation is less than 8in. The bracing climate and the large proportion of sunshiny days have given it an established reputation as a health resort, and it has several private sanatoria for the treatment of tuberculosis.

Albuquerque is the commercial capital of an irrigated farming district, of the sheep and cattle business, and the lumber industry of the state. It ships large quantities of wool. Its industrial establishments include saw and lumber mills, a sash factory, foundry and machine shops, woollen mills, brick yards, railway repair shops, and plants making cement blocks, harness and farm implements. In 1925 there were 28 factories, with an output valued at $5,016,303, which was 26% of the valuation for the entire state. On the plateau, about a mile east of the business district, stands the University of New Mexico (opened in 1892). In 1926–27 it had an enrolment of 638 and a library of 65,000 volumes, including a collection on the history of the state. An adaptation of the Pueblo style of architecture has been used in the university buildings and in many public buildings of the city

Albuquerque is in the heart of the Pueblo Indian country, and is an important market for Indian blankets. There is a federal industrial training school for Indian boys and girls. Within easy motoring distance are the pueblos of San Felipe, which has a church built by Fray Cristobal de Quinones (d. 1609); of Isleta and Santo Domingo, where fine ceremonial dances are still performed; of picturesque Laguna, with its interesting mission church; and of Acoma, perched on a precipitous mesa 357ft. high, which was already very old when Fray Marcos arrived in 1539.

The "old town," which lies along the river bank, was founded in 1701 by Gov. Pedro Rodríquez y Cubero, and named by him after the Duke of Alburquerque, a viceroy of New Spain. The Duke ordered the name to be changed to San Felipe de Alburquerque, as a compliment to the reigning king. With the passage of time it became reduced to one word, and that word lost one of its r's. The mission church of San Felipe de Neri (1735) is still standing, and the entire district keeps its old Spanish character. It was an important centre in the Spanish and the Mexican occupations. During the Civil War it was occupied by Confederate troops (Feb. 1862) under Gen. Henry Hopkins Sibley, who soon afterwards advanced into northern New Mexico. In his retreat into Texas he made a stand here, on April 8, 1862, against a detachment of Union troops commanded by Colonel R. S. Canby. The modern city was founded in 1879; the railway reached it in 1880; by 1890 it had a population of 3,785. A commission-manager form of government was adopted in 1917.

ALBURNUM (sapwood), the outermost and youngest part of the wood of a tree, through which the upward water current mainly passes. It is distinguished from the harder inner and older wood, the duramen or heart-wood.

ALBURY, a small country town of rising importance in Goulburn county, New South Wales. Situated at an elevation of 542ft. on the right (north) bank of the river Murray (*q.v.*),

approximately 1,470m. from its mouth, Albury marks the head of possible navigation (July–December) on this stream, though at present river steamers normally ply only as far as Echuca. Its position, again, on the western flank of the eastern highlands, not far from the point of debouchment of the Murray, and in the general line of connection between Melbourne and Sydney, constitutes Albury a crossing-place of some importance. As a fording point it has figured in the history of Australian exploration. In 1883 the Victoria and New South Wales railway systems were connected at this point, and Albury is now a bridge town on the main line linking Victoria and New South Wales (Albury–Sydney *c.* 350m , Albury–Melbourne *c.* 190 m.), and also the eastern and western portions of the continent (Transcontinental line, Fremantle and Perth–Brisbane). The river is crossed by means of an iron bridge from Wodonga on the Victorian side, and here also is a break of gauge (Victorian system: 5′ 3″; N S.W.: 4′ 8½″). A little above Albury is the confluence of the Murray with its tributary the Mitta Mitta. Albury, therefore, figures in the now historic River Murray Agreement (1914), and it will acquire further considerable importance as a result of the execution of the schemes under that agreement, notably that of the Hume reservoir. Albury, which has a mean annual temp of 60·7°; mean annual rainfall: 27·65in , of which 18·9in. falls in the seven months, April–October, is the centre and virtual capital of the eastern Riverina, a rich agricultural and pastoral district producing wheat, fruit and sheep. Albury became a municipality in 1859, and has shown a steady rise in population (1891, 5,447; 1921, 7,752; 1924, 8,310).

ALCAEUS or **ALKAIOS** (*c.* 600 B C), Greek poet, holds second place in the Alexandrian lyric canon. He was a contemporary of Sappho, and a member of one of the noble families of Mitylene

In the war against the Athenians (606), he fled from battle with the loss of his shield His political enemies drove him into exile, but towards the end of his life he is said to have been pardoned by Pittacus. His poems, which were written in the Aeolic dialect, included hymns; political poems (*stasiōtica*), in which he abused the tyrants, his political enemies; love-songs; and drinking-songs He seems to have invented the Alcaic metre, and was regarded as a model by Horace.

See Bergk, *Poetae Lyrici Graeci* (1882); also *The Songs of Alcaeus*, by J. Easby-Smith (Washington, 1901); Plehn, *Lesbiacorum Liber* (1826); Flach, *Geschichte der griechischen Lyrik* (1883–84); Farnell, *Greek Lyric Poets* (1891). New fragments edited by J. M. Edmonds (1909). *See* also Edgar Lobel, Ἀλκαίου Μέλη, *the Fragments of the Lyrical Poems of Alcaeus* (Oxford, 1928).

ALCAICS, the name of several lyric verses, from Alcaeus of Lesbos, their supposed inventor. They comprise:

(1) Alcaic hendecasyllable: ⏑ – ∪ – ⏑ – ∪ ∪ – ∪ ⏑

Examples: Latin, "odi profanum volgus et arceo"
English imitation, "O mighty-mouthed inventor of harmonies."

(2) Alcaic decasyllable: – ∪ ∪ – ∪ ∪ – ∪ – ⏑

Examples: Latin, "virginibus puerisque canto."
English imitation, "Milton, a name to resound for ages."

(3) Alcaic enneasyllable: ⏑ – ∪ – ⏑ – ∪ – ⏑

Examples: Latin, "audita Musarum sacerdos"
English imitation, "God-gifted organ-voice of England."

The Alcaic stanza consists of (1) twice repeated, followed by (3) and then (2), once each. It was a great favourite, not only of its inventor, but of Horace, who made some very slight modifications to adapt it to Latin. In modern languages it has been imitated by Tennyson (from whom the above English lines are taken) and occasionally by poets in other languages, but never with much success.

The manner in which the lines should be divided into feet is, in this as in all "Aeolic" metres, a highly controversial point.

ALCAIDE, a Spanish title meaning the governor of a fortress (Arabic *al-quāid*).

ALCALÁ (Moorish *al kala*, the "Fortress" or "Castle"), the name of thirteen Spanish towns, all founded or named by the Moors. Alcalá de Henares, pop. (1920) 11,142, is separately described on account of its historical importance. Alcalá la Real (17,267), a picturesque town with a fine abbey, is situated in the mountainous south-west part of Jaén Its distinctive name *la Real*, "the Royal," was conferred in memory of its capture by Alphonso XI. of Leon in 1340. In 1810 the French under Count Sebastiani here defeated the Spaniards. Alcalá de los Gazules (9,959), on the river Barbate, in the province of Cadiz, trades in cork and agricultural produce Alcalá de Guadaira (11,038), on the river Guadaira, near Seville, is popularly called Alcalá de los Panaderos, or "Alcalá of the Bakers," because it supplies Seville with large quantities of bread; it also manufactures for export the best "Seville oil."

ALCALA DE HENARES, Spain, 17m. E N E. of Madrid, on the river Henares. Pop. (1920) 11,142. Alcala de Henares contains a military academy. The town has been identified with the Roman *Complutum*, destroyed about 1000, and rebuilt by the Moors in 1083. Later its university, founded by Cardinal Jimenes de Cisneros in 1510, was second only to that of Salamanca. Here the famous *Complutensian Polyglot* Bible was prepared from 1514 to 1517. The college of San Ildefonso completed in 1583, was the chief university building. Its modernized Gothic church, the Colegiata, contains the 16th century marble monument of Jimenes (d. 1517) and a fine reredos.

On the removal of the university to Madrid in 1836 the town declined, and the university buildings became archives of state departments and of the Inquisition. One of the principal libraries is the former palace of the archbishops of Toledo

BIBLIOGRAPHY.—H. Florez and others, "Annales Complutenses" and "Chronicon Complutense" in *España Sagrada* (1754–1879); Galo Sanchez, *Fueros Castellanos de Soria y Alcalá de Henares* (1919).

ALCALDE, the title in Spanish for officials of somewhat varied functions in which, however, there is always a judicial element. *Alcalde de corte* was a judge of the palace court, having jurisdiction in and about the residence of the king. But the title is now exclusively used for the mayor of a town or village who discharges the functions of a justice of the peace. The title of *alcalde* must be carefully distinguished from *alcaide* (*q v.*) which means the governor of a fortress

ALCAMENES, a Greek sculptor of Lemnos and Athens. He was a younger contemporary of Pheidias and noted for the delicacy and finish of his works, among which a Hephaestus and an Aphrodite "of the Gardens" were conspicuous. Pausanias says (v. 10, 8) that he was the author of one of the pediments of the temple of Zeus at Olympia (*see* GREEK ART), but this seems a chronological and stylistic impossibility. At Pergamum there was discovered in 1903 a copy of the head of the Hermes "Propylaeus" of Alcamenes (*Athenische Mittheilungen*, 1904, p. 180). It is safer, however, to judge him by the sculptural decoration of the Parthenon, in which he must almost certainly have taken a share under the direction of Pheidias.

ALCAMO, province of Trapani, Sicily, 24m. W S W. of Palermo direct (51½m. by rail). Population (1921) 63,051. The Saracenic chief Al-Kamuk erected the castle (A.D. 828), considerably altered since. Frederick II. removed the site lower down (1233). The surrounding district is very fertile.

ALCANTARA, a small seaport of Brazil, in the State of Maranhão, on the west shore of the bay of São Marcos, 10m. from the city of Maranhão by water. It has a fairly good harbour, and excellent cotton and rice are grown in the vicinity and shipped from the port.

ALCÁNTARA, western Spain, province of Cáceres, on a rocky height on the left bank of the river Tagus, 7m. from the Portuguese frontier. Pop. (1920) 3,954. Alcántara (in Arab. "the bridge") owes its name to the magnificent Roman bridge which spans the Tagus on the northwest, built about A.D. 105, in honour of the emperor Trajan and at the cost of eleven Lusitanian communities. A small temple, dedicated to Trajan and other deified emperors, adjoined the bridge on the left bank Though it has been identified with Norba Caesarea and with Interamnium, it is doubtful whether there was a Roman town here. It became famous about 1215 as the stronghold of the knights of Alcántara, many of whose grand masters lie buried in the 13th-century Gothic church.

ALCAVALA, a duty charged in Spain and its colonies until the invasion of Napoleon (from Arab. *al-quabalah,* "tax," *quabala,* "to receive"; *cf.* Fr. *gabelle*). Originally imposed in 1341 by Alphonso XI. to secure freedom from the Moors, it was an *ad valorem* tax of 10%, increased afterwards to 14%, on the selling price of all commodities, whether raw or manufactured, and chargeable as often as they were sold or exchanged. This was a monstrous imposition which subjected every farmer, manufacturer, merchant and shopkeeper to the continual visits and examination of the tax-gatherers, whose number was necessarily very great.

ALCAZAR, B. DEL (1530–1606), Spanish poet, was born at Seville. He served under the Marqués de Santa Cruz and afterwards in the households of the Duque de Alcala and of the Conde de Gelves. Alcazar belonged to the Italianate school and modelled himself on Martial. The grace and cynicism of Baltasar del Alcazar are manifested in his *Poesias* (ed. F. R. Marin, 1910).

ALCÁZAR DE SAN JUAN or **ALCÁZAR,** Spain, province of Ciudad Real, and an important railway junction, where the lines to the east and south-east diverge from the main line to Andalusia. Pop. (1920) 16,117. Alcázar trades in wine and manufactures soap, gunpowder, chocolate and inlaid daggers. It is sometimes identified with the Roman *Alce,* captured by Tiberius Sempronius Gracchus in 180 B.C. It derives its name from its mediaeval Moorish castle (*al-kasr*), afterwards garrisoned by the knights of St. John. The entire district is associated with Cervantes and with the action of *Don Quixote* (El Toboso, 12m. E.N.E ; Argamasilla de Alba, 22m. S.E.). Local antiquaries even identify the knight with Don Rodrigo de Pacheco, whose portrait adorns the parish church.

ALCESTER, FREDERICK BEAUCHAMP PAGET SEYMOUR, Baron (1821–95), British admiral, was born April 12, 1821 Entering the navy in 1834, he served in the Mediterranean and the Pacific, was for three years flag-lieutenant to his uncle Sir George Seymour, and was promoted to be commander in 1847. He had a distinguished naval record and held a series of high commands. In 1880–83 he was commander-in-chief of the fleet in the Mediterranean, and in 1880 had also the chief command of the European squadron sent to the coast of Albania as a demonstration to the Porte to cede Dulcigno to Montenegro. In July 1882 Admiral Seymour commanded at the bombardment of Alexandria and in the subsequent operations on the coast of Egypt, for which service he was raised to the peerage, received a parliamentary grant of £25,000, the freedom of the City of London and a sword of honour. He retired from the service in 1886, and died in London, March 30, 1895.

ALCESTER (aw'stur), a market-town, Warwickshire, 16m. W.S.W. of Warwick on the Great Western, Southern, and London, Midland and Scottish railways. Population of parish (1921) 2,259. It is situated at the junction of the small stream Alne with the Arrow, a northern tributary of the Avon.

The name (Alnecestre, Alyncester) signifies "the camp on the Alne." A small Romano-British town or village was situated here on the road which ran from Derby to join the Fosse Way near Cirencester. Pavements, potsherds, coins and burials have been found, but nothing to indicate an important station. No written document relating to Alcester exists before the reign of Henry I. when it seems to have been a royal borough, but the title of borough soon lapsed. In the reign of Henry III. a moiety of the manor was purchased by Sir Walter Beauchamp, who granted a charter establishing a Tuesday market for corn, cattle and all kinds of merchandise, and also obtained grants of fairs. In 1444 Sir John Beauchamp purchased the remaining moiety of the manor, and was granted an additional fair. From this date the Beauchamps were lords of the whole manor until it passed by female descent to the Grevilles in the reign of Henry VIII. In 1140 a Benedictine monastery was founded here by Ralph Boteler of Oversley, and received the name of the Church of Our Lady of the Isle, owing to its insulation by a moat meeting the River Arrow. The monastery was suppressed among the smaller houses in 1536. Traces of the moat and the foundations are still to be seen in Priory Close. The ancient fairs survived to the end of the 19th century. The church of St. Nicholas was rebuilt in 1734.

The manufacture of needles, which employed nearly 1,000 hands in 1830, is now unimportant, having been absorbed into the centre of the industry at Redditch. There are implement and cycle works, metal glazing and polishing being a special feature.

ALCESTIS, in Greek legend, the wife of Admetus (*q.v.*).

ALCHEMY. In the narrow sense of the word, alchemy is the pretended art of making gold and silver, or transmuting the base metals into the noble ones. The idea of such transmutation probably arose among the Alexandrian Greeks in the early centuries of the Christian era; thence it passed to the Arabs, by whom it was transmitted to western Europe, and its realization was a leading aim of chemical workers down to the time of Paracelsus and even later. Alchemy in its wider and truer significance stands for the chemistry of the middle ages The idea of transmutation, in the country of its origin, had a philosophical basis, and was linked up with the Greek theories of matter there current; thus, by supplying a central philosophical principle, it to some extent unified and focused chemical effort, which previously, so far as it existed at all, had been expended on acquiring empirical acquaintance with a mass of disconnected technical processes. Alchemy in this sense is merely an early phase of the development of systematic chemistry; in Liebig's words, it was "never at any time anything different from chemistry."

Regarding the derivation of the word, there are two main views which agree in holding that it has an Arabic descent, the prefix *al* being the Arabic article. But according to one, the second part of the word comes from the Greek χυμεία, pouring, infusion, used in connection with the study of the juices of plants, and thence extended to chemical manipulations in general; this derivation accounts for the old-fashioned spellings "chymist" and "chymistry." The other view traces it to *khem* or *khamé,* hieroglyph *khmi,* which denotes black earth as opposed to barren sand, and occurs in Plutarch as χυμεία ; on this derivation alchemy is explained as meaning the "Egyptian art." The first occurrence of the word is said to be in a treatise of Julius Firmicus, an astrological writer of the 4th century, but the prefix *al* there must be the addition of a later copyist. In English, *Piers Plowman* (1362) contains the phrase "experimentis of alconomye," with variants "alkenemye" and "alknamye." The prefix *al* begins to be dropped about the middle of the 16th century.

Origins of Alchemy.—Numerous legends cluster round the origin of alchemy. According to one story, it was founded by the Egyptian god Hermes (Thoth), the reputed inventor of the arts and sciences; after him later alchemists called their work the "hermetic art," and the seal of Hermes, which they placed upon their vessels, is the origin of the common phrase "hermetically sealed" Another legend asserts that the fallen angels taught the arts to the women they married, their instruction being recorded in a book called *Chemā.* A similar story appears in the Book of Enoch, and Tertullian has much to say about the wicked angels who revealed to men the knowledge of gold and silver, of lustrous stones and of the power of herbs, and who introduced the arts of astrology and magic upon the earth. Another legend, to be found in Arabic sources, asserts that alchemy was revealed by God to Moses and Aaron. But there is some evidence that, in accordance with the strong and constant tradition among the alchemists, the idea of transmutation did originate in Egypt with the Greeks of Alexandria. In the Leyden museum there are a number of papyri which were found in a tomb at Thebes, written probably in the 3rd century A.D., though their matter is older. Some are in Greek and demotic, and one, of peculiar interest from the chemical point of view, gives a number of receipts, in Greek, which show a considerable knowledge in the manipulation of base metals to form alloys which simulate gold, and are intended to be used as a workshop manual in the manufacture of imitation jewellery. Possibly this is one of the books about gold and silver of which Diocletian decreed the destruction about A.D. 290. It has been suggested by M. P. E. Berthelot that the workers in these processes, which were a monopoly of the priestly caste and were

kept strictly secret, though fully aware that their products were not truly gold, were in time led by their success in deceiving the public to deceive themselves also, and to come to believe that they actually had the power of making gold from substances which were not gold. Philosophical sanction and explanation of this belief was then found by bringing it into relation with the theory of the *prima materia,* which was identical in all bodies but received its actual form by the adjunction of qualities expressed by the Aristotelian elements—earth, air, fire and water. Some support for this view is gained from study of the alchemistical writings of the period. Thus, in the treatise known as *Physica et Mystica* and falsely ascribed to Democritus (such false attributions are a constant feature of the literature of alchemy), various receipts are given for colouring and gilding metals, but the conception of transmutation does not occur. This treatise was probably composed at a date not very different from that of the Leiden papyrus. Later, however, as in the *Commentary* on this work written by Synesius to Dioscorus, priest of Serapis at Alexandria, which probably dates from the end of the 4th century, a changed attitude becomes apparent; the more practical parts of the receipts are obscured or omitted, and the processes for preparing alloys and colouring metals, described in the older treatise, are by a mystical interpretation represented as resulting in real transmutation.

But while there are thus some grounds for supposing that the idea of transmutation grew out of the practical receipts of Alexandrian Egypt, the alchemy which embraced it as a leading principle was also much affected by Eastern influences such as magic and astrology. The earliest Greek alchemistical writings abound in references to Oriental authorities and traditions. Thus the pseudo-Democritus, who was the reputed author of the *Physica et Mystica,* which itself concludes each of its receipts with a magical formula, was believed to have travelled in Chaldaea, and to have had as his master Ostanes the Mede, a name mentioned several times in the Leyden papyrus, and often by early Christian writers such as Tertullian, St. Cyprian and St. Augustine. The practices of the Persian adepts also are appealed to in the writings of the pseudo-Democritus, and of Zosimus and Synesius. The philosopher's egg, as a symbol of creation, is both Egyptian and Babylonian. In the Greek alchemists it appears as the symbol at once of the art and of the universe, enclosing within itself the four elements The conception of man, the microcosm, containing in himself all the parts of the universe or macrocosm, is also Babylonian, as again probably is the famous identification of the metals with the planets Even in the Leyden papyrus the astronomical symbols for the sun and moon are used to denote gold and silver, and in the *Meteorologica* of Olympiodorus lead is attributed to Saturn, iron to Mars, copper to Venus, tin to Hermes (Mercury) and electrum to Jupiter. Similar systems of symbols, but elaborated to include compounds, appear in Greek mss. of the 10th century, preserved in the library of St. Mark's at Venice. Subsequently electrum (an alloy of gold and silver) disappeared as a specific metal, and tin was ascribed to Jupiter instead, the sign of mercury becoming common to the metal and the planet.

Literature of Alchemy.—A considerable body of Greek chemical writings is contained in mss. belonging to the various great libraries of Europe, the oldest being that at St. Mark's, just mentioned. The contents of these mss. are all of similar composition, and in Berthelot's opinion represent a collection of treatises made at Constantinople in the 8th or 9th century. The treatises are nearly all anterior to the 7th century, and most appear to belong to the 3rd and 4th centuries; some are the work of authentic authors like Zosimus and Synesius, while others, such as profess to be written by Moses, Democritus, Ostanes, etc, are of clearly fictitious authorship. Some of the same names and the same works can be identified in the lists of the *Kitáb-al-Fihrist* (written by al-Nadim towards the end of the 10th century). But the Arabs did not acquire their knowledge of this literature at first hand. The earliest Hellenic culture in the East was Syrian, and the Arabs made their first acquaintance with Greek chemistry, as with Greek philosophy, mathematics, medicine, etc., by the intermediary of Syriac translations. (*See* ARABIAN PHILOSOPHY and SYRIAC LITERATURE.) Examples of such translations are preserved in mss. at the British Museum, partly written in Syriac, partly in Arabic with Syriac characters In Berthelot's opinion, the Syriac portion represents a compilation of receipts and processes undertaken in the Syrian school of medicine at Bagdad under the Abbasids in the 9th or 10th century, and to a large extent constituted by the earlier translations made by Sergius of Resaena in the 6th century. They contain, under the title *Doctrine of Democritus,* a fairly methodical treatise in ten books comprising the *Argyropoeia* and *Chrysopoeia* of the pseudo-Democritus, with many receipts for colouring metals, making artificial precious stones, effecting the *diplosis* or doubling of metals, etc. They give illustrations of the apparatus employed, and their close relationship to the Greek is attested by the frequent occurrence of Greek words and the fact that the signs and symbols of the Greek alchemists appear almost unchanged The other portion seems of somewhat later date. Another Syriac ms, in the library of Cambridge university, contains a translation of a work by Zosimus which is so far unknown in the original Greek. Berthelot gives reproductions of the British Museum mss. in vol. ii. of *La Chimie au moyen âge.*

Several alchemistical treatises, written in Arabic, exist in manuscript in the National Library at Paris and in the library of the University of Leyden, and have been reproduced by Berthelot, with translations, in vol. iii. of *La Chimie au moyen âge.* They fall into two groups: those in one are largely composed of compilations from Greek sources, while those in the other have rather the character of original compositions. Of the first group the most interesting and possibly the oldest is the *Book of Crates;* it is remarkable for containing some of the signs used for the metals by the Greek alchemists, and for giving figures of four pieces of apparatus which closely resemble those depicted in Greek mss., the former being never, and the latter rarely, found in other Arabic mss. Its concluding words suggest that its production was due to Khalid ben Yezid (died in 708), who was a pupil of the Syrian monk Marianus, and according to the *Kitáb-al-Fihrist* was the first Muslim writer on alchemy. The second group consists of a number of treatises professing to be written by Jaber, celebrated in Latin alchemy as Geber (*q v.*). Internal evidence suggests that they are not all from the same hand or of the same date, but probably they are not earlier than the 9th nor later than the 12th century. The Arabic chroniclers record the names of many other writers on alchemy, among the most famous being Rhazes and Avicenna.

But the further development of alchemy took place in the West rather than in the East. With the spread of their empire to Spain the Arabs took with them their knowledge of Greek medicine and science, including alchemy, and thence it passed to the nations of western Europe, through the medium of Latin translations which began about the 11th century. The *Liber de compositione alchemiae,* which professes to be by Morienus—perhaps the same as the Marianus who was the teacher of Khalid—was translated by Robertus Castrensis, who states that he finished the work in 1182 The earlier translations, such as the *Turba Philosophorum* and other works printed in collections like the *Artis auriferae quam chemiam vocant* (1572), *Theatrum chemicum* (1602), and J. J. Manget's *Bibliotheca chemica curiosa* (1702), are confused productions, written in an allegorical style, but full of phrases and even pages taken literally from the Greek alchemists, and citing by name various authorities of Greek alchemy. They were followed by treatises of a different character, clearer in matter, more systematic in arrangement, and reflecting the methods of the scholastic logic; these are farther from the Greek tradition, for although they contain sufficient traces of their ultimate Greek ancestry, their authors do not know the Greeks as masters and cite no Greek names. So far as they are Latin versions of Arabico-Greek treatises, they must have been much remodelled in the course of translation; but there is reason to suppose that many of them, even when pretending to be translations, are really original compositions. It is curious that although we possess a certain number of works on alchemy written in Arabic, and also many Latin treatises that profess to be translated from Arabic, yet in no case is the existence known of both the Arabic and the Latin version The Arabic works of Jaber, as contained in mss. at Paris and Leiden,

are quite dissimilar from the Latin works attributed to Geber, and show few if any traces of the positive chemical knowledge, as of nitric acid (*aqua dissolutiva* or *fortis*) or of the mixture of nitric and hydrochloric acids known as *aqua regis* or *regia*, that appears in the latter. The treatises attributed to Geber, in fact, appear to be original works composed not earlier than the 13th century and fathered on Jaber in order to enhance their authority.[1] If this view be accepted, an entirely new light is thrown on the achievements of the Arabs in the history of chemistry, for the chemical knowledge attributed to the Arabs has been so attributed largely on the basis of the contents of the Latin Geber, regarded as a translation from the Arabic Jaber. If, then, those contents do not represent the knowledge of Jaber, and if the contents of other Latin translations, which there is reason to believe are really made from the Arabic, show little, if any, advance on the knowledge of the Alexandrian Greeks, evidently the part played by the Arabs must be less, and that of the Westerns greater, than is generally supposed.

The descent of alchemistical doctrine can thus be traced with fair continuity for a thousand years, from the Greeks of Alexandria down to the time when Latin alchemy was firmly established in the West, and began to be written of by historical authors like Albertus Magnus, Roger Bacon and Arnoldus Villanovanus in the 13th century. But side by side with this literary transmission Berthelot insists that there was another mode of transmission, by means of the knowledge of practical receipts and processes traditional among jewellers, painters, workers in glass and pottery, and other handicraftsmen. The chemical knowledge of Egyptian metallurgists and jewellers, he holds, was early transmitted to the artisans of Rome, and was preserved throughout the dark ages in the workshops of Italy and France until about the 13th century, when it was mingled with the theories of the Greek alchemists which reached the West by way of the Arabs. Receipts given in the Leiden papyrus reappear in the *Compositiones ad Tingenda* and the *Mappae Clavicula*, both workshop receipt books, one known in an 8th-century ms. at Lucca, and the other in a 10th-century ms. in the library of Schlettstadt; and again in such works as the *De Artibus Romanorum* of Eraclius and the *Schedula Diversarum Artium* of Theophilus, belonging to the 11th or 12th century.

Theory of Transmutation.—The fundamental theory of the transmutation of metals is to be found in the Greek alchemists, although in details it was modified and elaborated by the Arabs and the Latin alchemists. Regarding all substances as being composed of one primitive matter—the *prima materia*—and as owing their specific differences to the presence of different qualities imposed upon it, the alchemist hoped, by taking away these qualities, to obtain the *prima materia* itself, and then to get from it the particular substance he desired by the addition of the appropriate qualities. The *prima materia* was early identified with mercury, not ordinary mercury, but the "mercury of the philosophers," which was the essence or soul of mercury, freed from the four Aristotelian elements—earth, air, fire and water—or rather from the qualities which they represent. Thus the operator had to remove from ordinary mercury, earth or an earthy principle or quality, and water or a liquid principle, and to fix it by taking away air or a volatile principle. The *prima materia* thus obtained had to be treated with sulphur (or with sulphur and arsenic) to confer upon it the desired qualities that were missing. This sulphur again was not ordinary sulphur, but some principle derived from it, which constituted the philosopher's stone or elixir—white for silver and yellow or red for gold. This is briefly the doctrine that the metals are composed of mercury and sulphur, which persisted in one form or another down to the 17th century. Of course there were numerous variations and refinements. Thus in the *Speculum Naturale* of Vincent of Beauvais (*c.* 1250) it is said that there are four spirits—mercury, sulphur, arsenic and sal ammoniac—and six bodies—gold, silver, copper, tin, lead and iron Of these bodies the first two are pure, the last four impure. Pure white mercury, fixed by the virtue of white non-corrosive sulphur, engenders in mines a matter which fusion changes into silver and united to pure clear red sulphur it forms gold, while with various kinds of impure mercury and sulphur the other bodies are produced. Vincent attributes to Rhazes the statement that copper is potentially silver, and any one who can eliminate the red colour will bring it to the state of silver, for it is copper in outward appearance, but in its inmost nature silver This statement represents a doctrine widely held in the 13th century, and also to be found in the Greek alchemists, that everything endowed with a particular apparent quality possesses a hidden opposite quality, which can be rendered apparent by fire. Later, as in the works attributed to Basil Valentine, sulphur, mercury and salt are held to be the constituents of the metals.

It must be noted that the processes described by the alchemists of the 13th century are not put forward as being miraculous or supernatural; they rather represent the methods employed by nature, which it is the end of the alchemist's art to reproduce artificially in the laboratory. But even among the late Arabian alchemists it was doubted whether the resources of the art were adequate to the task; and in the West, Vincent of Beauvais remarks that success had not been achieved in making artificial metals identical with the natural ones. Thus he says that the silver which has been changed into gold by the projection of the red elixir is not rendered resistant to the agents which affect silver but not gold, and Albertus Magnus in his *De Mineralibus*—the *De Alchemia* attributed to him is spurious—states that alchemy cannot change species but merely imitates them—for instance, colours a metal white to make it resemble silver or yellow to give it the appearance of gold He has, he adds, tested gold made by alchemists, and found that it will not withstand six or seven exposures to fire. But scepticism of this kind was not universal. Roger Bacon—or more probably some one who usurped his name—declared that with a certain amount of the philosopher's stone he could transmute a million times as much base metal into gold, and on Raimon Lull was fathered the boast "Mare tingerem si mercurius esset."

Later History of Alchemy.—In the earlier part of the 16th century Paracelsus gave a new direction to alchemy by declaring that its true object was not the making of gold but the preparation of medicines, and this union of chemistry with medicine was one characteristic of the iatrochemical school of which he was the precursor. Increasing attention was paid to the investigation of the properties of substances and of their effects on the human body, and chemistry profited by the fact that it passed into the hands of men who possessed the highest scientific culture of the time. Still, belief in the possibility of transmutation long remained orthodox, even among the most distinguished men of science. Thus it was accepted, at least academically, by Andreas Libavius (d 1616); by F. de la Boë Sylvius (1614–72), though not by his pupil Otto Tachenius, and by J. R. Glauber (1603–68); by Robert Boyle (1627–91) and, for a time at least, by Sir Isaac Newton and his rival and contemporary, G W. Leibnitz (1646–1716); and by G. E Stahl (1660–1734) and Hermann Boerhaave (1668–1738) Though an alchemist, Boyle, in his *Sceptical Chemist* (1661), cast doubts on the "experiments whereby vulgar Spagyrists are wont to endeavour to evince their salt, sulphur and mercury to be the true principles of things," and advanced towards the conception of chemical elements as those constituents of matter which cannot be further decomposed. With J. J. Becher (1635–82) and G. E. Stahl, however, there was a reversion to earlier ideas. The former substituted for the salt, sulphur and mercury of Basil Valentine and Paracelsus three earths—the mercurial, the vitreous and the combustible—and he explained combustion as depending on the escape of this last combustible element; while Stahl's conception of phlogiston—not fire itself, but the principle of fire—by virtue of which combustible bodies burned, was a near relative of the mercury of the philosophers, the soul or essence of ordinary mercury.

Perhaps J. B. van Helmont (1577–1644) was the last distinguished investigator who professed actually to have changed mer-

[1] These conclusions, which are due mainly to Berthelot, have been criticized by E. J. Holmyard and by J. R. Partington (*Nature*, 1923, vol. iii., pp. 191, 219). The former believes Geber to have been Jābir ibn Haiyān (8th century), and the latter believes the Latin works are correctly ascribed to Geber.



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LABORATORIES OF ALCHEMISTS

1. "The Alchemist," by David Teniers the Younger (1610–90)
2. Holding a salamander in the fire. From "The Book of Lambsprinck"
3. "The Alchemist at Work," attributed to Pieter Breughel the Elder, about 1558
4. "The German Alchemist," attributed to Hans Holbein the Younger (1497–1543)

cury into gold, though impostors and mystics of various kinds continued to claim knowledge of the art long after his time. Since the early years of the 20th century, however, the possibility of the transmutation of elements has entered upon a new phase. (*See* RADIOACTIVITY; TRANSMUTATION OF ELEMENTS; MATTER.)

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ALCIATI, ANDREA (1492–1550), Italian jurist, was born in Alzano, near Milan, on Jan. 12, 1492. He was one of the first to interpret the civil law by the history, languages and literature of antiquity, and to substitute original research for the servile interpretations of the glossators. His *Emblems*, a collection of moral sayings in Latin verse, was translated into French, Italian and Spanish.

ALCIBIADES (*c.* 450–404 B.C.), Athenian general and politician. He belonged to the family of the Alcmaeonidae, and was a near relative of Pericles. He was very handsome and possessed great wealth, which he squandered in every sort of dissipation and extravagance, including the upkeep of a fine stud of horses (Thuc. vi. 12, 16). He was an admirer of Socrates, who saved his life at Potidaea (432), a service which Alcibiades repaid at Delium; but he could not practise his master's virtues, and there is no doubt that the example of Alcibiades strengthened the charges brought against Socrates of corrupting the youth (399). In 421 he came to the fore as the political opponent of Nicias and the peace-party, and engineered an anti-Spartan alliance between Athens and the democracies of Argos, Mantinea and Elis. Sparta was thus placed in a critical position, and the policy might have been successful had Athens given it whole-hearted support. But in 418 Alcibiades was not re-elected general, and Sparta broke up the confederacy by the crushing victory of Mantinea. On the failure of Nicias in Thrace (418–417) he became the chief advocate of the Sicilian expedition, partly from policy and partly from private ambition, and was appointed commander jointly with Nicias and Lamachus. But on the day before the expedition sailed there occurred the mysterious mutilation of the Hermae, and Alcibiades was accused not only of being the originator of the crime, but also of having profaned the Eleusinian mysteries. He demanded an immediate inquiry, but his enemies obliged him to set sail with the charge still hanging over him.' When he reached Sicily he was recalled to stand his trial, but on the journey home he escaped to Sparta. Learning that he had been condemned to death in his absence, he openly joined the Spartans and persuaded them to send Gylippus to assist the Syracusans and to fortify Decelea in Attica, advice which proved the ruin of Athens. He then passed over to Asia Minor, induced many of the Ionic allies of Athens to revolt, and made an alliance with the Persian satrap Tissaphernes. But in a few months he had lost the confidence of the Spartans and made an enemy of King Agis. He therefore retired to the court of Tissaphernes (412), and hoping to secure his recall to Athens, advised the satrap to withdraw his active support from Sparta. At the same time he conspired with the oligarchic party at Athens, who brought about a revolution in 411 but did not recall Alcibiades. He therefore attached himself to the fleet at Samos, which remained loyal to the democracy, and was recalled by Thrasybulus, but he did not at once return to Athens. Being appointed commander in the neighbourhood of the Hellespont, he defeated the Spartan fleet at Abydos (411) and Cyzicus (410), and recovered Chalcedon and Byzantium. These successes encouraged him to return to Athens, where he was welcomed with enthusiasm (407); proceedings against him were cancelled, and he was appointed general with full powers. But the Athenians did not fully trust him, and the defeat at Notium (407) led them to dismiss him from his command. He thereupon retired to the Thracian Chersonesus. After the final defeat of Athens he took refuge in Phrygia with Pharnabazus, who was induced by the Spartans to have him murdered (404).

Alcibiades possessed great charm and brilliant abilities but was absolutely unprincipled. His advice, whether to Athens or Sparta, oligarchs or democrats, was dictated by selfish motives, and the Athenians could never trust him sufficiently to take advantage of his talents. "They feared," says Thucydides, "the extremes to which he carried his lawless self-indulgence, and . . . thought he was aiming at a tyranny . . . therefore, though his talents as a military commander were unrivalled, they entrusted the administration of the war to others; and so they speedily shipwrecked the state" (Jowett's trans.).

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ALCIDAMAS, of Elaea, in Aeolis, Greek sophist and rhetorician, flourished in the 4th century B.C. He was the pupil and successor of Gorgias and taught at Athens at the same time as Isocrates. We possess two declamations under his name: Περὶ Σοφιστῶν, directed against his rival Isocrates and setting forth the superiority of extempore over written speeches (a recently discovered fragment of another speech against Isocrates is probably of later date); Ὀδυσσεύς, in which Odysseus accuses Palamedes of treachery during the siege of Troy (this is generally considered spurious). Of other works only fragments and the titles have survived: Μεσσηνιακός, advocating the freedom of the Messenians and containing the sentiment that "all are by nature free"; a *Eulogy of Death*, in consideration of the wide extent of human sufferings; a Τέχνη or instruction-book in the art of rhetoric; and a Φυσικὸς λόγος. Lastly, his Μουσεῖον (a word of doubtful meaning) contained the narrative of the contest between Homer and Hesiod, two fragments of which are found in the Ἀγὼν Ὁμήρου καὶ Ἡσιόδου, the work of a grammarian in the time of Hadrian. A 3rd-century papyrus (Flinders Petrie, *Papyri*, ed. Mahaffy, 1891, pl. xxv.) probably contains the actual remains of a description by Alcidamas.

See fragments in Müller, *Oratores Attici*, ii. (1858); Vahlen, *Der Rhetor Alkidamas* (1864); Blass, *Die attische Beredsamkeit;* and the edition by Blass, 1881.

ALCINOUS (Gr. ăl-kĭn-ŏ-ŏs), in ancient Greek legend, king of the Phaeacians, in the island of Scheria, son of Nausithous and grandson of Poseidon. His reception and entertainment of Odysseus (*q.v.*), who when cast by a storm on the shore of the island was relieved by the king's daughter, Nausicaa, is described in the *Odyssey* (vi., xiii.). Scheria was identified in very early times with Corcyra, where Alcinous was reverenced as a hero. In the Argonautic legend, his abode was the island of Drepane (Apoll. Rhodius iv., 990).

ALCINOUS, the Platonic philosopher, lived probably in the time of the Caesars. He was the author of an analysis of Plato's philosophy, and attributed to Plato ideas of other philosophers. He produced latterly a synthesis of Plato and Aristotle with an admixture of Pythagorean or Oriental mysticism, and is closely allied to the Alexandrian school of thought. He recognized a God who is unknowable, and a series of beings (δαίμονες) who hold intercourse with men. He recognized also ideas and matter, and borrowed largely from Aristotle and the Stoics.

The Ἐπιτομή has been translated by Pierre Balbi (Rome, 1469) and by Marsilio Ficino; into French by J. I. Combes-Dounous (1800); and into English by Thomas Stanley in his *History of Philosophy*. Editions: Heinsius (Leyden, 1630); Fischer (Leipzig, 1783); in Aldine Edition of Apuleius (Venice, 1521, 1532); Fell (1667). *See* Ritter, *Geschichte der Philosophie*, iv. 249.

ALCIPHRON, Greek rhetorician, was probably a contemporary of Lucian (2nd century A.D.). He was the author of a collection of fictitious letters, of which 124 (118 complete and six fragments) have been published; they are written in the purest Attic dialect and are considered models of style. The scene is throughout at Athens; the imaginary writers are country people,

fishermen, parasites and courtesans, who express their sentiments and opinions on familiar subjects in elegant language. The "courtesan" letters are especially valuable, the information contained in them being chiefly derived from the writers of the New Comedy, especially Menander.

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ALCIRA, eastern Spain, province of Valencia; on the left bank of the river Júcar. Pop. (1920) 20,839. Alcira is a walled town, surrounded by palm, orange and mulberry groves, and by low-lying and unhealthy rice-swamps Silk, fruit, rice and cabinet woods are its chief products. It has a Roman bridge and has been thought to be the Roman Saetabicula or Suero; it was later a Moorish trading station.

ALCMAEON, son of Amphiaraus (*q.v.*). After the destruction of Thebes by the Epigonoi, Alcmaeon carried out his father's injunctions by killing his mother, as a punishment for which he was pursued by the Erinyes from place to place. On his arrival at Psophis in Arcadia, he was purified by its king Phegeus, whose daughter Arsinoe (or Alphesiboea) he married, making her a present of the fatal necklace and the robe of Harmonia. But the land was cursed with barrenness, and the oracle declared that Alcmaeon would never find rest until he reached a spot on which the sun had never shone at the time he slew his mother. Such a spot he found at the mouth of the river Achelous, where an island had recently been formed by the alluvial deposit; here he settled and, forgetting his wife Arsinoe, married Callirrhoe (*q.v.*), the daughter of the river-god. His new wife longed for the necklace and robe, and Alcmaeon, returning to Psophis, obtained possession of them, on the pretence that he desired to dedicate them at Delphi. When the truth became known he was pursued and slain by Phegeus and his sons. After his death Alcmaeon was worshipped at Thebes; his tomb was at Psophis in a grove of cypresses.

See Apollodorûs iii. 7; Thucydides ii. 68. 102; Pausanias viii. 24. x. 10; Ovid, *Metam.* ix. 400 *et seq.*

ALCMAEONIDAE, a powerful Athenian family, which played a leading part in the politics of the 6th and 5th centuries, B.C. The murder of the Cylonian conspirators (*c.* 632) brought the pollution of blood-guilt on them (*cf.* esp Hdt. v. 70–71 and Thuc. i. 126–127) and they were banished until the time of Solon. Alcmaeon seems to have made his fortune through the favour of the kings of Lydia. Megacles, who made a great marriage with the daughter of the ruler of Sicyon, led the merchant party in opposition to the tyrant Peisistratus, and was exiled (Hdt. i. 59); his son Cleisthenes drove out the tyrants (510), defeated the Spartan attempt to set up an oligarchy, and by his reforms secured the Athenian democracy. The Alcmaeonids were suspected, however, of treacherously helping the Persians by giving the famous shield signal at Marathon. To the same family belonged Pericles and Alcibiades.

See Herodotus vi. 121–131, and articles on CLEISTHENES, PERICLES, ALCIBIADES, GRAECO-PERSIAN WARS and *Camb. Anc. Hist.* vol. iv. ch. vi., § 6 and ch. viii.

ALCMAN or ALCMAEON (*fl.* in the 7th cent. B.C.), the founder of Doric lyric poetry, to whom was assigned the first place among the nine lyric poets of Greece in the Alexandrian canon. He was a Lydian of Sardis, who came as a slave to Sparta, where he was emancipated and given the citizenship. Alcman composed various kinds of poems in various metres; Parthenia (maidens' songs), hymns, paeans, prosodia (processionals), and love-songs, of which he was considered the inventor. The fragments are scanty, the most considerable being part of a *Parthenion* found in 1855 on an Egyptian papyrus; some hexameters discovered in 1898 are attributed to Alcman or Erinna (*Oxyrhynchus papyri*, i. 1898).

For general authorities *see* ALCAEUS.

ALCMENE (ălk-mā-nā), in Greek mythology the daughter of Electryon, king of Mycenae, and wife of Amphitryon. She was the mother of Heracles by Zeus, who assumed the likeness of her husband during his absence.

See Plautus, *Amphitruo.*

ALCOBAÇA, a town of Portugal, in the district of Leiria. Pop. (1920) 2,661. Alcobaça is chiefly interesting for its Cistercian convent, now partly converted into schools and barracks. The monastic buildings, a square, 725ft. across, were founded in 1148 and completed in 1222. During the middle ages it rivalled the greatest European abbeys in size and wealth. It was supplied with water by an affluent of the Alcoa, which still flows through the kitchen. The convent was partly burned by the French in 1810, secularized in 1834, and afterwards gradually restored. Portions of the library are now preserved in the public libraries of Lisbon and Braga. The monastic church (1222) is a good example of early Gothic, somewhat defaced by Moorish and other additions

ALCOCK, JOHN (*c.* 1430–1500), English divine, was born at Beverley in Yorkshire and educated at Cambridge. He was bishop successively of Rochester, Worcester and Ely, and twice held the office of lord chancellor. He died at Wisbech Castle Oct. 1, 1500. Alcock was one of the most eminent pre-Reformation divines; he was a man of deep learning and also of great proficiency as an architect. Besides founding a charity at Beverley and a grammar school at Kingston-upon-Hull, he restored many churches and colleges; but his greatest enterprise was the erection of Jesus College, Cambridge, which he established on the site of the former convent of St. Radigund.

Alcock's published writings, most of which are extremely rare, are: *Mons Perfectionis, or the Hill of Perfection* (London, 1497); *Gallicontus Johannis Alcock episcopi Eliensis ad frates suos curatos in sinodo apud Barnwell* (1498), a good specimen of early English printing and quaint illustrations; *The Castle of Labour*, translated from the French (1536); and various other tracts and homilies.

See J. Bass Mullinger's *Hist. of the University of Cambridge*, vol. i.

ALCOCK, SIR JOHN WILLIAM (1892–1919), English airman, was born in Manchester on Nov. 6, 1892, the son of a horse dealer. Before the World War he had been in possession of the aviation certificate for two years, when he joined the Royal Naval Air Force as an instructor in 1914. In 1916 he was posted at No. 2 wing at Mudros. Here he performed many famous exploits, including the bombing of Constantinople on Sept. 30, 1917. He was forced to alight at sea near Suvla bay on his return from this expedition, and he and his companions swam ashore, and were taken prisoners by the Turks. After leaving the Air Force in March 1919, he made a flying record with Lieut. Arthur Whitten Brown by flying from St. John's, Newfoundland, to Clifton, Ireland, in 16hrs. 12mins. He was then created K.B.E. A week later Alcock was flying to Paris in an amphibian aeroplane when he sustained fatal injuries while making a forced landing at Côte d'Evrard, Normandy, on Dec. 18, 1919.

ALCOCK, SIR RUTHERFORD (1809–1897), British consul and diplomatist, practised medicine until 1837. In 1844 he became consul at Fuchow in China, opened to trade by the treaty of 1842, and Mr. Alcock, as he then was, had to maintain an entirely new position with the Chinese authorities. He went in 1846 to Shanghai and there superintended the establishment and laying out of the British settlement. In 1858 he was appointed consul-general in the newly opened empire of Japan, and in the following year was promoted to be minister plenipotentiary. In 1860 Mr. Alcock's native interpreter was murdered at the gate of the legation, and in the following year the legation was stormed by a body of Ronins, whose attack was repulsed by Mr. Alcock and his staff. After a brief period at home he returned to Japan in 1864 and he was transferred to Peking in 1865, where he represented the British Government until 1871. Alcock was one of the first to awaken in England an interest in Japanese art; his best-known book *The Capital of the Tycoon,* appeared in 1863. He died in London on Nov. 2, 1897.

See A. Michie, *The Englishman in China during the Victorian Era, as illustrated in the career of Sir Rutherford Alcock* (Edinburgh, 1910).

ALCOFORADO, MARIANNA (1640–1723), writer of the *Letters of a Portuguese Nun,* was the daughter of a landed proprietor in Alemtejo. She made her profession as a Franciscan nun at 16 or earlier, without any real vocation, and lived a routine life in the convent of the Concepcion at Béja until her 25th year.

when she met Noel Bouton, afterwards marquis de Chamilly, and marshal of France. During the years 1665–67 Chamilly spent much of his time in and about Béja, and probably became acquainted with the Alcoforado family through Marianna's brother, who was a soldier. Custom then permitted those in religious orders to receive and entertain visitors, and Chamilly began an intrigue with Marianna which caused a scandal. To avoid the consequences Chamilly deserted Marianna, and withdrew clandestinely to France. The letters to her lover were written between Dec. 1667 and June 1668, and describe the successive stages of faith, doubt and despair through which she passed. These five short letters written by Marianna to "expostulate her desertion" have become a classic. There are signs in the fifth letter that Marianna had begun to conquer her passion, and after a life of rigid penance, accompanied by much suffering, she died at the age of 83. The letters came into the possession of the comte de Guilleragues, director of the *Gazette de France,* who turned them into French, and they were published anonymously in Paris in Jan. 1669. In 1810 Boissonade discovered Marianna's name written in a copy of the first edition by a contemporary hand, and the veracity of this ascription has been placed beyond doubt by the investigations of Luciano Cordeiro, who found a tradition in Béja connecting the French captain and the Portuguese nun

The foreign bibliography of the *Letters,* containing almost 100 numbers, will be found in Cordeiro's admirable study, *Soror Marianna, A Friera Portugueza,* 2nd ed (Lisbon, 1891). Besides the French editions, versions exist in Dutch, Danish, Italian and German; and the English bibliography is given by Edgar Prestage in his translation *The Letters of a Portuguese Nun (Marianna Alcoforado),* 3rd ed. (1903). The French text of the *editio princeps* was printed in the 1st ed. (1893) of this book. Edmund Gosse in the *Fortnightly Review,* vol. xlix. (old series) p. 506, shows the considerable influence exercised by the *Letters* on the sentimental literature of France and England.

ALCOHOL, the name applied to any member of a class of organic compounds (*see* ALCOHOLS). The word is of Arabic origin, being derived from the particle *al* and the word *kohl,* an impalpable powder used in the East for painting the eyebrows. For many centuries the word was used to designate any fine powder; its present day application is of comparatively recent date. Thus Paracelsus and Libavius both used the term to denote a fine powder, the latter speaking of an *alcohol* derived from antimony Paracelsus also used the term to denote a volatile liquid; *alcool* and *alcool vini* occur often in his writings, and once he adds *id est vino ardente.*

The word is commonly applied to one particular member of the class (ethyl alcohol or ethanol) having the formula C_2H_6O Alcohol, as an article of widespread consumption and use, has various other names, *e.g.*, "Spirits of Wine," "Eau de Vie," "Aqua Vitae."

Ethyl alcohol does not occur in appreciable quantities in nature except under abnormal conditions, the most common instances being the urine of persons suffering from diabetes or those addicted to excessive consumption of alcoholic beverages. In the vegetable kingdom it occurs, mixed with ethyl butyrate, in the unripe seeds of *Heracleum giganteum* and *H. sphondylium.* In consequence, however, of its ready formation by the fermentation of saccharine juices of vegetable origin, it has been known, in its impure state, from ancient times. It was not until 1808 that its constitution was determined by de Saussure, although Lavoisier had previously established its qualitative composition. Sir Edward Frankland, by demonstrating its relation to the hydrocarbon ethane ($CH_3{\cdot}CH_3$), proved it to be $CH_3{\cdot}CH_2OH$, one hydrogen atom of the ethane molecule being replaced by the hydroxyl group. Ethyl alcohol may be synthetically prepared by any of the general methods described in the article ALCOHOLS. The mechanism of alcoholic fermentation is discussed in the article FERMENTATION, and the manufacture of alcohol from fermented liquors in the article SPIRITS.

Properties.—Pure ethyl alcohol is a mobile colourless liquid having an agreeable ethereal odour. It boils at 78·3° C at a pressure of 760mm. of mercury; at −90° C it is a thick liquid, whilst at −130° C it solidifies to a white mass.. Its specific gravity at various temperatures is as follows, the gravities being compared with water at 4° C:

Temp., °C.	Sp. Grav.	Temp., °C.	Sp Grav.
10°	0 79784	30°	0 78075
15°	0 79360	35°	0 77641
20°	0 78934	40°	0 77203
25°	0 78506		

Its high coefficient of thermal expansion, coupled with its low freezing point, renders it a valuable thermometric fluid, especially when the temperatures to be measured are below −39° C when the mercury thermometer cannot be used. It burns readily in air with a blue smokeless flame, producing water and carbon dioxide. Since its combustion is attended with the evolution of great heat, alcohol is used extensively as a fuel.

Ethyl alcohol is miscible with water in all proportions, the mixing being accompanied by a contraction in volume and a rise in temperature. The maximum contraction corresponds approximately to a mixture of three molecules of alcohol and one of water. Owing to the energy with which it absorbs moisture from the air, it is difficult to obtain or preserve ethyl alcohol in a completely anhydrous state. Commercial alcohol, which usually contains about 95% of the pure alcohol and 5% of water, can be obtained by fractional distillation of spirituous liquors. This method of purification fails to remove the last traces of water, which can only be effected by distilling the commercial product after it has stood in contact with a dehydrating agent such as quick-lime, baryta, or anhydrous copper sulphate, or by taking advantage of its peculiar behaviour when mixed with benzene. Calcium chloride must not be used, as it forms a crystalline compound with alcohol, the latter playing the rôle of water of crystallization. The presence of water in alcohol may be detected in several ways. Aqueous alcohol, when mixed with benzene, carbon disulphide, or paraffin oil, becomes turbid. A more delicate method is the addition of a small quantity of anthraquinone and sodium amalgam, when absolute alcohol gives a green coloration, but in the presence of minute traces of water a red coloration is obtained.

Traces of ethyl alcohol can be detected by converting it into ethyl benzoate on shaking with benzoyl chloride and caustic soda; by warming it with iodine and potassium hydroxide and thus producing iodoform, which is recognized by its characteristic odour; or by oxidation to acetaldehyde. The latter test is elaborated by distillation into a strong solution of sodium hydroxide, when an "aldehyde resin" easily recognized by appearance and smell is formed.

Determination.—The quantity of alcohol present in a mixture of alcohol and water can readily be determined If other substances are present, it is usually necessary to separate them by distillation and sometimes by preliminary chemical treatment. The determination may be made by ascertaining the vapour tension or by finding the boiling point. The most common and convenient method, however, is the determination of the specific gravity of the aqueous mixture This can be ascertained by means of some form of pyknometer or hydrometer, standard tables being available which correlate gravities with proportion of alcohol. The latter may be expressed in various forms, depending upon the requirements of the Government or other authority by whom the tables have been prepared. The usual form is percentage of absolute alcohol by weight or by volume. The former has certain advantages as it is independent of temperature, whilst the latter, owing to the difference in the coefficients of expansion of the two ingredients, is subject to thermal variation In the United Kingdom and in America arbitrary standards called "Proof Spirit" are used. British "Proof Spirit" is that mixture of alcohol and water which at the temperature of 51° F weighs exactly $\frac{13}{12}$ of an equal measure of distilled water also at 51° F. It contains 49 28% of alcohol by weight, and at 60° F it contains 57·10% of alcohol by volume and has a specific gravity of 0 91976. The "quantity at proof" is given by the formula. (quantity of sample)

$$\times \frac{\text{(percentage of proof spirit)}}{100}$$

United States "Proof Spirit" is that which at 15·6° C contains exactly one-half its volume of alcohol.

The hydrometer used varies considerably and may indicate directly specific gravity, proportion of alcohol, or have an arbitrary scale, the readings of which have to be referred to tables. Sikes's hydrometer, the British legal instrument, is of the last-mentioned type. It was devised by Bartholomew Sikes, an English excise officer, at the end of the 18th century. The tables now used with it, however, are of modern compilation, and were legalized in 1915. Sikes's system has been extended by the addition of two hydrometers "A" and "B" to cover all strengths up to absolute alcohol at 84° F.

Yet another physical property which is frequently used for detecting and estimating ethyl alcohol is the refractive index. Holmes (see *Trans. Chem. Soc.*, 1913, 103, p. 2,165) gives the following indices of refraction (^nD) at 15·5° C for molecular mixtures of alcohol with water, that of pure alcohol being 1·36316.

Alcohol (mols.).	Water (mols.).	^nD	Alcohol (mols.).	Water (mols.).	^nD
4	1	1 36574	1	2	1 36408
2	1	1 36651	1	3	1 36152
1	1	1 36630	1	4	1 35883

Holmes found the maximum value 1·36661 to correspond to a mixture containing 79·2% of alcohol by weight.

Uses.—The most important industrial application of ethyl alcohol is as a solvent. It dissolves a large number of solid and liquid organic compounds, resins, hydrocarbons, fatty acids, and many mineral salts. Potassium and sodium readily dissolve in it, yielding alcoholates (ethoxides) in the form of voluminous white powders. With sulphuric acid it yields ethyl sulphuric acid and with sulphuric anhydride diethyl sulphate. The phosphorus haloids give the corresponding ethyl haloids. It is readily oxidized into acetaldehyde and acetic acid by such agents as manganese peroxide and sulphuric acid. With bleaching powder it yields chloroform, whilst with iodine and potassium hydroxide it reacts to give iodoform. Most gases dissolve in it more readily than in water; for instance 100 volumes will dissolve seven volumes of hydrogen, 25 volumes of oxygen or 16 volumes of nitrogen. (For industrial uses, *see* ALCOHOL IN INDUSTRY.)

Pharmacology, Toxicology and Therapeutics of Alcohol.—The great solvent power of alcohol is of high medicinal value in the preparation of solutions of alkaloids, resins, volatile oils, iodoform, etc. The effect of alcohol when applied externally to the human body depends upon the strength of the solution and the conditions of application. When of a strength above 10% it is antiseptic. If applied in such a manner that evaporation can take place readily, it has a cooling effect of which advantage is often taken by bathing the forehead with perfume to soothe headache. If on the other hand evaporation is retarded, the affinity of alcohol for water causes its extraction from the tissues, which become hardened. Thoroughly rubbed into the skin, alcohol dilates the blood vessels and produces a mild counter-irritant effect. Many alcoholic liniments are therefore employed for the relief of pain, especially lumbago and other forms of so-called "muscular rheumatism." When taken internally alcohol is completely and rapidly absorbed from the stomach and intestines and distributed by the blood to different organs of the body. The rate of absorption is checked if the alcohol is diluted either with water or with food taken immediately before drinking. A variable but small proportion of alcohol escapes unchanged in the breath and urine. The remainder is slowly oxidized in the body, disappearing at a uniform rate of about 0·185 cu.cm. per kg. of body per hour. None is known to be converted into substances which the body can retain.

The effects of consumption of alcohol are almost all due (directly or indirectly) to its action upon the nervous system. Thus the immediate sensation of well-being is due to the flushing of the skin, suppressing temporarily the sense of chill and to the fact that the sensibility to minor pains and inconveniences becomes blunted; whilst with larger doses the diminution of the power of self-control and sense of personal responsibility gives rise to excitability. In the secondary stage the fineness of the senses (hearing, touch, taste and vision) is affected, and this gives rise to an inability to control bodily movements such as facial expression. In the advanced stage of drunkenness, the intellectual processes of judgment and control are suspended, and in the absence of a strong appeal to emotional tendencies the drinker sinks inert and nerveless into a heavy sleep or condition of torpor, which lasts until the alcohol absorbed has all been oxidized. (*See* DRUNKENNESS; DELIRIUM.)

A dose of alcohol (such as would be present in 2¾ oz. of whisky or 1¾ pints of beer) exerts no influence on the performance of simple muscular acts not demanding precision. For acts requiring skill or accuracy efficiency is temporarily impaired by such a dose. The digestion is not affected by a moderate amount of alcohol, the deleterious results of consuming alcoholic beverages being probably due to other substances; *e.g.*, non-volatile bodies in wine, and higher alcohols and esters in distilled drinks such as brandy or whisky. Contrary to the common belief, alcohol does not act as a direct stimulant to the heart in cases of threatened failure. Recovery from fainting is probably due to the irritant action on the mucous membrane of the nose and throat comparable to that of smelling salts or burnt feathers. In protracted weakness the beneficial effect of alcohol appears to be due to its mildly narcotic and sedative action relieving the centres which in conditions of anxiety or pain affect the action of the heart For the purpose of "keeping out the cold" alcohol is probably not harmful in a small dose, as it promotes activity, but as a preliminary to long exposure it is dangerous It renders the drinker subject to an illusion of warmth and indifferent to the peril of extreme cold which may result fatally At the end of long exposure, however, after the patient has been placed in hot blankets a moderate dose of alcohol is beneficial, promoting the return of the blood to the superficial tissues to which the extreme heat is applied.

Excessive consumption of alcohol tends to shorten life, but it is uncertain if moderate drinking has any effect on longevity. The following extract from the British official returns is of interest in this connection, the year 1900 being inserted as the "peak" year under both headings.

	Consumption per head of the population			Death rate per million of the population	
	Beer, gals.	Spirits, Pf. gals.	Wine, gals.	From alcoholism	From cirrhosis of the liver
1897	30 23	1 20	0 40	77	133
1900	32 04	1 22	0 42	113	144
1922	17·67	0 37	0 24	14	46

After death the presence of alcohol can be detected in all the body fluids. Its especial affinity for the nervous system is indicated by the fact that, when all traces of it have disappeared elsewhere, it can still be detected with ease in the cerebro-spinal fluid. (*See* PHARMACOLOGY, and *Alcohol: Its Action on the Human Organism*, Medical Research Council, 1924.)

Fiscal.—Ethyl alcohol is a fruitful source of revenue to most of the Governments of the world. In Great Britain the excise duty on spirits varies from £3 12s. 6d. to £3 14s. per proof gallon, and the customs duty is in some instances as high as £6 3s. 5d. per liquid gallon. Both duties, however, are liable to considerable modification in certain circumstances. The revenue derived from the spirit duties has recently shown steady decline.—

Financial Year	*Net Receipts from Customs and Excise.*
1923–24	£54,036,746
1924–25	£51,053,606
1925–26	£49,927,645
1926–27	£43,552,785

In the U.S.A. the adoption of prohibition has greatly diminished the revenue importance of alcohol. Thus whilst in the fiscal year 1919 the yield of internal revenue tax on distilled spirits (including wines, etc.) and fermented liquors was $483,050,854.40, in 1926 it was only $26,452,028.63. The import duty on non-beverage alcohol is 15 cents per gallon, and on brandy and similar articles—imported for special purposes only—$5.00 per proof gallon. The quantities of distilled liquors in proof gallons imported in recent years have been as follows:—

1924	52,676	1926	71,622
1925	57,679	1927 (1st 9 months only)	50,971

The great industrial importance of alcohol has necessitated the introduction of a duty-free product retaining its suitability for the many purposes for which it may be used in the arts and manufactures. (For details of "denatured alcohol" *see* ALCOHOL IN INDUSTRY.) (J. J. F.; F. G. H. T.)

ALCOHOL, PATHOLOGICAL EFFECTS OF. The pathological effects of alcohol are due to a chronic poisoning rather than an acute. Large doses may, however, cause death almost instantaneously by a reflex action on the heart or by cardiac and respiratory depression after the drug has been absorbed. If the alcohol be taken in the form of spirits, the subject usually becomes thin, probably owing to the spirits so affecting the gastro-intestinal tract that little or no nourishment is absorbed; if beer be the form of drink the subject is liable to become fat. Prolonged drinking of any form of alcohol makes persons less able to withstand operations and diseases, such as phthisis and pneumonia, and is the direct cause of certain diseases of which the chief are the following:

Chronic Gastritis.—This is most likely to occur in those who drink spirits. The action of the strong alcohol on the stomach sets up an inflammatory condition which, owing to the continued action of the irritant, never subsides, with the result that permanent damage results and the proper digestion of food cannot take place and the patient becomes thinner and thinner.

Cirrhosis of the Liver (gin-drinker's liver).—The quantity of alcohol necessary to bring on this condition differs with different persons; in some cases a few months' indulgence may suffice, in others it may be a matter of years Whether the alcohol itself or some toxin due to gastro-intestinal disturbance acts on the liver is not certain, but the result is a chronic inflammation which passes on to an extensive growth of fibrous tissue This by its contraction compresses and destroys the liver cells and seriously impedes the flow of blood through the veins of the organ. The size of the liver varies within wide limits, but is usually small owing to the contraction of the fibrous tissue. The most important and constant result of this contraction is the effusion of fluid from the compressed and distended veins into the peritoneal cavity, constituting one of the types of dropsy called ascites. The patient gradually becomes more and more ill and death often ensues within a few months of the appearance of ascites. (*See* LIVER, DISEASES OF.)

Multiple or **Peripheral Neuritis** (*see* NEURITIS).

Gout (*q.v.*).—The habitual drinking of heavy or sweet wines is one of the causes of this disease, as is excessive beer drinking when combined with poor or insufficient food.

Mania may at times be due to chronic alcoholic poisoning and possibly chronic Bright's disease Certainly the kidneys will be affected more or less adversely by the toxins due to the gastro-intestinal disturbance.

Delirium tremens (*see* DELIRIUM) occurs in habitual drinkers.

ALCOHOL IN INDUSTRY. Owing to its very high price, duty-paid alcohol cannot be used for most industrial purposes (even in "wet" countries); exhaustive experiments were therefore carried out in England about the year 1853 to ascertain whether it would be possible so to treat alcohol as to enable it to be used industrially without any risk of the revenue being defrauded.

Industrial Methylated Spirits.—The experiments of 1853 resulted in the legislation of 1855 which authorized the use, for purely manufacturing purposes, of duty-free spirits mixed with 10% by volume of wood naphtha (an impure methyl alcohol), the product being unfit for beverage purposes and known as "methylated spirits." By the Revenue Act of 1906 "methylated spirits" became "industrial methylated spirits" and the volume of wood naphtha was reduced to 5%. Methyl alcohol (*q.v.*) was selected because it is very difficult to remove even by distillation, and because its presence can readily be detected. Industrial methylated spirits are for use in industrial and other operations for which mineralized methylated spirits are unsuitable. By the regulations dated Dec. 7, 1925, a pharmaceutical chemist may be authorized to obtain industrial methylated spirits for sale as such or for other specified purposes under defined conditions.

Industrial Methylated Spirits (Pyridinized).—Regulations dated Dec. 7, 1925, authorized industrial methylated spirits, having the same composition as industrial methylated spirits, with an added ½ of 1 part of crude pyridine, to be used in the manufacture of "finish" for sale.

Mineralized Methylated Spirits.—From 1861 to 1891 methylated spirits were allowed to be sold by retail in Great Britain in small quantities for domestic purposes, but use in large quantities or in manufacture was only possible under excise supervision In 1890, a new form known as "mineralized methylated spirits" was introduced, free from revenue supervision, for general use, the difference consisting in the further addition of ⅛ of 1% of mineral naphtha. Mineralized methylated spirits in 1928 are a mixture of 90 parts by volume of alcohol, 9½ parts of wood naphtha, and ½ part of crude pyridine, adding to every 100 gallons of the mixture ⅜ gallon of mineral naphtha and not less than $\frac{1}{40}$ oz. of powdered aniline dye (methyl violet).

Power Methylated Spirits.—Following on a report by a departmental committee in 1918, clauses were inserted in the Finance Act of 1920 legalizing the use of alcohol for power purposes under the name of "power methylated spirits." The regulations were issued in 1921, and such spirits are prepared according to the following formula.—92 parts of alcohol, 5 parts of benzol, ½ part of crude pyridine and 2½ parts of wood naphtha, together with $\frac{1}{40}$ oz of Spirit Red III. dye in each 100 gallons of the mixture. Spirits so prepared are sold free of duty and restriction when mixed with 25% of petrol, benzol, denatured ether or some other approved substance.

Non-dutiable (Specially Denatured) Spirits.—The Finance Act of 1902 made it possible to use duty-free spirits in any art or manufacture when it is proved that the use of methylated spirits is unsuitable or detrimental. The spirits must be rendered unfit for use as a beverage before and during use. Frequently a suitable denaturant is found in some acid used or produced during the manufacturing operations, or the alcohol is a constituent of some mixed solvent Thus the employment of pure alcohol denatured with 2% of pure methyl alcohol is allowed in the production of insulin without onerous excise restrictions. The use of pure duty-free spirits by "universities, colleges and other public institutions for research and teaching" are laid down in regulations issued in May 1911.

Customs and Excise.—Under the Finance Act of 1921 an allowance of 5d. per proof gallon, equivalent to about 8d. per bulk gallon, is made on spirits used for preparing industrial methylated spirits and power methylated spirits; or on spirits received for use in the arts and manufacture. Imported spirits used for the manufacture of mineralized methylated spirits are charged a differential duty of 2s. 10d or 2s 11d. per proof gallon if foreign, and 4d. or 5d per gallon if empire. When used for other purposes, empire spirits are free of duty, while foreign spirits are charged 2s. 6d. per proof gallon. A rebate under the Finance Act of 1921 amounting to 80% of the present duty is made in the case of duty-paid spirits used for medicinal and for scientific purposes.

Industrial Uses of Alcohol.—Apart from its use as a beverage, alcohol is the raw material for the manufacture of vinegar, ether and chloroform, and enters into the composition of many dye stuffs. It is largely used as a solvent for the preparation of pure chemicals as well as for cleaning purposes. Various scientific operations require its use, as does also the preservation of museum and hospital specimens.

Out of a total of rather over 4 million bulk gallons of industrial methylated spirits used during the year 1926–27, 2½ million gallons were employed for varnishes, "finishes," stains and paints. Of this quantity "finish" accounted for nearly 300,000 gallons of *pyridinized spirits*. The balance was distributed under 60 headings. The other chief uses were ether, 271,400 gallons; oil-cloths, leather-cloths and similar substances, 241,212 gallons; soap, 172,-661 gallons; and hospitals, asylums and infirmaries, 104,387 gallons. *Mineralized methylated spirits* are largely used for burning in lamps and for cleaning purposes. The quantity used in a year is about 1½ million bulk gallons *Power methylated spirits* must be mixed with petrol or benzol, or denatured ether, and when so

mixed may be distributed and used without restrictions for power purposes.

The following table gives the quantity in bulk gallons of the various descriptions of methylated spirits issued in the United Kingdom during the years specified:—

	1913–14.	1925–26.	1926–27.
Industrial methylated spirits	3,253,061	4,247,347	4,039,809*
Mineralized methylated spirits	1,754,514	1,446,358	1,593,022
Power methylated spirits .		91,282	46,447
Non-dutiable spirits . .	438,583	439,338	355,405
Totals .	5,446,158	6,224,325	6,034,683

*Includes 304,778 gallons industrial methylated spirits (pyridinized).

A great extension has occurred in the use of methyl alcohol for industrial purposes, apart from its use for denaturing, namely, from 38,000 gallons in 1913–14, to 300,000 gallons in 1926–27.

Industrial Alcohol in the British Dominions, etc.—The regulations governing the use of industrial alcohols in the British dominions, colonies and protectorates are generally similar to those of the Imperial Government. In *Australia* there are four classes, and the principal substances used as denaturants are wood naphtha, pyridine, benzene, benzine (petroleum) and crystal violet. In *Canada* there are three grades of "denatured alcohol" and seven grades of "specially denatured alcohol"; wood alcohol is the main denaturant, but benzine, iodine, benzol, nitrobenzol and other substances are used. There are four kinds of "methylated spirits" used in *New Zealand*, the denaturants being wood naphtha and also pyridine, mineral naphtha, turpentine and shellac, according to the intended use. "Methylated spirits" in the *Union of South Africa* are denatured with crude methyl alcohol and pyridine bases, or with Simonson oil and pyridine bases. For denaturing motor fuel the same denaturants are employed. In *Kenya Colony* "industrial alcohol" is denatured with crude methyl alcohol with or without pyridine bases, or, when used as a fuel for internal combustion engines, with sulphuric ether and pyridine bases. "Denatured spirits" in *Mauritius*, including spirits used as motor fuel, are denatured with wood naphtha and pyridine, or kerosene and pyridine. In *India* the generally accepted official formula prescribes the addition of 0·5% light caoutchoucine and 0·5% pyridine bases of mineral origin In the *West Indies* methylated spirits are always denatured with wood naphtha or methyl alcohol with, in some cases, the addition of mineral naphtha.

Industrial Alcohol in Other Countries.—The Netherlands legalized the use of denatured alcohol in 1865; in 1872 France permitted its use under a special tax, and in Germany its employment was authorized in 1879, the other European countries following—Austria in 1888, Italy in 1889, Sweden in 1890, Norway in 1891, Switzerland in 1893 and Belgium in 1896 Alcohol was used in Germany for many years before the war in increasing quantities as a source of heat, but its application for light and power started about 1887. In 1895 a distillation tax was imposed from which a refund was paid on alcohol used for other than beverage purposes.

In France a formula for general use has been approved which prescribes that to 100 litres of spirit, which must not contain more than 1% of essential oils and must indicate at least 90% alcohol at 15° C., must be added 5·5 litres of "Methylene type régie." The latter must indicate at least 90% alcohol, contain 25% acetone and at least 2·5% pyrogenous impurities produced by wood distillation. Should the use to which the alcohol is to be put justify such a course, a special formula for denaturing is allowed.

In Germany, apart from special substances added to denature alcohol for use in medicaments and foodstuffs, the materials added to alcohol destined for industrial use are as follows:—2·5 litres of wood spirit, or 1 litre of pyridine bases, or 0·025 litre of animal oils, or 1 litre of turpentine oil, or 2 litres of toluene, or 2 litres of benzine, or 0·5 kilogramme of centralite, for 100 litres of denatured spirit. For internal combustion engines 1·25 litres of a mixture of 2·5 parts wood spirit to 1 part of pyridine, 0·25 litres of methyl violet solution and from 2 to 20 litres of benzol may be added to 100 litres of spirit. For special industrial purposes other mixtures are allowed, the chief denaturants being shellac, camphor, carbon tetrachloride or ether. The use of duty-free pure alcohol is allowed in public hospitals and scientific institutions, and for the manufacture of fulminates, fuzes and smokeless powders.

France denatured 12 million bulk gallons in 1922, and 19 million bulk gallons in 1925. The quantity of alcohol used for industrial and other purposes in Germany is on the increase; in 1924–25 it amounted to nearly 24¾ million bulk gallons, whereas in 1925–26 it reached nearly 26½ million.

POWER ALCOHOL

Whilst alcohol can be used like petrol (gasolene) in motor engines, it cannot be used with maximum efficiency by itself in engines of modern motor vehicles because it requires a higher degree of compression than such engines are usually designed to stand, and also because, unless special arrangements are made, a motor engine will not start readily from the cold on alcohol. After mixture with benzol or petrol, or with ether in varying proportions, it can, however, be employed successfully. In the event of its production proving a commercial possibility it should, therefore, form a valuable addition to the liquid-fuel resources of the world.

In the appended table are given some comparative figures in connection with commercial petrols and alcohol, taken from a paper by H. R. Ricardo published in the *Automobile Engineer* (1921).—

Alcohol and Petrol as Fuel

	Sp. gr. at 15° C.	Latent heat at const. press (atmospheric) B. Th. U. per lb.	Corrected "Lower" calorific value B. Th. U. per lb.*	Minimum consumption at 5:1 compn., lb. per I H P. hours.	Corrected thermal efficiency per cent.	Minimum consumption at highest useful compn. lb. per I. H. P. hours.
Petrols from	0·704	132	18,580	0·414	31·6	0·389
to	0·782	142	19,250	0·425	31 9	0·435
Alcohol 95 vol %	0 815	442	11,130	0·705	32 5	0·565

*The lower calorific value plus the latent heat of evaporation at constant volume.

Miscibility.—Alcohol of the strength usually employed as a liquid fuel, viz, 95% by volume, will mix with ether in all proportions, and motor fuels consisting of alcohol and ether are in use; *e.g.*, Natalite. Alcohol will not form a stable mixture with benzol or petrol under all conditions of temperature, but increased miscibility at low temperature can be obtained by the addition of a third substance, and higher alcohols, of which butyl and amyl alcohol are the best, and many other liquids, have been patented for the purpose. If anhydrous or absolute alcohol is employed, miscibility with petrol is obtained under all practical conditions of use.

Absolute Alcohol.—The production of absolute alcohol is based on two main processes, (1) the use of solid and liquid dehydrating agents, and (2) dehydration by distillation of alcohol in the presence of liquids immiscible with water, such as benzene. The high latent heat of evaporation of alcohol explains very largely its anti-detonating effect on petrol, and this property will lead to its more general use as an anti-detonant.

Production of Power Alcohol.—Investigations started by the British Government in 1920 have shown, according to the official memorandum, that:—"The production of alcohol in any considerable quantities from vegetable materials grown in the United Kingdom is not economically possible owing to:—(1) insufficient acreage, (2) the high cost of cultivation and harvesting, (3) the high cost of manufacture, and (4) the fact that the most suitable raw materials are also important food stuffs." In a further memorandum, issued in 1925, the conclusion was reached that, of the materials considered for the purpose, viz., potatoes, mangolds and Jerusalem artichokes, the last named would seem

to be a possible source, but in an emergency only. Another official memorandum, issued in Dec. 1921, suggested that there were possibilities in some of the dominions, colonies and protectorates of making alcohol from molasses, and from suitable root and tuber crops, but not for export to this country in view of the low price of petrol.

An investigation has been made as to the possibility of employing cellulosic materials such as the grasses of Australia and Africa, and the waste vegetable products such as maize and rice straw, corn cobs, rice husks, sisal hemp waste, etc. A report made by the fuel research division of the department of scientific and industrial research, was issued in July 1927. The results of this work have established the details of a process consisting in a weak acid hydrolysis of the material, which converts the hemicellulose of the plant into simple pentose sugar, and the subsequent fermentation of the sugar, by means of a special micro-organism, into a liquid consisting of about 90% of alcohol and 10% of acetone—a more efficient fuel for internal combustion engines than alcohol alone.

Alcohol can also be produced from carbide, but this would only be possible commercially where very cheap power is available. The ethylene contained in coal and coke oven gases can be converted into alcohol, but even should it be possible to work out a cheap process, the ethylene that could be made available from these sources, would not be likely to add very much to the world's liquid fuel supplies. The progress made recently in the liquefaction of coal and in the catalytic synthesis of organic liquids from carbon monoxide and hydrogen makes it probable that the liquid fuel requirements of coal-producing countries will be met by these means in the not very distant future.

Power Alcohol in the British Empire.—Substantial efforts to manufacture and use power alcohol have been made in *British Guiana,* several sugar plantations producing it. The use of the mahua flower (*Bassia latifolia*) to produce power alcohol has been taken up by the *Hyderabad* State Government, and a factory has been erected at Kamareddi The possibilities of making alcohol in *Malaya* from the juice of the nipa-palm have been the subject of investigation The chances of success would appear to be promising. A large factory for the production of an alcohol-ether motor fuel has been built in *Mauritius.* In *Natal* a motor fuel composed of approximately 55 parts of alcohol and 45 parts of ether, and known as "Natalite," is manufactured from molasses and, to some extent, from maize. Motor fuel was being produced successfully in 1923 in *New Zealand* from waste potatoes, grain, fruit, molasses and various shrubs and roots. In *Queensland* a factory in the Mackay sugar district has been built with an output of about a million gallons of 95% alcohol a year. In *South Africa,* also, a good deal of attention has been devoted to the question of producing industrial and power alcohol from crops.

Power Alcohol in Other Countries.—Argentina has a "Carburante Nacional" composed of 50% of 98·4% alcohol, and 50% petrol by volume. An alcohol-ether motor fuel is produced in Cuba from molasses. Czecho-Slovakia produces a composite fuel known as "Dynalcol," a mixture of approximately 3 parts of alcohol to four parts of benzol. Work is being done at Strendstruf in Denmark on the cultivation of special potatoes of high starch content. In France a law was passed in 1923 prescribing a "Carburant National." It requires all importers of petrol, benzol, benzene, toluene and coal distillation products, either alone or mixed, to purchase from the state a quantity of absolute alcohol corresponding to a minimum of 10% on the quantity of petrol, etc., imported during the preceding month The alcohol is to be used exclusively in motor fuels consisting of not less than 95 and not more than 105 parts by volume of absolute alcohol to 100 parts by volume of hydrocarbons. The law has, however, become inoperative because users of the Carburant National are not satisfied with it, and it entails a considerable loss to the state.

Recovery in the alcohol industry in Germany awaits a restoration of the potato production to something like pre-war standards, when about 75% of the alcohol made was distilled from potatoes, of which 2,500,000 tons, unsuitable for other purposes, were utilized, producing an average of 77,000,000 gallons annually. The price which alcohol manufacturers may offer for potatoes is limited by the Government in the interest of conserving the potato crop for human and animal consumption The national liquid fuel in Germany, "Monopolin," is composed of 45% petrol, 45% alcohol, and 10% benzol.

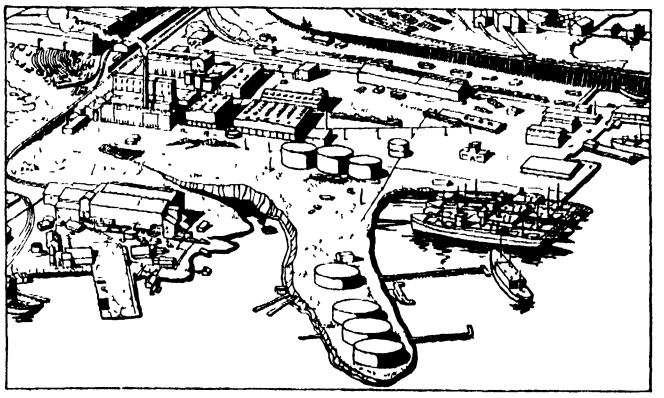
In the Hawaiian Islands the surplus of molasses is used to some extent for the production of alcohol for domestic purposes and for power In Japan there are one or two motor fuels of which alcohol is an ingredient to about 50% There are three plants in the Philippines for the manufacture of alcohol, and two liquid fuels are produced from it One is a mixture of alcohol and ether, the other a mixture of alcohol and petrol. In Sweden a mixture of 25 parts of alcohol, obtained from sulphite lyes, and 70 parts of benzol is being sold under the name of "Bentyl" for use in motors There are several distilleries in Norway capable of supplying alcohol from sulphite lyes up to 25% of the motor fuel requirements. (R. Ro.; F. L. N)

INDUSTRIAL ALCOHOL IN THE UNITED STATES

The principle of taxing and regulating alcoholic beverages is fundamental in all civilized countries, and this principle was applied to alcohol itself until industrial needs achieved special legislation, granting tax-free alcohol for industrial purposes

On Dec 17, 1897, a joint committee of Congress said "The uses of alcohol, other than as a beverage, are more largely and widely extended than is generally supposed But while the use of alcohol as a beverage is purely voluntary its employment for all other purposes is legitimate and necessary No article entering into the manufacture or the arts, whether of domestic or foreign production, performs more beneficial functions. There is scarcely a manufacturer in the country who does not use alcohol in the production of his goods to a greater or less extent."

All ethyl alcohol previous to 1906 carried a heavy revenue tax that effectively restrained any increase in its industrial use. But in 1906 the Tax Free Industrial and Denatured Alcohol Act was passed by Congress, and the development of industrial alcohol manufacture may be said to date from the passage of this Act, by which the tax on alcohol intended "for use in the arts and industries and for fuel, light and power" was lifted, provided it had been denatured and rendered unsuitable for use as a beverage.



THE PLANT OF THE U S. INDUSTRIAL ALCOHOL CO AT BALTIMORE

This plant, with its full rail and water facilities, occupies an admirable position for the manufacture of industrial alcohol. In the foreground are the huge storage tanks for molasses; at the right centre are the molasses tank steamers, with one of them unloading her cargo. The fermenting building, power plant and still houses are on the upper left

Supplemental laws were later enacted, with the result that the manufacture, distribution, sale and use of industrial alcohol has become vital. The advent of prohibition presented an added, and perhaps more potent, reason why the taxable pure ethyl alcohol should be replaced, as far as possible, with tax-free denatured alcohol, and Section 10, Title III, of the National Prohibition Act provides for denaturing plants at which ethyl alcohol could be lawfully denatured "by the admixture of such denaturing materials as shall render the alcohol or any compound in which it is authorized to be used unfit for use as an intoxicating beverage."

Under the provisions of Title III, the commissioner of Internal revenue is empowered to promulgate regulations covering the manufacture, distribution, sale and use of industrial alcohol.

"Black strap" molasses, a by-product of sugar-cane refining and once considered as a useless waste product, is at present the principal raw material for about 90% of all industrial alcohol made in the United States, 270,000,000gal. having been used during the year ending June 30, 1926. The remaining 10% used in alcohol production is composed principally of sugar, raisins, corn, rye, malt, rice, hops and other miscellaneous materials. The bulk of raw molasses used comes from Cuba, although a small supply is furnished by other islands of the West Indies, Hawaii and the cane-growing regions of the United States.

The importation of raw molasses has increased from 25,000,000 gal. for the year ended June 30, 1904, to 270,000,000gal. for the year ended June 30, 1926. Louisiana is the chief producing centre of the industry, followed by Illinois, Maryland and Pennsylvania, with a few plants situated in other parts of the country.

Completely Denatured Alcohol.—This is ethyl alcohol which has been rendered violently poisonous by the addition of denaturants according to a limited number of formulae prescribed by the U.S internal revenue bureau, and so made entirely unfit for beverage purposes, as well as injurious if used externally. It may be bought and sold without keeping records or making reports to the internal revenue bureau, but persons dealing in, storing or using such alcohol in quantities exceeding 10bbl or drums during a period of 30 days must keep such commercial records as will enable any Government officer to trace the receipt and disposal of such alcohol.

Of the formulae prescribed by the internal revenue bureau for completely denatured alcohol the following, "No. 1," is chiefly used:

FORMULA NO. 1

100 parts by volume ethyl alcohol, not less than 160% proof.
10 parts by volume approved wood alcohol
0·5 parts by volume approved benzine (kerosene).

Specially Denatured Alcohol.—This is designed for distribution to approved manufactures, under regulations, protected by a bond to guarantee the faithful performance of the conditions stipulated by the Government. In such alcohol only those denaturants are used which will not materially interfere with the special manufacturing use to which the alcohol is to be put. There are about 100 formulae for specially denatured alcohol which have been authorized by the Government for over 400 different uses.

Industrial Uses of Alcohol.—Ethyl alcohol is the most widely used solvent next to water, and after it has been properly denatured, enters directly or indirectly into the manufacture of varnishes, paints, artificial leather, anti-freeze solutions, explosives, moving picture film, inks, tobacco, lacquers, anaesthetics, antiseptics and hundreds of other products.

PRODUCTION OF INDUSTRIAL ALCOHOL FOR SPECIFIED YEARS

Fiscal years	Denaturing plants	Completely denatured	Specially denatured	Total
		(wine, gals.)		
1907	8	1,397,861	382,415	1,780,276
1914	25	5,213,130	5,191,846	10,404,976
1918	49	10,328,455	39,834,561	50,163,016
1919	45	9,976,721	28,294,219	38,270,940
1920	52	13,528,403	15,307,947	28,836,350
1921	67	12,392,595	9,996,230	22,388,825
1922	77	16,193,524	17,152,224	33,345,748
1923	76	27,128,230	30,436,913	57,565,143
1924	83	34,602,004	33,085,292	67,687,296
1925	91	46,983,970	34,824,303	81,808,273
1926	97	65,881,442	39,494,444	105,375,886
1927	94	56,093,748	39,354,933	95,448,681

The post-war developments in the automobile industry have resulted in more than half the annual output of industrial alcohol being devoted to some phase of its manufacture or operation. Nearly 40,000,000gal. are used annually by manufacturers of solutions which prevent the freezing of water in automobile radiators. Lacquer, another enormous consumer of industrial alcohol, is, because of its rapid drying qualities through evaporation of the alcohol (while paints and varnishes dry by a process of oxidation) and the ease with which it may be applied, rapidly superseding the use of oil paints and varnishes for the exterior finish of passenger cars. When dry it is inert and has a hard tough surface.

Ordinary alcohol contains 5% water and it was not until 1926–27 that absolute or anhydrous alcohol was developed to such a degree that it could be manufactured in tank car quantities at less than $1 00 per gal. The development of absolute alcohol is considered one of the great triumphs of the chemical industry.

The United States Navy and the United States post office have found that gasolene when mixed with absolute alcohol produces a superior aeroplane fuel. (J. C. McG.)

ALCOHOLISM: *see* DRUNKENNESS.

ALCOHOLOMETRY: *see* ALCOHOL, *Determination.*

ALCOHOLS, in organic chemistry, a class of compounds of which ethyl alcohol (*see* ALCOHOL) is perhaps the most common member derived from paraffinoid and non-aromatic hydrocarbons by the replacement of one or more hydrogen atoms by hydroxyl groups. This definition excludes such compounds as the phenol (hydroxy derivatives of benzene, naphthalene and other aromatic hydrocarbons) which are more acidic than the true alcohols.

Alcohols are classified on two distinct principles, one depending upon the number of hydroxyl groups present, the other on the nature of the remaining groups attached to the carbon atom which carries the hydroxyl group. Monohydric alcohols contain only one hydroxyl group; dihydric, two known as glycols; trihydric, three known as glycerols; and so on (*see* CHEMISTRY: *Organic*).

The second principle leads to alcohols of three distinct types, known as primary, secondary and tertiary (H. Kolbe, 1860). The genesis of these types may be readily understood by considering the relation which exists between the alcohols and the parent hydrocarbon. In methane, CH_4, the hydrogen atoms are of equal value, and hence only one monohydric alcohol, viz., CH_3OH, can be derived from it. This compound, methyl alcohol (carbinol), is the simplest primary alcohol, and it is characterized by the grouping $\cdot CH_2OH$. Ethane, C_2H_6, in a similar manner, can only give rise to one alcohol, namely ethyl alcohol or methylcarbinol, CH_3CH_2OH, which is also primary. Propane, $CH_3CH_2CH_3$, can give rise to two alcohols—a primary alcohol, $CH_3CH_2CH_2OH$ (normal propyl alcohol or ethylcarbinol), formed by replacing a hydrogen atom attached to a terminal carbon atom, and a secondary alcohol, $CH_3{\cdot}CH(OH){\cdot}CH_3$ (isopropyl alcohol or dimethylcarbinol), when the substitution is effected on the middle carbon atom. The grouping CH·OH characterizes the secondary alcohols; isopropyl alcohol is the simplest member of this class. Butane, C_4H_{10}, exists in the two isomeric forms—normal butane, $CH_3{\cdot}CH_2{\cdot}CH_2{\cdot}CH_3$, and isobutane, $CH(CH_3)_3$. Each of these hydrocarbons gives rise to two alcohols: *n*-butane gives a primary and a secondary; and isobutane a primary, when the substitution takes place in one of the methyl groups, and a tertiary, when the hydrogen atom of the ⋮CH group is substituted. Tertiary alcohols are thus seen to be characterized by the group ⋮C·OH, in which the residual valencies of the carbon atom are attached to alkyl groups. The three types of alcohol may be formulated as follows:—$R{\cdot}CH_2{\cdot}OH$ (Primary); (R_1R_2) CH·OH (Secondary); $(R_1R_2R_3)C{\cdot}OH$ (Tertiary).

Properties.—The alcohols are neutral in reaction, and the lower members possess the property of entering into combination with salts, in which the alcohol plays the rôle of water of crystallization. Sodium or potassium dissolves in the alcohols with the formation of alcoholates (alkyloxides), the hydrogen of the hydroxyl group being replaced by the metal. With strong acids water is split off and esters are formed The halide esters of the paraffin alcohols, formed by heating the alcohols with the halogen acids, are more conveniently prepared by the action of the phosphorous halide on the alcohol. Energetic dehydration gives rise to olefinic hydrocarbons, but under certain conditions ethers (*see* ETHER) are obtained.

The physical properties of the alcohols exhibit a gradation with the increase of molecular weight. The lower members are

colourless mobile liquids, readily soluble in water and exhibiting a characteristic odour and taste. The solubility decreases as the carbon content rises. The normal alcohols containing 1 to 16 carbon atoms are liquids at the ordinary temperatures; the higher members are crystalline, odourless and tasteless solids, closely resembling the fats in appearance. The boiling points of the normal alcohols increase regularly about 19° for each CH_2 increment; this is characteristic of all homologous series of organic compounds. Of the primary, secondary and tertiary alcohols having the same empirical formula, the primary have the highest, and the tertiary the lowest boiling point; this is in accordance with the fairly general rule that a gain in symmetry is attended by a fall in the boiling point.

Distinctive Tests for Primary, Secondary and Tertiary Alcohols.—Many reactions serve to distinguish these three types of alcohol. Of chief importance is their behaviour on oxidation. The primary alcohols are first oxidized to aldehydes (*q v*), which, on further oxidation, yield acids containing the same number of carbon atoms as in the original alcohol. Secondary alcohols yield ketones (*q v*), which are subsequently oxidized to a mixture of two acids Tertiary alcohols yield neither aldehydes nor ketones, but a mixture of two or more acids. Another method is based upon the different behaviour of the corresponding nitro-alkyl with nitrous acid The alcohol is first acted upon with phosphorus and iodine, and the resulting alkyl iodide is treated with silver nitrite, which gives the corresponding nitro-alkyl. The nitro-alkyl is then treated with potassium nitrite dissolved in concentrated potash, and sulphuric acid is added By this treatment the primary nitro-alkyl yields a nitrolic acid, the potassium salt of which forms an intense red solution; the secondary nitro-alkyl forms a pseudo-nitrole which gives an intense blue solution, while the tertiary compound does not react with nitrous acid. The reactions outlined above may be thus represented:—

$$R\cdot CH_2OH \rightarrow R\cdot CH_2I \rightarrow R\cdot CH_2\cdot NO_2 \rightarrow R\cdot C\begin{matrix}=NOH\\ -NO_2\end{matrix}$$

Primary alcohol. Nitrolic acid.

$$\begin{matrix}R\\ R_1\end{matrix}\!\!>\!CH\,OH \rightarrow \begin{matrix}R\\ R_1\end{matrix}\!\!>\!CH\cdot I \rightarrow \begin{matrix}R\\ R_1\end{matrix}\!\!>\!CH\cdot NO_2 \rightarrow \begin{matrix}R\\ R_1\end{matrix}\!\!>\!C\begin{matrix}-NO_2\\ =NO\end{matrix}$$

Secondary alcohol. Pseudo-nitrol.

$$(R_1R_2R_3)C\,OH \rightarrow (R_1R_2R_3)C\cdot I \rightarrow (R_1R_2R_3)C\,NO_2$$

Tertiary alcohol.

By heating to the boiling point of naphthalene (218°) tertiary alcohols are decomposed, while heating to the boiling point of anthracene (360°) suffices to decompose secondary alcohols, the primary remaining unaffected. These changes, which can be followed out by determinations of the vapour density, provide a method for characterizing alcohols.

Preparation.—Monohydric alcohols may be readily prepared from the corresponding alkyl halide by the action of moist silver oxide (which behaves as silver hydroxide), by the saponification of their esters; or by the reduction of polyhydric alcohols with hydriodic acid, and the subsequent conversion of the resulting alkyl iodide into the alcohol by moist silver oxide. Primary alcohols are obtained by decomposing their sulphuric acid esters (from sulphuric acid and the olefines) with boiling water; by the action of nitrous acid on primary amines; or by the reduction of aldehydes, acid chlorides or acid anhydrides. Secondary alcohols result from the reduction of ketones; and from the reaction of zinc alkyls on aldehydes or formic acid esters.

$$CH_3CHO \rightarrow CH_3\cdot CH\begin{matrix}-C_2H_5\\ -OZnC_2H_5\end{matrix} \rightarrow CH_3\cdot CH\begin{matrix}-C_2H_5\\ -OH\end{matrix}$$

Acetaldehyde. Methyl-ethyl-carbinol.

$$HC\begin{matrix}=O\\ -OC_2H_5\end{matrix} \rightarrow HC\begin{matrix}-OZnCH_3\\ -CH_3\\ -OC_2H_5\end{matrix} \rightarrow HC\begin{matrix}-OZnCH_3\\ -CH_3\\ -CH_3\end{matrix} \rightarrow HC\begin{matrix}-OH\\ -CH_3\\ -CH_3\end{matrix}$$

Formic ester. *iso*Propyl alcohol.

Tertiary alcohols were first synthesized by A. Butlerow in 1864, by reacting with a zinc alkyl (methyl or ethyl) on an acid chloride; an addition compound was first formed, which decomposed with water to give a ketone. When, however, a second molecule of a zinc alkyl was allowed to react, a compound was formed which gave a tertiary alcohol when decomposed with water.

$$R\,C\begin{matrix}=O\\ -Cl\end{matrix} \rightarrow R\cdot C\begin{matrix}-CH_3\\ -OZnCH_3\\ -Cl\end{matrix} \rightarrow R\cdot C\begin{matrix}-CH_3\\ -OZnCH_3\\ -CH_3\end{matrix} \rightarrow R\cdot C\begin{matrix}-CH_3\\ -OH\\ -CH_3\end{matrix}$$

Acid chloride. Tertiary alcohol.

It is interesting to note that, whereas zinc methyl and ethyl give tertiary alcohols, zinc propyl only gives secondary alcohols. The Grignard reaction (*q v.*) affords a means of synthesizing the three classes of monohydric alcohols, the process being based on the addition of a Grignard reagent to a carbonyl group When added to formaldehyde, a primary alcohol is obtained. With any other aldehyde a secondary alcohol is produced, whereas with a ketone the product is a tertiary alcohol.

The following monohydric alcohols receive special treatment under their own headings:—Alcohol (Ethyl), Allyl Alcohol, Amyl Alcohols, Benzyl Alcohol, Butyl Alcohols, Methyl Alcohol and Propyl Alcohols

ALCOTT, AMOS BRONSON (1799–1888), American educationalist and writer, was born of farming stock in Wolcott (Conn), Nov. 29, 1799. Extravagant pedlar, visionary schoolteacher, peripatetic philosopher, Bronson Alcott gives the lie to all theories of Yankee shrewdness and thrift "A venerable Don Quixote," as Carlyle termed him, "all bent on saving the world by a return to acorns and the golden age," he was ridiculed by the majority of his contemporaries, including Lowell in *A Fable for Critics* and some of the Transcendentalists But Emerson, although recognizing his limitations, remained a staunch friend; and educators have long since adopted many of the theories of this "American Pestalozzi" His truth to his ideals seems to have involved more suffering for his wife, Abigail May, and his four daughters than for himself School after school had to be given up, in part because of the conservatism of his patrons, in part because of harsh criticism such as that of Harriet Martineau, and in part because of too rigid adherence to his principles, as when he refused to dismiss the little negro girl who disrupted his Boston group Indeed, Alcott was too visionary even to be a satisfactory day-labourer In later life his western lecturing trips were made pleasant and financially profitable through his "riding in Louisa's chariot" and being known as the "grandfather of *Little Women*"; and his long-cherished dream of presiding over a Concord Summer School of Philosophy and Literature was fulfilled He had early received some recognition in England He died on March 4, 1888, just before his celebrated daughter



THE CONCORD HOME OF AMOS BRONSON ALCOTT, NEW ENGLAND TRANSCENDENTALIST WHOM CARLYLE CALLED "THE POTATO QUIXOTE"

Since in Alcott's lifetime his writings were recognizably inferior to his informal lectures or "conversations," it is natural that few should search to-day for the vignettes of contemporaries and the nuggets of wisdom scattered through his "Orphic Sayings" in the *Dial*, his *Tablets* (1868), *Concord Days* (1872) and *Table Talk* (1877). The poem *New Connecticut* (1887) and some of the *Sonnets and Canzonets* (1882) are of autobiographic value; and his *Observations on the Principles and Methods of Infant Instruction* (1830), together with Elizabeth Peabody's transcripts of his classroom procedure in *Record of a School* (1835), etc, reveal his educational innovations *A. Bronson Alcott: His Life and Philosophy* (1893), by F B. Sanborn and W. T. Harris, draws largely upon Alcott's diaries, and *Bronson Alcott's Fruitlands* (1915), an interesting compilation by Clara E. Sears, illuminates his unfortunate experiment in Communistic plain living and high thinking. *See* also Honoré W Morrow, *The Father of Little Women* (1927).

ALCOTT, LOUISA MAY (1832–1888), American author, was born in Germantown, now part of Philadelphia (Pa), Nov. 29, 1832. Like her mother, she felt deeply the family trials and privations caused by the unpracticality of her father, Amos Bronson Alcott. In later life she defined a philosopher as "a man up in a balloon, with his family and friends holding the ropes

which confine him to earth and trying to haul him down." When she was still a young girl her journal reflected her determination to earn money and make her family comfortable. Fortunately the Alcotts' wandering life had allowed her plenty of time out of doors, so that a strong body was built up for the active brain, and, as she herself put it, nature gave her a vital sense of God's presence "never to change through forty years of life's vicissitudes, but to grow stronger for the sharp discipline of poverty and pain, sorrow and success." She started her bread-earning career early as a dolls' dressmaker, and in a few years was putting her hand to anything that would bring in money to purchase necessaries and pay off debts for her family—teaching, sewing, even, for a short period, domestic service. "Pot-boilers" at this period brought in five or ten dollars apiece; of a wild, sensational type, they worked off her steam and perhaps gave some facility in writing Their nature may be judged from "The Baron's Gloves" and "A Whisper in the Dark," which have been included in her collected works. In 1860 50 dollars for an *Atlantic* story seemed like wealth and fame indeed Her first book was *Flower Fables* (1854), tales originally written for R. W. Emerson's little daughter Ellen; but she attained widespread celebrity only after the publication of her *Hospital Sketches,* serially in the *Commonwealth* and in book form in 1863 (republished with additions, 1869). These were a revision of her letters to her family during her period as nurse in the Union hospital at Georgetown, D.C. Her six weeks there in 1862–63 resulted not only in fame but also unfortunately in shattered health, and this, combined with her incessant overwork, finally caused her death, in Boston, March 6, 1888, two days after her father's death.

Of her life the best record is her own. As the "Jo" of *Little Women* (1868), the most popular girls' book ever written in America, she will always live in the hearts of her readers. Although this is probably the most autobiographical of her books, other of her experiences in Boston, Concord and abroad are reflected in *Jo's Boys* (1886); *An Old-Fashioned Girl* (1870); *Shawl Straps* (1872), one of the series *Aunt Jo's Scrap Bag* (6 vol., 1871–79); *Moods* (1864), a much revised novel, and L. Alcott's favourite; *Work* (1873); and many of her shorter pieces. *Little Men* (1871) describes her nephews, children of her older sister, Anna; *Lulu's Library* (3 vol., 1885–89) is named after the little niece whom the artist sister, May, when dying bequeathed to her; and *Jack and Jill* (1880) makes use of the Concord young people.

Miss Alcott's most enduring place is due to the cheeriness and wholesomeness of her pictures of boy and girl life. Her novels *Moods, Work* and *A Modern Mephistopheles* (1877) in the "No Name" series are experimental in technique; and even her juvenile books show the inequalities attendant upon her haste in production and her ill health. In early life poverty was responsible for her steady output; in later life nervous restlessness and perhaps excessive generosity caused her to feel the necessity of supplying all demands upon her. After only one article on Ralph Waldo Emerson, long her idol and her family's truest friend, do we find not the dollar sign in her journal but "a labour of love." In any estimate, however, her lavishness in giving not only of her money but also of her personal service to relatives, friends and strangers alike and her ardour in the causes of abolition and woman's suffrage must be considered. Through several generations she has held her place among America's most popular writers for children.

By far the best biography is Ednah D. Cheney's *Louisa May Alcott: Her Life, Letters, and Journals* (Boston, 1889), which contains Miss Alcott's early records and also her later annotations. Copious use is made of it by Belle Moses in *Louisa May Alcott, Dreamer and Worker* (1909), and by the writers of numerous shorter sketches.

ALCOY, south-eastern Spain, province of Alicante, on the small river Sérpis, and at the terminus of a branch of the Barcelona-Valencia-Alicante line. Pop. (1920) 36,463. Alcoy is built on high ground at the entrance to a gorge. It is a thriving industrial town, with manufactures of linen, woollen goods, agricultural machinery, almond confections and paper, especially cigarette paper. The Saltas de las Aguas, a waterfall, provides ample industrial power. For an account of the festival of St. George of Alcoy, *see* J. A. Llobet y Vallosera, *Apuntes historicos acerca de las fiestas que celebra cada año la ciudad de Alcoy a su patron San Jorge* (Alcoy, 1853).

ALCUIN (ALCHUINE), ecclesiastic and man of learning in the 8th century, who liked to be called by the Latin name of ALBINUS, and at the Academy of the palace of Charlemagne took the surname of FLACCUS, was born at Eboracum (York) in 735. Alcuin is important in the European history of his time, because he carried the learning of the British Isles to the court of Charlemagne and so to western Europe. He was educated at the cathedral school of York, under Aelbert, with whom he went to Rome in search of manuscripts. When Aelbert was appointed archbishop of York in 766, Alcuin succeeded him as head of the episcopal school. He again went to Rome in 780, to fetch the *pallium* for Archbishop Eanbald, and at Parma met Charlemagne, who persuaded him to come to his court, and gave him the great abbeys of Ferrières and of Saint-Loup at Troyes. The king desired his help in the revival of learning among the Franks. From 781 to 790 Alcuin was Charlemagne's right hand in this enterprise. He had as pupils the king of the Franks, the members of his family and the young clerics attached to the palace chapel; he was the life and soul of the academy of the palace, and we have still, in the *Dialogue of Pepin* (son of Charlemagne) *and Alcuin,* a sample of the intellectual exercises in which they indulged. It was under his inspiration that Charles wrote his famous letter *de litteris colendis* (Boretius, *Capitularia,* i. p. 78), and he founded the palace library. In 790 Alcuin returned to his own country, but Charlemagne needed him to combat the Adoptionist heresy, which was making headway in the marches of Spain. At the Council of Frankfort in 794 Alcuin upheld the orthodox doctrine, and obtained the condemnation of the heresiarch, Felix of Urgel. After this victory he returned to his own land, but only for a brief period. Charlemagne gave him the great abbey of St. Martin at Tours, and there he passed his last years Many students flocked to the abbey school; he had numerous manuscripts copied, the calligraphy of which is of extraordinary beauty (*v.* Léopold Delisle in the *Mémoires de l'Académie des Inscriptions,* vol. xxxii, 1st part, 1885). The script used was the Carolingian minuscule from which our own roman type derives. He wrote numerous letters to his friends in England, to Arno, bishop of Salzburg, and above all to Charlemagne. These letters, of which 311 are extant, are filled chiefly with pious meditations, but they form a mine of information as to the literary and social conditions of the time, and are the most reliable authority for the history of humanism in the Carolingian age. Others deal with astronomy, a favourite subject with the emperor. Alcuin died on May 19, 804.

Alcuin is the most prominent figure of the Carolingian Renaissance, in which have been distinguished three main periods: in the first of these, up to the arrival of Alcuin at the court, the Italians occupy the chief place; in the second, Alcuin and the Anglo-Saxons are dominant; in the third, which begins in 804, the influence of the Goth Theodulf is preponderant. Besides some graceful epistles in the style of Fortunatus, Alcuin wrote some long poems, and notably a whole history in verse of the church at York: *Versus de patribus, regibus et sanctis Eboracensis ecclesiae.* He wrote also manuals used in his educational work; a grammar and works on rhetoric and dialectics, written in the form of dialogues. He composed homilies, a treatise *de Fide Trinitatis,* etc., and is said to have revised the text of the Latin Bible.

The complete works of Alcuin have been edited by Froben: *Alcuini opera* (Regensburg, 1777). This edition is reproduced in Migne's *Patrolog. lat.* vols. c. and ci. The letters have been published by Jaffé and Dümmler in Jaffé's *Bibliotheca rerum germanicarum,* vol. vi., p. 132–897 (1873). E. Dümmler also published an authoritative edition, *Epistolae aevi Carolini,* vol. ii., p. 1-481, in the *Monumenta Germaniae,* and edited the poems in the same collection: *Poetae latini aevi Carolini,* vol. i., p. 169-341.

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sources de l'histoire Carolingienne, part i. (1898); C. J. B. Gaskoin, *Alcuin: His Life and his Work* (1904). *See* further W. Ueberweg, *Grundriss d. Gesch. d. Phil. des Mittelalters* (1915 ed), M J Rhodes, "Learning and Literature till Pope Sylvester II." in *Cambridge Mediaeval History,* vol. iii. (1922).

ALCYONE or **HALCYONE,** in Greek mythology, daughter of Aeolus and wife of Ceyx. For their insolence in calling themselves Zeus and Hera, Alcyone was changed into a diver, Ceyx into a kingfisher. In another story, Ceyx was drowned and his body cast on the shore. His wife found the body, and the gods, out of compassion, changed both into kingfishers. The winds ceased to blow during their brooding-time, hence the expression "halcyon days," used in ancient and modern times to denote a period of calm and tranquillity (Ovid, *Metam,* xi 410 et seq).

ALDABRA ISLANDS, in the Indian ocean, part of the British colony of Seychelles, in 9° 30′ S, 46° E, 265m N W. of the northern point of Madagascar and 690m S W of Mahé, in the Seychelles The islands are an oval atoll some 40m in circumference and about 1½m broad, enclosing a shallow lagoon. Channels divide the ring into four islands, which rise from 20 to 80ft. above the sea. Grande Terre or South island forms three-fifths of the circumference. The other islands are West island or Île Picard, Polymnie, Middle island, and several islets (*e.g.,* Île Michel) in the lagoon. The total land area is estimated at about 60sq m. Pop. (1906) 127. The external cliffs of coral and limestone are in places replaced by sandy beaches and sandhills There is very little soil. Dense scrub covers most of the land, but the lagoon shore is bounded by mangrove swamps The flora and fauna are of great interest The gigantic land tortoise (*Testudo elephantina*) is now carefully preserved. Peculiar birds include a rail (*Dryolimnas aldabranus*), an ibis (*Ibis abbottii*) and a dove (*Alectroenas sganzini*) Oysters and large crabs occur, and a small mussel is found in enormous numbers The flora includes mangroves, *Rubiaceae, Sapotaceae* and other forms requiring more than pure coralline material for their growth The predominant species are Madagascar plants and birds, carried by currents and winds. There are few endemic species of plants Aldabra seems to have been built up on the sunken surface of the old Gondwana continent by a deposit, in the opinion of Prof A Voeltzkow, of foraminiferal remains (mostly coccoliths and rhabdoliths), and it has never been joined to any other land (Stanley Gardiner) Dupont states that at Aldabra the coral foundation is totally above water. The coral limestone of the atoll is vitrified and gives out a ringing sound when struck or simply walked on The coral is generally reddish, but runs from light yellow to chocolate-brown

Aldabra was visited by the Portuguese in 1511 but was already known to the Arabs, who gave the name. In the 18th century the islets became dependencies of the French establishments at Bourbon (Réunion). In 1810 with Mauritius, Bourbon (for a time), the Seychelles and other islands, Aldabra became British. The inhabitants are emigrants from the Seychelles. Goats are bred and coco-nuts cultivated, but fishing is the chief industry. With other outlying islands Aldabra is held under lease from the Seychelles Government, the lessees having exclusive trading privileges.

See R. Dupont, *Report on a Visit of Investigation to . . . the Aldabra Group of the Seychelles Islands* (Seychelles, 1907); Dr. Abbott in *Proceedings,* United States National Museum (Washington, 1894); A. Voeltzkow in *Abh der Senckenbergischen Naturforschenden Ges* vol. xxvi. pt iv. (1901); J. S. Gardiner, "The Indian Ocean," *Geo. Journ.* (Oct. 1906).

ALDANOV, MARK ALEXANDROVICH (1889–), Russian novelist and publicist, also known as Landau-Aldanov, was born at Kiev. His most considerable work is a trilogy, *The Thinker,* in which the French Revolution is treated with learning, understanding and philosophy. He also discusses in *Armageddon* (1915) the World War, but here shows himself more elegant than precise.

ALDBOROUGH, a village in the West Riding of Yorkshire, England, 16m. W.N.W. of York. Pop. (1921), 424. There are evidences of settlement from early times, the site being known to the Romans as *Isurium Brigantum.*

ALDEBARAN, α Tauri, is the brightest star in the constellation Taurus (*q.v.*). It is reddish in colour and radiates about 74 times as much light as does the sun. Its magnitude is 1·1.

ALDEBURGH (Aldborough), municipal borough on the coast of Suffolk, England, the terminus of a branch of the London and North Eastern railway, 99½m. N.E of London. Population (1921) 2,889. The district is exposed, but a fine stretch of sand fringes Aldeburgh bay. To the west the river Alde broadens as if into an estuary, but its outflow is prevented by the sand, and it runs south for nearly 10m. parallel with the shore. The sand banks have arrested the encroachments of the sea, which submerged a former site of Aldeburgh.

Aldeburgh (Aldburc) takes its name from the river Alde. There is no pre-Conquest record but at the Domesday survey most of the land was held by Robert Malet, a Norman. In 1155 the manor was granted to the abbey of St. John of Colchester and later to Cardinal Wolsey In 1567 a Saturday market was granted. In the 16th century Aldeburgh was a place of considerable commercial importance. The earliest charter is that of 1529. In 1548 it was made a free borough, with a charter of incorporation and a market on Wednesday. Later charters were granted in 1553, 1558 and 1567, by James I. (who granted two annual fairs) in 1606, and by Charles I, in 1631 and 1637. The fairs and markets became so unimportant that they were discontinued about the middle of the 19th century. The town returned two members to parliament in 1572, and continued to do so until the Reform Act of 1832. Frequent disastrous incursions of the sea reduced Aldeburgh to a mere fishing village, but it is now a golfing centre There are coastguard and lifeboat stations A small Moot Hall of the 16th century is used for corporation meetings. Slaughden quay on the Alde admits small vessels, and herring and lobster fishing are carried on. Aldeburgh is governed by a mayor, four aldermen and 12 councillors Area 1,663 acres. It is included in the Woodbridge division of the parliamentary county of east Suffolk.

ALDEGREVER or **ALDEGRAF, HEINRICH** (1502–1558), German painter and engraver, was born at Paderborn, from whence he removed in early life to Soest, where he died. From the close resemblance of his style to that of Albrecht Dürer he has sometimes been called the Albert of Westphalia. There is a good collection of his engravings in the British Museum. Specimens of his painting are exceedingly rare. Five pictures are in Continental galleries, but the genuineness of the works in the Vienna and Munich collections attributed to him is at least doubtful, the only unchallenged example being a portrait of Engelbert Therlaen (1551) in the Berlin Museum.

ALDEHYDES, an important class of chemical compounds having the general formula R·CHO, where R is an alkyl (aliphatic) or aryl (aromatic) radical The name is derived from *alcohol dehydrogenatus* (J Liebig), indicating that these compounds may be obtained from primary alcohols by removal of hydrogen: $RCH_2 \cdot OH - 2H = R\ CHO$.

The group CHO which is to be found in all aldehydes contains the most active form of the carbonyl radical, CO, known to chemists, and it is to the intense reactivity of this radical that the aldehydes owe their importance as organic synthetic agents both in nature and in the chemical laboratory.

Aldehydes are generally named specifically after the acids into which they are converted by oxidation, thus formaldehyde, acetaldehyde and benzaldehyde furnish formic, acetic and benzoic acids, respectively. In more complicated cases, the termination *al* is employed to denote aldehydic functions, according to the Geneva convention of chemists, thus geranial, the aldehyde of lemon-grass oil, is the oxidation product of the alcohol, geraniol, contained in geranium oil (*see* Terpenes).

Many aldehydes are known to chemistry, some being produced artificially, whereas numerous others are found in the vegetable kingdom either free (*e.g.,* cinnamaldehyde in cinnamon oil) or combined in certain glucosides (*e g.,* benzaldehyde in amygdalin, *see* Glucosides).

Properties of Typical Aldehydes.—Formaldehyde, H COH, at once the simplest of the aldehydes and the prototype of the carbohydrates, $C(H_2O)$, is a gas at the ordinary temperature (b p −21° C) and is prepared by passing the vapour of methyl alcohol and air over heated copper gauze The gaseous aldehyde is collected in water to form a 30–40% solution known commercially

as Formalin (*q.v.*). This solution on concentration yields a white solid polymeride known as paraformaldehyde $(CH_2O)_3$ When, however, the gaseous formaldehyde is cooled, it polymerizes to a crystalline modification termed trioxymethylene, $(CH_2O)_3$. These polymeric forms are dissociated on heating into the gaseous monomeric formaldehyde $(CH_2O)_3 \rightleftharpoons 3CH_2O$.

Acetaldehyde, prepared by oxidation of ethyl alcohol and by direct synthesis from carbon monoxide and hydrogen (*v. infra*), is a volatile liquid boiling at 21° C. and miscible in all proportions with water. It is readily polymerized catalytically by traces of zinc chloride, hydrochloric acid, etc., at the ordinary temperature to para-acetaldehyde or "paraldehyde" $(C_2H_4O)_3$, a liquid boiling at 124° and only moderately soluble in water. Paraldehyde, employed medicinally as a sedative without action on the heart, is administered intravenously as an anaesthetic or hypnotic. When the foregoing polymerization of acetaldehyde takes place in a freezing mixture, metaldehyde (meta-acetaldehyde) is produced as a white crystalline solid subliming at 112–115° C. This substance is insoluble in water and when heated in a sealed tube at 100° is reconverted into the monomeric form. Metaldehyde, which is produced commercially, has been recommended as a smokeless fuel, replacing the spirit lamp for toilet purposes.

The simultaneous chlorination and oxidation of ethyl alcohol leads to trichloroacetaldehyde which in its hydrated state is the well-known drug Chloral Hydrate (*q.v.*).

Aldolisation.—The condensation of formaldehyde and acetaldehyde into their polymeric forms is a chemical change which is readily reversible by thermal dissociation. But in addition to this reversible change, aldehydes have the capacity for undergoing a polymerization in which the carbon atoms of separate molecules become directly attached so that the process becomes irreversible This mode of polymerization, which is termed aldolisation, undoubtedly plays an important part in the building up of carbon compounds in the green plant, following on the assimilation of carbon dioxide by photosynthesis. Aldol (β-hydroxybutaldehyde) is formed by a polymerization of two molecules of acetaldehyde:

$$CH_3{\cdot}CHO + H\,CH_2{\cdot}CHO = CH_3{\cdot}CH(OH){\cdot}CH_2{\cdot}CHO.$$

By loss of water aldol passes into the unsaturated crotonaldehyde, $CH_3{\cdot}CH.CH{\cdot}CHO$.

This adding of carbon to carbon occurs in a marked degree in the case of formaldehyde and the process is instrumental in the vegetable kingdom in the building up of complex carbohydrates (sugars, starches, cellulose) from formaldehyde, the simplest carbohydrate, $C(H_2O)$. The aldolisation of formaldehyde has been effected in the laboratory; a sixfold polymerization in the presence of magnesia (Loew) furnished α- and β-acroses, two synthetic sugars which have since been identified as inactive fructose and inactive sorbose respectively.

Resinification.—Acetaldehyde and certain of its homologues are converted into resins under the influence of alkalis. Acrolein, $CH_2{:}CH{\cdot}COH$, the simplest of the unsaturated aldehydes, is obtained by abstraction of water from glycerine by the agency of alkali bisulphates and phosphoric or boric acid. It is a colourless liquid boiling at 52·4° C. with a disagreeable, tear-exciting odour. In the presence of traces of acids, it readily undergoes polymerization to form a solid resinous material, metacrolein (*see* Resins, Synthetic). Acrolein forms a dibromide from which E. Fischer by the action of baryta water obtained the synthetic sugars, α- and β-acroses.

Benzaldehyde, the most important commercially of the aromatic aldehydes, is usually made from the chlorinated derivatives of toluene. Benzyl chloride, $C_6H_5{\cdot}CH_2Cl$, heated with queous lead or cupric nitrate furnishes benzaldehyde, which is also prepared by heating benzal or benzylidene chloride, $C_6H_5{\cdot}CHCl_2$ with milk of lime. As prepared by either method, benzaldehyde is contaminated with traces of chlorinated benzaldehydes, and when chlorine-free benzaldehyde is needed it is prepared by the direct oxidation of toluene by chemical means (manganese dioxide and sulphuric acid) or by electrolytic means (an acetone-sulphuric acid solution with platinum electrode).

Benzaldehyde is a colourless, highly refractive liquid boiling at 179–180° with the characteristic odour of oil of bitter almonds of which oil it is the essential constituent, being derived from the hydrolysis of the glucoside, amygdalin, present in the almond. It readily absorbs oxygen from the air, becoming oxidized to benzoic acid. With aqueous caustic alkalis it undergoes the Cannizzaro reaction, $2C_6H_5{\cdot}CHO = C_6H_5{\cdot}CH_2{\cdot}OH + C_6H_5{\cdot}CO_2H$, yielding molecular proportions of benzyl alcohol and benzoic acid. With alcoholic potassium cyanide, it gives benzoin, $C_6H_5{\cdot}CH(OH){\cdot}CO\,C_6H_5$. Benzaldehyde is also an important intermediate in the production of colouring matters (*see* Dyes, Synthetic, and Malachite). When condensed with acetic anhydride and dry sodium acetate, it yields cinnamic acid, whereas cinnamaldehyde arises from a condensation between benzaldehyde and acetaldehyde in the presence of sodium ethoxide.

Furfuraldehyde (furfural), $\begin{matrix} O\text{—}CH{:}CH \\ | \qquad\quad | \\ C(CHO){:}CH \end{matrix}$, is an example of a non-aromatic cyclic aldehyde (*see* Chemistry: *Organic, Heterocyclic*), formerly obtained by the hydrolysis of bran with dilute mineral acid and now manufactured in the U S A by the action of steam and dilute acid on oat hulls and corn cobs and stalks contained in large digestors The volatile furfuraldehyde (b p. 160–162°) is isolated and purified by fractional distillation.

GENERAL METHODS OF PREPARATION

1. *Direct synthesis.* Arising from a study of chemical reactions under high pressure it has been found that when carbon monoxide and hydrogen are heated together at 360–380° C. under a pressure of 200 atmospheres in the presence of a mixed catalyst consisting of the oxides of cobalt, copper, manganese and zinc, a mixture of aliphatic aldehydes is produced among which formaldehyde, acetaldehyde, propionaldehyde and higher aldehydes have been identified (*see* Pressure Chemistry).

2. *Action of ozone on olefines.* During an investigation of the action of ozone on various organic substances, C. D. Harries discovered that this active form of oxygen has a specific action on carbon compounds containing a double or ethylenic linkage. A molecular proportion of ozone attaches itself to the carbon atoms of the double linking forming an ozonide, which on treatment with water yields an aldehyde and an aldehyde peroxide, the latter becoming transformed into an acid. In the simplest case of ethylene this gas furnishes an explosive ozonide which subsequently gives rise to formaldehyde and formic acid,

$$CH_2{:}CH_2 + O_3 = \begin{matrix} CH_2\text{—}CH_2 \\ \diagdown\ \diagup \\ O_3 \end{matrix} \rightarrow CH_2O + CH_2O_2.$$

A similar ozonization applied to more complex olefines has led to aldehydes which are otherwise prepared only with difficulty.

$$\underset{\text{(cinnamaldehyde)}}{C_6H_5{\cdot}CH{:}CH{\cdot}CHO} + O_3 = \underset{\text{(benzoic acid)}}{C_6H_5{\cdot}CO_2H} + \underset{\text{(glyoxal)}}{CHO{\cdot}CHO}$$

3. *Dehydrogenation of primary alcohols.* The primary alcohols may be dehydrogenated either thermally or by oxidation. In the former process the alcohol is passed over a heated metallic catalyst, preferably copper, although nickel, palladium or platinum or such oxides at vanadium pentoxide, V_2O_5, may be employed. The oxidation of a primary alcohol to an aldehyde is generally effected by aqueous chromic acid (a solution of sodium bichromate and dilute sulphuric acid), but other oxidizing agents such as manganese dioxide and dilute sulphuric acid, or even atmospheric oxygen in presence of platinum black or bone black, may be employed.

4. *Synthesis through the Grignard reagent* (*q.v.*). A method of wide application for either aliphatic or aromatic aldehydes depends on the employment of the well-known Grignard reaction with ethyl formate, $H{\cdot}CO{\cdot}OC_2H_5$, an ester which it will be noticed contains the characteristic aldehydic group HCO. Thus when the formate is treated successively with magnesium ethyl iodide (the Grignard reagent from magnesium and ethyl iodide) and water, propionaldehyde is produced. A similar condensation on ethyl formate with magnesium phenyl bromide leads to benzaldehyde. In general the Grignard synthesis of aldehydes may be

represented by the following equations, when R is an organic radical and X a halogen (usually iodine or bromine):

$$H{\cdot}CO{\cdot}OC_2H_5+MgRX=H{\cdot}CR(OMgX){\cdot}OC_2H_5$$
$$H{\cdot}CR(OMgX){\cdot}OC_2H_5+H_2O=R{\cdot}CHO+C_2H_5{\cdot}OH+HOMgX$$

5. *Thermal decomposition of α-hydroxycarboxylic acids.* This process, discovered by H. R. Le Sueur, has been worked out chiefly with the higher fatty acids. For example, stearic acid is converted successively into α-bromostearic and α-hydroxystearic acids. The latter acid, on heating at 270° C, yields margaric aldehyde $C_{16}H_{33}{\cdot}CHO$ and formic acid. Incidentally this method forms a means of passing from common acids such as stearic and palmitic acids, which are readily obtained from natural sources, to acids such as margaric acid, $C_{16}H_{33}{\cdot}COOH$, which do not occur in nature.

6. The metallic formates contain the aldehydic group CHO and another general method for aldehydes depends on the heating together of an intimate mixture of calcium formate and the calcium salt of some other acid.

$$(CHO{\cdot}O)_2Ca+(C_nH_{2n+1}{\cdot}CO{\cdot}O)_2Ca=2CaCO_3+2C_nH_{2n+1}CHO$$

7. *Aromatic aldehydes from phenols* A long-known process for the conversion of phenols into hydroxy-aryl-aldehydes is associated with the names of C. L. Reimer and F. Tiemann. It consists in treating the phenolic compound with chloroform in presence of dilute alkalis With phenol itself the reaction proceeds as follows.

$$HO{\cdot}C_6H_5+CHCl_3+3NaOH=HO{\cdot}C_6H_4\,CHO+3NaCl+2H_2O$$

Two isomerides are produced, parahydroxybenzaldehyde and salicylaldehyde (orthohydroxybenzaldehyde) The latter isomeride occurs in the volatile oils of Spiraea and in the glucoside, salicin, of the willow.

8. *Syntheses by the aid of compounds containing bivalent carbon.* The two syntheses described under this heading, which are due to L Gattermann, are, like those of the preceding section, applicable only to the aromatic series. The first depends on the use of carbon monoxide, this gas and hydrogen chloride being passed into a solution of an aromatic hydrocarbon in a dry solvent in the presence of cuprous and aluminium chlorides. In the case of toluene the condensation gives rise to *p*-tolualdehyde. In all probability the carbon monoxide absorbed by the cuprous chloride forms an intermediate compound, HCOCl, with the hydrogen chloride and this nascent formyl chloride under the influence of aluminium chloride condenses with the hydrocarbon to give rise to the aldehyde:

$$CH_3{\cdot}C_6H_5+H{\cdot}COCl=CH_3{\cdot}C_6H_4{\cdot}COH+HCl$$

The second Gattermann synthesis involves the use of hydrogen cyanide (anhydrous prussic acid), and since this reagent is now procurable on a manufacturing scale (*see* PRUSSIC ACID) the synthesis offers industrial possibilities. The aromatic substance, which may be a hydrocarbon or a phenol, is dissolved in a dry solvent containing anhydrous aluminium or zinc chloride and to this mixture hydrogen cyanide is added while hydrogen chloride is bubbled in to saturation when the two hydrides interact potentially as HN CHCl:

$$HN{:}CHCl+C_6H_5{\cdot}OH=HN{:}CH{\cdot}C_6H_4OH+HCl$$

The aldehyde-imine thus formed as an intermediate product is hydrolysed when boiled with water into ammonia and the corresponding aldehyde, $HO{\cdot}C_6H_4{\cdot}CHO$. In this connection may be mentioned the synthesis of benzaldoxime by R. Scholl who treated benzene with mercury fulminate and partially hydrated aluminium chloride. The condensation may be regarded as occurring between fulminic acid (*q.v.*) and the hydrocarbon,

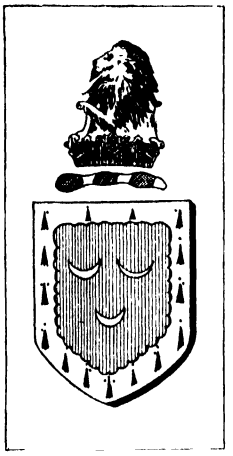
$$C_6H_6+C{:}NOH=C_6H_5CH{:}NOH$$

The three preceding reactions, including the two Gattermann syntheses and Scholl's condensation, represent the intervention of bivalent carbon as exemplified by carbon monoxide, CO, hydrogen cyanide, C:NH, and fulminic acid, C:NOH, respectively.

General Reactions of Aldehydes. The aldehydes combine additively with sodium hydrogen sulphite to furnish bisulphite compounds, $R{\cdot}CH(OH){\cdot}SO_3Na$. These compounds, being crystallizable and easily hydrolysed by dilute acid, are frequently used in the purification of the aldehydes. Sodium hydrosulphite also interacts with aldehydes giving rise to compounds of the general formula $R{\cdot}CH(OH){\cdot}SO_2Na$. The formaldehyde compound is the important reducing agent, Rongalite, employed in calico printing for discharging the colour of dyes.

Aldehydes react with hydrogen cyanide to form cyanohydrins, $R{\cdot}CH(OH){\cdot}CN$, which are hydrolysable to α-hydroxycarboxylic acids containing one more carbon atom than the original aldehyde. Aldehydes combine with hydroxylamine to form oximes (*q.v.*), and with phenylhydrazine to phenylhydrazones and with semicarbazide to crystallisable semicarbazones (*see* CHEMISTRY, *Organic*). Nascent hydrogen reduces aldehydes to primary alcohols, whereas with Grignard reagents they are converted into secondary alcohols. Formaldehyde condenses with aqueous ammonia to form hexamethylenetetramine, $N_4(CH_2)_6$, a valuable diuretic (hexamina B P) whereas the other aliphatic aldehydes combine with ethereal ammonia to give aldehyde-ammonias (hydroxyamines) of the type $R{\cdot}CH(OH){\cdot}NH_2$ from which the aldehyde can be regenerated by distillation with dilute acid. Aldehydes in general are characterized by the colour reaction of H Schiff, this being the reddish-violet coloration developed with a solution of magenta or fuchsine which has been decolorized by sulphurous acid. (G. T. M.)

ALDEN, ISABELLA (MACDONALD) (1841–), American juvenile writer, was born in Rochester, N Y., on Nov. 3, 1841. She was educated at Seneca collegiate institute in Ovid, N.Y., and at the Young Ladies' institute in Auburn, New York. In 1866 she married the Rev. Gustavus R. Alden Under the pseudonym of "Pansy" she wrote a series of some 75 juvenile works, known as the "Pansy Books," and from 1873 to 1896 edited the juvenile periodical *Pansy*. In addition, she wrote *The Prince of Peace*, a life of Christ, and various volumes of fiction for adult readers She also contributed extensively to religious journals.



THE ARMORIAL BEARINGS OF ALDEN OF ENGLAND, ANCESTOR OF THE "MAYFLOWER" COLONIST

ALDEN, JOHN (1599?–1687), one of the "Pilgrims" who in 1620 emigrated to America in the "Mayflower" and founded the Plymouth Colony He was a settler of Duxbury (Mass), where he lived for most of his life From 1633 until 1675 he was an "assistant" to the governor of the Colony, frequently acting as governor. At the time of his death on Sept. 12, 1687, he was the last male survivor of the "Mayflower" company He is remembered chiefly because of a popular legend, put into verse as *The Courtship of Miles Standish* by Henry W Longfellow, concerning his courtship of Priscilla Mullins, whom he married in 1623, after having wooed her first for his friend, Miles Standish.

ALDER, a genus of plants (*Alnus*) belonging to the family Betulaceae, the best known of which is the common alder (*A. glutinosa*). The genus comprises a few species of shrubs or trees, seldom reaching a large size, distributed through the north Temperate zone, and in the New World passing along the Andes southwards to Chile. The British species *A. glutinosa* is confined to the Old World. This tree thrives best in moist soils, has a shrubby appearance, and grows under favourable circumstances to a height of 40 or 50ft. It is characterized by its short-stalked roundish leaves, becoming wedge-shaped at the base and with a slightly toothed margin. When young they are somewhat glutinous, whence the specific name, becoming later a dark olive green. As with other plants growing near water it keeps its leaves longer than do trees in drier situations, and the glossy green foliage lasting after other trees have put on the red or brown of autumn renders it valuable for landscape effect. The stout cylindrical male catkins are pendulous, reddish in colour and 2 to 4in. long; the female are smaller, less than an inch in length and reddish-brown in colour, suggesting young fir-cones. When the small

winged fruits have been scattered the ripe, woody, blackish cones remain, often lasting through the winter. The alder is readily propagated by seeds, but throws up root-suckers abundantly. It is important as coppice-wood on marshy ground. The wood is soft, white when first cut and turning to pale red; the knots are beautifully mottled. Under water the wood is very durable, and it is therefore used for piles. The supports of the Rialto at Venice, and many buildings at Amsterdam, are of alder-wood. Furniture is sometimes made from the wood. The bark is astringent; it is used for tanning and dyeing.

ALDER-FLY, the name given to neuropterous insects of the family *Sialidae* with long filamentous antennae and four large wings, of which the hind pair has the anal area folded fan-wise when at rest. They are sluggish insects found only near fresh water. The eggs are often very numerous and are laid in clusters on plants, etc., close to the water. The larvae are aquatic, are provided with biting jaws and breathe by seven or eight pairs of filamentous abdominal gills. The pupae are found in soil, moss, etc., and there is no cocoon. *Sialis lutaria* is the common alder-fly of Britain. In North America the genus *Corydalis* is remarkable for the great size of the jaws in the male and the insect has a wing-expanse of about 120mm.: its larvae are called dobsons or hellgrammites by anglers who use them for bait.

ALDERMAN, a term implying the possession of an office of rank or dignity, and, in modern times, applied to an office-bearer in the municipal corporations and county councils of England and Wales, and in the municipal corporations of Ireland and the United States. Among the Anglo-Saxons, earls, governors of provinces and other persons of distinction received this title. Thus we read of the *aldermannus totius Angliae,* who seems to have corresponded to the officer afterwards styled *capitalis justiciarius Angliae,* or chief justice of England; the *aldermannus regis,* probably an occasional magistrate, answering to the modern justice of assize, or perhaps an officer whose duty it was to prosecute for the Crown; and *aldermannus comitatus,* a magistrate with a middle rank between what was afterwards called the *earl* and the *sheriff,* who sat at the trial of causes with the bishop and declared the common law, while the bishop proceeded according to ecclesiastical law. Besides these, we meet with the titles of *aldermannus civitatis, burgi, castelli, hundredi sive wapentachii,* etc. In England, before the passing of the Municipal Corporations act, their functions varied according to the charters of the different boroughs. By the Municipal Corporations act 1835, and other acts, consolidated by the Municipal Corporations act 1882, the aldermen are elected by the councillors for six years, one-half going out every three years. The number of councillors in each borough varies according to its magnitude. One-fourth of the municipal council consists of aldermen and three-fourths of councillors. In the counties, the number of aldermen is one-third of the number of councillors, except in London, where it is one-sixth. The corporation of the City of London was not included in the Borough Reform act, and the antiquated system remains there in full force. The court of aldermen consists of 26, 25 of whom are elected for life by the freemen of the respective wards, who return two persons, one of whom the court of aldermen elect to supply the vacancy. The city is divided into 26 wards; 24 of these send up one alderman each, the other two combine to choose a 25th. The 26th alderman serves for the independent borough of Southwark (*q.v.*) and is appointed by the other aldermen, who generally select the senior from among themselves when a vacancy occurs. The lord mayor is elected from such of the aldermen as have served the office of sheriff; of these the common hall, which consists of the freemen of the different wards, select two, and the aldermen elect one of these to the mayoralty. The court of aldermen has the power of appointment to certain offices, exercises judicial functions in regard to licensing and in disputes connected with the ward election, has some power of disposal over the city cash and possesses magisterial control over the city, each alderman being a judge and magistrate for the whole city, and by virtue of his office exercising the functions of a justice of the peace. The aldermen are members of the court of common council, the corporation's legislative body, consisting of 232 members, the remainder being elected annually by the freemen.

In the United States aldermen form as a rule a legislative rather than a judicial body, although in some cities they hold courts and possess very considerable magisterial powers.

ALDERNEY, the northernmost of the larger Channel Islands, 3½m. N.E.-S.W., average width 1 mile. Area, 1,962ac. Pop. (1921) 1,598. It lies 49°43′ N. and 2°12′ W. On the north coast, Braye harbour, with a fine breakwater, communicates twice or three times weekly with St. Peter Port, Guernsey, and weekly with Cherbourg, France. Rocks fringe all the coasts. A dangerous channel nearly 9m wide, known as the Race, separates it from Cap de la Hague. Here the remnant of the French fleet under Tourville escaped after the defeat of La Hogue in 1692. To the west, the Swinge (Singe), a narrower and equally difficult tidal race, separates Alderney from the uninhabited islands of Burhou, Ortach and others; still further west are the Casquets (lighthouse) which have a long record of shipwrecks. Alderney is a tableland 300ft. high in the west, but dropping towards the north-east. On the south the cliffs are very steep; elsewhere rocky headlands alternate with open sandy bays, of which the most important are Braye and Longy. At the latter there are evidences of settlement in prehistoric and in Roman times. Cambrian grits occur along the north-east coast, and south of Longy give rise to the Hanging Rocks; diorite and granite occupy the central, and granite-porphyry the south-west portion of the island. There are a few streams, but water is obtained mainly from wells. Trees are scarce. The town of St. Anne stands almost in the centre of the island with its arable land around it. This is largely unenclosed and still shows the old arrangement in strips. It was long under a system of continuous corn-growing, now superseded. It is encircled by the grazing lands which were communal until 1830. The modern church (1850), in Early English style, is the work of Sir Gilbert Scott, and a memorial to the Le Mesurier family, in which the hereditary governorship of the island was vested until the abolition of the office in 1825. There is a chain of derelict fortifications round the north coast, but Fort Tourgis on the west and Fort Essex on the east are still used as barracks. The soil of Alderney is fertile, grain and roots are grown and early potatoes are exported. Alderney cattle are largely reared and are usually kept tethered, but the island does not possess a stock book separate from Guernsey. Alderney is included in the bailiwick of Guernsey. Its court, consisting of a judge, six jurats, attorney general, prévot, greffier and sergent, is subordinate to that of Guernsey. For its relations to the constitution of the bailiwick and for its history *see* CHANNEL ISLANDS.

ALDERSHOT, municipal borough, Hampshire, England, 34 m. S W. by W. of London, on the Southern railway. Aldershot was a mere village till 1855 when a camp was established. Pop. (1891) 25,595; (1921) 28,764. Its germ is to be found in the temporary training camp on Chobham Ridges, formed in 1853 by Lord Hardinge, the military commander-in-chief, who also advised the choice of Aldershot as a permanent camp. The Government acted on his suggestion after the experience of the Crimea. Under the Military Works Act of 1897 and 1899 large sums were provided for completing the work. The town grew in size and importance as the camp became the centre of military training for the country. During 1904–14, besides troops in barracks, large numbers of militia and volunteer units gathered at Aldershot, during training periods, using the famous range at Bisley near by. The enormous and rapid development of all branches of the army and the rise of many new ones, during 1914–18 led to the formation of many new and some larger camps elsewhere. It became a great demobilization camp in 1918–19. Since 1919, its importance has declined. Aldershot is in the parliamentary division of Hampshire of the same name. The borough is governed by a mayor and corporation of 24 members. Area of municipal borough 4,176 acres.

ALDHELM (*c.* 640–709), bishop of Sherborne, English scholar, was born before the middle of the 7th century. He is said to have been the son of Kenten, who was of the royal house of Wessex, but who was certainly not, as Aldhelm's early biographer Faritius asserts, brother of King Ine. He received his first education in the school of an Irish scholar and monk, Mail-

dulf, Maeldubh, or Meldun (d. *c.* 675), who had settled in the British stronghold of Bladon or Bladow on the site of Malmesbury. Aldhelm was a pupil of Hadrian, abbot of St. Augustine's, Canterbury, whom he addresses as the "venerable preceptor of my rude childhood." He must, nevertheless, have been 30 years of age when he began to study with Hadrian. His studies included Roman law, astronomy, astrology, the art of reckoning, and the difficulties of the calendar. He learned, according to the doubtful statements of the early lives, both Greek and Hebrew. Ill-health compelled him to leave Canterbury, and he returned to Malmesbury. When Maildulf died, Aldhelm was appointed in 675 to succeed him, and became the first abbot. He introduced the Benedictine rule, and secured the right of the election of the abbot to the monks themselves. The community at Malmesbury increased, and Aldhelm was able to found two other centres of learning at Frome and at Bradford-on-Avon. The little church of St. Lawrence at Bradford may safely be regarded as his At Malmesbury he built a new church to replace Maildulf's modest building, and obtained considerable grants of land for the monastery. His fame as a scholar rapidly spread into other countries. Aldhelm was the first Englishman, so far as we know, to write in Latin verse, and his letter to Acircius (Aldfrith or Eadfrith, king of Northumbria) is a treatise on Latin prosody for the use of his countrymen In this work he included his most famous productions, 101 riddles in Latin hexameters. Each of them is a complete picture, and one of them runs to 83 lines. That his merits as a scholar were early recognized in his own country is shown by the encomium of Bede (*Eccl Hist.* v. 18), who speaks of him as a wonder of erudition. His fame reached Italy, and at the request of Pope Sergius I. (687–701) he paid a visit to Rome, of which, however, there is no notice in his extant writings. He was deputed by a synod of the church in Wessex to remonstrate with the Britons of Domnonia (Devon and Cornwall) on their differences from the Roman practice in the shape of the tonsure and the date of Easter. This he did in a long and rather acrimonious letter to their king Geraint (Geruntius), and their ultimate agreement with Rome is referred by William of Malmesbury to his efforts. In 705 Aldhelm became bishop of the new see of Sherborne He wished to resign the abbey of Malmesbury which he had governed for 30 years, but yielding to the remonstrances of the monks he continued to direct it until his death. The cathedral church which he built at Sherborne, though replaced later by a Norman church, is described by William of Malmesbury. He was on his rounds in his diocese when he died in the church of Doulting on May 25, 709 He was buried in the church of St. Michael, Malmesbury Aldhelm wrote poetry in Anglo-Saxon also, and set his own compositions to music, but none of his songs, which were still popular in the time of Alfred, have come down to us

Aldhelm's works were collected in J. A. Giles's *Patres eccl. Angl.* (1844), and reprinted by J. P. Migne in his *Patrologiae Cursus*, vol. lxxxix. (1850). The letter to Geraint, king of Domnonia, was supposed to have been destroyed by the Britons (W. of Malmesbury, *Gesta Pontificum*, p. 361), but was discovered with others of Aldhelm's in the correspondence of St. Boniface, archbishop of Mainz. A long letter to Eahfrid, a scholar just returned from Ireland (first printed in *Usserii Veterum Epistt. Hiber.-Sylloge*, 1632), is of interest as casting light on the relations between English and Irish scholars. Next to the riddles, Aldhelm's best-known work is *De Laude Virginitatis sive de Virginitate Sanctorum*, a Latin treatise addressed about 705 to the nuns of Barking, in which he commemorates a great number of saints. This was afterwards turned by Aldhelm into Latin verse (printed by Delrio, Mainz, 1601). The chief source of his *Epistola ad Acircium sive liber de septenario, et de metris, aenigmatibus ac pedum regulis* (ed. A. Mai, *Class. Auct.* vol. v.) is Priscian. For the riddles included in it, his model was the collection known as *Symposii aenigmata*. The acrostic introduction gives the sentence, "Aldhelmus cecinit millenis versibus odas," whether read from the initial or final letters of the lines. His Latin poems include one on the dedication of a basilica built by Bugge (or Eadburga), a royal lady of the house of Wessex.

Bibliography.—Faritius (d. 1117), an Italian monk of Malmesbury, afterwards abbot of Abingdon, wrote a *Vita S. Aldhelmi* (ms. Cotton, Faustina, B. 4), printed by Giles and Migne, also in *Original Lives of Anglo-Saxons* (Caxton Soc., 1854); but the best authority is William of Malmesbury, who in the fifth book, devoted to St. Aldhelm, of the *Gesta Pontificum* proposes to fill up the outline of Faritius, using the church records, the traditions of Aldhelm's miracles preserved by the monks of Malmesbury, and the lost "Handboc" or commonplace book of King Alfred. (See *De Gestis Pontificum*, ed. N. E. S. A. Hamilton, 1870, for the Rolls Series, pp. 330–443.) The life by John Capgrave in his *Legenda Nova* (1516) is chiefly an abridgement of Malmesbury's narrative. Consult also L. Bönhoff, *Aldhelm von Malmesbury* (1894); G. F. Browne, bishop of Bristol, *St. Aldhelm: His Life and Times* (1903); and W. B. Wildman, *Life of S. Ealdhelm, first Bishop of Sherborne* (1905), containing many interesting local details. For some poems attributed to Aldhelm, and printed in Dümmler's edition of the letters of St. Boniface and Lul in *Monumenta Germaniae Historica* (epistt tom. iii.), *see* H Bradley in *Eng. Hist Review*, xv p 291 (1000), where they are attributed to Aldhelm's disciple Aelthelwald. The very varied sources and the chronology of Aldhelm's work are discussed in "Zu Aldhelm und Baeda," by Max Manitius, in *Sitzungsberichte der kaiserlichen Akad. der Wissenschaften* (1886).

An excellent account of his ecclesiastical importance is given by W. Bright in *Chapters on Early English Church History* (1878).

For his position as a writer of Latin verse consult A. Ebert, *Allgemeine Geschichte d. Literatur des Mittelalters im Abendlande*, vol i. new edition (1889); M. Manitius, *Geschichte der christlichlateinischen Poesie, etc* (Stuttgart, 1891), pp 487–406; also H Hahn, *Bonifaz und Lul ihre angelsachsischen Korrespondenten*, chap i. (Leipzig, 1883). The two last-named works contain many further bibliographical references.

ALDINE PRESS, the printing office started by Aldus Manutius at the end of the 15th century in Venice, from which were issued the celebrated Aldine editions of the classics of that time. (*See* Manutius) The Aldine Press is famous in the history of typography (*q v.*), among other things, for the introduction of italics

ALDRED or **EALDRED** (d 1069), English ecclesiastic, became abbot of Tavistock about 1027, in 1044 was made bishop of Worcester, and in 1060 archbishop of York. It is stated by Florence of Worcester that Aldred crowned King Harold II. in 1066, although the Norman authorities mention Stigand as the officiating prelate. After the battle of Hastings, Aldred joined the party who sought to bestow the throne upon Edgar the Aetheling, but when these efforts appeared hopeless he was among those who submitted to William the Conqueror at Berkhampstead. Selected to crown the new King, he performed the ceremony on Christmas Day 1066, and in 1068 performed the same office at the coronation of Matilda, the Conqueror's wife He died at York on Sept 11, 1069, and was buried in his own cathedral.

See *The Anglo-Saxon Chronicle*, edited by C. Plummer (Oxford, 1892–99); Florence of Worcester, *Chronicon ex Chronicis*, edited by B. Thorpe (London, 1848–49); William of Malmesbury, *De Gestis Pontificum Anglorum*, edited by N.E S A. Hamilton (London, 1870); W H. Dixon, *Fasti Eboracenses*, vol. i, edited by J. Raine (London, 1863); T. Stubbs, *Chronica Pontificum Ecclesiae Eboracensis*, edited by J. Raine (London, 1879–94), E A. Freeman, *History of the Norman Conquest*, vol ii, iii, iv. (Oxford, 1867–79).

ALDRICH, HENRY (1647–1710), dean of Christ Church, Oxford, and in 1092 vice-chancellor of the University, was born at Westminster in 1647, and died at Oxford Dec. 14, 1710. He was a man of versatile talent, who wrote a *Compendium Artis Logicae* used as a text-book in Oxford far into the 19th century, composed many excellent anthems and church services and adapted much church music of Palestrina and Carissimi to English words with skill and judgment. He designed the church and campanile of All Saints and the Peckwater quadrangle of Christ Church.

Dean Aldrich bore a great reputation for conviviality, and wrote a humorous Latin version of the popular ballad:

A soldier and a sailor,
A tinker and a tailor, etc.

Another specimen of his wit is furnished by the following epigram of the five reasons for drinking.

Si bene quid memini, causae sunt quinque bibendi;
Hospitis adventus, praesens sitis atque futura,
Aut vini bonitas, aut quaelibet altera causa

The translation runs:

If on my theme I rightly think,
There are five reasons why men drink·—
Good wine; a friend; because I'm dry;
Or lest I should be by and by;
Or—any other reason why.

ALDRICH, NELSON WILMARTH (1841–1915), American politician, was born at Foster, R.I, on Nov. 6, 1841. His

first political service was as a member (1869–75) and president (1871–72) of the Providence common council. He was a member of the lower house of the Rhode Island legislature in 1875–76, and speaker in the latter year. By this time he had become very influential in Republican State politics, and in 1878 and again in 1880 was elected to Congress. In 1881 he resigned to take a seat in the Senate, where he served continuously for 30 years. By reason of his mastery of parliamentary detail and his skill in bringing about combinations of opposing groups, he became one of the most powerful leaders of the Republicans in the Senate. He was an able champion of protection and an authority on finance, and his knowledge of these subjects was embodied in various tariff and currency enactments. He sponsored the Aldrich-Vreeman currency law of 1908. As chairman of the national monetary commission, brought into existence by that Act, he directed extensive investigations of the banking systems of the world. He published a scheme, based on the information thus secured, for the reform of the American banking system known as the Aldrich plan. He also was largely responsible for the Payne-Aldrich Tariff Act of 1909, which, by reason of its high rates, aroused much opposition, especially in the agrarian districts. Because of his extensive personal financial interests and his intimate connection with powerful financial groups, he came to be looked upon as the special representative of the moneyed interests and of the highly protected industries. He died in New York city on April 16, 1915.

ALDRICH, RICHARD (1863–), music critic, was born at Providence, R.I., July 31, 1863. He studied at Harvard under J. K. Paine and in Germany. Associate critic of the New York *Tribune* 1891–1902, he then became music critic to the New York *Times*, holding the position to 1924, except for the period Feb. 1918–May 1919, when he was captain in the Military Intelligence Division, U.S.A. He prepared a volume on Schumann, edited a series of musical biographies, collaborated with H. E. Krehbiel in *History of the Philharmonic Society*, translated Lilli Lehman's *How to Sing*, and wrote *A Guide to Parsifal* and *A Guide to the Nibelungen Ring*.

ALDRICH, THOMAS BAILEY (1836–1907), American author, was born in Portsmouth, N.H., Nov. 11, 1836. The deepest impressions of his boyhood were made by the exotic city of New Orleans and the historic town of Portsmouth, which he portrays in his autobiographical *Story of a Bad Boy* (1870). He had been taken to Portsmouth to prepare for Harvard, a plan which his father's death made impracticable. After spending several years as clerk in his uncle's office in New York, the publi-



FROM STODDARD, "POETS' HOMES"

THE HOUSE AT PONKAPOG, MASSACHUSETTS, ONE-TIME HOME OF THOMAS BAILEY ALDRICH, CELEBRATED FOR THE "STORY OF A BAD BOY"

cation of his first book of verse *The Bells* (1855) and the success of his "Ballad of Babie Belle" caused him to resign to become junior literary critic on the *Evening Mirror*. He soon became sub-editor of Willis's other magazine, the *Home Journal*, and for the remainder of his life, with the exception of the time spent as war correspondent for the *Tribune*, he devoted himself to creative and editorial work. He was for short periods adviser to different publishing houses, but his chief work was with the magazines—the *Saturday Press* (1859–60), the *Illustrated News* (1863), *Every Saturday* (1865–74), and the *Atlantic Monthly* (1881–90). Although he made intimate friends of the young poets, artists and wits of New York, the cultural atmosphere of New England in which, according to him, he became "Boston plated," and the frequent European tours of his later life undoubtedly were the most influential factors in ripening his art. Few poets have so ruthlessly discarded their earlier poems in their later editions, Aldrich even going so far as to buy and destroy every copy of *Pampinea* (1861) that he could find. His verse is better studied, then, in his later volumes, chiefly *Cloth of Gold* (1874), *Flower and Thorn* (1877), *Friar Jerome's Beautiful Book* (1881), *Mercedes and Later Lyrics* (1884), *Windham Towers* (1890), and the collected editions of 1865, 1882, 1897 and 1906. These showed him to be a poet of lyrical skill, dainty touch and felicitous conceit. In describing some single picture, mood, conceit or episode, no American poet has shown more skill. He repeatedly essayed the long narrative or dramatic poem but with less success. Beginning with the collection of stories entitled *Marjorie Daw and Other People* (1873), Aldrich applied to his later prose work that minute care in composition which had previously characterized his verse. His use of the surprise ending was perhaps the most effective feature of his short stories. *Prudence Palfrey* (1874), *The Queen of Sheba* (1877), and *The Stillwater Tragedy* (1880), novels, lack depth of characterization and vitality; but his *Story of a Bad Boy* (1870) has become an American classic. *A Rivermouth Romance* (1877) and *An Old Town by the Sea* (1893) commemorate with affectionate touch the author's birthplace; *From Ponkapog to Pesth* (1883) is made up of pleasant travel sketches; and *Ponkapog Papers* (1903), of pungent jottings and whimsical essays. Aldrich's later life was saddened by the death of his son, Charles, but his serenity, urbanity and charm never wholly deserted him. He died in Boston, March 19 1907.

Aldrich's *Writings* were collected in 1897 and in 1907 (Ponkapog ed.). Ferris Greenslet is the author of a sympathetic *Life* (1908), and Mrs. Aldrich wrote a pleasant volume of reminiscence, *Crowding Memories* (1920).

ALDRINGER (ALTRINGER, ALDRINGEN), JOHANN, Count von (1588–1634), Austrian soldier, was born at Diedenhofen (Thionville) in Lorraine. He had behind him 25 years' service in the Spanish Army when he returned to Germany in 1631. He served after Breitenfeld as Tilly's artillery commander, and he was present at the battle of the Lech, where he was wounded. When Tilly died of his wounds, Aldringer, who was now a count of the empire, succeeded to the command. Made field-marshal after the assault of the Alte Veste, near Nuremberg, at which he had been second in command under Wallenstein, duke of Friedland (with whom he was a great favourite), he was next placed at the head of the corps formed by Maximilian I. of Bavaria to support Wallenstein.

Finally Aldringer was won over by the court party which sought to displace the too successful duke of Friedland. After Wallenstein's death Aldringer commanded against the Swedes on the Danube, and at the defence of Landshut he fell (July 22 1634). His great possessions descended to his sister, and thence to the family of Clary and Aldringen.

See Brohm, *Johann von Aldringen* (Halle, 1882), and Hermann Hallwich, *Johann von Aldringen* (Leipzig, 1885); also *Allgemeine Deutsche Biographie*, s.v. Gallas, correcting earlier biography of Aldringer in the same work.

ALDROVANDI, ULISSI (1522–1605), Italian naturalist, was born of noble parentage at Bologna, where he was professor of natural history from 1560 onwards. At his instance the senate of Bologna established in 1568 a botanical garden, of which he was appointed the first director. About the same time he became inspector of drugs, and in that capacity published in 1574 a work entitled *Antidotarii Bononiensis Epitome*, which formed the model for many subsequent pharmacopoeias. The results of his various researches were embodied in a great *Natural History*. The first three volumes, comprising his ornithology, were published in 1599, and a fourth, treating of insects, appeared in 1602. The value of the work is increased by the number and beauty of its illustrations. After his death a number of other volumes

were compiled from his manuscript materials under the editorship of several of his pupils.

ALE, an old word for a fermented liquor obtained chiefly from malt. The derivation is from Ang.-Sax. *ealu,* a sort of beer. In England "ale" is nowadays almost synonymous with "beer." Before the introduction of hops into England from Flanders in the 16th century, ale was the name exclusively applied to malt liquor, the term beer being gradually introduced to describe liquor brewed with an infusion of hops. This distinction does not now apply, except in so far as the term "ale" is not applied to black beers (stout and porter) nor to lager beer. In the United States, however, it was customary to confine the designation "beer" to the article obtained by the bottom fermentation process. In former times the Welsh and Scots had two distinct kinds of ale, called common and spiced ales, the relative values of which were appraised by law in the following terms: "If a farmer have no mead, he shall pay two casks of spiced ale, or four casks of common ale, for one cask of mead." There are numerous varieties of English ales, such as mild ale, which is a full, sweetish beer, of a dark colour and with relatively little hop, pale ale, which is relatively dry, of light colour and of a more pronounced hop flavour than the mild ale; and bitter and stock ales, the latter term being generally reserved for superior beers, such as are used for bottling. The terms pale, bitter, stock, light, etc , are to be regarded as trade distinctions and not as exact definitions of quality or type.

Parish Ales.—In old England an "ale" was synonymous with a parish festival or merry-making at which ale was the chief drink The word was generally used in composition. Thus there were leet-ales (that held on leet or manorial court day); lamb-ales (that held at lamb-shearing); Whitsun-ales, clerk-ales, church-ales and so on. The word *bridal* is really bride-ale, the wedding feast. Bid-ales, once very common throughout England, were "benefit" feasts to which a general invitation was given, and all the neighbours attending were expected to make some contribution to help the object of the "benefit" (See *Bidding-Weddings* under BRIDE.) These parish festivals were of much ecclesiastical and social importance in mediaeval England The chief purpose of church-ales and clerk-ales, at least, was to facilitate the collection of parish-dues, or to make an actual profit for the church from the sale of the liquor by the churchwardens These profits kept the parish church in repair, or were distributed as alms to the poor. At Sygate, Norfolk, on the gallery of the church is inscribed:

> God speed the plough
> And give us good ale enow
> Be merry and glade,
> With good ale was this work made.

On the beam of a screen in the church of Thorpe-le-Soken, Essex, is the following inscription in raised Gothic letters, on a scroll held by two angels: "This cost is the bachelers made by ales thesn be ther med" The date is about 1480. The feast was usually held in a barn near the church or in the churchyard In Tudor times church-ales were held on Sundays Gradually the parish-ales were limited to the Whitsun season, and these still have local survivals. The colleges of the universities used formerly to brew their own ales and hold festivals known as college-ales Some of these ales are still brewed and famous, like "chancellor" at Queen's college, and "archdeacon" at Merton college, Oxford, and "audit ale" at Trinity, Cambridge (*See* BEER)

See Brand's *Popular Antiquities of Great Britain* (Wm. Carew Hazlitt's edition, 1905).

ALEANDRO, GIROLAMO (HIERONYMUS ALEANDER) (1480–1542), Italian cardinal, one of the greatest scholars of his time, was born at Motta, near Venice on Feb. 13, 1480, and died at Rome on Feb. 1, 1542. He was for some time rector of the University of Paris. In 1520 he was sent to Germany as papal nuncio at the coronation of Charles V., and was also present at the Diet of Worms, where he headed the opposition to Luther. The edict against the reformer, which was finally adopted by the emperor and the Diet, was drawn up and proposed by Aleandro. After the close of the Diet the papal nuncio went to the Netherlands, where he kindled the flames of persecution, two monks of Antwerp, the first martyrs of the Reformation, being burnt in Brussels at his instigation. In 1523 Clement VII. sent him as nuncio to the court of Francis I. He was taken prisoner at the battle of Pavia (1525), and was released only on payment of a heavy ransom. He was subsequently employed on various papal missions, especially to Germany, but was unable to check the progress of the new doctrines. He was created cardinal in 1536 by Paul III.

Aleandro compiled a *Lexicon Graeco-Latinum* (1512), and wrote Latin verse of considerable merit inserted in M. Tuscanus's *Carmina Illustrium Poetarum Italiorum* The Vatican library contains a volume of ms letters and other documents written by him in connection with his various missions against Luther. They were utilized by Pallavicino in his *Istoria del Concilio Tridentino* (i 23–28), who gives a very partial account of the Worms conference

Aleandro, who is sometimes called "the elder," must be distinguished from his grand-nephew, also called Girolamo Aleandro (1574–1629). The younger Aleandro was a very distinguished scholar, and wrote *Psalmi poenitentiales versibus elegiacis expressi* (1593); *Gaii, veteris juris consulti Institutionum fragmenta, cum commentario* (1600); *Explicatio veteris tabulae marmoreae solis effigie symbolesque exculptae* (1616).

ALEARDI, ALEARDO, COUNT (1812–1878), Italian poet, was born at Verona on Nov 4, 1812, and thus soon after his birth became an Austrian subject. Inspired from his cradle with a hatred of the foreigner, he found himself unable to publish his patriotic verses. But the revolutionary year 1848 made an opening for his *Lettere a Maria.* He took an active part in the popular uprising, and was for some time imprisoned In 1856 he produced the finest of his pieces, an ode to the maritime cities of Italy, and in 1858 a poem on his own misfortunes After the expulsion of the Austrians from Lombardy he returned to Verona, published his poems in a collected edition (1862), became professor at the Academy of Fine Art, member of the Italian parliament and eventually senator Aleardi's warmth of patriotic feeling hardly finds adequate expression in his poetry; it is his merit to excel in description, but his fault to substitute description for action.

ALE-CONNER, an officer appointed yearly at the court-leet of ancient English manors for the assize of ale and ale-measures. The *gustatores cervisiae*—called in different localities by the different names "ale-tasters," "ale-founders" and "ale-conners"—were sworn to examine beer and ale, to take care that they were good and wholesome and were sold at proper prices With modern methods of assessing the excise on beer and ale the custom of appointing ale-tasters has in most places fallen into disuse. (*See* ADULTERATION)

ALECSANDRI or ALEXANDRI, VASILE (1821–1890), Rumanian lyric poet, was born at Bacau in Moldavia and educated first in Jassy and afterwards (1834–39) in Paris. In 1839 he began to collect Rumanian popular songs. He first published his collection in 1844. His *Doine şi Lacrimioare,* lyrical poems, appeared at Paris in 1852, and in 1852–53 he produced at Jassy a fuller collection of popular ballads and songs. In 1867 he published some fugitive pieces, written in a lighter vein and entitled *Pastele;* these were followed in 1871 by the *Legende* of similar character. More serious are his dramatic writings which began with *Despot Voda* and culminated in *Ovid* In later life Alecsandri took an active part in politics; he became minister for foreign affairs (1859–60), and in 1885 was appointed Rumanian minister in Paris. His best title to fame consists in the fact that he gave the first impetus to the collection of Rumanian popular songs and first drew attention to their inimitable charm

See L. Sainsanu, *Autorii Români moderni* (1891), pp. 90 and 318. A complete edition of Alecsandri's writings was published at Bucharest in 1875 *seq.* (9 vols).

ALEKHINE, ALEXANDER (1892–), champion chess-player, was born in Moscow on Nov. 1, 1892. He displayed precocious ability as a chess-player, and in 1910 he did well at the Hamburg tournament at the age of seventeen When the World War broke out in 1914 he was playing at the Mannheim tournament and escaped from internment to serve in the Red Cross division of the Russian army. After the Revolution he became a

naturalized Frenchman, and studied law at the University of Paris. The winner of 20 international tournaments, he won the world championship for blindfold chess (New York, 1924). In 1927 he won the chess championship of the world from Capablanca, who had held it since 1921.

For his methods *see* his book, *My Best Hundred Games* (Eng. trans, 1927).

ALEMÁN, MATEO (1547–1609?), Spanish novelist and man of letters, was born at Seville. He graduated at Seville university in 1564, studied later at Salamanca and Alcalá, and from 1571 to 1588 held a post in the treasury; in 1594 he was arrested on suspicion of malversation, but was speedily released. In 1599 he published the first part of *Guzmán de Alfarache,* a celebrated picaresque novel which passed through not less than 16 editions in five years, and was translated into French (1600), English (1623) and Latin (1623); a spurious sequel was issued in 1602, but the authentic continuation did not appear till 1604 In 1608 Alemán emigrated to America, and is said to have carried on business as a printer in Mexico City; his *Ortografia castellana* (1609), published there, contains ingenious and practical proposals for the reform of Spanish spelling. Nothing is recorded of Alemán after 1609, but it is sometimes asserted that he was still living in 1617.

BIBLIOGRAPHY.—*See* J. Hazañas y la Rua, *Discursos leidos en la Real Academia Sevillana de Buenas letras el 25 de marzo de 1892* (Sevilla, 1892); J. Gestoso y Perez, *Nuevos datos para ilustrar las biografias del Maestro Juan de Malara y de Mateo Alemán* (Sevilla, 1896).

ALEMBERT, JEAN LE ROND D' (1717–1783), French mathematician and philosopher, was born at Paris in Nov. 1717. He was a foundling but it afterwards became known that he was the illegitimate son of the Chevalier Destouches and Madame de Tencin. The infant was entrusted to the wife of a glazier named Rousseau who lived close by the Church of St. Jean le Rond, where the child was found. Destouches, without disclosing his identity, provided for the boy, who was educated at the Mazarin College under the Jansenists.

On leaving college he returned to the house of his foster-mother, where he continued to live for 30 years Having studied law, he was admitted as an advocate in 1738, but did not enter upon practice. He next devoted himself to medicine; but his natural inclination proved too strong for him, and within a year he resolved to give his whole time to mathematics. In 1741 he received his first public distinction in being admitted a member of the Academy of Sciences, to which he had previously presented several papers, including a *Mémoire sur le calcul intégral* (1739). In his *Mémoire sur la réfraction des corps solides* (1741) he was the first to give a theoretical explanation of the phenomenon which is witnessed when a body passes from one fluid to another more dense in a direction not perpendicular to the surface which separates the two fluids. In 1743 he published his *Traité de dynamique,* a work famous as developing the mechanical principle, known as "d'Alembert's principle," first enunciated in 1742 (*see* MECHANICS). In 1744 d'Alembert applied this principle to the theory of the equilibrium and the motion of fluids, *Traité de l'équilibre et du mouvement des fluides,* and all the problems before solved by geometricians became in some measure its corollaries This discovery was followed by that of the calculus of partial differences, the first trials of which were published in his *Réflexions sur la cause générale des vents* (1747). This work was dedicated to Frederick the Great, who made several unsuccessful attempts to induce him to settle in Berlin. In 1763 he visited Berlin, and on that occasion finally refused the office of president of the Academy of Berlin, which had been already offered to him more than once. In 1747 he applied his new calculus to the problem of vibrating chords, the solution of which, as well as the theory of the oscillation of the air and the propagation of sound, had been given but incompletely by the geometricians who preceded him. In 1749 he furnished a method of applying his principles to the motion of any body of a given figure; and in 1754 he solved the problem of the precession of the equinoxes, determined its quantity and explained the phenomenon of the nutation of the earth's axis. In 1752 he published an *Essai d'une nouvelle théorie sur la résistance des fluides,* which contains a large number of original ideas and new observations. In 1746 and 1748 he published in the *Memoirs* of the Academy of Berlin "Recherches sur le calcul intégral," a branch of mathematical science which is greatly indebted to him. In his *Recherches sur différents points importants du système du monde* (1754–56) he perfected the solution of the problem of the perturbations of the planets, which he had presented to the academy some years before

D'Alembert's association with Diderot in the preparation of the *Dictionnaire Encyclopédique* led him to a wider range of work. He contributed the *Discours préliminaire* on the rise, progress, and affinities of the various sciences, which he read to the French Academy on the day of his admission as a member, Dec. 18, 1754. He also wrote several literary articles for the first two volumes of the encyclopaedia, and to the remaining volumes he contributed mathematical articles chiefly. Of d'Alembert's works on other than mathematical subjects the most important is the *Éléments de Philosophie* (1759) in which he discussed the principles and methods of the different sciences D'Alembert was much interested in music both as a science and as an art, and wrote *Éléments de musique théorique et pratique* (1779), which was based upon the system of J. P. Rameau with important modifications and differences.

D'Alembert continued to the end to lead the quiet and frugal life dictated by his limited means as well as his simple tastes His later years were saddened by the death of Mademoiselle de Lespinasse, whose acquaintance he made at the house of Madame du Deffand. She nursed him assiduously during an illness he had in 1765, and from that period till her death in 1776 they lived in the same house. On her part there seems to have been from first to last nothing more than warm friendship, but his feelings towards her were of a stronger kind and her death deeply affected him He never recovered his elasticity of spirits, though he continued to occupy himself with his favourite pursuits, and to frequent the society of his brother philosophers After the death of Voltaire (1778), whose friend and correspondent he had been for more than 30 years, he was regarded as the leader of the philosophical party in the Academy. He died at Paris on Oct 29, 1783.

BIBLIOGRAPHY.—The scientific works of d'Alembert have never been published in a collected form. The most important of them have been mentioned above, with the exception of the *Opuscules mathématiques* (1761–80). His literary and philosophical works were collected and edited by Bastien (1805). A better edition by Bossange was published at Paris in 1821. The best account of the life and writings of d'Alembert is contained in Condorcet's *Éloge,* presented to the Academy and published in 1784.

ALEMBIC, an apparatus for distillation (*q.v.*) used chiefly by the alchemists, and now superseded by more convenient forms of still, both in the laboratory and in the factory. It consisted essentially of three parts: a vessel containing the material to be distilled and called, from its gourd-like shape, the cucurbit, or mattrass; a vessel to receive and condense the vapour, called the head or capital; and a receiver for the distillate, connected by a pipe with the capital. The entire apparatus was sometimes constructed of glass, but more usually the cucurbit was of copper or earthenware, and the capital alone of glass.

ALENÇON, COUNTS AND DUKES OF. The first line of the counts of Alençon was founded by Yves, lord of Bellesme, who in the middle of the 10th century possessed and fortified the town of Alençon. Mabille, countess of Alençon and heiress of this family (d. 1082) married Roger of Montgomery, and from them descended a second house of Alençon which became extinct in the person of Robert IV.; the county of Alençon was then joined to the royal domain. It was successively granted as an appanage to Peter, son of St. Louis (1268), and to Charles, count of Valois, brother of Philip the Fair (1293). The third house of Alençon sprang from Charles, second son of the count of Valois, who was killed at the battle of Crécy in 1346.

The countship of Alençon was raised to a peerage in 1367 and into a dukedom in 1414. John, 1st duke of Alençon, was killed at Agincourt on Oct. 25, 1415, after having with his own hand slain the duke of York His son, John, was dispossessed of his duchy by the King of England, but reconquered it in 1449. In 1524 the dukedom of Alençon reverted to the crown, in consequence of the

death of the Duke Charles IV. without issue. It was given as a jointure to Catherine de' Medici in 1559, and as an appanage to her son Francis in 1566. It was pawned by Henry IV. to the duke of Württemberg, and subsequently it passed to Gaston, duke of Orleans, by grant of Louis XIII.; to Elizabeth of Orleans, duchess of Guise; to Charles, duke of Berry, grandson of Louis XIV. (1710); and to Monsieur (Louis XVIII.), brother of Louis XVI.

The title of duc d'Alençon was given to Ferdinand of Orleans, son of the duc de Nemours, and grandson of Louis-Philippe.

ALENÇON, north-west France, capital of department of Orne, 36m. N. of Le Mans on a branch of the Western railway. Pop. (1926) 13,447. The regularly built town lies in a wide and fertile plain at the confluence of the Sarthe and Briante. The ancient castle, taken by William of Normandy in 1048, is in ruins save for one 14th and two 15th century towers. Notre Dame, the chief church (15th century), has an ornamented Gothic porch, and 16th century stained windows. The manufacture of *point d'Alençon* (a species of lace copied from Venice and introduced by Colbert) is still pursued. Weaving and bleaching of cloth, printing, the manufacture of vehicles, of boots and shoes and of bricks are carried on; there is trade in the horses of the district. Alençon is the seat of a prefect and a court of assizes. It has tribunals of first instance and of commerce, a board of trade arbitrators, a chamber of arts and manufactures, and corn and cloth markets.

ALENIO, GIULIO (ah-lā'nē-ō) (1582–1649), Italian Jesuit missionary, was born at Brescia. He landed at Macao in 1610, and penetrated into China three years later. During his 30 years' residence in China he adopted the dress and manners of the country, was the first Christian missionary in Kiang-si, and built several churches in Fukien. He wrote in Chinese a *Life of Christ* (Peking, 1635–37, 8 vol.; often reprinted, *e.g.*, in 1887 in 3 vol., and used even by Protestant missionaries) and a cosmography (*I che fang wai ki Hang-chow*, 1623, 6 vol.), which was translated into Manchu under the title *The True Origin of 10,000 Things*, a copy of which was sent from Peking to Paris in 1789. Alenio died at Fuchow in 1649.

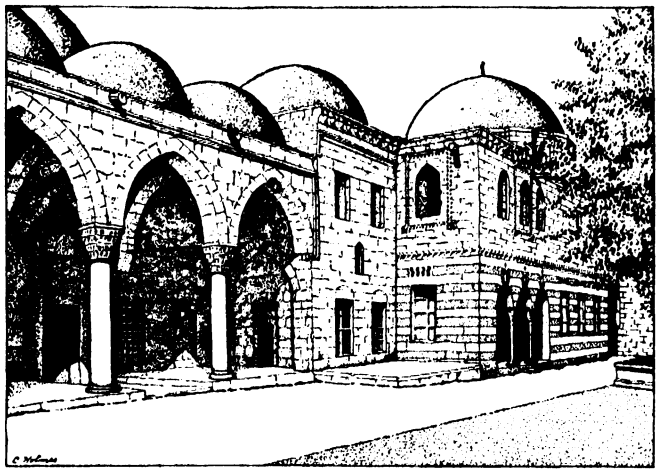
For bibliography *see* de Backer and Sommervögel, *Bibl. de la Cie. de Jésus*, i. 158–160.

ALENTEJO, ancient province of central and southern Portugal; bounded on the north by Beira, east by Spanish Estremadura and Andalusia, south by Algarve and west by the Atlantic ocean and Portuguese Estremadura. Pop. (1900) 416,105; area 9,219sq.m. The principal rivers are the Tagus, which divides Alentejo from Beira; the Guadiana, which, crossing the Spanish frontier, flows southwards through the province; and the Sado, which rises in the Serra de Monchique, and flows to the north. There are several extensive plains, notably that lying south-west of the Serra de Portalegre; that of Beja, between the Sado and Guadiana; and of Ourique, farther south between the same rivers. Some portions of these plains are fruitful, others marshy, while large tracts are desolate.

The climate in the lowland is hot and unhealthy in summer because of stagnant marshes. Towards the Spanish frontier the soil is fertile, and in the south are extensive forests of oak, pine, chestnut, cork and ilex, especially on the sides of the Mezquita and Caldeirão ranges. In the more fertile parts, grapes, figs, citrons, pomegranates and other fruits are produced. Wheat is the main crop; maize and rice are also grown, and some attention is given to the rearing of mules, asses, goats, cattle and sheep; while the Alter breed of horses, named after the villages of Alter do Chão and Alter Pedroso (3,971), near Portalegre, is often accounted the best in the country. Agriculture, however, is backward, the sparse population being mostly concentrated in the towns. Droves of large swine are fed on the waste lands, affording excellent hams. The mineral wealth of Alentejo, little exploited, includes copper and iron mines and marble quarries. Local industries include preparation of exceptionally fine olive oil, and the manufacture of cloth, pottery and leather. Alentejo is traversed by two main lines of railway, the Madrid-Badajoz-Lisbon and Lisbon-Faro. For administrative purposes the province is divided into the districts of Portalegre in the north, Evora in the central region and Beja in the south.

ALEPPO, a district and city in Syria. Under Turkish rule the name of the city (Halab) was borne also by a *vilayet* and a *sanjaq*. With the British occupation of the area in 1918 an Arab military governor was installed and when France took possession of Syria under the League of Nations mandate Aleppo gave its name to one of the five *états* (territories) into which Syria was divided. In 1925 the *états* of Aleppo and Damascus were united to form one *état*, Syria, with seven *sanjaqs*, of which Aleppo is one. Tobacco is largely grown and the district is one of the centres of the silk industry. Wheat and a small quantity of hemp are also grown.

The city stands on a plateau in the valley of the Kuwaik (anc. Chalys) 10m. above its dissipation in the salt marsh El-Matkh.



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

TEKYAH AT ALEPPO OF ABU BEKR, FATHER-IN-LAW OF MOHAMMED
Situated at the northern end of the city, this tekyah, or religious house for the accommodation and ceremonial rites of dervishes, is representative of the many religious buildings in Aleppo

History.—As early as 2000 B.C., when the "kings of Aleppo held a great kingdom," the Hittite monarch Murshil I. swept down through the Taurus passes and took the city. The Pharaoh Thutmose III. seized it (1490 B.C.) when he marched north, "laying waste the settlements of the foe of wretched Naharin." About the middle of the 15th century its king allied himself with the king of Hanigalbat, but the Hittite Tudhalia I. defeated them and sacked Aleppo. The city recovered only to fall victim to his successors Hattushil and Subbiluliuma, the latter of whom made Telipinush, his son, its king. The region became the battleground between Egypt and the Hittites and the struggle for its possession is reflected in the preface to the treaty (*c.* 1310 B.C.) between Murshil III. and Rimisharma, king of Aleppo. At the battle of Kadesh on the Orontes (1288 B.C.), where Ramses II. barely escaped defeat, a king of Aleppo took part on the Hittite side and was all but drowned. The Egyptians have depicted on their monuments "the wretched chief of Aleppo turned upside down by his soldiers after his majesty had hurled him into the water." In 854 B.C. Shalmaneser II. of Assyria visited the city and sacrificed to Adad. Seleucus Nicator (312–280 B.C.) enlarged Aleppo and named it Beroea, after the Macedonian city. In 164 B.C. Menelaus, the fomenter of war with the Asmoneans, was put to death by being thrust down into a tower filled with embers, a form of execution peculiar to the place. The name Halab reappears with the Arab conquest of Syria (A.D. 638), when the city was occupied without opposition by Abu 'Ubaidah. The Hamdanid Saif ed-Daulah (A.D. 936–967), who called himself "king of Aleppo," made Halab his residence, but the Byzantine Nicephorus Phocas surprised and sacked the city (962) but failed to capture the citadel. It was temporarily occupied by John Zimisces, emperor of Byzantium in 974. Shortly afterwards it received and acknowledged the Egyptian Fatimides, and twice, from 1038–42 and 1058–60, Egyptian troops garrisoned the town. From 1090–1117 it formed part of the Seljuk dominion. Then succeeded the unsettled times of the Crusades. The Crusaders, although they seized its territory, never occupied the city. They besieged it in

1118 and again in 1124 (Baldwin II), when, after four months, it was reduced to the utmost extremity before being relieved by an army from Mosul. The 12th century saw three serious earthquakes, 1114, 1139, and the most serious of all, 1170, after which the city had to be rebuilt by Nūr ed-Dīn. Benjamin of Tudela visited it in 1173. Saladin made it his northern base and stronghold against the Crusading princes of Antioch (1183). The Tatar invasions of the 13th and 14th centuries engulfed it, and with the rest of Syria it came under the Mameluke sway at the end of the 13th century. Aleppo surrendered to Tamerlane when he made an incursion into Syria (1400–01) The Mameluke rule in Syria was finally overthrown by the triumph of the Ottoman Turks under Selīm I. in 1517, the decisive battle being at Merj Dābik, a day's journey west of Aleppo. From the 16th to the 19th centuries it remained in Turkish hands In the latter part of the 18th and the beginning of the 19th century it suffered grievously from internal feuds (in which the Janissaries took an active part), which were exploited by the Ottoman governors for their own ends. Earthquakes in 1822 and 1830 and visitations of cholera in 1823, 1827 and 1832 left the city a wreck and its population greatly diminished. It could offer but feeble resistance to the army of Mohammed Ali of Egypt in 1833. It then became the centre of Egyptian domination in Syria until it was restored to the Turks in 1840. Tumults and massacres of Christians occurred in 1850 and 1862. On Oct. 26, 1918, it was occupied by the 5th cavalry division of the Egyptian expeditionary force. Aleppo showed hostility to the French army of occupation when it replaced the British in 1920.

The Modern City.—The population of the modern city is about 200,000. The older portion is contained within a wall with nine gates (*bāb*). The Europeans reside mainly in the Kittāb and 'Azīzīyah and the Jews in the Bahsītah. The citadel occupies what appears to be an artificial mound in the centre of the town and is surrounded by a dry moat. Two of the mosques have a special interest, the Zakarīyah, in which is a tomb reputed to be that of Zacharias, father of John the Baptist, and the Kīkanah into the wall of which is built a basalt block with Hittite inscription. Aleppo is the mart for north Syria. It is renowned for the beauty of its *sūqs* (market-places) and adornment of its dwellings, and it is relatively clean and well paved Its bazaars and khans (in which its wholesale trade is concentrated) are unusually large. Gardens extend in a narrow strip for miles along the river and are much resorted to in summer In winter frost and snow are not uncommon, but the climate is healthy despite the prevalence of the Aleppo boil or button, which develops into an ulcer, leaving eventually an unsightly scar.

Trade.—Aleppo formerly derived its importance from its commanding position on the trade route between Europe and Persia and India. One of the first provincial factories and consulates of the British Turkey (Levant) company was established in it in the reign of James I., and a British agent had been in residence there even in Elizabeth's time. It was connected with Baghdad, the western outpost of the East India company, by a private postal service. The first blow was struck at this trade by the discovery of the Cape route to India, the second by the opening of the land route, through Egypt to the Red sea, and the third and final one by the making of the Suez canal. Aleppo is now connected by rail with its Mediterranean port, Alexandretta, *via* the Baghdad railway (1920), and with Tripoli *via* Homs (1909). A branch line to Alexandretta *via* Antioch, which would halve the time of rail transport, is projected. Meanwhile there is a rapidly extending motor transport traffic between the two places. The industries of Aleppo include starch, soap, textiles (cotton, silk and fine stuffs), carpet weaving, dye and copper work. It exports, in addition to its manufactures, cereals, tobacco, pistachio nuts, wool, cotton and *semn* (melted butter packed in skins). It is one of the chief markets for sheep and a centre of the wool trade. Trade with Anatolia has diminished since the erection of the frontier.

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ALES or **ALESIUS, ALEXANDER** (1500–65), Scottish reformer, was born at Edinburgh, April 23, 1500. As canon of the collegiate church of St. Andrews he opposed the Reformers, but was converted by the arguments and the courageous death of Patrick Fern in 1538 He escaped to Germany and at Wittenberg signed the Augsburg Confession. He went to England in 1535, and was well received by Cranmer and Thomas Cromwell, but the statute of Six Articles (1539) drove him back to Germany. He was professor of theology at Leipzig at the time of his death (March 17, 1565).

Alesius was the author of a large number of exegetical, dogmatic and polemical works, of which over 20 are mentioned by Bale in his *List of English Writers*. In his controversial works he upholds the synergistic views of the Scottish theologian John Major. He wrote an appeal to his native land in *Cohortatio ad Concordiam Pietatis, missa in Patriam suam* (1544), which had the express approval of Luther, and a *Cohortatio ad Pietatis Concordiam ineundam* (1559).

The best early account of Alesius is the *Oratio de Alexandro Alesio* of Jacob Thomasius (April 1661), printed in his *Orationes* (No. xiv, Leipzig, 1683); the best modern account is by Dr. A W. Ward in the *Dictionary of National Biography*. *See* also A. F Mitchell's introduction to Gau's *Richt Vay* (Scottish Text Society, 1888).

ALÈS, South France, capital of an arrondissement in the department of Gard, 25m. N.N W of Nîmes on the P L M. railway Pop. (1926) 29,749. The town is at the foot of the Cévennes, on the left bank of the Gardon, which half surrounds it. The proximity of the high plateau—a region of social difficulty and poverty—made Alès in the 16th century an important Huguenot centre In 1629 it was taken by Louis XIII. A bishopric was established here in 1694 but suppressed in 1790. The church of St Jean is a heavy building of the 18th century Alès has associations with Pasteur and Dumas The town is one of the most important markets for raw silk and cocoons in the south of France, and the Gardon supplies power to numerous silk-mills. It is also the centre of a mineral field, which yields coal, iron, silver, zinc and antimony; its blast-furnaces, foundries, tanneries, distilleries, glass-works and engineering works afford employment to many workmen

Alès has a tribunal of commerce, a board of trade-arbitrators, and a school of mines. In 1926 the name of the town was changed from Alais to Alès.

ALESIA, the ancient name for a hill in the department of Côte d'Or, France, now Alise-Ste-Reine. (Pop. of commune [1926] 476.) The site was important in early times Here Vercingetorix, the Gaulish national leader, was besieged by Caesar in 52 B.C.—the former's surrender leading to the final conquest of Gaul. The native leader is commemorated by a statue on Mt. Auxois. The discovery of the remains of a town and temple in 1906–10 shows that the site remained important through Gallo-Roman times. The ground plan of a large mediaeval structure which has been revealed by excavations, suggests the continuity of interest in this hill-top site into the middle ages. Its situation on a hill top, off modern lines of communication has led to its decay. The region is visited annually by large numbers of tourists.

For account of Alesia *see* Déchelette *Manuel d'Archéologie*, II. 3, pp. 958 ff. 1914 (bibl.).

Siege of Alesia, was the climax of the great revolt which endangered Julius Caesar's conquest of Gaul. He was temporarily back in Italy, after his expeditions across the Rhine and the Channel, when word came of the general rising (end of 53 B.C.) of most of the Gallic tribes under Vercingetorix, a chieftain of the Arverni (modern Auvergne). Fortunately for Caesar it came before he was entangled in the Civil War, and by rapid countermeasures, involving arduous mid-winter marches, he partially restored the situation. But guerilla warfare on a far-reaching scale undermined his efforts, he was forced to abandon his siege of

Gergovia (near modern Clermont-Ferrand) Vercingetorix's own town, and through the Aedui joining in the revolt, was cut off from his base in the south. In this critical situation Caesar first moved to effect a junction with Labienus's detachment, which had with difficulty returned from an abortive attempt on Lutetia (modern Paris), and then sought a line of retreat back to his base, taking an easterly route. But Vercingetorix, emboldened by success to discard pure harassing strategy, moved to intercept him near modern Langres, and surprised him on the march. The Romans succeeded in repulsing the attack, and Vercingetorix retreated to a fortified camp at Alesia (probably Mont Auxois, near modern Dijon). Thus assured of his communications being free, Caesar decided to lay siege to Alesia, which now held the soul as well as a large part of the body of the revolt. He completely invested the position, surrounding it with lines of contravallation, ten miles in perimeter and fortified with all the science of Roman field engineering, and outside these he built lines of circumvallation to protect himself from any relieving forces. These soon gathered in great force but inadequate organization, and their onsets were repulsed until, finding that Vercingetorix's sortie was equally ineffectual, they retired. The third and last attempt, made at the weakest spot—a hill which could not be included in the lines of circumvallation—was barely withstood, but with its failure Vercingetorix was forced, from lack of supplies, to surrender. Thereafter, although isolated outbreaks occurred, the Roman grip upon Gaul was not again seriously threatened.

ALESSANDRI, ALESSANDRO (Alexander ab Alexandro) (1461–1523), Italian jurist, was born at Naples about the year 1461. His work entitled *Dies Genales* appeared at Rome in 1522, and was constructed after the model of the *Noctes Atticae* of Aulus Gellius, and the *Saturnalia* of Macrobius It consists of a confused mass of heterogeneous materials relating to philology, antiquities, law, dreams, spectres, etc. and is characterized by considerable credulity.

ALESSANDRIA, capital of province of same name and episcopal see, Piedmont, Italy, on the river Tanaro, 57m. S E. of Turin by rail. Pop (1921) 41,021 (town), 78,278 (commune). Founded in 1168 for defence against the marquis of Monferrato and the town of Pavia, it was besieged in 1174 by Frederick Barbarossa for six months without success. The Lombard League then included it among the allied cities and named it Alessandria, after Pope Alexander III. It was ceded to Savoy by the Peace of Utrecht in 1713, and its citadel was begun in 1728 Fortifications were made during the French occupation (1800–1814) after Marengo; they were destroyed by the Austrians (1815) and were later rebuilt, but are now obsolete, though Alessandria is still an important fortress. The citadel is on the left bank of the Tanaro, the town on the right. It has various manufactures, especially felt hats, is a commercial centre and the focus of railway lines to Turin via Asti, to Valenza (thence to Vercelli, Mortara—for Novara or Milan—and Pavia), to Tortona, to Novi, to Acqui and to Bra.

ALESSI, GALEAZZO (1512–1572), Italian architect, was born at Perugia, and was probably a pupil of Caporali. He was an enthusiastic student of ancient architecture, and his style gained for him a European reputation. Genoa is indebted to him for a number of magnificent palaces, and his art may be studied in the churches of San Paolo and Santa Vittoria at Milan, in certain parts of the Escurial, and in numerous churches and palaces throughout Sicily, Flanders, and Germany.

See Rossi, *Di Galeazzo Alessi memorie* (Perugia, 1873).

ALETHIOLOGY, an uncommon expression for the doctrine of truth (Gr. ἀλήθεια, truth) used by Sir William Hamilton in his philosophic writings when treating of the rules for the discrimination of truth and error. The term was first used by Lambert in his *New Organon*, 1764.

ALETRIUM (mod. Alatri), a town of the Hernici, about 6m. due N. of Frusino, Italy, mentioned 306 B C. for fidelity to Rome. In Cicero's time it was a *municipium*, and continued in this position throughout the imperial period. Finely preserved fortifications of blocks of local limestone have an outer circuit of about 2½m. An embanking wall, the rule in the cities of this part, has a maximum height of about 30ft. Two gates and three posterns are to be found. A central hill (1,647ft.) was the citadel. Fortifications of three periods can be traced; the last, perhaps a little more recent than the city wall, is best preserved A flat surface was formed partly by smoothing off the rock and partly by the erection of huge terrace walls which rise to a height of over 50ft, enclosing a roughly rectangular area of 235 by 115yds. Two approaches to the citadel pass through the wall.

ALEURITES (Gr. ἀλευρίτης, pertaining to ἄλευρον, ground meal, from ἀλεῖν, to grind), a genus of trees belonging to the family Euphorbiaceae. *Aleurites triloba* is widely cultivated throughout the tropical and sub-tropical parts of the world for its fruit, which is about the size of a walnut, and contains several seeds which are rich in oil. The oil is extracted and used for food and light; it is known in India as *kekuna*, and the tree as the candle-nut In the Sandwich islands the nuts are strung upon strips of wood and used as torches. The oil is exported to Europe for candle-making *A. cordata* flourishes in China, where it is known as the varnish-tree

ALEUT (ăl'ę-o͞ot), a native of the Aleutian islands and part of the Alaska peninsula, a branch of the Eskimo stock They differ from the Eskimo in their brachycephaly, but resemble them in features, and their language, though well differentiated, is fundamentally Eskimo. Their culture, too, is from the same source, though adapted to a raw and wet rather than an extremely cold environment. They came under Russian control, became Orthodox Christians, are now hybrid in blood as well as customs, and reduced in numbers. In 1834 there remained 2,200; in 1900, 1,700.

ALEUTIAN ISLANDS, a chain of small islands situated in the Northern Pacific ocean, and extending about 1,200m westward from the extremity of the Alaskan peninsula toward the peninsula of Kamchatka; they constitute part of the Territory of Alaska, U S A The islands, of which an alternative collective name is the Catherine archipelago, comprise four groups—the Fox, Andreanof, Rat and Near islands. They are all included between 52° and 55° N. and 172° E and 163° W.

The axis of the archipelago near the mainland of Alaska has a south-west trend, but near the 179th meridian its direction changes to the north-west This change of direction corresponds to a curve in the line of volcanic fissures which have contributed their products to the building of the islands The island chain is really a western continuation of the Aleutian range on the mainland The great majority of the islands bear evident marks of volcanic origin, and there are numerous volcanic cones on the north side of the chain, some of them active; many of the islands, however, are not wholly volcanic, but contain crystalline or sedimentary rocks, and also amber and beds of lignite The coasts are rocky and surf-worn and the approaches are exceedingly dangerous, the land rising immediately from the coasts to steep, bold mountains.

The climate of the islands is oceanic, with moderate and fairly uniform temperatures and heavy rainfall. Fogs are almost constant The summers are much cooler than on the mainland at Sitka (*q v.*), but the winter temperature of the islands and of south-eastern Alaska is very nearly the same. The mean annual temperature for Unalaska, the most important island of the group, is about 38° F. The growing season lasts about 135 days, from early in May till late in September, but agriculture is limited to the raising of a few vegetables The islands are practically destitute of trees, but are covered with a luxuriant growth of herbage, including grasses, sedges and many flowering plants. Attempts have been made to raise sheep and reindeer on the islands, but the industry is still in its infancy with some uncertainty as to future results. The principal occupations of the natives have always been fishing and hunting, and the women weave basketry of exquisite fineness. From the end of the 18th century the Russian fur traders had settlements here for the capture of the seal and the sea otter and the blue and the Arctic fox. Under the American régime seal fishing off the Aleutians, save by the natives, has never been legal, but the rapid depletion of animals has threatened the Aleuts (as the natives are commonly called) with starvation. In recent years the raising of foxes, especially of blue fox, has been

conducted quite extensively throughout the islands and with a fair measure of success. This industry furnishes employment to many natives. Fish and sea-fowl are extremely abundant.

The natives are rather low in stature, but plump and well shaped, with short necks, swarthy faces, black eyes and long black hair. They are a branch of the Esquimauan family, but differ greatly from the Eskimo of the mainland in language, habits, disposition and mental ability. They were good fighters until they were cowed by the treatment of the Russians, who practically reduced them to slavery. Christianity is recognized in the form of the Greek Orthodox Church.

In dress and mode of life they have adopted outwardly civilized customs.

It is stated that before the advent of the Russians there were 25,000 Aleuts (*q.v.*) on the archipelago, but that the barbarities of the traders nearly extinguished the native population. The total population of the archipelago in 1920 was 1,080. The principal settlements are on the Unalaska Islands. Of these Unalaska, the oldest, settled in 1760–75, has a custom house, a Russian-Greek church, and a Methodist mission and orphanage, and is the headquarters for a considerable fleet of United States coast guard vessels which patrol the sealing grounds of the Pribilofs; adjacent is Dutch Harbor. The Commander Islands group near the Asiatic coast is geographically, but since the acquisition of the Russian possessions in America not politically, a part of the Aleutian system.

In 1741 the Russian Government sent out Vitus Bering, a Dane, and Alexei Chirikov, a Russian, in the ships "Saint Peter" and "Saint Paul" on a voyage of discovery in the northern Pacific. After the ships were separated by a storm, Chirikov discovered several eastern islands of the Aleutian group, and Bering discovered several of the western islands, finally being wrecked and losing his life on the island of the Commander group that now bears his name. The survivors of Bering's party reached Kamchatka in a boat constructed from the wreckage of their ship, and reported that the islands were rich in fur-bearing animals. Siberian fur hunters at once flocked to the Commander Islands and gradually moved eastward across the Aleutian islands to the mainland. In this manner Russia gained a foothold on the north-western coast of North America. The Aleutian islands consequently belonged to Russia, until that country in 1867 transferred to the United States all its possessions in America.

ALEWIFE or SPRING-HERRING (*Alosa tyrannus*), a fish allied to the shad (*q.v.*), which spawns in large numbers in the tidal parts of the rivers of eastern North America, from the St. Lawrence southwards, during the spring. It grows to a length of a foot and is excellent for the table.

ALEXANDER, the name of eight Popes:

ALEXANDER I. was bishop of Rome from about 106 to 115. He has been identified, without any foundation, with Alexander, a martyr of the Via Nomentana, whose day is May 3.

ALEXANDER II. (Anselmo Baggio), Pope from 1061 to 1073, was a native of Milan. As bishop of Lucca he seconded the efforts of Hildebrand (afterwards Gregory VII.) for the suppression of simony and the enforcement of the celibacy of the clergy. By Hildebrand's influence he was elected Pope, but the German court nominated Cadalus, bishop of Parma, who was proclaimed at the council of Basel as Honorius II., and marched to Rome. Alexander's ultimate victory over his rival was due to Hildebrand.

ALEXANDER III. (Orlando Bandinelli), Pope from 1159 to 1181, was a Siennese, and teacher of canon law in Bologna and author of the *Stroma,* or the *Summa Magistri Rolandi,* one of the earliest commentaries on the Decretum Gratiani and of *Sentences,* based on the *Introductio ad theologiam* of Abelard. In 1153 he became papal chancellor, and was the leader of the cardinals opposed to Frederick Barbarossa. On Sept. 7, 1159, he was chosen to succeed Adrian IV., a minority of the cardinals, however, electing the cardinal priest Octavian, who assumed the name of Victor IV. This antipope, and his successors Paschal III. (1164–68) and Calixtus III. (1168–78), had the imperial support; but after the defeat of Legnano, Barbarossa finally (in the peace of Venice, 1177) recognized Alexander as Pope. On March 12, 1178, Alexander returned to Rome, which he had been compelled to leave twice, from 1162 to 1165, and again in 1167. The first period he spent in France, the latter chiefly in Gaeta, Benevento, Anagni and Venice. In March 1179 Alexander held the third Lateran synod, reckoned by the Roman Catholic Church as the 11th oecumenical council; its acts embody among them the present law



POPE ALEXANDER III. BESTOWING THE SWORD UPON DOGE ZIANI OF VENICE. FROM THE FRESCO IN THE PALAZZO PUBBLICO AT SIENA, BY SPINELLO ARETINO (1333–1410)

requiring that no one may be elected Pope without the votes of two-thirds of the cardinals. This synod marks the summit of Alexander's power. Besides checkmating Barbarossa, he had humbled Henry II. of England in the affair of Thomas Becket, he had confirmed the right of Alphonso I. of Portugal to the crown, and even as a fugitive had enjoyed the favour and protection of Louis VII. of France. Nevertheless, soon after the close of the synod the Roman republic forced Alexander to leave the city, which he never re-entered; and on Sept. 29, 1179, some nobles set up the antipope Innocent III. By the judicious use of money, however, Alexander got him into his power, so that he was deposed in Jan. 1180. In 1181 Alexander excommunicated William the Lion of Scotland and put the Kingdom under the interdict. The great Pope died at Civita Castellana on Aug. 30, 1181.

See Herzog-Hauck, *Realencyklopädie,* 3rd ed. i. 340–44; Wetzer and Welte, *Kirchenlexikon,* 2nd ed., 1481. The most elaborate biography is H. Reuter, *Geschichte Alexanders III. und der Kirche seiner Zeit* (2nd ed., Leipzig, 1860).

ALEXANDER IV. (Rinaldo), Pope from 1254 to 1261, was a member of the family of the counts of Segni. On the death of Innocent IV. he was elected Pope at Naples on Dec. 12, 1254. He is described as a stout man, kindly, cheerful, but of no great brilliancy. He succeeded Innocent IV. as guardian of Conradin, the last of the Hohenstaufen, to whom he promised benevolent protection; but in less than a fortnight he conspired against him

and bitterly opposed Conradin's uncle Manfred. Alexander fulminated with excommunication and interdict against the party of Manfred, but in vain; nor could he enlist the kings of England and Norway in a crusade against the Hohenstaufen. Rome itself became too Ghibelline for the Pope, who withdrew to Viterbo, where he died on May 25, 1261. His pontificate was signalized by efforts to unite the Greek and Latin churches by the establishment of the Inquisition in France, by favours to the mendicant orders, and by an attempt to organize a crusade against the Tatars.

The registers of Alexander IV. are published by Bourel de la Roncière and others in the *Bibliothèque des Écoles françaises d'Athènes et de Rome* (Paris, 1895 *et seq.*).

ALEXANDER V. (Peter Philargès), Pope from 1409 to 1410, was born in Crete of unknown parents and entered the order of St Francis. He was a member in turn of the Universities of Oxford and Paris, and finally settled in Lombardy, where, thanks to the favour of Gian Galeazzo Visconti, he became eventually archbishop of Milan Created cardinal by Innocent VII, he worked for the realization of the union of the Church, in spite of the two rival popes He was one of the promoters of the council of Pisa, and after that assembly had declared Gregory XII and Benedict XIII deposed, the cardinals elected Alexander as Pope (June 26, 1409), thus adding a third to the number of rival pontiffs. During his short reign of ten months Alexander V.'s aim was to extend his obedience with the assistance of France. He died suddenly at Bologna in the night of May 3–4, 1410, and it was suspected, though without proof, that he had been poisoned.

ALEXANDER VI. (Rodrigo Borgia), (1431–1503), pope from 1492 until his death, is the most memorable of the corrupt and secular Popes of the Renaissance. He was born, Jan. 1, 1431, at Xativa, near Valencia in Spain. He assumed the name of his mother's family, Borgia or Borja, on the elevation of his maternal uncle to the papacy as Calixtus III. (April 8, 1455) He studied law at Bologna, and after his uncle's election he was created successively bishop, cardinal and vice-chancellor of the church. He served in the Curia under five Popes, and acquired much administrative experience, influence and wealth, although no great power; he was economical in his habits, though on occasion he displayed great splendour and lived in a fine palace. Of his many mistresses, the one for whom his passion lasted longest was Vannozza (Giovanna) dei Cattani, born in 1442, and wife of three successive husbands The connection began in 1470, and she bore him children whom he openly acknowledged as his own: Giovanni, afterwards Duke of Gandia (born 1474), Cesare, (born 1476), Lucrezia (born 1480), and Goffredo or Giuffre (born 1481 or 1482). Before his elevation to the papacy, Cardinal Borgia's passion for Vannozza diminished. Her place was filled by the beautiful Giulia Farnese (Giulia Bella), wife of an Orsini, but his love for his children by Vannozza remained as strong as ever, and proved, indeed, the determining factor of his whole career. He lavished vast sums on them and loaded them with every honour.

On the death of Pope Innocent VIII, the three likely candidates for the Holy See were Cardinals Borgia, Ascanio Sforza and Giuliano della Rovere. Borgia, by his great wealth, succeeded in buying the largest number of votes, including that of Sforza, and was elected Aug. 10, 1492, assuming the name of Alexander VI At first his reign was marked by a strict administration of justice and an orderly method of Government, in contrast with the anarchy of the previous pontificate, as well as by great outward splendour. But he indulged his unbridled passion for endowing his relatives at the expense of the Church and of his neighbours Cesare, then a youth of 16 and a student at Pisa, was made archbishop of Valencia, his nephew Giovanni received a cardinal's hat, and for the Duke of Gandia and Giuffre the pope proposed to carve fiefs out of the Papal States and the Kingdom of Naples Among the fiefs destined for the Duke of Gandia were Cervetri and Anguillara, lately acquired by Virginio Orsini, head of that powerful and turbulent house, with the pecuniary help of Ferdinand of Aragon, king of Naples (Don Ferrante). This brought Ferdinand of Aragon into conflict with Alexander, who consequently made an alliance with the king's enemies, especially the Sforza family, lords of Milan.

In this he was opposed by Cardinal della Rovere, whose candidature for the papacy had been backed by Ferdinand. Della Rovere, feeling that Rome was a dangerous place for him, fortified himself in his bishopric of Ostia at the Tiber's mouth, while Ferdinand allied himself with Florence, Milan, Venice, and the Pope formed a league against Naples (April 25, 1493) and prepared for war. Ferdinand appealed to Spain for help; but Spain was anxious to be on good terms with the pope to obtain a title over the newly discovered continent of America, and could not afford to quarrel with him.

Alexander meditated great marriages for his children. Lucrezia had been married to the Spaniard Don Gasparo de Procida, but the union was annulled, and in 1493 she was married to Giovanni Sforza, lord of Pesaro, the ceremony being celebrated at the Vatican with unparalleled magnificence But in spite of the splendours of the court, the condition of Rome became every day more deplorable. The city swarmed with Spanish adventurers, assassins, prostitutes and informers, murder and robbery were committed with impunity, heretics and Jews were admitted to the city on payment of bribes, and the pope himself shamelessly cast aside all show of decorum, living a purely secular and immoral life, and indulging in the chase, dancing, stage plays and indecent orgies. One of his boon companions was Jem, the brother of the Sultan Bayezid, detained as a hostage.

Alexander carried on a double policy, always ready to seize opportunities to aggrandize his family. But through the intervention of the Spanish ambassador he made peace with Naples in July 1493 and also with the Orsini. In order to dominate the Sacred College more completely he created 12 new cardinals, among them his own son Cesare, then only 18 years old, and Alessandro Farnese, the brother of Giulia Bella, one of the Pope's mistresses. On Jan 25, 1494, Ferdinand died and was succeeded by his son Alphonso II. Charles of France now advanced formal claims on the Kingdom, and Alexander authorized him to pass through Rome ostensibly on a crusade against the Turks, without mentioning Naples. But when the French invasion became a reality he was alarmed, recognized Alphonso as king, and concluded an alliance with him in exchange for various fiefs to his sons (July 1494). Preparations for defence were made; but the pope was unable to defend Rome, and came to terms with the invader. Charles conquered Naples and was crowned king there on May 12, 1495, but a reaction set in. A league of the principal powers assembled a force in Italy which threatened Charles's retreat. He cut his way through and returned to France, and Ferdinand II. was re-established at Naples with Spanish help.

Alexander availed himself of the defeat of the French to break the power of the Orsini. Virginio Orsini, who had been captured by the Spaniards, died a prisoner at Naples, and the pope confiscated his property But the rest of the clan still held out, and the papal troops sent against them under Guidobaldo, Duke of Urbino, and the Duke of Gandia were defeated at Soriano (Jan. 1497). Peace was made through Venetian mediation, the Orsini paying 50,000 ducats in exchange for their confiscated lands. The Orsini still remained very powerful, and Alexander could count on none but his 3,000 Spaniards.

Now occurred the first of those ugly domestic tragedies for which the house of Borgia remained infamous. On June 14 the Duke of Gandia, lately created Duke of Benevento, disappeared; the next day his corpse was found in the Tiber. Alexander, overwhelmed with grief, shut himself up in Castle St Angelo. The rumour spread about that Cesare, the Pope's second son, was the author of the deed, and the search for the assassin then ceased No doubt Cesare, who contemplated quitting the Church, was inspired by jealousy of Gandia's influence with the Pope. Violent and revengeful, he now became the most powerful man in Rome, and even his father quailed before him

As he needed funds to carry out his various schemes, the Pope began a series of confiscations, of which one of the victims was his own secretary, in order to enrich him The process was a simple one. any cardinal, nobleman or official who was known to be rich would be accused of some offence, imprisonment and perhaps murder followed at once, and then the confiscation of his

property. The disorganization of the Curia was appalling, the sale of offices became a veritable scandal, the least opposition to the Borgia was punished with death, and even in that corrupt age the state of things shocked public opinion. The story of Alexander's relations with Savonarola is narrated under the latter heading; it is sufficient to say here that the Pope's hostility was due to the friar's outspoken invectives against papal corruption and to his appeals for a General Council. Alexander, although he could not get Savonarola into his own hands, browbeat the Florentine Government into condemning the reformer to death (May 23, 1498).

The Pope was unable to maintain order in his own dominions; the houses of Colonna and Orsini were at open war with each other, but after much fighting they made peace on a basis of alliance against the Pope. He had annulled Lucrezia's marriage with Sforza in 1497, and arranged her marriage to the Duke of Bisceglie, a natural son of Alphonso of Aragon. Cesare, who renounced his cardinalate, was sent on a mission to France at the end of the year, bearing a bull of divorce for the new king, Louis XII., in exchange for which he obtained the duchy of Valentinois (hence his title of Duca Valentino) and a promise of material assistance in his schemes to subjugate the feudal princelings of Romagna; he married a princess of Navarre. In spite of the remonstrances of Spain and of the Sforza, Alexander allied himself with France in Jan. 1499 and was joined by Venice. By the autumn Louis was in Italy and expelled Lodovico Sforza from the Milanese In order to consolidate his possessions still further now that French success seemed assured, the Pope determined to deal drastically with Romagna, which although nominally under papal rule was divided into a number of practically independent lordships on which Venice, Milan and Florence cast hungry eyes.

Cesare, nominated *gonfaloniere* of the Church, and strong in French favour, proceeded to attack the turbulent cities one by one (for details *see* BORGIA, CESARE). But the expulsion of the French from Milan and the return of Lodovico Sforza interrupted his conquests, and he returned to Rome early in 1500. This year was a jubilee year, and crowds of pilgrims flocked to the city from all parts of the world, bringing money for the purchase of indulgences, so that Alexander was able to furnish Cesare with funds for his enterprise. In the north the pendulum swung back once more and the French reoccupied Milan in April, causing the downfall of the Sforza much to Alexander's gratification.

But there was no end to the Vatican tragedies, and in July the Duke of Bisceglie, whose existence was no longer advantageous, was murdered; this left Lucrezia free to contract another marriage. The Pope, ever in need of money, now created 12 new cardinals, from whom he received 120,000 ducats; and fresh conquests for Cesare were considered But while a crusade was talked of, the real object was central Italy, and in the autumn Cesare, favoured by France and Venice, set forth with 10,000 men to complete his interrupted enterprise. On his return to Rome (June 1501) Cesare was created Duke of Romagna. Louis XII. now concluded a treaty with Spain for the division of the Neapolitan kingdom, which was ratified by the Pope on June 25, Frederick being formally deposed. The French army proceeded to invade Naples, and Alexander took the opportunity, with the help of the Orsini, to reduce the Colonna to obedience. In his absence he left Lucrezia as regent, offering the astounding spectacle of a Pope's natural daughter in charge of the Holy See. Shortly afterwards he induced Alphonso d'Este, son of the Duke of Ferrara, to marry her (Jan. 1502).

As France and Spain were quarrelling over the division of Naples and the Campagna barons were quiet, Cesare set out once more in search of conquests (*see* BORGIA, CESARE). As soon as Alexander heard the news of Cesare's successes (1502) he decoyed Cardinal Orsini to the Vatican and cast him into a dungeon, where he died. His goods were confiscated, his aged mother was turned into the street, and numbers of other members of the clan in Rome were arrested, while Giuffre Borgia led an expedition into the Campagna and seized their castles. Thus the two great houses of Orsini and Colonna, who had long fought for predominance in Rome, and often flouted the Pope's authority, were subjugated. Three more high personages fell victims to the Borgias' greed this year, viz., Cardinal Michiel, who was poisoned in April, and J. da Santa Croce, who had helped to seize Cardinal Orsini and Troches or Troccio, one of the family's most faithful assassins; all these murders brought immense sums to the pope. About Cardinal Ferrari's death there is more doubt; he probably died of fever, but the Pope confiscated his goods

The war between France and Spain for the possession of Naples dragged on, and Alexander was ever intriguing, ready to ally himself with whichever power promised at the moment most advantageous terms. Cesare was preparing for another expedition into central Italy in July 1503, when, in the midst of all these projects and negotiations both he and his father were taken ill with fever. The occurrence was, of course, attributed to poison, although it was merely the result of malaria, at that time very prevalent in Rome. On Aug. 18 Alexander died at the age of 72. His death was followed by scenes of wild disorder, and Cesare, being himself ill, sent Don Michelotto, his chief bravo, to seize the Pope's treasures before the demise was publicly announced Alexander's successor on the chair of St. Peter was Francesco Todeschini-Piccolomini, who assumed the name of Pius III.

Alexander VI. has become almost a mythical character, and countless legends and traditions are attached to his name. His career shows no great political ideas, and his one thought was family aggrandizement. While it is unlikely that he meditated making the papacy hereditary in the house of Borgia, he certainly gave away its temporal estates to his children as though they belonged to him. The secularization of the church was carried to a pitch never before dreamed of, and it was clear to all Italy that he regarded the papacy as an instrument of worldly schemes with no thought of its religious aspect. During his pontificate the church was brought to its lowest level of degradation. The condition of his subjects was deplorable, and if Cesare's rule in Romagna was an improvement on that of the local tyrants, the people of Rome have seldom been more oppressed than under the Borgia. Alexander was not the only person responsible for the general unrest in Italy and the foreign invasions, but he was ever ready to profit by them Even if we do not accept all the stories of his murders and poisonings and immoralities as true, there is no doubt that his greed and his essentially vicious nature led him to commit a great number of crimes. For many of the misdeeds attributed to him, Cesare was responsible, but of others the Pope cannot be acquitted. The one pleasing aspect of his life is his patronage of the arts, and in his days a new architectural era was initiated in Rome with the coming of Bramante. Raphael, Michelangelo and Pinturicchio all worked for him and a curious contrast, characteristic of the age, is afforded by the fact that a family so steeped in vice and crime could take pleasure in the most exquisite works of art.

BIBLIOGRAPHY—The chief contemporary authorities for this reign are: the diary of Alexander's master of ceremonies, Johannes Burchardus, edited by L. Thuasne (Paris, 1883–84), which is characterized by accuracy and by a candour often amounting to gross indecency; the despatches of Giustiniani, the Venetian ambassador, edited by P. Villari (Florence, 1876), which are based on the most accurate information; and Paolo Cappelli's "Diarii" in E. Alberi's *Relazioni*, series ii, iii. Among modern works the most important are· F. Gregorovius's *Geschichte der Stadt Rom* (3rd ed., Stuttgart, 1881), a work of immense research and admirable synthesis, giving a very unfavourable view of the Borgia; A. von Reumont's *Geschichte der Stadt Rom* (Berlin, 1867–70), also a valuable book; M. Creighton's *History of the Papacy* (London, 1897) is very learned and accurate, but the author is more lenient towards Alexander; F. Gregorovius's *Lucrezia Borgia* (Stuttgart, 1874) contains a great deal of information on the Borgia family; P. Villari's *Machiavelli* (English translation, new ed., 1892) deals with the subject at some length. Of the Catholic writers, L. Pastor, *Geschichte der Päpste* (Freiburg, i. B., 1886), should be consulted, for although the author tries to extenuate the pope to some extent, on the whole he is fair. *See* also Rafael Sabatini, *The Life of Cesare Borgia;* G. Portigliotti, *The Borgias,* trans. by Bernard Miall (1928).

ALEXANDER VII. (Fabio Chigi), Pope from 1655 to 1667, was born at Siena on Feb. 13, 1599. He was successively inquisitor at Malta, vice-legate at Ferrar and nuncio in Cologne (1639–51). Innocent X. subsequently made him cardinal-secretary of State. When Innocent died, Chigi, the candidate favoured by Spain, was

elected Pope on April 7, 1655. The Conclave believed he was strongly opposed to the nepotism then prevalent In the first year of his reign Alexander VII. forbade his relations even to visit Rome; but in 1656 he gave them the best-paid civil and ecclesiastical offices, also palaces and princely estates Alexander disliked business of State, preferring literature and philosophy, a collection of his Latin poems appeared at Paris in 1656 under the title *Philomathi Labores Iuveniles*. He also encouraged architecture, and in particular constructed the beautiful colonnade in the piazza of St. Peter's He favoured the Jesuits, in their conflict with the Jansenists, forbade in 1661 the translation of the Roman Missal into French, and in 1665 canonized Francis of Sales His pontificate was marked by protracted controversies with France and Portugal. He died on May 22, 1667.



AFTER A 17TH CENTURY ITALIAN MEDAL IN METROPOLITAN MUSEUM OF ART

PROFILE OF POPE ALEXANDER VII ON AN EARLY ITALIAN MEDAL HE CONSTRUCTED THE BEAUTIFUL COLONNADE IN THE PIAZZA OF ST PETER'S

ALEXANDER VIII (Pietro Ottoboni), Pope from 1689 to 1691, was born in 1610 of a noble Venetian family, was created cardinal, and then successively bishop of Brescia and datary The ambassador of Louis XIV succeeded in procuring his election, Oct. 6, 1689, as successor to Innocent XI.; nevertheless, after months of negotiation Alexander finally condemned the declaration made in 1682 by the French clergy concerning the liberties of the Gallican church Charities on a large scale and unbounded nepotism exhausted the papal treasury He bought the books and manuscripts of Queen Christina of Sweden for the Vatican library. Alexander condemned in 1690 the doctrines of so-called philosophic sin, taught in the Jesuit schools He died on Feb 1, 1691

ALEXANDER I. (ALEKSANDER PAVLOVICH) (1777–1825), emperor of Russia, son of the grand-duke Paul Petrovich, afterwards Paul I., and Maria Fedorovna, daughter of Frederick Eugene of Wurttemberg, was born on Dec 28, 1777 The strange contradictions of his character make Alexander one of the most interesting as he is one of the most important figures in the history of the 19th century. Autocrat and "Jacobin," man of the world and mystic, he was to his contemporaries a riddle which each read according to his own temperament Napoleon thought him a "shifty Byzantine" To Metternich he was a madman to be humoured Castlereagh gave him credit for "grand qualities," but said that he was "suspicious and undecided" His complex nature was, in truth, the outcome of the complex character of his early education Reared in the free-thinking atmosphere of the court of Catherine II he had imbibed from his Swiss tutor, Frédéric César de Laharpe, the principles of Rousseau's gospel of humanity; from his military governor, General Soltikov, the traditions of Russian autocracy; while his father had inspired him with his own passion for military parade These contradictory tendencies remained with him through life, revealed in the fluctuations of his policy and influencing through him the fate of the world. Another element in his character discovered itself when in 1801 he mounted the throne over the body of his murdered father; a mystic melancholy liable at any moment to issue in extravagant action At first, indeed, this exercised but little influence on his life Young, impressionable, well-meaning and egotistic, Alexander plunged with all the ardour of youth into the task of realizing his political ideals While retaining for a time the old ministers who had served and overthrown the emperor Paul, one of the first acts of his reign was to appoint a secret committee, called ironically the "Comité du salut public," consisting of young and enthusiastic friends of his own—Victor Gavovich Kochubey, Nikolai Nikolaevich Novosiltsov, Paul Alexandrovich Strogonov and Adam Czartoryski—to draw up a scheme of internal reform Their aims were far in advance of the possibilities of the time, and even after they had been raised to regular ministerial positions, but little of their programme could be realized. For Russia was not ripe for liberty; and Alexander, the disciple of the revolutionist Laharpe, was—as he himself said—but "a happy accident" on the throne of the tsars. He spoke, indeed, bitterly of "the state of barbarism in which the country had been left by the traffic in men." "Under Paul," he said, "three thousand peasants had been given away like a bag of diamonds If civilization were more advanced, I would abolish this slavery, if it cost me my head"[1] But the universal corruption, he complained, had left him no men; and the filling up of the government offices, with Germans and other foreigners merely accentuated the sullen resistance of the "old Russians" to his reforms That Alexander's reign, which began with so large a promise of amelioration, ended by riveting still tighter the chains of the Russian people was, however, mainly due to the defects of the tsar himself.

His love of liberty, though sincere, was in fact unreal. It flattered his vanity to pose before the world as the dispenser of benefits; but his theoretical liberalism was mated with an autocratic will which brooked no contradiction "You always want to instruct me!" he exclaimed to Derzhavin, the minister of justice, "but I am the autocratic emperor, and I will this, and nothing else!" Moreover, with this masterful temper was joined an infirmity of purpose which ever let "I dare not wait upon I would," and seized upon any excuse for postponing measures the principles of which he had publicly approved. The codification of the laws initiated in 1801 was never carried out during his reign, nothing was done to improve the intolerable status of the Russian peasantry; the constitution drawn up by Speranski, and passed by the emperor, remained unsigned Alexander, in fact, who, without being consciously tyrannical, possessed in full measure the tyrant's characteristic distrust of men of ability and independent judgment, lacked also the first requisite for a reforming sovereign, confidence in his people; and it was this want that vitiated such reforms as were actually realized He experimented in the outlying provinces of his empire; and the Russians complained that, not content with governing through foreign instruments, he was conferring on Poland, Finland and the Baltic provinces benefits denied to themselves In Russia, too, certain reforms were carried out; but they could not survive the suspicious interference of the autocrat and his officials The newly created council of ministers, and the senate, endowed for the first time with certain theoretical powers, became in the end but the slavish instruments of the tsar and his favourites of the moment. The elaborate system of education, culminating in the reconstituted, or newfounded, universities of Dorpat, Vilna, Kazan and Kharkov, was strangled in the supposed interests of "order" and of orthodox piety; while the military colonies which Alexander proclaimed as a blessing to both soldiers and state were forced on the unwilling peasantry and army with pitiless cruelty Even the Bible Society, through which the emperor in his later mood of evangelical zeal proposed to bless his people, was conducted on the same ruthless lines. The Roman archbishop and the Orthodox metropolitans were forced to serve on its committee side by side with Protestant pastors; and village popes were compelled to disseminate what they regarded as works of the devil

Alexander's grandiose imagination was, however, more strongly attracted by the great questions of European politics than by attempts at domestic reform On the morrow of his accession he had reversed the policy of Paul, denounced the League of Neutrals, made peace with England (April 1801), and opened negotiations with Austria Soon afterwards, at Memel, he entered into a close alliance with Prussia. The development of this alliance was interrupted by the short-lived peace of Oct. 1801; and for a while it seemed as though France and Russia might come to an understanding Carried away by the enthusiasm of Laharpe, who had returned to Russia from Paris, Alexander began openly to proclaim his admiration for French institutions and for the person of Bonaparte Soon, however, came a change Laharpe, after a new visit to Paris, presented to the tsar his *Reflexions on the*

[1] Savary to Napoleon, Nov. 4, 1807. Tatischev, p 226

True Nature of the Consulship for Life, which, as Alexander said, tore the veil from his eyes, and revealed Bonaparte as "the most famous tyrant the world has produced." His disillusionment was completed by the murder of the duc d'Enghien, and diplomatic relations with Paris were broken off.

The tsar's attitude during the war that followed was pregnant with issues momentous for the world. In opposing Napoleon, "the oppressor of Europe and the disturber of the world's peace," Alexander already believed himself to be fulfilling a divine mission. In his instructions to Novosiltsov, his special envoy in London, he elaborated the motives of his policy in language which anticipated those exalted ideals of international policy which the Covenant of the League of Nations has now sought to realize. The outcome of the war, Alexander argued, was not to be only the liberation of France, but the universal triumph of "the sacred rights of humanity." To attain this it would be necessary "after having attached the nations to their government by making these incapable of acting save in the greatest interests of their subjects, to fix the relations of the states amongst each other on more precise rules, and such as it is to their interest to respect." A general treaty was to become the basis of the relations of the states forming "the European confederation," which would attain some of its results if, at the conclusion of the general war, it were possible to establish on clear principles the prescriptions of the rights of nations. "Why could not one submit to it," the tsar continued, "the positive rights of nations, assure the privilege of neutrality, insert the obligation of never beginning war until all the resources which the mediation of a third party could offer have been exhausted, having by this means brought to light the respective grievances, and tried to remove them? It is on such principles as these that one could proceed to a general pacification, and give birth to a league of which the stipulations would form, so to speak, a new code of the law of nations, which, sanctioned by the greater part of the nations of Europe, would without difficulty become the immutable rule of the cabinets, while those who should try to infringe it would risk bringing upon themselves the forces of the new union."[1] Meanwhile Napoleon never gave up hope of detaching him from the coalition. He had no sooner entered Vienna in triumph than he opened negotiations with him; he resumed them after Austerlitz. Russia and France, he urged, were "geographical allies"; there was between them no true conflict of interests; together they might rule the world. But Alexander was still determined "to persist in the system of disinterestedness in respect of all the states of Europe which he had thus far followed," and he again allied himself with Prussia. The campaign of Jena and the battle of Eylau followed; and Napoleon, though still intent on the Russian alliance, stirred up Poles, Turks and Persians to break the obstinacy of the tsar. A party too in Russia itself was clamorous for peace; but Alexander, after a vain attempt to form a new coalition, summoned the Russian nation to a holy war against Napoleon as the enemy of the Orthodox faith. The outcome was the rout of Friedland (June 13 and 14, 1807). Napoleon saw his chance and seized it. Instead of making heavy terms, he offered to the chastened autocrat his alliance, and a partnership in his glory.

The two emperors met at Tilsit on June 25. Alexander, dazzled by Napoleon's genius, was completely won. Napoleon knew well how to appeal to the imagination of his new-found friend. He would divide with Alexander the empire of the world; as a first step he would leave him in possession of the Danubian principalities and give him a free hand to deal with Finland; and, afterwards, the emperors of the East and West would drive the Turks from Europe and march across Asia to the conquest of India. A programme so stupendous awoke in Alexander's impressionable mind an ambition to which he had hitherto been a stranger The interests of Europe were forgotten. "What is Europe?" he exclaimed to the French ambassador. "Where is it, if it is not you and we?"[2]

These new visions did not, however, blind Alexander to the obligations of friendship; and he refused to retain the Danubian principalities as the price for suffering a further dismemberment of Prussia. It was not long before the first enthusiasm of Tilsit began to wane. Napoleon promised much, and performed little. The French remained in Prussia, the Russians on the Danube; each accused the other of breach of faith. Meanwhile, however, the personal relations of Alexander and Napoleon were cordial; and it was hoped that a fresh meeting might adjust all their differences. The meeting took place at Erfurt in Oct. 1808, and resulted in a treaty which defined a common policy. But Alexander's relations with Napoleon none the less changed. He realized that Napoleon had never intended his proposed "grand enterprise" seriously, and had only used it to preoccupy the mind of the tsar while he consolidated his own power in central Europe. From this moment the French alliance was for Alexander also an affair of pure policy. He used it, in the first instance, to remove "the geographical enemy" from the gates of St. Petersburg by wresting Finland from the Swedes (1809); and he hoped by means of it to make the Danube the southern frontier of Russia. Events were in fact rapidly tending to the rupture of the Franco-Russian alliance. Alexander, indeed, assisted Napoleon in the war of 1809, but he declared that he would not allow Austria to be crushed; and Napoleon complained bitterly of the inactivity of the Russian troops during the campaign. The tsar in his turn protested against Napoleon's encouragement of the Poles In the matter of the French alliance he knew himself to be practically isolated in Russia, and he declared that he could not sacrifice the interest of his people and empire to his affection for Napoleon. The treaty of Vienna, which added largely to the grand-duchy of Warsaw, he complained had "ill requited him for his loyalty," and he was only mollified for the time by Napoleon's public declaration that he had no intention of restoring Poland.

But if Alexander suspected Napoleon, Napoleon was no less suspicious of Alexander; and, partly to test his sincerity, he sent an almost peremptory request for the hand of the grand-duchess Anne, the tsar's youngest sister. After some little delay Alexander returned a polite refusal. Napoleon's answer was to refuse to ratify the convention of Jan. 4, and to announce his engagement to the archduchess Marie Louise. From this time the relation between the two emperors became more and more strained. The annexation of Oldenburg, of which the duke was the tsar's uncle, to France in Dec. 1810, added another to the personal grievances of Alexander against Napoleon; while the ruinous reaction of the "continental system" on Russian trade made it impossible for the tsar to maintain a policy which was Napoleon's chief motive for the alliance. An acid correspondence followed, and ill-concealed armaments, which culminated in the summer of 1812 in Napoleon's invasion of Russia. Yet, even after the French had passed the frontier, Alexander still protested that his personal sentiments towards the emperor were unaltered. It was the occupation of Moscow and the desecration of the Kremlin, the sacred centre of Holy Russia, that changed his sentiment into passionate hatred. In vain the French emperor, within eight days of his entry into Moscow, wrote him a letter, revealing the desperate straits of the Grand Army, and appealed to "any remnant of his former sentiments."[1] Alexander returned no answer to these "fanfaronnades." "No more peace with Napoleon!" he cried, "He or I, or I or he: we cannot longer reign together!"

The campaign of 1812 was the turning-point of Alexander's life. Its horrors, for which he felt himself largely responsible, overset still more a mind never too well balanced. At the burning of Moscow, he declared afterwards, his own soul had found illumination, and he had received the divine revelation of his mission as the peacemaker of Europe. He tried to calm the unrest of his conscience by correspondence with the leaders of the evangelical revival, and sought for guidance in texts of scripture. It was not, however, according to his own account, till he met the Baroness de Krüdener (*q.v.*) at Basle, in the autumn of 1813, that his soul found peace. From this time a mystic pietism influenced his policy. Madame de Krüdener, and her colleague, the evangelist Empaytaz, became the confidants of his most secret thoughts; and during the campaign that ended in the occupation

[1] Instructions to M Novosiltsov, Sept. 11, 1804. Tatischev, p. 82.

[2] Savary to Napoleon, Nov. 18, 1807. Tatischev, p. 232.

[1] Alexander speaking to Colonel Michaud. Tatischev, p. 612.

of Paris the imperial prayer-meetings were the oracle on whose revelations hung the fate of the world.

Such was Alexander's mood when the downfall of Napoleon left him the most powerful sovereign in Europe. With the memory of Tilsit still fresh in men's minds, it was not unnatural that to cynical men of the world like Metternich he merely seemed to be disguising "under the language of evangelical abnegation" vast and perilous schemes of ambition. The puzzled powers were, in fact, the more inclined to be suspicious in view of other, and seemingly inconsistent, tendencies of the emperor, which yet seemed all to point to a like disquieting conclusion. For though Alexander had declared war against the revolution, Laharpe was once more at his elbow, and the catchwords of the gospel of humanity were still on his lips. The very proclamations which denounced Napoleon as "the genius of evil," denounced him in the name of "liberty," and of "enlightenment." A monstrous intrigue was suspected for the alliance of the eastern autocrat with the Jacobinism of all Europe, which would have issued in the substitution of an all-powerful Russia for an all-powerful France. At the congress of Vienna Alexander's attitude accentuated this distrust. Castlereagh, whose aim was the restoration of "a just equilibrium" in Europe, reproached the tsar to his face for a "conscience" which suffered him to imperil the concert of the powers by keeping his hold on Poland in violation of his treaty obligation [1]

Yet Alexander was sincere. Even the Holy Alliance, the pet offspring of his pietism, does not deserve the sinister reputation it has since obtained To the other powers it seemed, at best "verbiage" and "exalted nonsense," at worst an effort of the tsar to establish the hegemony of Russia on the goodwill of the smaller signatory powers To the Liberals, then and afterwards it was clearly a hypocritical conspiracy against freedom. Yet to Alexander himself it seemed the only means of placing the "confederation of Europe" on a firm basis of principle[2] and, so far from its being directed against liberty he declared roundly to all the signatory powers that "free constitutions were the logical outcome of its doctrines" Europe, in fact, owed much at this time to Alexander's exalted temper. During the period when his influence was supreme, the fateful years between the Moscow campaign and the close of the congress of Aix-la-Chapelle, it had been used largely in the interests of moderation and liberty. To him mainly it was due that France was saved from dismemberment, and received a constitution which, to use his own words, "united crown and representatives of the people in a sense of common interests [3] By this wise intervention Switzerland was saved from violent reaction. To his protection it was due that the weak beginnings of constitutional freedom in Germany were able for a while to defy the hatred of Austria Lastly, whatever its ultimate outcome, the constitution of Poland was a genuine effort to respond to the appeal of the Poles for a national existence.

From the end of the year 1818 Alexander's views began to change. A revolutionary conspiracy among the officers of the guard, and a foolish plot to kidnap him on his way to the congress of Aix-la-Chapelle, are said to have shaken the foundations of his Liberalism At Aix he came for the first time into intimate contact with Metternich, who was swift to take advantage of the psychological moment. From this time dates the ascendancy of Metternich over the mind of the Russian emperor and in the councils of Europe It was, however, no case of sudden conversion. Though alarmed by the revolutionary agitation in Germany, which culminated in the murder of his agent, the dramatist Kotzebue (*q v.*), Alexander approved of Castlereagh's protest against Metternich's policy of "the governments contracting an alliance against the peoples," as formulated in the Carlsbad decrees, 1819 [4] He still declared his belief in "free institutions, though not in such as are forced from feebleness, nor contracts ordered by popular leaders from their sovereigns." "Liberty," he maintained, "should be confined within just limits. And the limits of liberty are the principles of order." [1]

It was the apparent triumph of the principles of disorder in the revolutions of Naples and Piedmont, combined with increasingly disquieting symptoms of discontent in France, Germany and among his own people, that completed Alexander's conversion. In the seclusion of the little town of Troppau, where in Oct 1820 the powers met in conference, Metternich found an opportunity for cementing his influence over Alexander which had been wanting amid the turmoil and feminine intrigues of Vienna and Aix [2] The issue was momentous. In January Alexander had still upheld the ideal of a free confederation of the European states, symbolized by the Holy Alliance; he had still protested against the claims of collective Europe to interfere in the internal concerns of the sovereign states. On Nov. 19 he signed the Troppau protocol, which consecrated the principle of intervention and wrecked the harmony of the concert (*see* TROPPAU, CONGRESS OF)

At Laibach, whither in the spring of 1821 the congress had been adjourned, Alexander first heard of the revolt of the Greeks From this time until his death his mind was torn between his anxiety to realize his dream of a confederation of Europe and his traditional mission as leader of the Orthodox crusade against the Turks At first, under the careful nursing of Metternich, the former motive prevailed. He struck the name of Alexander Ypsilanti from the Russian army list, and directed his foreign minister, Count Capo d'Istria, himself a Greek, to disavow all sympathy of Russia with his enterprise; and, next year, a deputation of the Greeks of the Morea on its way to the congress of Verona was turned back by his orders on the road He made, indeed, some effort to reconcile the principles at conflict in his mind. He offered to surrender the claim that the affairs of the East were the "domestic concerns of Russia," and to march into Turkey, as Austria had marched into Naples, "as the mandatory of Europe." [3] Metternich's opposition to this first opened his eyes to the true character of Austria's attitude towards his ideals. Once more in Russia, far from the fascination of Metternich's personality, the immemorial spirit of his people drew him back into itself; and when, in the autumn of 1825, he took his dying empress for change of air to the south of Russia, in order—as all Europe supposed—to place himself at the head of the great army concentrated near the Ottoman frontiers, his language was no longer that of "the peace-maker of Europe," but of the Orthodox tsar determined to take the interests of his people and of his religion "into his own hands" Before the momentous issue could be decided, however, Alexander died at Taganrog on Dec 1 (Nov. 18, O S) 1825, "crushed," to use his own words, "beneath the terrible burden of a crown" which he had more than once declared his intention of resigning. A report, current at the time and often revived, affirmed that he did not in fact die. By some it was supposed that a mysterious hermit named Fomich, who lived at Tomsk until 1870 and was treated with peculiar deference by successive tsars, was none other than Alexander;[4] but this legend is now discredited [5]

Modern history knows no more tragic figure than that of Alexander The brilliant promise of his early years; the haunting memory of the crime by which he had obtained the power to realize his ideals; and, in the end, the terrible legacy he left to Russia; a principle of government which, under lofty pretensions, veiled a tyranny supported by spies and secret police; an uncertain succession; an army permeated by organized disaffection; an armed Poland, whose hunger for liberty the tsar had whetted but not satisfied; the quarrel with Turkey, with its alternative of war or humiliation for Russia; an educational system rotten with official hypocrisy; a church in which conduct counted for nothing; orthodoxy and ceremonial observance for everything, economical

[1] Castlereagh to Liverpool, Oct. 1814. F.O. papers, Vienna VII.
[2] Martens IV. part i., p. 49.
[3] *Etat des négociations actuelles,* etc., mem. prepared by order of the tsar, July 16, 1815, enclosed in Castlereagh to Liverpool, F. O. Cont. papers. Congress Paris, Castlereagh, 22.
[4] Despatch of Lieven, Nov. 30 (Dec. 12), 1819, and Russ. Circular of Jan. 27, 1820. Martens IV., part i., p. 270.

[1] *Aperçu des idées de l'Empereur,* Martens IV., part i, p. 269.
[2] Metternich *Mem.*
[3] Martens IV., part i., pp 307, etc.
[4] *See* W. Gasiorowski, *Tragic Russia,* translated by Viscount de Busancy (1908).
[5] *See* Waliszewski, *Le Règne d'Alexandre 1er.*

and financial conditions scarce recovering from the verge of ruin; and lastly, that curse of Russia—serfdom.

In private life Alexander displayed many lovable qualities. All authorities combine in praising his handsome presence and the charm of his address. His personal friendship, too, once bestowed, was never lightly withdrawn. By nature he was sociable and pleasure-loving, he proved himself a notable patron of the arts and he took a conspicuous part in all the gaieties of the congress of Vienna. In his later years, however, he fell into a mood of settled melancholy; and, though still accessible to all who chose to approach him with complaints or petitions, he withdrew from all but the most essential social functions, and lived a life of strenuous work and of Spartan simplicity. His gloom had been increased by domestic misfortune. He had been married, in 1793, without his wishes being consulted, to the beautiful and amiable Princess Maria Louisa of Baden (Elizabeth Feodorovna), a political match which proved the misfortune of both. The only child of the marriage, a little grandduchess, died on May 12, 1808; and their common sorrow drew husband and wife closer together. Towards the close of his life their reconciliation was completed by the wise charity of the empress in sympathizing deeply with him over the death of his beloved daughter by Madame Narishkine.

See also EUROPE; RUSSIA; FRANCE; TURKEY; VIENNA, CONGRESS OF; NAPOLEON; METTERNICH; CAPO D'ISTRIA.

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ALEXANDER II. (1818–1881), emperor of Russia, eldest son of Nicholas I., was born on April 29, 1818. Up to the moment of his accession in 1855 no one ever imagined that he would be known to posterity as a great reformer. In so far as he had any decided political convictions he seemed to be animated with the reactionary spirit of his time. The moral atmosphere of St. Petersburg (Leningrad) was very unfavourable to the development of any originality of thought or character. It was a time of government on martinet principles, under which all freedom of thought and all private initiative were suppressed vigorously by the administration. Alexander Nicolaevich received the education commonly given to young Russians of good family at that time—a smattering of a great many subjects and a good practical acquaintance with the chief modern European languages. His ordinary life was that of an officer of the Guards, modified by the ceremonial duties incumbent on him as heir to the throne. His natural kindliness and indisposition for a military life had been fostered by his tutor Zhukovski, the amiable humanitarian poet, and they remained with him all through life. In 1841 he married the daughter of the grand duke Louis II. of Hesse, Maximilienne Wilhelmine Marie, thenceforward known as Maria Alexandrovna, who bore him six sons and two daughters. He did not travel much abroad, for his father, in his desire to exclude from Holy Russia the subversive ideas current in Western Europe, disapproved of foreign tours and could not consistently encourage in his own family what he tried to prevent among the rest of his subjects. He visited England, however, in 1839, and in the years immediately preceding his accession he was entrusted with several missions to the courts of Berlin and Vienna. On March 2, 1855, during the Crimean War, he succeeded to the throne on the death of his father.

The first year of the new reign was devoted to the prosecution of the war and, after the fall of Sevastopol, to negotiations for peace. Then began a period of radical reforms, recommended by public opinion and carried out by the autocratic power. The rule of Nicholas, which had sacrificed all other interests to that of making Russia an irresistibly strong military power, had been tried by the Crimean War and found wanting A new system had, therefore, to be adopted. All who had any pretentions to enlightenment declared loudly that the only way of restoring Russia to its proper position in Europe was to develop its natural resources and to reform thoroughly all branches of the administration. Fortunately for Russia the autocratic power was in the hands of a man who was impressionable enough to be deeply influenced by the spirit of the time, and who had sufficient prudence and practical common sense to prevent his being carried away by the prevailing excitement into the dangerous region of Utopian dreaming At first he moved so slowly that many of the impatient, would-be reformers began to murmur But important changes were made in the legislation concerning industry and commerce, and the new freedom thus accorded produced a large number of limited liability companies. At the same time plans were formed for constructing a great network of railways, partly for economic and partly for military purposes Further progress was blocked by a great obstacle—the existence of serfage, and Alexander II. grappled boldly with the difficult and dangerous problem. Taking advantage of a petition presented by the Polish landed proprietors of the Lithuanian provinces, praying that their relations with the serfs might be regulated in a more satisfactory way, he authorized the formation of committees "for ameliorating the condition of the peasants" and laid down the principles on which the amelioration was to be effected Without consulting his ordinary advisers, the tsar then ordered a copy of these instructions to be forwarded to the provincial governors of European Russia and suggested that perhaps the landed proprietors of other provinces might express a similar desire. In all provinces where serfage existed emancipation committees were formed. Emancipation involved very complicated problems affecting deeply the economic, social and political future of the nation. The main point at issue was whether the serfs should become agricultural labourers dependent economically and administratively on the landlords or be transformed into a class of independent communal proprietors. The emperor gave his support to the latter project, and the Russian peasantry accordingly acquired rights and privileges such as were enjoyed at that time by no other peasantry in Europe. In the numerous other questions submitted to him he began by consulting carefully the conflicting authorities, and while leaning as a rule rather to the side of those who were known as "Liberals" he never went so far as they desired and always sought some middle course by which conflicting interests might be reconciled. On March 3, 1861, the sixth anniversary of his accession, the emancipation law was signed and published. Other reforms followed in quick succession during the next five or six years: army and navy organization, a new judicial administration on the French model, a new penal code and a greatly simplified system of civil and criminal procedure, an elaborate scheme of local self-government for the rural districts and the large towns, with elective assemblies possessing a restricted right of taxation, and a new rural and municipal police under the direction of the minister of the interior. These new institutions were incomparably better than the old ones which they replaced, but they did not work such miracles as inexperienced enthusiasts expected. Comparisons were made, not with the past, but with an ideal state of things which never existed in Russia or elsewhere. Hence arose a general feeling of disappointment which acted on

different natures in different ways. Thus appeared in the educated classes two extreme groups: on the one hand, the discontented Conservatives, who recommended a return to a more severe disciplinarian *régime;* and on the other, the discontented Radicals, who would have been satisfied with nothing less than the adoption of a thoroughgoing socialistic programme. Between the two extremes stood the discontented Moderates, who indulged freely in grumbling without knowing how the unsatisfactory state of things was to be remedied. For some years the emperor, with his sound common sense and dislike of exaggeration, held the balance fairly between the two extremes; but when radicalism assumed more and more the form of secret societies and revolutionary agitation, he felt constrained to adopt severe repressive measures.

The revolutionary agitation was of a very peculiar kind. It was confined to a section of the educated classes and emanated from the universities and higher technical schools. At the beginning of the reform period there had been much enthusiasm for scientific as opposed to classical education. Russia required, it was said, not classical scholars, but practical scientific men capable of developing her natural resources. The government, in accordance with that view, had encouraged scientific studies until it discovered to its astonishment that there was some mysterious connection between natural science and revolutionary tendencies. Thus arose a struggle between the youthful, hot-headed partisans of revolutionary physical science and the zealous official guardians of political order—a struggle which has made the strange term Nihilism (*q v*) a familiar word not only in Russia but also in western Europe The movement gradually assumed the form of terrorism and aimed at the assassination of prominent officials and even of the emperor himself, and the natural result was that the reactionary tendencies of the government were strengthened

In foreign policy Alexander II. showed the same qualities of character as in internal affairs, ever trying prudently to steer a middle course. When he came to the throne the Crimean War was still going on, but he concluded peace with the allies as soon as he thought the national honour had been satisfied. Prince Gorchakov for fifteen years avoided foreign complications so that the internal strength of the country might be developed, while the national pride and ambition received a certain satisfaction by the expansion of Russian influence and domination in Asia. Twice, indeed, during that period the chancellor ran the risk of provoking war The first occasion was in 1863, when the Western powers seemed inclined to interfere in the Polish question, and the Russian chancery declared categorically that no interference would be tolerated The second occasion was during the Franco-German War of 1870–71, when the cabinet of St. Petersburg boldly declared that it considered itself no longer bound by the Black Sea clause of the Treaty of Paris On both occasions hostilities were averted. Not so on the next occasion, when Russia abandoned her attitude of *recueillement.* When the Eastern question was raised in 1875 by the insurrection of Hercegovina, Alexander II. had no intention or wish to provoke a great European war. No doubt he was waiting for an opportunity of recovering the portion of Bessarabia which had been ceded by the treaty of Paris, and he perceived in the disturbed state of eastern Europe a possibility of obtaining the desired rectification of frontier, but he hoped to effect his purpose by diplomatic means in conjunction with Austria. At the same time he was anxious to obtain for the Christians of Turkey some amelioration of their condition, and to give thereby some satisfaction to his own subjects. As autocratic ruler of the nation which had long considered itself the defender of the Eastern Orthodox faith and the protector of the Slav nationalities, he could not remain inactive at such a crisis, and he gradually allowed himself to drift into a position from which he could not retreat without obtaining some tangible result. Supposing that the Porte would yield to diplomatic pressure and menace so far as to make some reasonable concessions, he delivered his famous Moscow speech, in which he declared that if Europe would not secure a better position for the oppressed Slavs he would act alone.

The diplomatic pressure failed and war became inevitable. During the campaign he displayed the same perseverance and the same moderation that he had shown in the emancipation of the serfs. To those who began to despair of success, and advised him to conclude peace on almost any terms so as to avoid greater disasters, he turned a deaf ear; but when his more headstrong advisers urged him to insist on terms which would probably have produced a conflict with Great Britain and Austria, he resolved, after some hesitation, to make the requisite concessions. In this resolution he was influenced by the discovery that he could not rely on the expected support of Germany, and the discovery made him waver in his devotion to the German alliance, which had been the main pivot of his foreign policy; but his personal attachment to the emperor William prevented his adopting a hostile attitude towards the empire he had helped to create.

The patriotic excitement produced by the war did not weaken the revolutionary agitation. The struggle between the Terrorists and the police authorities became more and more intense, and attempts at assassination became more and more frequent. Alexander II. succumbed by degrees to the mental depression produced originally by the disappointments which he experienced in his home and foreign policy; and in 1880, when he had reigned twenty-five years, he entrusted to Count Loris-Melikov a large share of the executive power. In that year the empress died, and a few weeks afterwards he married secretly a Princess Dolgoruki, with whom he had entertained intimate relations for some years. Early in 1881, on the advice of Count Loris-Melikov, he determined to try the effect of some moderate liberal reforms on the revolutionary agitation, and for this purpose he caused a ukase to be prepared creating special commission, composed of high officials and private personages who should prepare reforms in various branches of the administration. On the very day on which this ukase was signed—March 13, 1881—he fell a victim to a Nihilist plot When driving in one of the central streets of St. Petersburg, near the Winter Palace, he was mortally wounded by the explosion of some small bombs and died a few hours afterwards. (D M W.)

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ALEXANDER III. (1845–1894), emperor of Russia, second son of Alexander II, was born on March 10, 1845 In natural disposition he bore little resemblance to his soft-hearted, liberal-minded father, and still less to his refined, philosophic, sentimental, chivalrous, yet cunning grand-uncle, Alexander I He rather gloried in the idea of being of the same rough texture as the great majority of his subjects. His straightforward, abrupt manner savoured sometimes of gruffness, while his direct, unadorned method of expressing himself harmonized well with his rough-hewn, immobile features and somewhat sluggish movements. His education was not fitted to soften these peculiarities. During the first 20 years of his life he had no prospect of succeeding to the throne, because he had an elder brother, Nicholas, who seemed of a fairly robust constitution. Alexander received only the perfunctory and inadequate training of an ordinary grand duke of that period, which did not go much beyond primary and secondary instruction, practical acquaintance with French, English and German, and a certain amount of drill When he became heir-apparent by the death of his elder brother in 1865, he began to study the principles of law and administration under Prof Pobedonostsev, who influenced the character of his reign by instilling into his mind the belief that zeal for Eastern Orthodoxy ought, as an essential factor of Russian patriotism, to be specially cultivated by every right-minded tsar. His elder brother, when on his deathbed, had expressed a wish that his affianced bride, Princess Dagmar of Denmark (*see* MARIE FEODOROVNA), should marry his successor. The marriage was celebrated on Nov 9, 1866 The union proved a most happy one to the end. During those years when he was heir-apparent—1865 to 1881—he allowed it to become known that he had certain ideas of his own which did not coincide with the principles of the existing Government.

He deprecated undue foreign influence in general and German influence in particular. He desired to see a homogeneous Russia —homogeneous in language, administration and religion. His father, though a good patriot according to his lights, had strong German sympathies, often used the German language in his private relations, occasionally ridiculed the exaggerations of the Slavophils and based his foreign policy on the Prussian alliance. The antagonism first appeared publicly during the Franco-German War, when the tsar supported the cabinet of Berlin and the cesarevitch did not conceal his sympathies with the French. It reappeared in an intermittent fashion during the years 1875–79, on the Eastern question. At first the cesarevitch was more Slavophil than the Government, but any of the prevalent popular illusions he may have imbibed were soon dispelled by personal observation in Bulgaria, where he commanded the left wing of the invading army. He did not, however, make himself conspicuous in any way during the campaign, but fulfilled his military duties in a conscientious and unobtrusive manner. After many mistakes and disappointments the army reached Constantinople, and the Treaty of San Stefano was signed; but much that had been obtained by that important document had to be sacrificed at the Congress of Berlin. Prince Bismarck failed to do what was confidently expected of him. In return for the Russian support, which had enabled him to create the German empire, it was thought that he would help Russia to solve the Eastern question in accordance with her own interests, but to the surprise and indignation of the cabinet of St. Petersburg he confined himself to acting the part of "honest broker" at the congress, and shortly afterwards he ostentatiously contracted an alliance with Austria for the express purpose of counteracting Russian designs in eastern Europe. The cesarevitch drew the practical conclusion that for Russia the best thing to do was to recover as quickly as possible from her temporary exhaustion and to prepare for future contingencies by a radical scheme of military and naval reorganization. In accordance with this conviction he called his father's attention to the grave disorders and corruption in the army His representations were not favourably received. Alexander II. had lost much of the reforming zeal which distinguished the first decade of his reign, and had no longer the energy required to undertake drastic reforms On March 13, 1881, Alexander II was assassinated by a band of Nihilists, and the autocratic power passed to the hands of his son.

In the last years of his reign, Alexander II. had been much exercised by the spread of Nihilist doctrines and the increasing number of anarchist conspiracies. On the very day of his death he signed a ukase, creating a number of consultative commissions which might have been easily transformed into an assembly of notables. Alexander III. at once cancelled the ukase before it was published, and in the manifesto announcing his accession to the throne he let it be very clearly understood that he had no intention of limiting or weakening the autocratic power which he had inherited from his ancestors Nor did he afterwards show any inclination to change his mind. All the internal reforms which he initiated were intended to correct what he considered as the too liberal tendencies of the previous reign. In his opinion Russia was to be saved from anarchical disorders and revolutionary agitation, not by the parliamentary institutions and so-called liberalism of western Europe, but by the three principles which the elder generation of the Slavophils systematically recommended—nationality, Eastern Orthodoxy and autocracy. His political ideal was a nation containing only one nationality, one language, one religion and one form of administration; and he did his utmost to prepare for the realization of this ideal by imposing the Russian language and Russian schools on his German, Polish and Finnish subjects, by fostering Eastern Orthodoxy at the expense of other confessions, by persecuting the Jews and by destroying the remnants of German, Polish and Swedish institutions in the outlying provinces. In the other provinces he sought to counteract what he considered the excessive liberalism of his father's reign. For this purpose he clipped the feeble wings of the zemstvo, an elective local administration resembling the county and parish councils in England, and placed the autonomous administration of the peasant communes under the supervision of landed proprietors appointed by the Government. At the same time he sought to strengthen and centralize the imperial administration, and to bring it more under his personal control. In foreign affairs he was emphatically a man of peace, but not at all a partisan of the doctrine of peace at any price. Though indignant at the conduct of Prince Bismarck towards Russia, he avoided an open rupture with Germany, and even revived for a time the Three Emperors' alliance. It was only in the last years of his reign, when M. Katkov had acquired a certain influence over him, that he adopted towards the cabinet of Berlin a more hostile attitude, and even then he confined himself to keeping a large quantity of troops near the German frontier, and establishing cordial relations with France. With regard to Bulgaria he exercised similar self-control. The efforts of Prince Alexander and afterwards of Stambolov to destroy Russian influence in the principality excited his indignation, but he persistently vetoed all proposals to intervene by force of arms. In central Asian affairs he followed the traditional policy of gradually extending Russian domination without provoking a conflict with Great Britain, and he never allowed the bellicose partisans of a forward policy to get out of hand. As a whole his reign cannot be regarded as one of the eventful periods of Russian history; but it must be admitted that under his hard, unsympathetic rule the country made considerable progress. He died at Livadia on Nov. 1, 1894, and was succeeded by his eldest son, Nicholas II.

ALEXANDER I., king of Epirus about 342 B.C., brother of Olympias the mother of Alexander the Great, and son-in-law of Philip of Macedon, whose daughter Cleopatra he married (336). In 332 he crossed over to Italy to assist the Tarentines against the Lucanians, Bruttians and Samnites. He gained considerable successes, and made an arrangement with the Romans for a joint attack upon the Samnites; but the Tarentines, suspecting him of the design of founding an independent kingdom, turned against him Although the advantage at first rested with Alexander, he gradually lost it, and his supporters dwindled away In 330 (or earlier) he was defeated at Pandosia, and slain by a Lucanian emigrant.

See Justin viii. 6, ix. 6, xii. 2; Livy viii. 3, 17, 24; Aulus Gellius xvii. 21; also article MACEDONIAN EMPIRE.

ALEXANDER II., king of Epirus (succeeded 272 B.C.). In 264 he invaded Macedonia but was driven out of that country and his own kingdom by Demetrius, son of Antigonus Gonatas. He was later restored to Epirus. He subsequently recovered his kingdom (Polybius ii. 45, ix. 34; Plutarch, *Pyrrhus,* 9; Justin xviii. 1, xxvi. 2, xxviii. 1).

See Thirlwall, *History of Greece,* vol. viii.; Droysen, *Hellenismus;* B. Niese, *Gesch. d. griech. u. maked. Staaten;* J. Beloch, *Griech. Gesch.,* vol. iii.

ALEXANDER (1893–1920), king of the Hellenes, second son of King Constantine and Queen Sophia, was born Aug. 1, 1893, and ascended the throne of Greece on the dethronement of his father, June 14, 1917. The Government itself was for the time in the hands of Venizelos, who had the confidence of the Allies; but the defeat of Germany, and Venizelos's diplomatic triumphs at the Peace Conference, seemed to breathe a new spirit into the young king. From the day of his triumphal entry into Adrianople, he took an active personal interest in the prospect of being the ruler of Greater Greece.

He died Oct. 25, 1920, by blood poisoning from the bite of a pet monkey. In Nov. 1919 King Alexander made a morganatic marriage with an Athenian lady, Aspasia Manos; and after his death a daughter was born to her in Paris on March 25, 1921. On Oct. 12, 1922, the marriage was declared valid by royal decree, so that Alexander's daughter became her father's legal heir, though she did not thereby acquire any rights in respect to the throne.

ALEXANDER III., known as THE GREAT (356–323 B.C.), king of Macedon, was the son of Philip II. of Macedon and Olympias, an Epirote princess. His father was pre-eminent for practical genius, his mother a woman of half-wild blood, weird, visionary and terrible; and Alexander himself is singular among men of action for the imaginative splendours which guided him.

and among romantic dreamers for the things he achieved. He was born in 356 B.C., probably about October (Hogarth, pp. 284 *seq.*). The court at which he grew up was the focus of great activities, for Philip, by war and diplomacy, was raising Macedon to the headship of the Greek states, and the air was charged with great ideas. To unite the Greek race in a war against the Persian empire was set up as the ultimate mark for ambition, the theme of idealists. The great literary achievements of the Greeks in the 5th century lay already far enough behind to have become invested with a classical dignity; the meaning of Hellenic civilization had been made concrete in a way which might sustain enthusiasm for a body of ideal values, authoritative by tradition. And upon Alexander in his 14th year this sum of tradition was brought to bear through the person of the man who beyond all others had gathered it up into an organic whole: in 343–342 Aristotle (*q v.*) came to Pella at Philip's bidding to direct the education of his son We do not know what faculty the master-thinker may have had for captivating this ardent spirit; at any rate Alexander carried with him through life a passion for Homer, however, he may have been disposed to greyer philosophic theory. But his education was not all from books The coming and going of envoys from many states, Greek and Oriental, taught him something of the actual conditions of the world. He was early schooled in war. At the age of 16 he commanded in Macedonia during Philip's absence and quelled a rising of the hill-tribes on the northern border; in the following year (338) he headed the charge which broke the Sacred Band at Chaeronea. Then came family dissensions such as usually vex the polygamous courts of the East. In 337 Philip repudiated Olympias for another wife, Cleopatra. Alexander went with his mother to her home in Epirus, and, though he soon returned and an outward reconciliation between father and son was contrived, their hearts were estranged The king's new wife was with child; her kinsmen were in the ascendant; the succession of Alexander was imperilled. Some negotiations which Pixodarus, the satrap of Caria, opened with the Macedonian court with a view to effecting a marriage alliance between his house and Philip's, brought Alexander into fresh broils. In 336 Philip was suddenly assassinated whilst celebrating at Aegae the marriage of his daughter to Alexander I of Epirus in the presence of a great concourse from all the Greek world. It is certain that the hand of the assassin was prompted by someone in the background; suspicion could not fail to fall upon Alexander among others. But guilt of that sort would hardly be consistent with his character as it appears in those early days.

Accession.—Alexander was not the only claimant to the vacant throne, but, recognized by the army, he soon swept all rivals from his path. The newly born son of Philip by Cleopatra, and Alexander's cousin Amyntas, were put to death, and Alexander took up the interrupted work of his father. That work was on the point of opening its most brilliant chapter by an invasion of the great king's dominions; the army was concentrated and certain forces had already been sent on to occupy the opposite shore of the Hellespont. The assassination of Philip delayed the blow, for it immediately made the base, Macedonia, insecure, and in such an enterprise, plunging into the vast territories of the Persian empire, a secure base was everything. Philip's removal had made all the hill-peoples of the north and west raise their heads and set the Greek states free from their fears. A demonstration in Greece, led by the new king of Macedonia, momentarily checked the agitation, and at the diet at Corinth Alexander was recognized as captain-general (ἡγεμὼν αὐτοκράτωρ) of the Hellenes against the barbarians, in the place of his father Philip. In the spring of 335 he went out from Macedonia northwards, struck across the Balkans, by the Koja or Shipka pass, frustrating the mountain warfare of its tribes by a precision of discipline which, probably, no other army of the time could have approached, and traversed the land of the Triballians (Rumelia) to the Danube. To gratify his own imagination or strike the imagination of the world he took his army over the Danube and burnt a settlement of the Getae upon the other side. Meanwhile the Illyrians had seized Pelion (Pliassa), which commanded the passes on the west of Macedonia, and from the Danube. Alexander marched straight thither over the hills. He had hardly restored Macedonian prestige in this quarter when he heard that Greece was aflame. Thebes had taken up arms. By a forced march he took the Thebans completely by surprise, and in a few days the city, which a generation before had won the headship of Greece, was taken. There were to be no half-measures now; the city was wiped out of existence with the exception of its temples and the house which had been Pindar's Greece might now be trusted to lie quiet for some time to come. The Panhellenic alliance (from which Sparta still stood aloof) against the barbarians was renewed. Athens, although known to be hostile at heart to the Macedonian power, Alexander treated all through with eager courtesy.

Invasion of Asia Minor.—In the spring of 334, Alexander crossed with an army of between 30,000 and 40,000 men, Macedonians, Illyrians, Thracians and the contingents of the Greek states, into Asia. The place of concentration was Arisbe on the Hellespont. Alexander himself first visited the site of Troy and there went through those dramatic acts of sacrifice to the Ilian Athena, assumption of the shield believed to be that of Achilles and offerings to the great Homeric dead, which are significant of the poetic glamour shed, in the young king's mind, over the whole enterprise, and which men will estimate differently according to the part they assign to imagination in human affairs. To meet the invader the great king had in Asia Minor an army certainly not much larger than Alexander's, if as large, gathered under the satraps of the western provinces at Zeleia. He had also, what was more serious, command of the Aegean. Alexander could communicate with his base only by the narrow line of the Hellespont, and ran the risk, if he went far from it, of being cut off altogether. To draw him after them, while avoiding a conflict, was sound strategy for the Persian generals. It was urged upon them by their colleague the Rhodian Memnon.

Granicus.—Strategic considerations were cancelled by the Persian barons' code of chivalry, and Alexander found them waiting for him on the banks of the Granicus. It was a cavalry mêlée, in which the common code of honour caused Macedonian and Persian chieftains to engage hand to hand, and at the end of the day the relics of the Persian army were in flight, leaving the high-roads of Asia Minor clear for the invader Alexander could now accomplish the first part of the task belonging to him as captain-general to the Hellenes, that liberation of the Greek cities of Asia Minor, for which Panhellenic enthusiasts had cried out so long He went to take possession of the old Lydian capital Sardis, the headquarters of the Persian government on this side of the Taurus, and the strong city surrendered without a blow. And now in all the Greek cities of Aeolis and Ionia the oligarchies or tyrants friendly to Persia fell, and democracies were established under the eye of Alexander's officers. Only where the cities were held by garrisons in the Persian service, garrisons composed mainly of Greek mercenaries, was the liberator likely to meet with any resistance. From Ephesus indeed the garrison fled upon the news of Granicus, but Miletus required a siege. The Persian fleet in vain endeavoured to relieve it, and Miletus did not long hold out against Alexander's attack. It was at Halicarnassus that Alexander first encountered the stubborn resistance, at Halicarnassus where Memnon and the satraps of Caria had rallied what land-forces yet belonged to Persia in the west. When winter fell, Alexander had captured the city itself, but the two citadels still held out against his blockade.

Meanwhile Alexander was making it plain that he had come not merely as captain-general for a war of reprisals, but to take the Persian's place as king of the land. The conquered provinces were organized under Macedonian governors and in Caria a dethroned princess of the native dynasty, Ada, was restored to power. In the winter, whilst Parmenio advanced upon the central plateau to make the occupation of Phrygia effective, Alexander himself passed along the coast to receive the submission of the Lycians and the adherence of the Greek cities of the Pamphylian sea-board The hills inland were the domain of fighting tribes which the Persian government had never been able to subdue To conquer them, indeed, Alexander had no time, but he stormed some of their fortresses to hold them in check, and marched

through their territory when he turned north from Pamphylia into the interior. The point of concentration for the following year's campaign had been fixed at Gordium, a meeting-place of roads in Northern Phrygia. The story of Alexander's cutting the fatal "Gordian knot" on the chariot of the ancient Phrygian king Gordius is connected with his stay in this place.

Extension of Alexander's Power.—Whilst Alexander had been grounding his power in Asia Minor, he had run a narrow risk of losing his base in Europe. He had after the siege of Miletus disbanded the Graeco-Macedonian fleet, surrendering for the time all attempts to challenge the command of the Aegean. Memnon the Rhodian, now in supreme command of the Persian fleet, saw the opportunity to detach the Greek island-states where discontent always smouldered in Alexander's rear. But Memnon died at the critical moment whilst laying siege to Mytilene and the great plan collapsed. A Persian fleet still held the sea, but it effected little, and presently fresh Graeco-Macedonian squadrons began to hold it in check. It was, however, the need to ensure command of the sea and free all lines of communication behind him that determined Alexander's plan for the next campaign. If he mastered the whole coast-line of the Levant, the enemy's fleet would find itself left in the air. The Syrian coast was accordingly his immediate objective when he broke up from Gordium for the campaign of 333. He was through the Cilician Gates before the Persian king, Darius III., had sent up a force adequate to hold them. His passage through Cilicia was marked by a violent fever that arrested him for a while in Tarsus, and meantime a Persian army was waiting for him in northern Syria under the command of Darius himself. In the knot of mountains which close in about the head of the Gulf of Alexandretta, Alexander, following hard by the coast, marched past the Persian army whilst it was crossing the Amanus chain more to the East.

Battle of Issus.—To cut Alexander's communications with the rear, Darius now committed the error of entangling his large force in the mountain defiles. Alexander turned, and near the town of Issus fought his second pitched battle, sending Darius and the relic of his army in wild flight back to the East.[1] It was an incident which did not modify Alexander's plan. He did not press the pursuit far, although the great king's camp with his harem fell into his hands. The chivalrous courtesy which he showed to the captive princesses was a favourite theme for later rhetoricians. He went on his way to occupy Syria and Phoenicia. It is now that we get definite evidence as to the scope of Alexander's designs; for Darius opened negotiations in which he ultimately went so far as to offer a partition of the empire, all west of the Euphrates, to be Alexander's. Alexander refused the bargain and definitely claimed the whole.[2] The conquest of the Phoenician coast was not to be altogether easy, for Tyre shut its gates and for seven months Alexander had to sit before it—one of those obstinate sieges which mark the history of the Semitic races. When it fell, Alexander had the old Tyrian people scattered to the winds, sold as slaves. Gaza offered a resistance equally heroic, lasting two months, and here too the old population was dispersed. The occupation of the rest of Syria and Palestine proceeded smoothly, and after the fall of Gaza Alexander's way lay open into Egypt.[3] Egypt was the last of the Mediterranean provinces to be won, and here no defence was made. To the native Egyptians Alexander appeared as a deliverer from the Persian tyranny, and he sacrificed piously to the gods of Memphis. The winter (332–331) which Alexander spent in Egypt saw two memorable actions on his part. One was the expedition (problematic in its motive and details) to the oracle of Zeus Ammon (Oasis of Siwa), where Alexander was hailed by the priest as son of the god, a belief which the circle of Alexander, and perhaps Alexander himself, seem hereafter to have liked to play with in that sort of semi-serious vein which still allowed him in the moments of every-day commonplace to be the son of Philip. The other action was the foundation of Alexandria at the Canopic mouth of the Nile, the place destined to be a new commercial centre for the eastern Mediterranean world which Alexander had now taken in possession, to rise to an importance which the founder, although obviously acting with intention, can hardly have foreseen. (E. Keller, *Alex. d. Grosse nach der Schlacht bei Issus*, 1904).

Invasion of Persia.—In the spring of 331 Alexander could at last leave the Mediterranean to strike into the heart of the



AFTER Q. CURTIUS RUFUS, "ALEXANDRI MAGNI VITA," 1696

ALEXANDER DEFEATING DARIUS III. KING OF PERSIA IN 331 B.C.
The battle of Arbela (more properly Gaugamela) resulted in the destruction of the last army of Persia. After the victory there was no further organized resistance, and Alexander seized Susa and Babylon

Persian empire, for by his occupation of the coasts the Persian command of the sea had inevitably collapsed. Returning through Syria, and stopping at Tyre to make final arrangements for the conquered provinces, he traversed Mesopotamia and struck the Tigris some four marches above the site of Nineveh. It was near Nineveh that Darius was waiting with an army, stronger in cavalry than in infantry, mustered from all parts of the empire. The happy coincidence of a lunar eclipse gives us Sept. 20, 331, as the exact day upon which the Macedonian army crossed the Tigris.

Battle of Arbela.—Alexander came within sight of the Persian host without having met with any opposition since he quitted Tyre. He had now to settle the most serious problem which had yet faced him, for in the plains the Persian army was formidable by sheer bulk. But the day showed the Macedonian army equal to the task. The last army gathered by an Achaemenian king was shattered in the battle called popularly after the city of Arbela some 60m. distant, or more precisely after the village of Gaugamela hard by. Darius fled eastwards into Media and again Alexander waited till he had secured the provinces to the south. He followed the Tigris into Babylonia, the central seat of the empire and its richest region, and from Babylon went on to seize the fabulous riches which the Persian kings had amassed in their spring residence, Susa. Thence he at last ascended upon the Iranian plateau. The mountain tribes on the road (the Uxii, Persian *Huzha*), accustomed to exact blackmail even from the king's train, learnt by a bitter lesson that a stronger hand had come to wield the empire. Alexander entered Persis, the cradle of the Achaemenian house, and came upon fresh masses of treasure in the royal city, Persepolis. He destroyed the royal palace by fire, an act which has been variously estimated by historians. Ostensibly a solemn revenge for the burning of Greek temples by

[1] *See* Bauer, "Die Schlacht bei Issus" in *Jahreshefte d. österr. archäol. Instit.* ii., pp. 105 f.; A. Janke, *Auf Alex. d. grossen Pfaden;* Gruhn, *Das Schlachtfeld von Issus;* Lammert in *Berl. Philol. Wochenschr.* (1905), col. 1,506 f.

[2] Pridik, *De Alex. Mag. epist. commercio* (Dorpat, 1893); Schwartz, art. "Curtius" in Pauly-Wissowa, col. 1,884.

[3] The story of Alexander's visit to Jerusalem rests on no better authority than a later Jewish romance.

Xerxes, it has been justified as a symbolical act calculated to impress usefully the imagination of the East, and condemned as a senseless and vainglorious work of destruction.

With the spring of 330 Alexander was prepared for further pursuit. Darius fled northwards from Ecbatana upon his approach. At Ecbatana new masses of treasure were seized, but when once the necessary measures which its disposal and the



THE DEATH OF ALEXANDER THE GREAT AT BABYLON IN 323 B C
Alexander's death, in his 33rd year, put an end to the Macedonian subjugation of the East and left his empire a prey to his ambitious generals. From an 18th century Persian ms in the Metropolitan Museum of Art

occupation of the Median capital entailed were taken, Alexander continued the pursuit. It was an exciting chase of king by king, in which each covered the ground by incredible exertions, shedding their slower-going followers as they went, past Rhagae (Rai) and the Caspian gates, till early one morning Alexander came in sight of the broken train which still clung to the fallen king He had become a puppet in the hands of his cousin Bessus and the Persian magnates with him (*see* DARIUS III), and at this extremity they stabbed him and allowed Alexander to become master only of his corpse (summer 330).

The pursuit had brought Alexander into that region of mountains to the south of the Caspian which connects western Iran with the provinces to the east of the great central desert. To conquer this remaining portion of the empire, Alexander now went on through the mountain belt, teaching the power of his arms to the hillsmen, Tapyri and Mardi, till he came, passing through Zadracarta (Asterabad), to Parthia and thence to Aria. In these farther provinces of Iran the Macedonian invader had for the first time to encounter a serious national opposition, for in the west the Iranian rule had been merely the supremacy of an alien power over native populations indifferent or hostile. Here the ruling race was at home. In Asia, Alexander learnt that Bessus had taken the diadem as Darius's successor in Bactria, but so soon as he marched against him Aria rose in his rear, and Alexander had to return in haste to subdue the revolt. Nor did he, when this was accomplished, again strike directly at Bactria, but made a wide turning movement through Seistan over Kandahar into the Kabul valley. It was on the way, in Seistan at Prophthasia (mod. *Farrah?*), that the alienation between Alexander and his Macedonian followers, which becomes sensible in the latter part of his career, first showed itself in an ugly form. Alexander had come to merge the characters of Macedonian king and Hellenic captain-general, with which he had set out, in that of Oriental despot (Spieker, *Hof u. Hofordnung Al. d. Gr.*, 1904). He wore on occasions of state the Persian dress. (According to pseudo-Plutarch, *de fort Al i.* 8, it was the simpler *Persian* dress, not the Median) A discontent began to work among the Macedonians, and at Prophthasia the commander of the Macedonian cavalry, Philotas, the son of Parmenio, and certain others were arraigned before the army on the charge of conspiring against the king's life. They were condemned and put to death Not satisfied with procuring this, Alexander had Parmenio himself, who had been left in command in Media, put to death by secret orders. It is perhaps the worst crime, because the most cold-blooded and ungenerous, which can be laid to his charge. By the winter of 329–328 Alexander had reached the Kabul valley at the foot of the Paropamisadae (Hindu Kush).

The ordinarily received chronology makes Alexander reach the Kabul valley in the winter of 330-329. That to fit the actions and distances covered by Alexander into such a scheme, assuming that he went by Seistan and Kandahar, would involve physical impossibilities has been pointed out by Count Yorck v. Wartenburg and D. G. Hogarth.

Northern India.—In the spring of 328 Alexander crossed the Hindu Kush into Bactria and followed the retreat of Bessus across the Oxus and into Sogdiana (Bokhara). Here Bessus was at last caught and treated with the barbaric cruelty which the rule of the old Persian monarchy prescribed for rebels Till the spring of 327 Alexander was moving to and fro in Bactria and Sogdiana, beating down the recurrent rebellions and planting Greek cities. Just as in 335 he had crossed the Danube, so he now made one raid across the frontier river, the Jaxartes (Sir Daria), to teach the fear of his name to the outlying peoples of the steppe (summer 328). And meanwhile the rift between Alexander and his European followers continued to show itself in dark incidents—the murder of Clitus at Maracanda (Samarkand), when Alexander struck down an old friend, both being hot with wine; the claim that Alexander should be approached with prostration (*proskynesis*), opposed somewhat strangely by the philosopher Callisthenes, Aristotle's nephew, who had come in the king's train and embroidered his history of the campaign with gross flatteries; the conspiracy of the pages in Bactria, which was made an occasion for putting Callisthenes to death. It was now that Alexander completed the conquest of the provinces north of the Hindu Kush by the reduction of the last mountain strongholds of the native princes In one of them he captured Roxana, the daughter of Oxyartes, whom he made his wife. Before the summer of 327 he had once more crossed the Hindu Kush on his way to India (for the campaigns in the north-east *see* F. von Schwarz, *Alex d Grossen Feldzuge in Turkestan*, v. 1893).

Whilst the heavier troops moved down the Kabul valley to Peucelaotis (Chārsadda) under Perdiccas and Hephaestion, Alexander with a body of lighter-armed troops and cavalry pushed up the valleys which join the Kabul from the north—through the regions now known as Bajour, Swat and Buner, inhabited by Indian hill peoples, as fierce then against the western intruder as their Pathan successors are against the British columns The books give a number of their "cities" reduced by Alexander—walled mountain villages which can in some cases be identified more or less certainly with places where the clans are established to-day. The crowning exploit was the reduction of Aornus,[1] a stronghold perched on a precipitous summit above the Indus, which it was said that Heracles had failed to take. How much of the story of Alexander's discovery of the sacred mountain of the Nysa and the traces of Dionysus is due to the invention of Aristobulus and Clitarchus (Arrian did not find it in Ptolemy) we cannot say. Meantime Perdiccas and Hephaestion had built a bridge over the Indus, and by this in the spring of 326 Alexander passed into the Punjab (at Ohind, 16m. above Attock, according to Foucher, *Notes sur la géogr. anc. du Gandhāra*, 1902). The country into which he came was dominated by three principalities, that of Ambhi (Gr. *Omphis*, Curt. viii. 12. 6) between the Indus and the Hydaspes (*Jhelum, Jehlam*), centred in the great city of Takkasila (Gr. *Taxila*), that of the Paurava rajah (Gr. *Porus*) be-

[1]Sir Aurel Stein believes that he has discovered Aornus; see *Geographical Journal*, vol. 70, No. 6, pp. 515–540, 1927

tween the Hydaspes and Acesines (*Chenab*), and that of Abhisara (Gr. *Abisares*) between the same two rivers higher up, on the confines of Kashmir (Stein, *Rajatarangini*, transl. bk. i. 180, v. 217). The king of Taxila and Porus were at enmity, and for this cause the invader could reckon upon Omphis as a firm ally. Porus was prepared to contest the passage of the Hydaspes with all his strength. Abisares preferred to play a double game and wait upon events. Alexander reached the Hydaspes shortly before the rains broke, when the river was already swollen. Porus held the opposite bank with a powerful army, including 200 elephants. Alexander succeeded in taking a part of his forces across the river higher up during a night of torrential rain, and then he fought the fourth and last of his pitched battles in Asia, the one which put to proof more shrewdly than any of the others the quality of the Macedonian army as an instrument of war, and yet again emerged victorious. Porus fell sorely wounded into his hands [1] Porus had saved his honour, and now Alexander tried, and not in vain, to gain him as a friend. When he continued his progress eastwards across the Acesines, Porus was an active ally. Alexander moved along close under the hills. After crossing the Hydraotes (Rāvī) he once more came into contact with hostile tribes, and the work of storming petty towns began again. Then the Hyphasis (Beas) was reached, and here the Macedonian army refused to go any farther. It was a bitter mortification to Alexander, who probably believed that he had not much farther to go to reach the ocean and the eastern limit of the inhabited world. For three days the will of king and people were locked in antagonism; then Alexander gave way, the long eastward movement was ended; the return began.

The Return.—Alexander left the conquered portion of India east of the Indus to be governed under Porus, Omphis of Taxila, and Abisares, the country west of the Indus under Macedonian governors, and set out to explore the great river to its mouth (for the organization of the Indian provinces, *see* especially Niese, vol. i., pp. 500). The fleet prepared on the Hydaspes sailed in Nov 326, while a land army moved along the bank. The confluence of the Hydaspes and Acesines passed, the Macedonians were once more in a region of hostile tribes with towns to be stormed. It was at one of these, a town of the Malli, that a memorable incident occurred, such as characterized the personality of Alexander for all succeeding time. He leapt from the wall with only three companions into the hostile town, and, before the army behind him could effect an entrance, lay wounded almost to death.[2] He recovered and beat down the resistance of the tribes, leaving them annexed to the Macedonian satrapy west of the Indus. Below the confluence of the Punjab rivers into the single stream of the Indus the territory of loose tribes was succeeded by another group of regular principalities, under the rajahs called by the Greeks Musicanus, Oxycanus and Sambus. These opposed a national resistance to the Macedonians, the fires of which were fanned by the Brahmans, but still the strong arm of the western people prevailed. The rajah of Patala at the apex of the Indus delta abandoned his country and fled. It was the high summer of 325 when Alexander reached Patala. From there he explored both arms of the delta to the ocean, now seen by the Macedonians for the first time. He had determined that the Indus fleet should be used to explore this new world and try to find a waterway between the Indus and the Persian Gulf. A great part of the land-forces had been already sent off under Craterus in the earlier summer to return west by Kandahar and Seistan; the fleet was to sail under the Greek Nearchus from the Indus mouth with the winter monsoon; Alexander himself with the rest of the land-forces set out in Sept. 325, to go by the coast of Baluchistan, through the appalling sand-wastes of the Mekran.[3]

[1]Beside V. Smith (cited below) *see* Schubert, "Die Porusschlacht," in *Rhein. Mus.* lvi., 1901, p. 543.

[2]There seems nothing to fix the exact spot of this town; the common identification with Multan is, according to Raverty and V. Smith, certainly wrong.

[3]For the Indian campaigns of Alexander *see* especially McCrindle, *Invasion of India by Alexander the Great* (1896); Vincent A. Smith, *Early History of India* (1904), and the references there given to the researches of Sir T. H. Holdich, Raverty and Foucher; A. Anspach, *De Alex. Magni exped. ind.* (1903).

He would seem to have kept down to the coast until the headland of Ras Malan was reached, scattering before him the bands of Arabitae and Oritae who were the inhabitants of this well-provisioned tract. For the 150 miles between Ras Malan and Pasni, Alexander was compelled by the natural barriers to march inland, and it was here that his troops sank under the horrors of heat and thirst and sand. The coast once regained, the way was easy; no such desert had to be traversed, when Alexander again struck inland for the chief city of the Gedrosians (Pura), and thence made his way into Carmania. Here the spent troops rested; here the army of Craterus joined them, and Nearchus came to announce his safe arrival at the entrance of the Persian gulf.[1]

The machine of empire had not functioned altogether smoothly while the king had been absent, and on Alexander's reappearance many incapables and rogues in high office had to be replaced by better men. In Carmania, in Persis, complaints from the provinces continued to reach him, as well as the news of disorders in Macedonia and Greece. New orders and appointments served to bring the empire into hand again, and at Susa in the spring of 324 Alexander rested, the task of conquering and compassing the Achaemenian realm achieved. The task of its internal reorganization now began to occupy him—changes, for instance, in the military system which tended to assimilate Macedonians and Orientals. The same policy of fusion was furthered by the great marriage festival at Susa, when Alexander took two more wives from the Persian royal house, married a number of his generals to Oriental princesses, and even induced as many as he could of the rank-and-file to take Asiatic wives. This policy did not allay the discontent of the Macedonian army, and when Alexander in the summer of 324 moved to the cooler region of Media, an actual mutiny of the Macedonians broke out on the way at Opis on the Tigris. It was occasioned by the discharge of the Macedonian veterans, and only the personal magnetism of Alexander and his threat to entrust himself altogether to the Orientals availed to quell it. At Ecbatana the death of Hephaestion for a time plunged Alexander into a passion of mourning. But by the winter (324-323) he was again active, bringing the hill-tribes on the south-west border of Media, the Cossaei, into subjection. In the spring of 323 he moved down to Babylon, receiving on the way embassies from lands as far as the confines of the known world, for the eyes of all nations were now turned with fear or wonder to the figure which had appeared with so superhuman an effect upon the world's stage. The embassy from Rome, however, is almost certainly a later, and an inevitable, invention. The exploration of the waterways round about the empire was Alexander's immediate concern, the discovery of the presumed connection of the Caspian with the Northern Ocean, the opening of a maritime route from Babylon to Egypt round Arabia. The latter enterprise Alexander designed to conduct in person; under his supervision was prepared in Babylon an immense fleet, a great basin dug out to contain 1,000 ships, and the water-communications of Babylonia taken in hand. Innovations were carried out in the tactical system of the army which were to modify considerably the methods of future battle-fields. At last all was ready; the 20th of the month Daesius (? June 5) was fixed for the king's setting forth. On the 15th and 16th Alexander caroused deep into the night at the house of the favourite Medius. On the 17th he developed fever; for a time he treated it as a momentary impediment to the expedition; but on the 27th his speech was gone, and the Macedonian army was suffered to pass, man by man, through his chamber to bid him farewell. On the 28th (June 13) Alexander died.[2]

His son by Roxana, the so-called ALEXANDER "AEGUS," was born a few months later. He and his uncle Philip, as joint kings, were placed under the guardianship of Perdiccas, Peithon and Antipater in succession. After the death of Antipater (319) Roxana fled with him to Epirus, and was afterwards taken back to Mace-

[1]Tomaschek, "Topographische Erläuterung der Kustenfahrt Nearchs" in the *Sitzungsberichte der kaiserl. Akad. d. Wissensch.* of Vienna (*Philosoph.-histor. Klasse*, vol. cxxi.); Major P. M. Sykes, *Ten Thousand Miles in Persia* (1902), pp. 166 *et seq.*

[2]For Alexander's funeral *see* F. Jacoby in *Rhein. Mus.* (1903), pp. 461 *et seq.*

donia, together with Olympias, by Polyperchon. All three fell into the hands of Cassander; Alexander and his mother were put to death in 310–309 by order of Cassander (*Justin* xiv. 6, xv. 2). The meaningless surname of *Aegus*, still given in some books to this Alexander, is perhaps derived from a modern misreading of the text of the Astronomical Canon, ΑΙΓΟΥ for ΑΛΛΟΥ.

Character and Policy.—Alexander the Great is one of the instances of the vanity of appealing from contemporary disputes to "the verdict of posterity"; his character and his policy are estimated to-day as variously as ever. Certain features—the high physical courage, the impulsive energy, the fervid imagination—stand out clear; beyond that disagreement begins. That he was a great master of war is admitted by most of those who judge his character unfavourably, but even this has been seriously questioned (*e.g.*, by Beloch, *Griech, Gesch.* iii. [i.], p. 66). There is a dispute as to his real designs. That he aimed at conquering the whole world and demanded to be worshipped as a god is the traditional view. Droysen denies the former, and Niese maintains that his ambition was limited by the bounds of the Persian empire and that the claim to divine honours is fabulous (*Historische Zeitschr*, lxxix, 1897, 1 f.). It is true that our best authority, Arrian, fails to substantiate the traditional view satisfactorily; on the other hand those who maintain it urge that Arrian's interests were mainly military, and that the other authorities, if inferior in trustworthiness, are more complete in range of vision. Of those, again, who maintain the traditional view, some, like Niebuhr and Grote, regard it as convicting Alexander of mad ambition and vainglory; whilst to Kaerst, Alexander only incorporates ideas which were the timely fruit of a long historical development. The policy of fusing Greeks and Orientals again is diversely judged To Droysen and Kaerst it accords with the historical conditions; to W. W. Tarn, whose chapters in the *Cambridge Modern History*, vol vi, give an able survey of Alexander's career in the light of the most recent studies, it was one of Alexander's great contributions to history; to Grote and to Beloch it is a betrayal of the prerogative of Hellenism.

Some notion of the personal appearance of Alexander may be got from the literature and the surviving monuments. He is described as of an athletic frame, though not taller than the common, and a white and ruddy complexion. The expression of his eyes had something "liquid and melting" (*τῶν ὀμμάτων τήν διάχυσιν καὶ ὑγρότητα*) and the hair which stood up over his forehead gave the suggestion of a lion. He had a way of carrying his head somewhat aslant. (*See* especially Plut. *Alex.* 4; *de Alex fort.* ii. 2) The greatest masters of the time executed portraits of him, Lysippus in sculpture, Apelles in painting and Pyrgoteles in graven gems. Among surviving monuments, we have no completely certified portraits except the Tivoli herm (now in the Louvre) and the coins struck by his successors. The herm is a dry work and the head upon the coins shows various degrees of idealization. There are, however, a considerable number of works which can make out a better or worse claim either to be portraits of Alexander or to reproduce his type, and a large field of discussion is therefore open as to their values and classification (F. Kopp, *Über das Bildnis Alexanders d. Grossen* (1892); K. J. Ujfalvy, *Le Type physique d'Alexandre le Grand* (1902); T. Schreiber, *Studien über das Bildnis Alexanders d. Grossen* (1903); J. J. Bernoulli, *Die erhaltenen Darstellungen Alexanders d. Grossen* (1905). Alexander shaved clean, and set the fashion in this respect for the Graeco-Roman world for the next 500 years.

The campaigns and life of Alexander did not lack contemporary historians, some of them eye-witnesses and even associates. They included the philosopher Callisthenes, put to death by Alexander in 327, whose history went up to the death of Darius, Alexander's general Ptolemy, afterwards king in Egypt; Nearchus, who commanded the fleet that sailed from the Indus to the Persian Gulf; Onesicritus, who served as pilot in the same fleet, and Aristobulus who was with Alexander in India. Clitarchus, whose highly coloured version of the life of Alexander became the popular authority for succeeding generations, is now believed to have written in the 3rd century A.D. Besides the historical narrative, there were works mainly geographical or topographical left by persons like Baeton and Diognetus, whom Alexander had employed (as *βηματισταί*) to survey the roads over which he passed. All such original sources have now perished. The fragments are collected in the Didot edition of Arrian by Karl Müller. Not reckoning scattered notices, we depend principally upon five later compositions, Diodorus, book xvii. (*c.* 20 B.C.), the work of Quintus Curtius (*c.* A.D. 42), Plutarch's (*c.* A.D. 45–125) *Life of Alexander*, Arrian's *Anabasis* and *Indica* (*c.* A.D. 150), and the relevant books of Justin's abridgement (2nd cent. A.D.) of the history of Trogus (*c.* 10 B.C.?). To these we may add the Latin *Itinerarium Alexandri*, a skeleton outline of Alexander's campaigns dedicated to the Emperor Constantius (A.D. 324–361), printed at the end of the Didot edition of Arrian, and the *Epitome Rerum Gestarum Alexandri magni*, an abridgement made in the 4th or 5th century of a lost Latin work of uncertain date, combining history with elements taken from the *Romance* (edited by O. Wagner, Leipzig, 1900). The relation of these works to the various original sources constitutes the critical problem before the modern historian in reference to the history of Alexander. A bibliography of modern literature bearing on Alexander will be found connected with Mr. W. W. Tarn's chapters in the *Cambridge Ancient History*, vol. vi. (E. R. B)

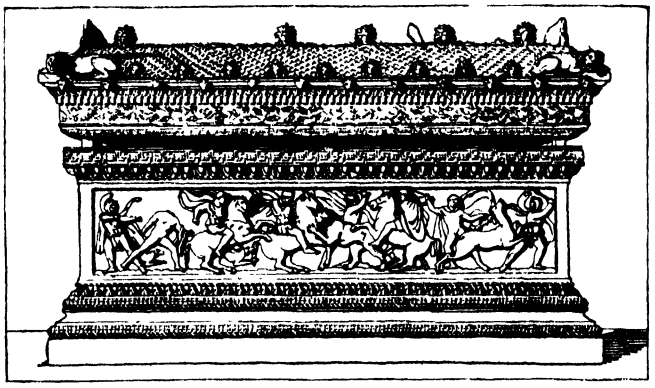
THE ROMANCE OF ALEXANDER

The figure of Alexander naturally impressed itself upon the imagination of the world which his career had shaken. The romance of Alexander is found written in the languages of nearly all peoples from the Indian Ocean to the Atlantic, but all these versions are derived, mediately or immediately, from the Greek original which circulated under the false name of Callisthenes. The Greek pseudo-Callisthenes (otherwise *Aisopos*) we possess in three recensions, based all upon a book produced in Egypt in the 2nd century A.D. But this book itself was a farrago of heterogeneous elements—pieces of genuine history, ancient stories once told in Babylon of Gilgamesh or Etanna; literary forgeries of the days soon after Alexander, like the oldest part of the "Testament of Alexander," and variations according to the bent of different times and peoples In the Persian version Alexander (Iskander) became a son of Darius; among the Mohammedans he turned into a prophet, hot against idols; the pen of Christian monks made him an ascetic saint.

The Alexander romance found its way into Europe through the Latin versions of the pseudo-Callisthenes, not from the more sober narrative of Quintus Curtius. The pseudo-Callisthenes, in a recension which has not been preserved, was translated into Latin by Julius Valerius about the end of the 3rd century, and an epitome of this translation, also in Latin, was made some time before the 9th century, and is introduced by Vincent de Beauvais into his *Speculum historiale*. The first book deals with his birth and early exploits The trace of Alexandrian influence is to be found in the pretence that his actual father was Nectanebus, a fugitive king of Egypt. The latter was a great magician, able, by operating upon waxen figures of the armies and ships of his enemies, to obtain complete power over their real actions Obliged, however, to flee to Pella in Macedonia, he established himself as an astrologer, and as such was consulted by the childless Olympias. Having promised that Zeus Ammon would visit her in the form of a dragon, he himself assumed the disguise. In due course Alexander was born, and Philip's suspicions were overcome by a second appearance of the dragon, which was held to prove the divine fatherhood. The child was small and somewhat deformed, but of great courage and intelligence. When he was twelve years old he was instructed in starcraft by Nectanebus, who was killed by a fall into a pit, into which he had been playfully pushed by Alexander. The first book also relates his conquests in Italy, Africa, Syria and Asia Minor; his return to Macedonia and the submission of Greece. The second book continues the history of his conquests, and the third contains the victory over Porus, the relations with the Brahmans, the letter to Aristotle on the wonders of India, the histories of Candace and the Amazons, the letter to Olympias on the marvels of Farther Asia and lastly the account of Alexander's death in Babylon.

The most widespread Latin version of the story, however, was the *Historia de proeliis*, printed at Strasbourg in 1486, which began to supersede the *Epitome* of Julius Valerius in general favour about the end of the 13th century It is said to have been written in the 10th century by the Neapolitan arch-presbyter Leo. Auxiliary sources for the mediaeval romance-writers were: the opuscule (4th century) known as *Alexandri magni iter ad Paradisum*, a fable of Eastern origin directed against ambition;

the *Itinerarium Alexandri* (340), based partly on Julius Valerius and dedicated to Constans, son of the emperor Constantine; the letter of Alexander to Aristotle (*Epist. de situ et mirabilibus Indiae*) and the correspondence between Alexander and the king of the Brahmans, Dindimus, both of which are often contained in mss. of the *Epitome;* and the treatise (based on a lost history of Alexander by Onesicritus), *De gentibus Indiae et Bragmanibus,*



THE SARCOPHAGUS OF ALEXANDER THE GREAT AT CONSTANTINOPLE

ascribed without certainty to Palladius (d. *c.* 430), successively bishop of Helenopolis and Aspona.

In the Ethiopic versions we find the Greek gods in the guise of Enoch, Elijah, etc., while Philip is a Christian martyr, and Alexander himself a great apostle, even a saint; quotations from the Bible are frequent. Syriac and Armenian versions were made in the 5th century. Persians and Arabs told the deeds of Iskander; and Firdousi made use of the story in the *Shâhnáma.* Another early Persian poet, Nizami, made the story specially his own In the 11th century Simeon Seth, *protovestiarius* at the Byzantine court, translated the fabulous history from the Persian back into Greek.

The Alexander legend was the theme of poetry in all European languages; six or seven German poets dealt with the subject, and it may be read in French, English, Spanish, Danish, Swedish, Icelandic, Flemish and Bohemian.

French.—The principal extant French romances based on the Alexander legend are. (1) A fragment by Alberic of Besançon (more properly Briançon), 11th century; (2) *Li romans d'Alexandre,* 12th century, by Alexandre de Bernai and other poets, in rhymed verse; (3) *l'Histoire du noble et vaillant roy Alixandre le Grant* (1506), a prose romance taken from the *Historia de proeliis;* and the *Alexandreis* (c.1180) of Gaultier de l'Isle or de Châtellon, a Latin poem based on Quintus Curtius.

English Versions.—The letter from Alexander to Aristotle and his correspondence with Dindimus are found in Early English versions dating from the 11th century. The Monk in Chaucer's *Canterbury Tales* prefaces his account of Alexander with the statement that his story is so common—

> That every wight that hath discrecioun
> Hath herd somewhat or all of his fortune.

There exist fragments of an English alliterative romance on the subject written in the west midland dialect, dating from the second half of the 14th century. Another alliterative poem in the northern dialect, of 15th-century origin, is based on the *Historia de proeliis* Earlier than any of these is the rhyming *Lyfe of Alisaunder* (*c.* 1330), which is printed in H. Weber's *Metrical Romances* (vol. i., 1810). *The Scots Buik of the most noble and vailyzeand Conqueror Alexander the Great,* printed by Alexander Arbuthnot (d. 1585) about 1580, reprinted in 1831 for the Bannatyne Club, contains three episodes of the cycle, the "Forray of Gadderis" (not taken from the *Fuerre de Gadres,* but from the *Assaut de Tyr* in the *Romans d'Alixandre*), "The Avowes of Alexander" and "The Great Battel of Effesoun," taken from the *Voeux du paon. A Buke of the Conqueror Alexander the Great* by Sir Gilbert Hay (fl. 1456) is in ms. at Taymouth Castle.

BIBLIOGRAPHY.—The best sketch of the Alexander romance literature is by Paul Meyer, *Alexandre le grand dans la littérature française au moyen âge* (1886). The first volume contains some French texts, and the second a detailed discussion of the various versions from the pseudo-Callisthenes downwards. *See* also J. Zacher, *Pseudo-Callisthenes, Forschungen zur . . . Alexandersage* (Halle, 1867), and for Oriental versions, T. Noldeke, "Beitrage zur Geschichte des Alexanderromans" (*Denkschriften der ksl. Akad. d. Wissenschaften, Phil.-hist Klasse,* vol. 38: Vienna, 1890). For early printed versions *see* Brunet, *Manuel du libraire, s.v. "Alexandre."*

The text of the pseudo-Callisthenes was edited by C. W. Müller from three mss. in the Bibl. Nat. and printed in the Arrian of the Coll. Didot (Paris, 1846), and by H. Meusel (Leipzig, 1871) from a Leyden ms. A. Mai ed. Julius Valerius (Milan, 1817). *Itinerarium Alexandri* (Class. Auct. vol. vii.; Milan, 1835); J. Zacher, *Alex iter ad Paradisum* (Regensburg, 1859); and the *Epitome* (Halle, 1867); the Oxford ms. of the *Epitome* was edited by G. Cilli (Strasbourg, 1905); G. Landgraf, *Die "Vita Alexandri" . . . des Archpresbyter Leo (Historia de proelus)* (Erlangen, 1885); Alexander's letter to Aristotle and his correspondence with Dindimus are included in the Teubner edition of Julius Valerius (ed. B. Kubler, Leipzig, 1888). A newly discovered anonymous *Epitome* was edited by O. Wagner (Leipzig, 1900).

The fragment by Alberic was edited by P. Heyse (Berlin, 1856); Lamprecht's German text by H Weismann (Frankfurt, 1850) and by C. Kinzel (Halle, 1884), the *Alexandreis* of Gaultier de Lille, by F. A. Müldener (Leipzig, 1863), an Icelandic prose version (*c.* 1250) of the same, *Alexanders Saga,* by C. R. Unger (Christiania, 1848); *Li Romans d'Alixandre,* by H Michelant (Stuttgart, 1846), the Ethiopic version by E. A. T. Wallis Budge (1896, with English translation); the Syriac text of pseudo-Callisthenes by Budge (Cambridge, 1889).

Besides the English editions quoted in the text, the alliterative English poems were partially edited by J. Stevenson for the Roxburghe Club (1849). There is a great deal of information on the various texts in H. L. Wood's *Catalogue of Romances in the British Museum* (1883, vol. i., pp. 94 *et seq*). Among other works *see* E. Rohde, *Der griechische Roman* (2nd ed, Leipzig, 1900); F Kampers, "Alex d. Grosse und die Idee des Weltimperiums in Prophetie und Sage" (in H. Granert's *Studien,* etc, Freiburg, 1901); Adolf Ausfeld, *Der griechische Alexanderroman* (Leipzig, 1907), edited after the author's death by W. Kroll. (X)

ALEXANDER (1461–1506), king of Poland, succeeded his brother John Albert in 1501. He carried on the hopeless struggle of the crown against the growing power of the Polish senate and nobles, who deprived him of financial control and curtailed his prerogative. For want of funds, Alexander was unable to assist the Grand Master of the Order of the Sword against Muscovite aggression, or prevent Tsar Ivan III. from ravaging Lithuania with the Tartars. The utmost the king could do was to garrison Smolensk and other fortresses and employ his wife Helena, the tsar's daughter, to mediate a truce between his father-in-law and himself. Only the death of Stephen, the great hospodar of Moldavia, enabled Poland still to hold her own on the Danube. The liberality of Pope Julius II, who granted Alexander Peter's Pence and other financial help, enabled the Polish king to restrain somewhat the arrogance of the Teutonic Order in the Prussian provinces. Alexander died on Aug. 5, 1506.

See V. Czerny, *The Reigns of John Albert and Alexander Jagiello* (Pol.) (Cracow, 1882).

ALEXANDER I. (*c.* 1078–1124), king of Scotland, was the fourth son of Malcolm Canmore by his wife Margaret. On the death of his brother Edgar in 1107 he became king of Scotland north of the Forth and Clyde, southern Scotland being reserved for his brother David. He founded many abbeys and bishoprics, among them Inchcolm and Scone. He died April 27, 1124 (*see* SCOTLAND, *History*).

ALEXANDER II. (1198–1249), king of Scotland, son of William the Lion, whom he succeeded in 1214. He joined the English barons in their struggle against King John, marched into England and besieged Norham Castle in 1215. In 1217 he again invaded England but eventually made peace with Henry III, and the understanding was strengthened by his marriage with Henry's sister, Joanna, in 1221.

Peace with England was broken over a claim by Henry for homage from the Scottish king, and again by a threat of invasion in 1243, but both disputes were amicably settled. Alexander attempted to reduce the Western Isles, which were dependent on Norway, as he had already reduced Argyll, but while on an expedition for the purpose he died at Kerrera July 8, 1249.

ALEXANDER III. (1241–1285), king of Scotland, son of Alexander II. by his second wife Mary de Coucy, succeeded to

the throne in 1249, at the age of eight. The years of his minority were marked by an embittered struggle for the control of affairs between two rival parties, the one led by Walter Comyn, earl of Menteith, the other by Alan Durward, the justiciar. At the marriage of Alexander to Margaret of England in 1251, Henry III. seized the opportunity to demand from his son-in-law homage for the Scottish kingdom, but the claim was refused

On attaining his majority, Alexander laid formal claim before the Norwegian king Haakon for sovereignty over the Hebrides, where Scandinavians had settled since the 9th century. Haakon replied by a formidable expedition in 1263. Sailing round the west coast of Scotland he halted off Arran, where negotiations were opened. These were prolonged by Alexander until the autumn storms should begin. At length Haakon attacked only to encounter a terrific storm which greatly damaged his ships. The battle of Largs (Oct. 12, 1263) was indecisive. But even so Haakon's position was hopeless. Baffled he turned homewards, but died on the way.



FROM TYTLER, "SCOTTISH WORTHIES"
OBVERSE SIDE OF THE GREAT SEAL OF ALEXANDER III., KING OF SCOTLAND, HONOURED BY HIS PEOPLE AS THE LAST OF THE "KINGS OF PEACE"

In 1266 Haakon's successor concluded a treaty by which the Isle of Man and the Western Isles were ceded to Scotland in return for a sum of 4,000 marks in four yearly payments, Orkney and Shetland alone being retained for Norway The marriage of Alexander's daughter, Margaret, to Eric, son of King Magnus, was also agreed. Towards the end of Alexander's reign, the death of all his three children within a few years made the question of the succession one of pressing importance.

In 1284 he induced the Estates to recognize as his heir-presumptive his grand-daughter Margaret, the "Maid of Norway," and next year the desire for a male heir led him to contract a second marriage Alexander was killed by a fall from his horse in the dark while riding to visit the queen at Kinghorn on March 16, 1285. The "Lament for Alisaunder," cited by Wynton, written in praise of Alexander III., is one of the earliest Scottish poems extant

ALEXANDER (ALEXANDER OBRENOVICH) (1876–1903), king of Serbia, was born on Aug 14, 1876. On March 6, 1889, his father, King Milan, abdicated and proclaimed him king of Serbia under a regency until he should attain his majority at 18 years of age. King Alexander, on April 13, 1893, being then in his 17th year, proclaimed himself of full age, and took the royal authority into his own hands His action was popular, and was rendered still more so by his appointment of a radical ministry

In May 1894 King Alexander abolished the liberal constitution of 1889 and restored the conservative one of 1869. His attitude during the Turco-Greek war of 1897 was one of strict neutrality. In 1898 he appointed his father commander-in-chief of the Serbian Army, and from that time, or rather from his return to Serbia in 1894 until 1900, ex-King Milan was regarded as the *de facto* ruler of the country. But while, during the summer of 1900, Milan was at Carlsbad making arrangements to secure the hand of a German princess for his son, King Alexander suddenly announced his engagement to Mme. Draga Mashin, a widow, formerly a lady-in-waiting to Queen Natalie. Ex-King Milan gave up his post, the government resigned, and King Alexander had great difficulty in forming a new cabinet. But the Tsar Nicholas congratulated the king on his engagement and agreed to act as principal witness at the wedding. The marriage was celebrated on Aug. 5, 1900.

Alexander tried to reconcile political parties by granting on his own initiative a liberal constitution (April 6, 1901), introducing for the first time in the constitutional history of Serbia the system of two chambers (*skupshtina* and senate). This did not reconcile the army, which was alarmed by the rumour that one of the two unpopular brothers of Queen Draga, Lieut. Nicodiye, was to be proclaimed heir-apparent. Meanwhile Alexander suspended (March 1903) the constitution for half an hour, time enough to publish the decrees by which the old senators and councillors of state were dismissed and replaced by new ones. This arbitrary act naturally increased the general discontent. It was thought that with a packed senate and a large government majority in the *skupshtina* King Alexander would not hesitate any longer to proclaim Queen Draga's brother as the heir to the throne. Ostensibly to prevent this, but in reality to replace Alexander Obrenovich by Peter Karagjorgjvić, a military conspiracy was organized. The conspirators penetrated into the palace and savagely murdered King Alexander and Queen Draga in the early morning of June 11, 1903. (*See* SERBIA: *History.*)

ALEXANDER I., king of the Serbs, Croats and Slovenes (1888–), was born at Cetinje on Dec. 4, 1888, the second son of Prince Peter Karagjorgjević, later king of Serbia, and of Zorka, third daughter of Prince Nicholas of Montenegro His mother died in 1890, and during his early years he shared the exile of his father at Geneva. In 1899 he was sent to St. Petersburg (Leningrad) to be educated, and in 1904 entered the *corps des pages* at the tsar's court. It was not till 1909, nearly six years after his father's election to the Serbian throne, that the young prince came to reside permanently in Serbia. Soon after his return his elder brother, Prince George, was obliged to renounce the succession (March 1909), owing to his unbalanced temperament, and various incidents that occurred during the Bosnian crisis; and Alexander was thereupon formally recognized as crown prince On the outbreak of the Balkan war (1912) he assumed nominal command of the 1st Army and won his spurs at the battle of Kumanovo, subsequently serving with distinction in the campaigns against Turkey and Bulgaria

On June 24, 1914 King Peter, whose health had completely broken down, appointed him prince regent, and he thus held the position of commander-in-chief when the World War broke out. He remained permanently at army headquarters, and shared with his soldiers all the privations of the retreat through Albania On reaching the coast he fell ill and underwent a serious operation, but when already convalescent resolutely declined the proffered assistance of an Italian destroyer which had been sent to convey him across the Adriatic; he remained till all the refugees had been transported into safety, and eventually found his way on foot to Durazzo. After the exiled Serbian Government had established itself at Corfu, Prince Alexander and M. Pašić paid visits to Paris and London, where the prince was received with warm ovations On April 5, 1916, on receiving an important deputation of British sympathizers (led by the archbishop of Canterbury, the lord mayor, Lord Milner and Sir Edward Carson), he publicly identified the dynasty with the cause of unity, expressing his conviction that in the final victory "our Yugoslav people, united in a single state, will have their part."

During the rest of the War he remained at Serbian headquarters and shared his army's victorious advance in Oct 1918. On Dec. 1 delegates of the Yugoslav National Council in Zagreb formally recognized him as regent in all the Yugoslav provinces of the former dual monarchy, and he assumed the title of "prince-regent of the Serbs, Croats and Slovenes." The attempt made upon his life on June 29, 1921, after he had taken the oath the previous day to the new Yugoslav constitution, was the outcome, not of any personal unpopularity, but of the subversive aims of the Communists and other revolutionary groups, who hoped to create confusion in the new state, owing to the lack of a direct heir to the throne. On Aug. 16, 1921 Prince Alexander succeeded his father as king of Yugoslavia On June 8, 1922 he married Marie, second daughter of King Ferdinand of Rumania, and on Sept. 6, 1923 an heir was born, who received the name of Peter, a second son being called after Tomislav, the first Croatian king

King Alexander inherited from his father a respect for constitutional and parliamentary traditions, which was conspicuously lacking in his predecessors of the Obrenović dynasty;

and his influence has been repeatedly exercised behind the scenes to smooth down the acerbities of party strife. It was very largely due to his insistence that a reconciliation was achieved between the Serbian Radicals under M. Pašić and the Croat Peasant Party under M Radić in the summer of 1925—an event which contributed greatly towards the political consolidation of Yugoslavia. (R. W. S.-W.)

ALEXANDER (ALEXANDER OF BATTENBERG) (1857–1893), first prince of Bulgaria, born on April 5, 1857, was the second son of Prince Alexander of Hesse and the Rhine by his morganatic marriage with Julia, Countess von Hauke, who received the title of princess of Battenberg. Prince Alexander was nephew of the Tsar Alexander II., who had married a sister of Prince Alexander of Hesse. In his boyhood and early youth he was frequently at St. Petersburg (now Leningrad), and he accompanied his uncle during the Bulgarian campaign of 1877. When Bulgaria under the Berlin Treaty was constituted an autonomous principality under the suzerainty of Turkey, Prince Alexander was elected prince of Bulgaria at the instance of the tsar. He was at that time serving in the guards at Potsdam. He travelled to Bulgaria via St. Petersburg, and took the oath to the new constitution at Trnovo on July 8, 1879. The new ruler was 22 years of age, and chose his advisers at first from the Russophil conservative side, and, finding the liberals irreconcilable, he suddenly (May 9, 1881) issued a proclamation demanding absolute power for himself for seven years and appointing a Russian general, Ernroth, as head of the administration. This edict was ratified by a Grand Sobranje summoned for the purpose. But Alexander found himself in reality under the tutelage of two Russian generals, Soboleff and Alexander Kaulbars, sent from St. Petersburg. He chafed under the restraint, joined hands with his subjects, and restored the constitution (Sept. 18, 1883). The consequent breach with Russia was widened in 1885 when Alexander, who had been forewarned of the *coup d'état* at Philippopolis which deposed the governor-general of Eastern Rumelia and proclaimed union with Bulgaria, entered Philippopolis on Sept 21 and assumed the government.

The tsar struck his nephew's name off the Russian army list, and recalled the Russian officers Alexander strengthened his position by his brilliant defence against the Serbian invasion and the victory at Slivnitsa, Nov. 16–19, and the capture of Pirot. The sultan, in 1886, agreed that Alexander should be governor-general of Eastern Rumelia for five years. The Bulgarians would have liked a more explicit arrangement, and on the night of Aug. 20, 1886, the prince was kidnapped, compelled to abdicate, and handed over to the Russians. In a fortnight he was back at Sofia, but an abject telegram to the tsar had destroyed his prestige with his subjects, and the hostility of the tsar and of Bismarck drove him to abdicate in earnest on Sept. 8, 1886.

He spent the rest of his life principally at Graz, where he died on Oct 23 1893

See especially E. G Costi, *Furst Alexander von Battenberg* (2nd ed. Vienna, 1928); also Koch, *Furst Alexander von Bulgarien* (Darmstadt, 1887; English translation, 1887); Matveyev, *Bulgarien nach dem Berliner Congress* (Petersburg, 1887); Bourchier, "Prince Alexander of Battenburg," in *Fortnightly Review*, Jan. 1894.

ALEXANDER, despot of Pherae in Thessaly from 369 to 358 B.C. His tyranny caused the Aleuadae of Larissa to invoke the aid of Alexander II. of Macedon, but after his withdrawal Alexander treated his subjects as cruelly as before. The Thessalians now applied to Thebes; Pelopidas, who was sent to their assistance, was treacherously thrown into prison (368), and it was necessary to send Epaminondas with a large army to secure his release. Alexander's conduct caused renewed intervention; in 364 he was defeated by the Thebans at Cynoscephalae, where Pelopidas fell Alexander was at last compelled by Thebes to acknowledge the freedom of the Thessalian cities, to limit his rule to Pherae, and to join the Boeotian league. He was murdered by his wife's brother at her instigation.

ALEXANDER, son of Numenius, Greek rhetorician, flourished in the first half of the second century A.D., author of a treatise on rhetoric (Περὶ τῶν τῆς διανοίας καὶ τῆς λέξεως σχημάτων), of which only an abridgment is extant; it was followed as an authority by later writers. Later epitomes were made in Latin by Aquila Romanus and Julius Rufinianus under the title *De Figuris Sententiarum et Elocutionis.*

Text in Spengel, *Rhetores Graeci* (1856).

ALEXANDER, DE ALVA STANWOOD (1845–1925), American lawyer and political historian, was born in Richmond, Me., on July 17, 1845. He enlisted in the Union army in 1862 and served until the end of the Civil War. Following his graduation at Bowdoin college, Brunswick, Me., in 1870, he was editor of the *Daily Gazette*, Ft. Wayne, Ind., in 1871–74, and was secretary of the Indiana Republican State committee in 1874–78. He was admitted to the bar and practised law in Indianapolis, Ind., from 1877 to 1881, served in the U S. Treasury department from 1881 to 1885, and then resumed law practice in Buffalo, New York. Engaging in politics, he was elected Republican representative in Congress for seven consecutive terms, 1897–1911. He died in Buffalo, N.Y., on Jan. 29, 1925.

He published a valuable *Political History of the State of New York* (1906–09); *History and Procedure of the House of Representatives* (Boston, 1916) and *Four Famous New Yorkers* (1923), a continuation of his *Political History.*

ALEXANDER, SIR GEORGE (1858–1918), English actor, whose family name was Samson, was born in Reading on June 19, 1858, and died on March 16, 1918. He made his first appearance on the London stage as Caleb Deecie in *Two Roses* in 1881 with Irving at the Lyceum. In 1891 he became manager of the St. James's theatre There he produced a number of successful plays by Oscar Wilde, Pinero, C. Haddon Chambers, H. A. Jones, Alfred Sutro and others, he himself taking the leading rôles. Sir George Alexander was the type of the successful actor-manager on the London stage in the beginning of the 20th century. In 1907 he was elected a member of the London County Council as a municipal reformer. He received a K.C.B. in 1911.

ALEXANDER, SIR JAMES EDWARD (1803–1885), British general and traveller, was born on Oct. 16, 1803, and died on April 2, 1885. He was largely responsible for the preservation and transfer to England of the obelisk, Cleopatra's Needle, in 1877.

His varied experiences provided material for a large number of books, among which were *Travels from India to England* (1827); *Transatlantic Sketches* (1833); *An Expedition of Discovery into the Interior of Africa* (1838)

ALEXANDER, JEROME (1876–), American chemist, was born in New York city, on Dec 21, 1876. He graduated in 1896 from the College of the City of New York from which in 1899 he received the degree of master of science. He was an official and chief chemist for various companies from 1896 until 1921, when he began individual practice as consulting chemist and engineer. In connection with this work he specialized in the chemistry of colloids and was an early investigator in America with the ultramicroscope. He published *Colloid Chemistry* (1919) and, in collaboration with numerous scientists, *Colloid Chemistry, Theoretical and Applied* (1926). In 1909 he translated Richard Zsigmondy's *Colloids and the Ultramicroscope.* His writings include also the sections "Glue and Gelatin" and "Colloid Chemistry" in Roger's *Industrial Chemistry* (1912), the article "Albuminoids or Scleroproteins" in Allen's *Commercial Organic Analysis* (1913), and the chapter "Colloid Chemistry" in Liddell's *Handbook for Chemical Engineers* (1920).

ALEXANDER, JOHN WHITE (1856–1915), American painter, was born in Allegheny (Pa.), Oct. 7, 1856. He was left an orphan when very young, became an illustrator for *Harper's Magazine,* studied in Europe, became a pupil of the Royal Academy at Munich, and also worked in Venice, in Holland and in Paris, where he attracted much attention by his exhibition at the Salon of two female portraits entitled "Gris" and "Noir." He became a member of the Société Nationale des Beaux Arts (Paris), of the National Academy of Design (New York), of which he was president 1909–15, of the International Society (London), and of the Vienna and Munich societies of painters. In 1901 he was made a Chevalier of the Legion of Honour. He

executed decorative panels for the Congressional library, Washington (D.C.), and a large decoration for the Carnegie institute, Pittsburgh (Pa.), and his works include numerous portraits and subject pictures. He died in New York June 1, 1915.

ALEXANDER, WILLIAM (1824–1911), Protestant archbishop of Armagh and primate of all Ireland, was born at Londonderry on April 13, 1824, and educated at Tonbridge school and Brasenose college, Oxford. He was made bishop of Derry and Raphoe in 1867, and was elevated to the primacy in 1896. His poems were collected in 1887 under the title of *St. Augustine's Holiday, and other Poems.*

His wife, CECILE FRANCES HUMPHREYS (1818–1895), wrote some tracts in connection with the Oxford movement, but is famous as the author of "Jesus calls us o'er the tumult," "There is a green hill far away," and other well-known hymns (nearly 400 in all). A collection of her verse was published in 1896.

ALEXANDER, WILLIAM LINDSAY (1808–1884), Scottish divine, born at Leith, Aug 24, 1808, and died Dec. 20, 1884. Educated at St. Andrews and Edinburgh, he was classical tutor at the Blackburn Theological Academy (1827), minister of North College street church, Edinburgh (1834), editor of Kitto's *Biblical Encyclopaedia* (1861), a member of the committee appointed to revise the Old Testament (1870), and principal of the Edinburgh Theological Hall (1877).

ALEXANDER AETOLUS, of Pleuron in Aetolia, Greek poet and man of letters, flourished about 280 B.C. He was commissioned by Ptolemy Philadelphus to arrange the tragedies and satyric dramas in the library of Alexandria; in 276 he went to the court of Antigonus Gonatas, king of Macedonia. He was one of the Alexandrian tragic Pleiad We know the title of only one of his plays (*Astragalistae*). He also wrote short epics, epigrams, and elegies, the considerable fragments of which show learning and eloquence.

Meineke, *Analecta Alexandrina* (1853); Bergk, *Poetae Lyrici Graeci;* Couat, *La Poésie alexandrine* (1882).

ALEXANDER BALAS (*i.e.*, "lord"), a native of Smyrna of humble origin, gave himself out to be the son of Antiochus IV. Epiphanes and heir to the Syrian throne His claims were recognized by the Roman senate At first unsuccessful, he finally defeated the reigning king Demetrius Soter in 150 B.C. and made himself king. But in 146 Demetrius' son, with the help of Alexander's father-in-law, Ptolemy Philometor, defeated him in a pitched battle near Antioch in Syria. He fled for refuge to a Nabataean prince, who murdered him.

See 1 Maccab 10 et seq; Justin xxxv. 1 and 2; Josephus, *Antiq.* xiii. 2; Appian, *Syr.* 67; Polybius xxxiii. 14.

ALEXANDER CORNELIUS, Greek grammarian surnamed POLYHISTOR from his great learning, born at Miletus, became a Roman citizen in 82 B.C., after being taken prisoner in the Mithridatic war. Of the extant fragments of his works (which were mainly historical and geographical) (Mueller, *Fragmenta Historicorum Graecorum,* iii), those relating to the Jews are important as containing quotations from lost Jewish authors.

ALEXANDER JOHN, FIRST PRINCE OF RUMANIA: *see* CUZA, ALEXANDER JOHN.

ALEXANDER NEVSKI (1220–1263), Russian hero and saint, grand duke of Vladimir, spent the early years of his life in constant warfare with the Germans, Swedes and Lithuanians, who sought to rescue Novgorod and Pskov from Russia. He is called Nevski from his victory over the Swedish general, Birger Jarl, on the banks of the Neva (July 15, 1240). Two years later his defeat of the knights of the Teutonic Order on Lake Peipus (April 5) compelled them to renounce their conquests. In 1252 the grand khan appointed Alexander grand-duke of Vladimir in place of his elder brother Andrew. Alexander thenceforth did his best to prevent any possible pretext for a new Tatar invasion. In 1262 he obtained a mitigation of the tribute, and the abolition of the military service hitherto rendered by the Russians to the Tatars. The Orthodox Church canonized Alexander for his services to his country.

See Sergyei Mikhailovich Solovev, *History of Russia* (Russ. 2nd ed. 1897, vol. iii.).

ALEXANDER OF APHRODISIAS, pupil of Aristocles of Messene, Greek commentator on the writings of Aristotle, and styled, by way of pre-eminence, ὁ ἐξηγητής ("the expositor"), was a native of Aphrodisias in Caria. He came to Athens towards the end of the 2nd century A.D., became head of the Lyceum and lectured on peripatetic philosophy. The object of his work was to free the doctrine from the syncretism of Ammonius and to reproduce the pure doctrine of Aristotle. Commentaries by Alexander on the following works of Aristotle are still extant: The *Analytica Priora,* i.; the *Topica;* the *Meteorologica;* the *De Sensu;* and the *Metaphysica,* i.–v., together with an abridgment of what he wrote on the remaining books of the *Metaphysica.* The most important of Alexander's other extant works are *On Fate,* in which he argues against the Stoic doctrine of necessity; and *On the Soul,* in which he contends that the undeveloped reason in man is material (*νοῦς ὑλικός*) and inseparable from the body He argued strongly against the doctrine of immortality. He identified the active intellect (*νοῦς ποιητικός*), through whose agency the potential intellect in man becomes actual, with God.

Several of Alexander's works were published in the Aldine edition of Aristotle (Venice, 1495–98); his *De Fato* and *De Anima* were printed along with the works of Themistius at Venice (1534); the former work, which has been translated into Latin by Grotius and also by Schulthess, was edited by J. C. Orelli (Zürich, 1824); and his commentaries on the *Metaphysica* by H. Bonitz (Berlin, 1847). J. Nourisson has treated of his doctrine of fate, *De la liberté et du hazard* (Paris, 1870).

See PERIPATETICS (*ad fin*); ALEXANDRISTS; POMPONAZZI, PIETRO; also A Apelt, "Die Schrift d. Alex. v. Aphr.," *Philologus,* xlv. (1886); C. Ruelle, "Alex. d'Aphr. et le prétendu Alex. d'Alexandrie," *Rev. des études grecques,* v. (1892); E. Zeller's *Outlines of Gk. Phil.* (Eng. trans. ed. 1905. p. 296).

ALEXANDER OF HALES (ALEXANDER HALENSIS), known as DOCTOR IRREFRAGABILIS, was one of the first English scholars and theologians to make his influence felt in Paris. Born *c.* 1175 in Gloucestershire, he went to study at Paris, where he became a master of arts sometime before 1210. About 1231 he entered the Friars Minor, and after his appointment as the first *magister regens* of the chair of theology held by his order in the university became celebrated as a teacher John of Rochelle, Bonaventura and probably Roger Bacon were among his pupils. He died in 1245. Roger Bacon tells us that Alexander's *Summa Theologiae* weighed more than a horse and was not entirely of his own composition The latter statement is well substantiated, and pending publication of the critical edition which is being made by the Franciscans of Quaracchi little can be said with certainty about Alexander's theories. However, we know that he attempted to correlate the predominating Augustinianism of his day with the newly introduced philosophy of Aristotle and the Arabians, and apart from the doctrines that were common to the scholastics (*see* SCHOLASTICISM) we find in him certain theories that were to become characteristic of the Franciscan school Thus he admits the plurality of forms, the independence of body and soul, the existence of an intelligible matter or potency in all spiritual creatures, and the Augustinian theory of Divine Illumination in knowledge. Alexander's *Summa Theologiae* (best edition, Venice 1576) was extensively utilized by Albert the Great, St. Thomas, and St. Bonaventura.

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ALEXANDER OF TRALLES (ALEXANDER TRALLIANUS), Greek physician, born at Tralles in Lydia, lived probably about the middle of the 6th century B.C. The Greek text of his Βιβλία ἰατρικά was printed at Paris in 1548 and his *De Lumbricis* at Venice in 1570.

See E. Milward, *Trallianus Reviviscens* (1734).

ALEXANDER SEVERUS (MARCUS AURELIUS SEVERUS ALEXANDER) (208–235), Roman emperor from A.D. 222 to 235, was born at Arca Caesarea, in Palestine, on Oct. 1, 208. He was the son of an imperial procurator. In 221 his grandmother, Julia Maesa, persuaded her nephew, the emperor Heliogabalus, to adopt him as successor and create him Caesar. In the next year, on

March 11, Heliogabalus was murdered, and Alexander was proclaimed emperor by the Praetorians and accepted by the senate. He was then a mere lad, amiable, well-meaning, but entirely under the dominion of his mother, Julia Mammaea, who surrounded him with wise counsellors, but who alienated the army by extreme parsimony, while neither she nor her son had a strong enough hand to keep tight the reins of military discipline. Mutinies became frequent in all parts of the empire; to one of them the life of the jurist and praetorian praefect, Ulpian, was sacrificed; another compelled the retirement of Dio Cassius from his command. On the whole, however, the reign of Alexander was prosperous till he was summoned to the East to face the new power of the Sassanians (*see* PERSIA: *History*). Of the war that followed we have very various accounts; Mommsen leans to that which is least favourable to the Romans. At all events, though the Persians were checked for the time, the conduct of the Roman army showed an extraordinary lack of discipline. The emperor returned to Rome and celebrated a triumph (233), but next year he was called to face German invaders in Gaul, where he was slain (on March 18 or 19, 235), together with his mother, in a mutiny which was probably led by Maximinus, a Thracian legionary, and at any rate secured him the throne. Alexander was the last of the Syrian princes. His advisers were the famous jurist, Ulpian, the historian, Dio Cassius, and a select board of 16 senators; a municipal council of 14 assisted the city praefect in administering the affairs of the 14 districts of Rome. The luxury and extravagance that had formerly been so prevalent at the court were put down; the standard of the coinage was raised; taxes were lightened; literature, art and science were encouraged; the lot of the soldiers was improved; and, for the convenience of the people, loan offices were instituted for lending money at a moderate rate of interest. In religious matters Alexander preserved an open mind In his private chapel he had busts of Orpheus, Abraham, Apollonius of Tyana and Jesus Christ.

See Lampridius, *Alexander Severus;* Dio Cassius lxxviii. 30, lxxix. 17, lxxx. i.; Herodian vi. 1–18; Porrath, *Der Kaiser Alex Sev.* (1876); Pauly-Wissowa, *Realencyklopädie,* ii 2.526 *seq* (Groebe); monograph by Sir Richard Hopkins, *Cambridge Historical Essays,* No. xiv. (1907). A von Domaszewski "Die Daten der Scriptores historiae Augustae von Severus Alexander bis Carus," *Sitzungsberichte der Heidelberger Akademie der Wissenschaften* (1917) for a different chronology. K. Honn, *Quellenuntersuchungen zu den Viten des Heliogabalus und des Severus Alexander* (1911).

ALEXANDER THE PAPHLAGONIAN, a celebrated impostor and worker of false oracles, was born at Abonouteichos (*see* INEBOLI) in Paphlagonia in the early part of the 2nd century A.D. The vivid narrative of his career given by Lucian might be taken as fictitious but for the corroboration of certain coins of the emperors Lucius Verus and Marcus Aurelius (J. H. Eckhel, *Doctrina Nummorum Veterum,* ii, p 383, 384) and of a statue of Alexander, said by Athenagoras (*Apology,* c. 26) to have stood in the forum of Parium. Alexander succeeded in establishing an oracle of Aesculapius at his native town. Having circulated a prophecy that the son of Apollo was to be born again, he contrived that there should be found in the foundations of the temple to Aesculapius, then in course of construction at Abonouteichos, an egg in which a small live snake had been placed. Alexander had little difficulty in convincing the Paphlagonians of the second coming of the god under the name of Glycon. A large tame snake with a false human head, wound round Alexander's body as he sat in a shrine in the temple, gave "autophones" or oracles unasked, but the usual methods practised were those of the numerous oracle-mongers of the time, of which Lucian gives a detailed account, the opening of sealed enquiries by heated needles, a neat plan of forging broken seals, and the giving of vague or meaningless replies to difficult questions. The reputation of the oracle spread, and Alexander set up an "intelligence bureau" in Rome, instituted mysteries like those of Eleusis, from which the Christians and Epicureans were alike excluded as "profane," and celebrated a mystic marriage between himself and the moon. Lucian's own close investigations into Alexander's methods of fraud led to a serious attempt on his life. The whole account gives a graphic description of the inner working of one among the many new oracles that were springing up at this period. Alexander lived to be seventy and amassed great sums of money.

BIBLIOGRAPHY.—*See* Lucian, Ἀλεξάνδρος ἢ ψευδόμαντις; F. Gregorovius, *The Emperor Hadrian,* translated by M. E. Robinson (1898); and Samuel Dill, *Roman Society from Nero to Marcus Aurelius* (1904).

ALEXANDER ARCHIPELAGO, a maze of about 1,100 islands and islets (area about 13,000sq.m.) lying close inland off the south-west coast of Alaska, U.S.A, situated between 54° 40′ and 58° 30′ N. They are the remnant of a submerged mountain system; the islands rise 3,000 to 5,000ft. above the sea with luxuriantly wooded tops and bold sheer sides scarred with marks of glacial action. In some respects the scenery is similar to that of Norway. Through the inner channels, sheltered from the Pacific by the island ramparts, runs the "inland passage," the tourist route northward from Seattle, Washington. The principal islands from north-west to south-east are Chicagof, Baranof, Admiralty, Kupreanof, Kuiu, Prince of Wales (the largest of the archipelago and of all the islands about Alaska, measuring about 140m. in length and 40m. in width), Etolin and Revillagigedo. Sitka, the former capital, is on the west coast of Baranof island.

ALEXANDERS (botanical name, *Smyrnium olusatrum* family Umbelliferae), a stout herbaceous plant with a furrowed, much-branched stem 1–3ft. high, and large compound leaves with broad sheathing stalks, and broad, cut or lobed segments. The small yellow flowers are borne in compound umbels. The plant is a native of the Mediterranean region, and was formerly cultivated as a pot-herb. It is now found apparently wild in Great Britain and Ireland, growing in waste places, especially near the sea and amongst ruins.

ALEXANDERSBAD, a watering-place, Bavaria, Germany, romantically situated in the Fichtelgebirge, near Wunsiedel, 1,900ft. above the sea. Its waters are ferruginous and largely used in nervous and rheumatic disorders. In the neighbourhood is the Luisenburg (or Luxburg), a hill commanding a fine view of the whole Fichtelgebirge.

ALEXANDERSON, ERNST F. W. (1878–), engineer and inventor, born at Uppsala, Sweden, Jan. 25, 1878. He early exhibited a strong aptitude for mechanics. After graduating from the Royal Technical university in Stockholm, he passed a year at the Royal Institute of Technology at Berlin. In 1901 he went to the United States; in 1902 he entered the draughting department of the General Electric Company at Schenectady, two years later becoming a member of the engineering staff. During his 25 years with the General Electric Company he took out more than 200 patents, many of them significant in the advance of the electrical art. He has done valuable work in railway electrification and electric ship propulsion. His contributions are in the field of radio, and probably the best known of these is the Alexanderson high frequency alternator, which, in conjunction with the magnetic amplifier and multiple tuned antenna, has been extensively used in commercial long-wave trans-oceanic radio communication. His invention employing the high-power vacuum tube for relaying and modulation forms the basis of all broadcasting transmitters. The Alexanderson system of tuned radio frequency reception has made possible the modern selective receiver, thus solving the problem of interference between the numerous transmitting stations. This system is used in the best receiving sets to-day. He has also developed and demonstrated a system of television and a system of broadcasting pictures by radio.

In 1920 the Radio Corporation of America was formed at the request of the U.S. Government to exploit the Alexanderson system of trans-oceanic radio telegraphy, which was used extensively during the World War. Alexanderson was lent by the General Electric Company to act as chief engineer of the new enterprise. Later, returning to his work at Schenectady, he was made chief consulting engineer of the Radio Corporation, while remaining a consulting engineer of the General Electric Company. He was at one time president of the Institute of Radio Engineers.

ALEXANDRA (1844–1925), Queen Consort of Edward VII., King of Great Britain and Ireland, eldest daughter of Prince Christian of Gluecksburg, afterwards King Christian IX. of

Denmark, and Louise, daughter of the Landgrave William of Hesse, was born at Copenhagen Dec. 1, 1844, her full name being Alexandra Caroline Maria Charlotte Louisa Julia. One of her sisters married the tsar of Russia and became the mother of the Tsar Nicholas II. As a child Alexandra was simply brought up and early evinced a love of music and of fairy tales, being encouraged in this by her parents' friendship with Hans Andersen. She was married to Albert Edward, Prince of Wales, afterwards Edward VII., March 10, 1863, and was crowned with him in Westminster Abbey, Aug. 9, 1902.

Her singular beauty and charm—first celebrated in Tennyson's *A Welcome to Alexandra* (1863) when she came to England as a bride—preserved even into old age, won her immense popularity, and her progress through the streets of London on Alexandra Day, or Rose Day, a yearly event inaugurated by her in 1912 to raise funds for the London hospitals by the selling of roses in the streets, attracted vast crowds. She had earlier shown her great interest in the care of the sick by giving her name to the Queen Alexandra's Imperial Nursing Service, organized in 1902 to supply nurses for naval and military hospitals, as well as by her gift to the London Hospital in 1899 of the first Finsen lamp for light treatment of skin diseases. Her love of country life, and especially of horses and dogs, endeared her to a nation, like herself, lovers of animals. Though she took her full share in all public ceremonials, she was happiest in her country home at Sandringham. There in Dec. 1924 she kept her 80th birthday, surrounded by her children and grandchildren, and there she died Nov. 20, 1925. She was buried beside King Edward in St. George's Chapel, Windsor.

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(J. E. C.)

ALEXANDRE, NOËL (NATALIS ALEXANDER) (1639–1724), French theologian and ecclesiastical historian, born at Rouen, Jan. 19, 1639, was professor of philosophy at the convent of Saint-Jacques in Paris. He became provincial of his order in 1706, but was banished to Châtellerault in 1709 for having subscribed to the *Cas de conscience* (1703). He died in Paris, Aug. 21, 1724.

The best known of his numerous works is the *Selecta historiae ecclesiasticae capita, et in loca ejusdem insignia dissertationes historicae, chronologicae, dogmaticae* (1676–86), which was placed on the Index by Innocent XI. on account of his bold defence of the Gallican claims.

See *Catalogue complet des oeuvres du Père Alexandre* (1716); Quétif-Echard, *Scriptores ordinis praedicatorum* (1719–21), t. ii. p. 810; and full bibliography in A. Vacant, *Dict. de Théologie* (scholarly article by P. Mandounet, cols. 769–772). Of the numerous editions of Alexandre's ecclesiastical history the best is that of P. J. D. Mansi, which contains many valuable notes and additions (Lucca, 1749) and has been frequently reprinted.

ALEXANDRETTA, a city of Syria, on the gulf of the same name. Pop. 15,000, two-thirds Muslim. Iskanderun (its Turkish name) preserves the name but probably not the exact site of the city founded to commemorate Alexander's victory over the Persians at Issus (333 B.C.). The name "little Alexandria" appears to date from the 4th century A.D. The city is surrounded by a girdle of hills, spurs of the Cilician Taurus. Its site on marshy, deltaic ground has made it notoriously unhealthy, as an early epithet *scabiosa* indicates, and the yellow hue of the natives of to-day reflects the constant prevalence of fever. The British Levant (Turkey) Company maintained an agency and factory here for 200 years till 1825 in spite of appalling mortality among its employees. Alexandretta lies in the *état* Syria of French mandated territory and has attached to it a *sanjaq*. The Anatolian frontier reaches the sea 12m. to the north. A branch line (1913) connects Alexandretta to the north at Topra-Kale with the Baghdad railway. A journey to Aleppo thus involves crossing the frontier twice. Alexandretta was formerly the main outlet for the overland trade from Persia and India until the construction of the Suez Canal diverted this to shipboard. It still remains the main port for the district of Aleppo, a connection with which by railway *via* Antioch is projected. It provides the only safe anchorage on the Syrian coast. There is as yet only a small boat harbour and transhipment of goods has to be effected by lighters in open roadstead, but French enterprise is expected to alter this. Imports are mainly cotton, silk and woollen goods as well as yarns, dyes and buffalo hides for the soles of native shoes. Exports include live stock (cattle and sheep to Egypt), textiles, tobacco, silk cocoons, pistachio nuts, oranges, lemons, liquorice and gall-nuts. Britain has here a vice-consul. Petroleum has been discovered south-west of Alexandretta, and antimony and chrome are reported to exist in the surrounding hills.

See *Admiralty Handbook of Syria* (1913); *Diplomatic and Consular Reports on Turkey; Reports on Syria of Department of Overseas Trade.*

ALEXANDRIA, a city and chief seaport of Egypt, and for over a thousand years from its foundation the capital of the country, situated on the Mediterranean in 31° 12′ N., 29° 15′ E., and 129m. by rail N.W. of Cairo. The ancient Canopic mouth of the Nile (now dry) was 12m. east.

I. **The Modern City.**—The city is built on the strip of land which separates the Mediterranean from Lake Mareotis (Mariut),



A BAZAAR STREET IN THE NATIVE QUARTER OF ALEXANDRIA, EGYPT
Alexandria, an important trading centre of Egypt, still retains after 2,000 years the cosmopolitan spirit engendered by its founder, Alexander the Great. It numbers among its inhabitants Egyptians, Greeks, Jews and Europeans and has industries ranging from the ancient oriental art of rug weaving to paper manufacture

and on a T-shaped peninsula which forms harbours east and west. The stem of the T was originally a mole leading to an island (Pharos) which formed the cross-piece. In the course of centuries this mole has been silted up and is now an isthmus half a mile wide. On it a part of the modern city is built. The cape at the western end of the peninsula is Ras et-Tin (Cape of Figs); the eastern cape is known as Pharos or Kait Bey.

The customs house and chief warehouses are by the western harbour, but the principal buildings of the city are in the east

and south-east quarters. The Place Mehemet Ali, or Grand square, which is the centre of the life of the city and the starting-point of the electric tramways, is an oblong open space, tree-lined, in the centre of which there is an equestrian statue of the prince after whom it is named. The square is faced with handsome buildings mainly in the Italian style, including the law courts, exchange, Ottoman bank, English church and the Abbas Hilmi theatre. A number of short streets lead from the square to the eastern harbour. Here a sea wall, completed in 1905, provides a magnificent drive and promenade along the shore for a distance of about 3 miles. From the south end of the square the Rue Sherif Pasha—in which are the principal shops—and the Rue Tewfik Pasha lead to the boulevard, or rue, de Rosette. In it are the Zizinia theatre and the municipal palace (containing the public library); the museum, containing an excellent collection of antiquities, lies up a short street to the north. The western end of the boulevard leads to the Place Ibrahim, often called Place Ste. Cathérine, from the Roman Catholic church at its south-east side. In a street running south from the boulevard to the railway station is the mosque of Nebi Daniel, containing the tombs of Said Pasha and other members of the khedivial family.

The north quarter, thoroughly oriental in style, is mainly occupied by Egyptians and Levantines. This Arab quarter is traversed by the Rue Ras et-Tin, leading to the promontory of that name. Here, overlooking the harbour, is the khedivial yacht club (built 1903) and the palace built by Mehemet Ali. In the district between the Grand square and the western harbour, one of the poorest quarters of the city, is an open space with Fort Caffareli or Napoleon in the centre. This quarter has been pierced by several straight roads, one of which, crossing the Mahmudiya canal by the Pont Neuf, leads to Gabbari, the most westerly part of the city, and an industrial and manufacturing region, possessing asphalt works and oil, rice and paper mills. On either side of the canal are the warehouses of wholesale dealers in cotton, wool, sugar, grain and other commodities In the southern part of the city are the Arab cemetery, "Pompey's Pillar" and the catacombs. "Pompey's Pillar" (A.D. 302), which stands on the highest spot in Alexandria, is nearly 99ft. high, including the pedestal. The shaft is of red granite and is beautifully polished. The catacombs, a short distance south-west of the pillar, are hewn out of the rocky slope of a hill, and are an elaborate series of chambers adorned with pillars, statues, religious symbols and traces of painting.

The eastern bay is rocky, shallow and exposed, and is now used only by fishing craft, though a breakwater to protect its quays was completed in 1916. The harbour is on the west of Pharos and partly formed by a breakwater (built 1871–73 and prolonged 1906–07), 2m. long. The breakwater starts opposite the promontory of Ras et-Tin, on which is a lighthouse, 180ft. above the sea, built by Mehemet Ali. Another breakwater starts from the Gabbari side, the opening between the two works being about half a mile. A number of scattered rocks lie across the entrance, but through them two fairways have been made, and the enclosed water is divided into an outer and inner harbour by a mole, 1,000yd. long, projecting north-west from the southern shore. The inner harbour covers 464 acres. It is lined for 2½m. by quays, affording accommodation for ships drawing up to 28ft. The outer harbour (1,400 acres water area) is furnished with a graving dock, 520ft. long, and with quays and jetties along the Gabbari foreshore.

Alexandria is linked by a network of railway and telegraph lines to the other towns of Egypt, and there is a trunk telephone line to Cairo. The city secured in 1906 a new and adequate water-supply, modern drainage works having been completed the previous year. Being the great *entrepôt* for the trade of Egypt, the city is the headquarters of the British chamber of commerce and of most of the merchants and companies engaged in the development of the Delta. Over 80% of the total exports and imports of the country pass through the port.

The population of the city, including the suburbs, in 1927 was 570,314. The foreigners numbered over 100,000, of whom the majority were Greeks, Italians, Syrians, Armenians and other Levantines, though almost every European and Oriental nation is represented. The labouring population is mainly Egyptian; the Greeks and Levantines are usually shopkeepers or petty traders.

II. **The Ancient City.**—The Greek Alexandria was divided into three regions: (1) the Jews' quarter, forming the north-east portion of the city; (2) Rhacotis, on the west, occupied chiefly by Egyptians; (3) Brucheum, the Royal or Greek quarter, forming the most magnificent portion of the city. In Roman times Brucheum was enlarged by the addition of an official quarter, making up the number of four regiones in all. The city was laid out as a gridiron of parallel streets, each of which had an attendant subterranean canal; and the two main streets, lined with colonnades and said to have been each about 200ft. wide, intersected in the centre of the city. The island of Pharos was joined to the mainland by a mole nearly a mile long and called the Heptastadium. The end of this abutted on the land at the head of the present Grand square, where rose the "Moon Gate." All that now lies between that point and the modern Ras et-Tin quarter is built on the silt which gradually widened and obliterated this mole. The Ras et-Tin quarter represents all that is left of the island of Pharos, the site of the actual lighthouse having been weathered away by the sea. On the east of the mole was the great harbour, now an open bay; on the west lay the port of Eunostos, with its inner basin Kibotos, now vastly enlarged to form the modern harbour.

In Strabo's time (latter half of 1st century B.C.) the principal buildings were as follows, enumerated as they were to be seen from a ship entering the great harbour. (1) the royal palaces, filling the north-east angle of the town and occupying the promontory of Lochias, which shut in the great harbour on the east. Lochias, the modern Pharillon, has almost entirely disappeared into the sea, together with the palaces, the private port and the island of Antirrhodus. There has been a land subsidence here, as throughout the north Delta and indeed all the north-east coast of Africa; and on calm days the foundations of buildings may be seen, running out far under sea, near the Pharillon. (2) The great theatre, on the modern Hospital hill near the Ramleh station. This was used by Caesar as a fortress, where he stood a siege from the city mob after the battle of Pharsalus. (3) The Poseideion or temple of the sea-god, close to the theatre and in front of it. (4) the Timonium built by Anthony. (5, 6, 7) The Emporium (exchange), Apostases (magazines) and Navalia (docks), lying west of (4), along the sea-front as far as the mole. Behind the Emporium rose (8) the great Caesareum, by which stood the two obelisks, later known as "Cleopatra's Needles," and now removed to London and New York. This temple became in time the Patriarchal church, some remains of which have been discovered; but the actual Caesareum, so far as not eroded by the waves, lies under the houses lining the new sea-wall. (9) The Gymnasium and (10) the Palaestra are both inland, near the great Canopic street (Boulevard de Rosette) in the eastern half of the town, but on sites not determined. (11) The temple of Saturn: site unknown. (12) The Mausolea of Alexander (Soma) and the Ptolemies in one ring-fence, near the point of intersection of the two main streets. (13) The museum with its library and theatre in the same region; but on a site not identified. (14) The Serapeum, the most famous of all Alexandrian temples. Strabo tells us that this stood in the west of the city; and recent discoveries go far to place it near "Pompey's Pillar" (*see* above), which, however, was an independent monument erected to commemorate Diocletian's siege of the city. On the eastern point of the Pharos island stood the great lighthouse, one of the "Seven Wonders," reputed to be 400ft. high. The first Ptolemy began it, and the second completed it, at a total cost of 800 talents. It is the prototype of all lighthouses in the world. A temple of Hephaestus also stood on Pharos at the head of the mole.

III. **History.**—Founded in 332 B.C. by Alexander the Great, Alexandria was intended to supersede Naucratis (*q.v.*) as a Greek centre in Egypt, and to be both a secure naval base for his designs on Persia and a link between Macedonia and the rich Nile valley. If such a city was to be on the Egyptian coast, there was only one possible site, behind the screen of the Pharos island and

removed from the silt thrown out by Nile mouths. An Egyptian townlet, Rhacotis, already stood on the shore and was a resort of fishermen and pirates. Alexander occupied Pharos, and had a walled city marked out by Deinocrates on the mainland to include Rhacotis. A few months later he left Egypt for the East and never returned to his city; but his corpse was ultimately entombed there. His viceroy, Cleomenes, continued the creation of Alexandria. The Heptastadium, however, and the mainland quarters seem to have been mainly Ptolemaic work. Inheriting the trade of ruined Tyre and becoming the centre of the new commerce between Europe and the Arabian and Indian East, the city grew in less than a century to be larger than Carthage; and for some centuries more it had to acknowledge no superior but Rome. It was a centre not only of Hellenism but of Semitism, and the greatest Jewish city in the world. There the Septuagint was produced. The early Ptolemies kept it in order and fostered the development of its museum into the leading Greek university; and as a free Greek city, it retained its own senate into Roman times. In 80 B.C., however, it passed formally under Roman jurisdiction according to the will of Ptolemy Alexander; though it had been under Roman influence for more than a hundred years previously. There Julius Caesar dallied with Cleopatra in 47 B.C. and was mobbed by the rabble; there his example was followed by Antony, for whose favour the city paid dear to Octavian, who placed over it a prefect from the imperial household. Alexandria seems from this time to have regained its old prosperity, commanding, as it did, an important granary of Rome; in the Augustan age, its free population was estimated at 300,000 in addition to an immense number of slaves. In A.D. 215 the emperor Caracalla visited the city; and, in order to repay some insulting satires that the inhabitants had made upon him, a general massacre was perpetrated. Notwithstanding this terrible disaster, Alexandria soon recovered its former splendour, and for some time longer was esteemed the first city of the world after Rome, while it now acquired fresh importance as a centre of Christian theology and church government. There Arianism was formulated and there Athanasius, the great opponent of both heresy and pagan reaction, worked and triumphed. As native influences, however, began to reassert themselves in the Nile valley, Alexandria gradually became an alien city, more and more detached from Egypt; and, losing much of its commerce as the peace of the empire broke up during the 3rd century A.D., it declined fast in population and splendour. In 616 it was taken by Chosroes, king of Persia, and in 640 by the Arabians, under 'Amr, after a siege that lasted 14 months, during which Heraclius, the emperor of Constantinople, did not send a single ship to its assistance. Notwithstanding the losses that the city had sustained, 'Amr was able to write to his master, the caliph Omar, that he had taken a city containing "4,000 palaces, 4,000 baths, 12,000 dealers in fresh oil, 12,000 gardeners, 40,000 Jews who pay tribute, 400 theatres or places of amusement." The well-known tale of how the famous library was used for six months to supply the furnaces of the public baths is now regarded as doubtful, in view of the many calamities which the collection had already suffered. About the year 646 'Amr was deprived of his government by the caliph Othman. The Egyptians, by whom 'Amr was greatly beloved, were so much dissatisfied by this act, and even showed such a tendency to revolt, that the Greek emperor determined to make an effort to reduce Alexandria. The attempt proved perfectly successful. The caliph, perceiving his mistake, immediately restored 'Amr, who, on his arrival in Egypt, drove the Greeks within the walls of Alexandria, captured the city after a most obstinate resistance, and completely demolished its fortifications. Alexandria now rapidly declined in importance. The building of Cairo in 969, and, above all, the discovery of the route to the East by the Cape of Good Hope in 1498, nearly ruined its commerce; the canal, which supplied it with Nile water, became blocked; and although it remained a principal Egyptian port, it played no great part in history until Napoleon's Egyptian expedition thrust it into prominence.

Battle of 1801.—The French troops stormed the city on July 2, 1798, and it remained in their hands until the arrival of the British expedition of 1801. The battle of Alexandria, fought on March 21, of that year, between the French army under Gen. Menou and the British expeditionary corps under Sir Ralph Abercromby, took place near the ruins of Nicopolis, on the narrow spit of land between the sea and Lake Aboukir. The British position on the night of the 20th extended across the isthmus, the right resting upon the ruins of Nicopolis and the sea, the left on the lake of Aboukir and the Alexandria canal. The line faced generally southwest towards the city, the reserve division under Maj.-Gen. (Sir) John Moore on the right, the Guards brigade in the centre, and three other brigades on the left. The French attacked before dawn. The first shock was repulsed, but a French column penetrated in the dark between two regiments of the British and a confused fight ensued in the ruins, in which the 42nd (Black Watch) captured a colour. The front and rear ranks of the 28th (Gloucestershires) were simultaneously engaged, and the conduct of the regiment won for it the distinction of wearing badges both at the front and at the back of their head-dress. Other regiments which assisted in the overthrow of the French column were the 23rd, 40th and 58th. In a second attack Sir Ralph Abercromby was engaged in personal conflict with some French dragoons, and about this time received a mortal wound, though he remained on the field and in command to the end. The attack on the centre was repulsed by the cool and steady fire of the Guards, and the left wing maintained its position with ease, but the French cavalry for the second time came to close quarters with the reserve. About half-past eight the combat began to wane, and the last shots were fired at ten. The forces engaged were approximately 14,000 British to about 20,000 French, and the losses were:—British, 1,468 killed, wounded and missing, including Abercromby (who died on the 28th), Moore and three other generals wounded; French, 1,160 killed and (?) 3,000 wounded. The British subsequently advanced upon Alexandria, which surrendered on Aug. 31.

In the 19th Century.—By this time it had sunk to a small town of about 4,000 inhabitants; and it owed its modern renascence solely to Mehemet Ali, who wanted a deep port and naval station for his viceregal domain. He restored its water communication with the Nile by making the Mahmudiya canal, finished in 1820; and he established at Ras et-Tin his favourite residence. The old Eunostus harbour became the port, and a flourishing city arose on the old Pharos island and the Heptastadium district, with outlying suburbs and villa residences along the coast eastwards and the Mareotic shore. Being the starting-point of the "overland route" to India, and the residence of the chief foreign consuls, it quickly acquired a European character. At Alexandria most of the negotiations between the powers and Mehemet Ali were conducted; thence started the Egyptian naval expeditions to Crete, the Morea and Syria; and thither sailed the betrayed Ottoman fleet in 1839. It was twice threatened by hostile fleets, the Greek in 1827 and the combined British, French and Russian squadrons in 1828. It was connected with Cairo by railway in 1856, and remained the real capital of Egypt till Said Pasha died there in 1863 and Ismail came into power. Though this prince continued to develop the city, giving it a municipality in 1866 and new (but inadequate) harbour works in 1871–78, he developed Cairo still more; and the centre of gravity definitely shifted to the inland capital.

Bombardment of 1882.—Fate, however, again brought Alexandria to the front. After a mutiny of soldiers there in 1881, the town was greatly excited by the arrival of an Anglo-French fleet in May 1882, and on June 11 a terrible riot and massacre took place, resulting in the death of a large number of Europeans. Since satisfaction was not given for this and the forts were being strengthened at the instigation of Arabi Pasha, the British admiral, Sir Beauchamp Seymour (afterwards Lord Alcester), sent an ultimatum on July 10 and demolished the forts the next day. As Arabi did not submit, a British military expedition landed at Alexandria on Aug 10, the sequel being the British occupation of the whole country.

IV. **Antiquities.**—Persistent efforts have been made to explore the antiquities of Alexandria The authorities of the museum have been enabled from time to time to carry out systematic

excavations when opportunity offered; D G. Hogarth made tentative researches on behalf of the Egyptian Exploration Fund and the Society for the Promotion of Hellenic Studies in 1895; and a German expedition worked for two years (1898–99). But the great and growing modern city stands right over the ancient one, making it almost impossible to find any considerable space in which to dig, except at enormous cost; and the general subsidence of the coast has sunk the lower-lying parts of the ancient town under water Unfortunately the spaces still most open are the low grounds to north-east and south-west, where it is practically impossible to get below the Roman strata.

The most important results were those achieved by Dr. G. Botti, late director of the museum, in the neighbourhood of "Pompey's Pillar," where there is a good deal of open ground. Here substructures of a large building or group of buildings have been exposed, which are perhaps part of the Serapeum. Hard by immense catacombs and columbaria have been opened which may have been appendages of the temple. These contain one very remarkable vault with curious painted reliefs, now lighted by electricity and shown to visitors. The objects found in these researches are in the museum, the most notable being a great basalt bull, probably once an object of cult in the Serapeum. Other catacombs and tombs have been opened in Kom es-Shugafa Hadra (Roman) and Ras et-Tin (painted). The Germans found remains of a Ptolemaic colonnade and streets in the north-east of the city, but little else. Hogarth explored part of an immense brick structure under the mound of Kom ed-Dik, which may have been part of the Paneum, the Mausolea or a Roman fortress The making of the new foreshore led to the dredging up of remains of the Patriarchal church; and the foundations of modern buildings are seldom laid without some objects of antiquity being discovered. The wealth underground is doubtless immense; but, despite all efforts, there is not much for antiquarians to see in Alexandria outside the museum and the neighbourhood of "Pompey's Pillar."

ALEXANDRIA, town in Bonhill parish, Dumbartonshire, Scotland, on the right bank of the Leven, about 3m N of Dumbarton, served by the L.N E R. and L M S R. It owes its origin almost entirely to cotton printing and bleaching works based on an abundant supply of excellent water and contains a large Turkey-red dyeing establishment. Pop. (1921) 5,600. Alexandria is connected with Bonhill, on the opposite bank of the river, by a bridge which replaced in 1898 one bought three years earlier by the county council from the Smollett family, who have been closely associated with the district since the time of Sir James Smollett, the novelist's grandfather. Alexandria takes the name from a member of this family, Alexander Smollett. The industries of Bonhill are calico printing, dyeing and bleaching. Pop. (1921) of parish 10,359. Jamestown, about 1m N E. of Alexandria, with a station on the L. and N E. railway, contains some of the largest cotton printing works in Scotland. Pop. of parish (1921) 2,389.

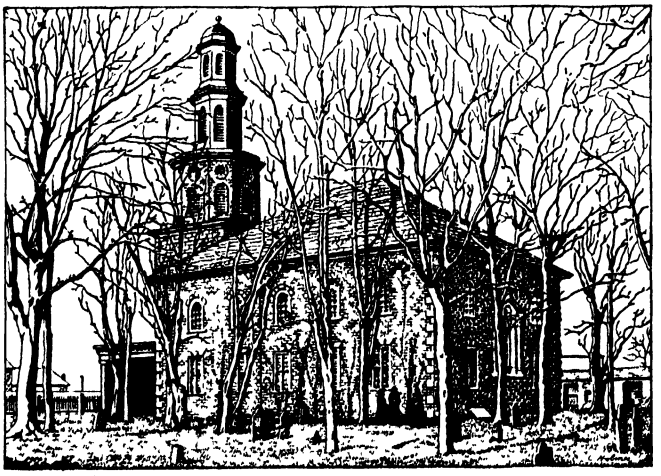
ALEXANDRIA, a city of Louisiana, U S A , on the south bank of the Red river, in the centre of the state; the capital of Rapides parish. It is on Federal highways 71 and 165, and is served by the Louisiana Railway and Navigation Company, the Texas and Pacific, the Rock Island, the Missouri Pacific, the Southern Pacific and the Louisiana and Arkansas railways, and by steamboats on the river. The population in 1920 was 17,510, (45% were negroes), and was estimated locally at 25,000 in 1927.

The city is on a level plain in the centre of extensive forests of long-leaf pine, interspersed with various hard woods. Rice, cotton, sugar, alfalfa and vegetables are the principal crops raised in the vicinity. There are over 100 factories in and near the city, with an aggregate output valued at $15,000,000, including sawmills, a creosoting plant, foundries and machine shops, cottonseed-oil mills, brick yards, an oil refinery, broom-handle and talcum factories and railroad repair shops The city has a large wholesale and retail trade. A free traffic bridge leads to the town of Pineville, on the north side of the river (pop. 1920, 2,188), where there is a national cemetery. A state hospital for the insane, and Louisiana college, a Baptist co-educational institution which was opened in 1906, Camp Beauregard (8,000 ac.), a U.S. Veterans' hospital, the State Industrial School for girls and the State Colony for the feeble-minded are also near by.

Alexandria was named after Alexander Fulton, on whose grant from Spain the first settlement was made in 1785. It was incorporated as a town in 1818 and received a city charter in 1882. In May 1863 and again in March 1864, it was occupied by Union forces under Admiral David D. Porter and Gen. N. P. Banks. When finally vacated, May 12–13, 1864, the city was almost entirely burned. The Union gunboats, which had passed up the river toward Shreveport at high tide, were caught above the falls at Alexandria, and saved by a splendid piece of engineering (a dam at the falls) by Lieut.-Col. Joseph Bailey (1827–67).

ALEXANDRIA, a city and a port of entry in Northern Virginia, U.S A., on the W. bank of the Potomac river, 7m. below Washington, D.C ; contiguous to, but independent of, Arlington county. It is served by the Richmond, Fredericksburg and Potomac, the Southern, and the Old Dominion railways, and by the Norfolk and Washington, D C., Steamboat Company. Through the Potomac yards for the classification of freight, on the northern boundary of the city, there is a daily movement of over 3,000 cars. The river is a mile wide at this point, with a good harbour. The population was 18,060 in 1920; of whom 4,112 were negroes; and 18,473 in 1925 (estimate).

Alexandria is a quaint, old-fashioned city, with quiet, shady streets. Many buildings date back to the 18th century: Christ church (1783–88), in which George Washington and Robert E Lee worshipped; Carlyle house (1752), where General Braddock in 1755 organized his ill-fated expedition against Fort Duquesne, and where, later in the same year, the famous Council of Governors met to determine upon concerted action against the French; City hotel; Washington Free school (1785); Friendship Engine house (1774); the home of "Light Horse Harry" Lee, and his son, Robert E. Lee; Marshall house, where the first fatality of the Civil War took place; and others of historic interest. An imposing modern land-mark, visible for many miles, is the George Washington National Masonic memorial, recently built at a cost of $5,000,000. About 2½m. west of Alexandria is the Protestant Episcopal Theological seminary, opened in 1823.



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OLD CHRIST CHURCH AT ALEXANDRIA, VA , IN WHICH GEORGE WASHINGTON SERVED AS ONE OF THE FIRST VESTRYMEN AND WHERE ROBERT E. LEE WORSHIPPED

Alexandria is a distributing and jobbing centre for the northern counties of Virginia. There is a United States Naval Torpedo station on the water-front and a large plant for the construction and repair of refrigerator-cars is near the city. There are about 60 other industrial plants. Their principal products are glass, clothing, silk, spark plugs, beverages, ice and fertilizers. The municipality owns its gas plant, but the water supply is under private control. The daily newspaper, the Alexandria *Gazette,* was founded in 1784.

The first settlement here was made in 1695. In 1749 a town was laid out, called Belle Haven, or Belhaven. A few years

later the name was changed to Alexandria, in honour of John Alexander, who had owned the land in the latter part of the 17th century. The city soon became an important port for the products of Northern Virginia, from which flour and tobacco were shipped to the West Indies and even to Europe. Improved roads were built for wagon-trains, and "rolling roads" were constructed, on which hogsheads of tobacco were rolled down from the plantations to the port. This economic development was checked by the anomalous political history of the city. From 1790 to 1846 it was part of the District of Columbia, at first with a vague and uncertain status, and later overshadowed by the development of the capital. Hardly had it been ceded back to Virginia before the clouds of the Civil War began to gather, and during the whole course of the war it was occupied by Union troops. After the erection of the State of West Virginia (1863), and until the close of the war, it was the seat of the "Alexandria Government" (*see* VIRGINIA). In 1814 the city was threatened by a British fleet, but averted attack by a payment of about $100,000. Alexandria was incorporated in 1779 and rechartered in 1852. A commission-manager form of government was adopted Sept. 1, 1922.

ALEXANDRIAN SCHOOL, a term applied to certain tendencies in literature, science and art, which took their rise in Alexandria. That city, founded by Alexander the Great, was in every way admirably adapted for becoming the new centre of the world's activity and thought. Its situation brought it into commercial relations with all the nations lying around the Mediterranean, and at the same time rendered it the one communicating link with the wealth and civilization of the East. The great natural advantages it thus enjoyed were increased to an enormous extent by the care of the sovereigns of Egypt, the Ptolemies Soter (323–285), Philadelphus (285–247) and Euergetes (247–222). The first began to draw around him from various parts of Greece a circle of men eminent in literature and philosophy. To these he gave every facility for the prosecution of their learned researches. Under the inspiration of his friend Demetrius of Phalerum, the Athenian orator, statesman and philosopher, this Ptolemy laid the foundations of the great Alexandrian library. He also built, for the convenience of his men of letters, the museum, which was in many respects not unlike a modern university. Philadelphus, whose librarian was the poet Callimachus, bought up all of Aristotle's library, and included in his collection some foreign works, among these was the Pentateuch, the Greek translation of which (the Septuagint) dates from his time. Euergetes largely increased the library by getting possession of the official Athenian copies of the dramatists, and by compelling all travellers who arrived in Alexandria to leave a copy of any work they possessed.

The intellectual movement so originated extended over a long period of years, 306 B.C.–A.D. 642 which falls into two divisions; 306–30 B.C. from the foundation of the Ptolemaic dynasty to its final subjugation by the Romans; and 30 B.C. to A.D. 642 when Alexandria was destroyed by the Arabs. In the first of the two periods the intellectual activity was of a purely literary and scientific nature. This was particularly noticeable under the early Ptolemies, Alexandria being then almost the only home in the world for pure literature. During the last century and a half before the Christian era, the school, as it might be called, began to break up and to lose its individuality. This was due partly to the state of government under some of the later Ptolemies, partly to the formation of new literary circles in Rhodes, Syria and elsewhere, whose supporters, though retaining the Alexandrian peculiarities, could scarcely be included in the Alexandrian school. Under Roman sway the influence of the school was extended over the whole known world, but men of letters began to concentrate at Rome rather than at Alexandria. Meanwhile, Alexandria developed a new movement, which was not in the old direction—having, indeed, nothing in common with it. With its character largely determined by Oriental gnosticism and containing Jewish and later, Christian elements, this second Alexandrian school resulted in the speculative philosophy of the Neoplatonists and the religious philosophy of the Gnostics and early church fathers.

Thus we may distinguish an earlier Alexandrian school, which is scientific and literary, and a later, which is philosophic and theological. In both, "school" is used rather loosely; we should perhaps do better to speak of "tendency."

I. Literature.—The general character of the literature of the school appears as the necessary consequence of the state of affairs brought about by the fall of Greek nationality and independence. The great works of the Greek mind had formerly been the products of the free and active, yet not undisciplined atmosphere of the Greek city-state. But with the rise of Macedonia, the city-state vanished from practical politics, taking with it freedom as a Greek understood it, and in large measure, independence and originality of thought. A substitute for this originality was found by the Alexandrians in learned research, stimulated by a reverential interest in the works of the past (*cf.* CLASSICS). They studied criticism, grammar, prosody and metre, antiquities and mythology. The results of this study constantly appear in their productions. Their works are written by and for the learned; they appeal to a small public, little interested in political and military affairs of the time, courtly, as was natural, seeing that many were under the direct patronage of a king, full of literary and scientific interests of all kinds, but, as it happened, not including any writer of first-rate genius. Three tendencies are very marked; viz., (1) Interest in all branches of science, and in the statement of its results in literary form. (2) Interest in the technique of literary expression, particularly that of verse; prose was for some reason far less popular. (3) Preoccupation in what was then a comparatively new literary motif, since it dates only from Euripides, namely the psychology of love. Most of the great love stories date from this period, and almost for the first time, the heroine is apt to be the central figure. The chief literary forms were.—

(1) *Epic.*—This, against the advice and practice of the greatest literary authority, Callimachus, was attempted by several writers. The *Argonautica* of Apollonius Rhodius survives; it is a very learned work, showing immense knowledge of epic metre and diction, and many episodes (notably the central one, the loves of Jason and Medea) are full of merit; but as a whole, it is dull and lacks unity. Epic was also written by Rhianus, who produced a long poem, now lost, on the Messenian wars. Better and more characteristic was the *epullion,* or little epic, in which some one episode was treated at length, the rest of the story being merely alluded to. Good examples are the two poems on Heracles and on the Dioscuri, in the Theocritean corpus; the most famous was the *Hecale* of Callimachus, of which fragments survive.

(2) *Didactic poetry.*—This was very popular, for it gave an opportunity to handle neatly and tastefully a subject interesting in itself. Prominent examples are the *Phaenomena* of Aratus, a versified handbook of astronomy and meteorology; the *Theriaca* of Nicander, on snake-bites and herbal remedies for them, is remarkable for its highly learned and obscure diction, a fault, or rather a deliberate affectation, of many Alexandrians. Many mythological poems, as the *Aetia* of Callimachus, approach didactic poetry in subject, since they profess to explain customs, rites and so forth.

(3) *Elegiac poems* were of many kinds. Most characteristic were those dealing with love; in this genre, which was not strictly new, since it had been handled long before by Mimnermus, for instance, the Alexandrians, with their new interest in psychology and *ethos,* excelled, to judge from the scanty fragments remaining, and the criticisms and imitations of Latin writers such as Propertius. The *Lyde* of Antimachus was the pioneer of this movement; the first Alexandrian writer of the erotic elegy was Philetas of Cos; Callimachus, Hermesianax, and others also won distinction therein. The elegy was also used for mythological narrative, sometimes lengthy, as in Callimachus' *Aetia;* the mythological works of Euphorion, however, seem to have been mostly in hexameters. As an important offshoot of these compositions, we may notice the epigram (*cf.* ANTHOLOGY) which assumed a new importance among the Alexandrians.

(4) *Closet-drama,* including both tragedies and comedies. As the great age of drama was over, nothing first-rate was to be expected from the Pleiad, as the seven most admired authors in

this vein were called. The fragments which survive, and the Alexandra of Lycophron (in form a *rhesis* or messenger's speech from a tragedy, and a byword for its extreme obscurity) do not whet our appetite for more.

(5) *The mime*, a short dialogue, or monologue dealing with everyday life. Besides anonymous fragments, we have several mimes of Herodas, a writer little appreciated in antiquity. They are artificial in language, for they are in the dialect and metre of the old Ionian writers of iambics; in content, they show keen and cynical observation of commonplace, and not always very reputable, men and women. A development of this kind of work, and of the earlier prose mimes of Sophron, was the pastoral, usually a dialogue in form, sketching, with or without idealization, country life, especially that of herdsmen. The great name here is that of Theocritus, among whose *Eidullia* ("little scenes or pictures") are some of the most beautiful poems in any language. Several of his imitators, such as Bion, Moschus, and the unknown writer of the Eighth Idyll, are decidedly pretty, although artificial.

(6) *Prose:* here the characteristic form is rhetorical history, or at least history written with an eye to stylistic effect, although research was not absent. Timaeus and Theopompus (both lost) were among the most celebrated; Cleitarchus and others wrote on the exploits of Alexander, which became in their hands more and more mixed with sheer fable. Polybius' history is in large measure a counterblast to the rhetorical style; it remained an almost isolated attempt.

(7) *Lyric poetry* was but mediocre, for it was not an age of intense emotions freely expressed. However, numerous pieces were written in lyric metres, avoiding the great complication and variety of Pindar and his contemporaries and keeping to those forms of verse which are easily reducible to fixed rules. Here Sotades may be mentioned. He wrote a number of poems in a variety of Ionics called after him Sotadean; the subjects appear to have been highly indecent.

(8) *Parody and satire* flourished, for example the *Silloi* of Timon, mock epic verses abusing philosophers.

In *grammar and philology*, the work of the Alexandrian critics, although lacking the minute accuracy of the best modern scholarship, aided as that is by palaeography, comparative philology, and archaeology, was most meritorious. It was their aim to collect and preserve in a correct and intelligible form the literature of Greece, and to comment adequately on it, where necessary. Their methods (*διόρθωσις*, textual or lower criticism, with *ἀνάγνωσις*, correct accentuation; *τέχνη* or syntactical study, *ἐξήγησις* or commentary, and *κρίσις* higher or literary criticism, differ little in principle from our own. (*See* CLASSICS; TEXTUAL CRITICISM.) Besides the great Aristarchus, and Zenodotus, whose labours on Homer were second only to Aristarchus' in value, may be named Aristophanes of Byzantium, Homeric critic and inventor of the signs for accents; Crates; and several of the most famous writers, as Apollonius Rhodius, Lycophron, and Callimachus. Many works were written on grammar (as by Dionysius Thrax, the first important Greek grammarian), chronology (Eratosthenes is the great name here, *see* CHRONOLOGY); (Callimachus wrote on the chronology of the drama), mythology (the *Bibliotheca* falsely ascribed to Apollodorus, and many scholia, epitomize much of this learning), geography (again Eratosthenes took a leading part), and astronomy (Hipparchus, and later Claudius Ptolemaus, from whom the Ptolemaic system is named; *see* ASTRONOMY). Medicine was studied with much success (Herophilus and Erasistratus were great anatomists), and finally, the mathematicians of that age notably advanced this science; Archimedes and Apollonius of Perga are especially great names (*see* MATHEMATICS) while Eucleides is still familiar as the "Euclid" but recently displaced as a text-book of geometry.

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II. Philosophy.—The mutual criticisms of the various philosophic schools, all of which continued to exist, had resulted in a general feeling of uncertainty and scepticism. As a result, any doctrine which claimed infallible certainty was sure of a hearing; and this was found in the various Eastern religions, notably Judaism. Hence arose that characteristic feature of Alexandrian thought which we may call *gnosticism*. A supposed revelation (*gnosis*) personal or derived from ancient writings, set forth with Greek logic and rhetoric, is the central feature of all the most characteristic Alexandrian philosophy (*see* NEO-PYTHAGOREANISM; HERMES TRISMEGISTUS).

So far as the Jewish succession is concerned, the great name is that of Philo in the first century of our era. He took Greek metaphysical theories, and, by the allegorical method, read them into the Old Testament. He dealt with (*a*) human life as explained by the relative nature of Man and God, (*b*) the Divine nature and the existence of God, and (*c*) the great *Logos* doctrine as the explanation of the relation between God and the material universe. From these three arguments he developed an elaborate theosophy which was a syncretism of oriental mysticism and pure Greek metaphysic, and may be regarded as representing the climax of Jewish philosophy. Of pagan schools of philosophy, the first was Neo-Pythagoreanism, the second and last Neo-Platonism (*q.v.*). Their doctrines were a synthesis of Platonism, Stoicism and the later Aristotelianism with a leaven of oriental mysticism which gradually became more and more important. The world to which they spoke had begun to demand a doctrine of salvation to satisfy the human soul. They therefore devoted themselves to examining the nature of the soul, and taught that its freedom consists in communion with God, to be achieved by absorption in a sort of ecstatic trance. This doctrine reaches it height in Plotinus, after whom it degenerated into magic and theurgy in its unsuccessful combat with the victorious Christianity. Finally this pagan theosophy was driven from Alexandria back to Athens under Plutarch and Proclus, and occupied itself largely in purely historical work based mainly on the attempt to reorganize ancient philosophy in conformity with the system of Plotinus. This school ended under Damascius when Justinian closed the Athenian schools (A.D. 529). The influence of all this on some of the most enlightened Christians, as Clement and Origen, was enormous. They strove after a Christian *gnosis*. Side by side with them, a swarm of semi-Christian Gnostic sects arose. Such ideas are still present much later in Synesius, bishop of Ptolemais, and Neo-Platonism, gradually absorbed into Christianity, profoundly and lastingly modified its theology.

See *Histories of Philosophy* by Zeller, Ueberweg, Windelband, etc., and bibliography of CHURCH HISTORY and the other special articles referred to above.

ALEXANDRIA TROAS, an ancient Greek city of the Troad, situated on the west coast at nearly its middle point, a little south of Tenedos. It was built by Antigonus, perhaps about 310 B.C., and was called by him Antigonia Troas. Early in the next century the name was changed by Lysimachus to Alexandria Troas, in honour of Alexander's memory. As the chief port of north-west Asia Minor, the place prospered greatly in Roman times, and the existing remains sufficiently attest its former importance. Thence St. Paul sailed for Europe for the first time, and there occurred later the episode of the raising of Eutychus (Acts xx. 5–12). The circuit of the old walls can be traced, and there are remains of some ancient buildings, including a bath and gymnasium and an aqueduct built by Trajan. The harbour had two large basins, now almost choked with sand.

ALEXANDRINA, LAKE, in South Australia, forms with Lake Albert and the curious boomerang-shaped Coorong a series of extensive and shallow lagoons about the outlet of the River Murray. (Lake Alexandrina: area, *c.* 220sq.m.; depth: 7–10ft.; L. Albert: *c.* 64sq.m.; 3–6ft.) A relic of a sea-gulf—analogous to Spencer and St. Vincent gulfs—which penetrated northwards into what is now the lower Murray basin, Lake Alexandrina was formed by a (geologically) recent elevation of the coast line, so that now the Murray, lacking a "mouth" in the ordinary sense, can only be approached by an entrance over a shifting sand-bar carrying some 7–12ft. of water and beset with breakers. Moreover the large water-surface which these lakes expose, coupled with a sub-arid climate (average annual temp. *c.* 61–62°; average annual rainfall *c.* 22 in.) leads to an evaporation which has been esti-

mated at 42,000 million cu.ft. per annum (Lakes Alexandrina and Albert). This loss, which has normally to be borne by the River Murray system, is particularly felt in dry seasons. An intake of sea-water may then occur and adversely affect pastoral and agricultural interests for some distance upstream. Associated with certain incidents in the history of Australian exploration—notably that of Sturt's voyage of discovery down the Murrumbidgee-Murray in 1830—Lake Alexandrina is now chiefly of interest as constituting one of Australia's national problems. The River Murray valley is of rapidly growing importance. Lack of a natural outlet by way of the mouth has encouraged, if it has not caused, the development of numerous railway lines which tap the river at various points along its course. The riparian States, and particularly the capitals of those States, have vested interests which militate against the construction of a river-mouth port. This project, however, is appealing ever more insistently as one of national importance. Various solutions—notably a port at Goolwa served by a connecting canal—have been proposed. After being referred to various commissions and expert investigations, the question was discussed by Sir George Buchanan (Report on Transport in Australia, vol. ii., 1927), and the matter was explicitly referred to by the Commonwealth Premier in a speech which was held by some to foreshadow action by the Commonwealth Government. Subsequently, the draining of Lake Albert was proposed, and the conversion of its bed into agricultural land.

ALEXANDRINE VERSE, a name given to the leading measure in French poetry. It is the heroic French verse, used in epic narrative, in tragedy, and in the higher comedy. There is some doubt as to the origin of the name; but most probably it is derived from a collection of romances, compiled in the 12th century, of which Alexander of Macedon was the hero. Before the publication of this work most of the trouvère romances appeared in octosyllabic verse. There is also a theory that the form was invented by a poet named Alexandre. The new work, which was henceforth to set the fashion to French literature, was written in lines of 12 syllables, but with a freedom of pause which was afterwards greatly curtailed. The new fashion, however, was not adopted all at once. The metre fell into disuse until the reign of Francis I, when it was revived by Jean Antoine de Baif (1532–89), one of the seven poets known as the *Pléiade* (*q.v.*) Jodelle (1532–73) mingled episodical Alexandrines with the *vers communs* of his tragedies and so introduced them into drama. It was Ronsard, however, who made the verse popular and gave it vogue in France. From his time it became the recognized vehicle for all great poetry, and the regulation of its pauses became more strict. Two laws came to be established with regard to the pauses. The first is, that each line should be divided into two equal parts, the sixth syllable always ending with a word. In the earlier use of this metre, on the contrary, it frequently happened that the sixth and seventh syllables belonged to the same word. The other is that, except under the most stringent conditions, there should be none of what the French critics call *enjambement,* that is, the overlapping of the sense from one line on to the next. Ronsard completely ignored this rule, which was after his time settled by the authority of Malherbe. Later French poets have abandoned the rigidity of Malherbe, as a reference to a popular play like Rostand's *Cyrano de Bergerac* will show.

Michael Drayton, who was 22 years of age when Ronsard died, seemed to think that the Alexandrine might be as pleasing to English as it was to French ears, and in this metre he wrote a long poem called the *Polyolbion.* The metre, however, failed to catch the English ear. In English heroic verse it is but rarely introduced; but in the favourite narrative metre, known as the Spenserian, it comes in regularly as the concluding line of each stanza. In English usage, moreover, there is no fixed rule as to the position of the pause. Thus Thomson (*Castle of Indolence,* i. 42):—

> And music lent new gladness to the morning air.

The danger in the use of the Alexandrine is that, in attempting to give dignity to his line, the poet may only produce heaviness, incurring the criticism of Pope:—

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

The Alexandrine was the dominant metre in Dutch poetry from the 16th to the middle of the 19th century, and about the time of its introduction to Holland it was accepted in Germany by the school of Opitz. In the course of the 17th century, after being used without rhyme by Seckendorf and others, it formed a transitional station on the route to German blank verse, and has since then been rarely employed, except occasionally in rhymed comedy.

ALEXANDRISTS, the name given to those philosophers of the Renaissance, who, in the great controversy on the subject of personal immortality, adopted the explanation of the *De Anima* given by Alexander of Aphrodisias. According to the orthodox Thomism of the Roman Catholic Church, Aristotle rightly regarded reason as a faculty of the individual soul. Against this, the Averroists, led by Agostino Nifo (*q.v.*), introduced the modifying theory that universal reason in a sense individualizes itself in each soul and then absorbs the active reason into itself again. These two theories respectively evolved the doctrine of individual and universal immortality, or the absorption of the individual into the eternal One. The Alexandrists, led by Pietro Pomponazzi, boldly assailed these beliefs and denied that either was rightly attributed to Aristotle. They held that Aristotle considered the soul as a material and therefore a mortal entity which operates during life only under the authority of universal reason. Hence the Alexandrists denied the possibility of immortality in every shape or form. Since the soul is organically connected with the body, the dissolution of the latter involves the extinction of the former.

ALEXANDRITE, a variety of chrysoberyl (*q.v.*) discovered in the Urals in 1833, on the day set apart for celebrating the majority of the cesarevich, afterwards the tsar, Alexander II., in whose honour the stone was named It is remarkable for being strongly dichroic, generally appearing dark green by daylight and raspberry-red by candle-light, or by daylight transmitted through the stone. As red and green were the military colours of Russia, the mineral became highly popular as a gem-stone.

ALEXANDROPOL or **ALEXANDRAPOL:** *See* LENINAKAN.

ALEXANDROV, TODOR (1882–1924), Macedonian leader, was born at Stip in Central Macedonia. As a youth he took part in the comitadji campaign against Turkey, becoming one of the most prominent leaders of the Bulgarian bands in Macedonia. After the treaties which concluded the World War had allotted his native district to Yugoslavia, he came to Sofia and began to reorganize the old I.M.R.O. (International Macedonian Revolutionary Organization) against Yugoslavia and Greece. Imprisoned by Stamboliski, he escaped through the connivance of his friends, retired to the mountains near Petritch, and there organized a power which was able not only to terrorize Serbian and Greek Macedonia, but also to defy the Bulgarian Government, against which he declared irrevocable hostility in 1923, after he had failed to persuade Stamboliski to support his cause. Alexandrov himself aimed at an autonomous Macedonia, with its capital at Salonika, and thus incurred the hostility of the more moderate group of "Federalists," who were on tolerable relations with the Yugoslav Government. He helped to bring about the fall and death of Stamboliski in June 1923, and under the Government of Tsankov was practically an independent ruler; but when this Government also disavowed the Macedonians, Alexandrov turned elsewhere for help, and entered into relations, first with Turkey, then with M. Radič, the Croat leader, and finally with the Third International. A treaty concluded in the summer of 1924 between the Macedonian Autonomists and the Third International was alleged to bear Alexandrov's signature, but afterwards repudiated by him. Violent dissensions broke out in his party over the advisability or not of accepting Russian help, and as a result of them, Alexandrov was murdered on Aug. 31, 1924.

Alexandrov was for years the uncrowned and absolute king of the Bulgarian Macedonians, who almost worshipped him He was a very fine figure, tall, black-bearded and handsome, and as ruthless as he was brave. His courts knew only three verdicts: acquittal, a hundred stripes, or death, the last being inflicted for theft, insult to a woman, or political treachery. He must have

been responsible for many hundreds of deaths; withal, he was a man of personal probity and fanatical and selfless patriotism.

(C. A. M.)

ALEXANDROVSK, a town in Sakhalin Island in the far eastern area of the R.S.F.S.R. Lat. 51° 10′ N. Long. 142° 5′ E Pop. (1926) 7,807. It is a port on the west coast in the coal and naphtha area and is the administrative centre for the Russian part of the island.

ALEXANDROVSK, a town in South Russia, now called Zaporozhe (*q.v.*).

ALEXEYEV, MIKHAIL (1857–1918), Russian soldier, was born Nov. 3, 1857. Entering the army in 1876, he became a general in 1904. At the outbreak of the World War he was appointed chief of staff on the south-western front, and in that capacity was largely responsible for the Russian victory in Galicia in 1914. In March 1915 he took over command of the armies on the north-western front and by his energy and ability saved them from complete destruction. Appointed chief of the general staff in Aug. 1915, he had to give up this office in Nov. 1916 on account of ill health.

From March to May 1917 he commanded the army; recalled in September by Kerensky, he attempted to mediate between Kerensky and Kornilov. Failing in this, he went to S. Russia and there organized the "Volunteer" army. On the death of Kornilov in March 1918, the military command of the army was taken over by Denikin and Alexeyev became leader of the Government. On Sept. 25, 1918 he died of heart disease at Ekaterinodar.

ALEXIS, Greek comic poet of the Middle Comedy, was born at Thurii and taken early to Athens, where he became a citizen. He wrote during the latter half of the 4th century and perhaps the early part of the 5th. Plutarch says that he lived to the age of 106, and that he died on the stage while being crowned. According to Suidas, who calls him Menander's uncle, he wrote 245 comedies, of which about 130 titles are preserved. The fragments (about 1,000 lines) attest the wit and refinement of the author (Koch, *Comicorum Atticorum Fragmenta*).

ALEXIS, WILLIBALD, the pseudonym of GEORG WILHELM HEINRICH HÄRING (1798–1871), German historical novelist. He was born June 29, 1798 at Breslau, where his father, who came of a French refugee family, named Hareng, was an official. He attended the Werdersche Gymnasium in Berlin, and served as a volunteer in the campaign of 1815. On his return he studied law at the universities of Berlin and Breslau. Settling in Berlin, he edited, 1827–35, the *Berliner Konversationsblatt,* in which for the first two years he was assisted by Friedrich Christoph Förster (1791–1868). In 1852 he retired to Arnstadt in Thuringia, where after many years of broken health he died Dec. 16, 1871.

Alexis made his name as a writer by an idyll in hexameters, *Die Treibjagd* (1820), and several short stories in which the influence of Tieck is observable; but his reputation was first established by two historical romances, *Walladmor* (1823), and *Schloss Avalon* (1827), which, published as being "freely translated from the English of Sir Walter Scott, with a preface by Willibald Alexis," so closely imitated the style of the famous Scotsman as really to deceive even Scott's admirers. Alexis published a number of successful short stories (*Gesammelte Novellen,* 1830–31), some books of travel, and the novels *Das Haus Dusterweg* (1835) and *Zwölf Nächte* (1838).

In *Cabanis* (1832), a story of the time of Frederick the Great, he entered the field of patriotic-historical romance, in which he earned the name of "der Maerkische Walter Scott" (Walter Scott of the Mark). *Cabanis* is written in the first person, is rather clumsy in construction, and has the faults of excessive romanticism. From 1840 onwards he published at short intervals a series of romances, each dealing with some epoch in the history of Brandenburg. Among them may be noted *Der Roland von Berlin* (1840); *Der falsche Woldemar* (1842); *Die Hosen des Herrn von Bredow* (1846–48), in which room is found for many delightful folk and ghost stories; and *Ruhe ist die erste Bürgerpflicht* (1852). In 1842, in conjunction with the publicist Julius Eduard Hitzig (1780–1849), he began the publication of *Der neue Pitaval* (continued by A. Vollert, Leipzig, 1842–65; new edition Leipzig, 1866–91), a collection of criminal anecdotes culled from all nations and all times. This publication attained great popularity, and is to-day of psychological interest and value.

BIBLIOGRAPHY.—His *Gesammelte Werke* were published in Berlin (1874); the *Vaterländische Romane* in eight volumes (1881, 1884), and, since the expiration of the copyright in 1901, in many cheap reprints. Cf. *W. Alexis' Erinnerungen,* edited by M. Ewert (1900); and essays by Julian Schmidt, *Neue Bilder aus dem geistigen Leben unserer Zeit* (1873); G. Freytag, *Werke,* vol. xvi. and xxiii.; A. Stern, *Zur Literatur der Gegenwart* (1880); and T. Fontane, *Bayreuther Blätter,* vi. (1883).

ALEXISBAD, a spa of Anhalt, Germany, under the Harz mountains, 1,000ft. above sea-level, noted for its medicinal waters, of which the Alexisbrunnen, a ferruginous spring, is used for drinking, while the Selkebrunnen supplies the baths, which are of use in feminine disorders. The place was founded in 1810 by Duke Alexius of Anhalt-Bernburg.

ALEXIUS I. (1048–1118), emperor of the East, was the third son of John Comnenus, nephew of Isaac Comnenus, emperor 1057–59. His father declined the throne on the abdication of Isaac, who was accordingly succeeded by four emperors of other families between that date and 1081. Under one of these emperors, Romanus Diogenes (1067–71), he served with distinction against the Seljuk Turks. Under Michael Parapinaces (1071–78) and Nicephorus Botaniates (1078–81) he was also employed, along with his elder brother Isaac, against rebels in Asia Minor, Thrace and in Epirus (1071). The success of the Comneni roused the jealousy of Botaniates and his ministers, and the Comneni were almost compelled to take up arms in self-defence. Botaniates was forced to abdicate and retire to a monastery, and Isaac declined the crown in favour of his younger brother Alexius, who then became emperor in the 33rd year of his age. His long reign of nearly 37 years was full of difficulties (*see* ROMAN EMPIRE, LATER). At the very outset he had to meet the formidable attack of the Normans (Robert Guiscard and his son Bohemund), who took Dyrrhachium and Corfu, and laid siege to Larissa in Thessaly. The Norman danger ended for the time with Robert Guiscard's death (1085) and the conquests were recovered. He had next to repel the invasions of Patzinaks (Petchenegs) and Kumans in Thrace, with whom the Manichaean sects of the Paulicians and Bogomilians made common cause; and thirdly, he had to cope with the fast-growing power of the Turks in Asia Minor. Above all he had to meet the difficulties caused by the arrival of the warriors of the first crusade, which had been in a great degree initiated owing to the representations of his own ambassadors, though the help which he wanted from the West was simply mercenary forces and not the immense hosts which arrived to his consternation and embarrassment. The first part, under Peter the Hermit, he got rid of by sending them on to Asia Minor, where they were massacred by the Turks (1096). The second and much more serious host of warriors, led by Godfrey of Bouillon, he conducted also into Asia, promising to supply them with provisions in return for an oath of homage, and by their victories recovered for the empire a number of important cities and islands —Nicaea, Chios, Rhodes, Smyrna, Ephesus, Philadelphia, Sardis, and in fact most of Asia Minor (1097–99). This is ascribed as a credit to his policy and diplomacy by his daughter, by the Latin historians of the crusade to his treachery and falseness. The last 20 years of his life were marked by persecution of the followers of the Paulician and Bogomilian heresies (one of his last acts was to burn Basilius, a Bogomilian leader, with whom he had engaged in a theological controversy), by renewed struggles with the Turks (1110–17), and by anxieties as to the succession, which his wife Irene wished to alter in favour of her daughter Anne's husband, Nicephorus Bryennius, for whose benefit the special title panhypersebastos (*i.e.* as it were *augustissimus si quis alius*) was created. This intrigue disturbed even his dying hours. He deserves the credit of having raised the empire from a condition of anarchy and decay at a time when it was threatened on all sides by new dangers. No emperor devoted himself more laboriously or with a greater sense of duty to the task of ruling.

BIBLIOGRAPHY.—Zonaras xviii. 27–29; Anna Comnena's *Life; see* also Du Cange, *Familiae Byzantinae;* Friedrich Wilken, *Rerum ab*

Alexio I., Joanne, Manuele et Alexio II. Comnenis Romanorum, Byzantinorum imperatoribus gestarum, libri iv. Commentatio (Heidelberg, 1811); Finlay, *History of Greece* (vol. iii., Oxford, 1877); Gibbon, *Decline and Fall of the Roman Empire*, edited with notes, etc., by Prof. J. B. Bury (1898) where further authorities are cited; F. Chalandon, *Essai sur le règne d'Alexis Ier Comnène* (1900).

(J. B. B.)

ALEXIUS II. (COMNENUS) (1167–1183), emperor of the East, was the son of Manuel Comnenus and Maria, daughter of Raymund, prince of Antioch, and was born at Constantinople on Sept. 10, 1167. On Manuel's death, Maria, who had been immured in a convent under the name of Xene, had herself proclaimed regent (1179–80), and handing over her son to evil counsellors, who encouraged him in every vice, supported the government of Alexius the protosebastos (nephew of Manuel), who was supposed to be her lover. The young Alexius and his friends now tried to form a party against the empress mother and the protosebastos; and his sister Maria, wife of Caesar John, stirred up riots in the streets of the capital. Their party was defeated (May 2, 1182), but Andronicus Comnenus took advantage of these disorders to enter Constantinople, where he was received with almost divine honours, and overthrew the regents. His arrival was celebrated by a barbarous massacre of the Latins in Constantinople, which he made no attempt to stop. He allowed Alexius to be crowned, but forced him to consent to the death of all his friends, including his mother, his sister and the Caesar, and refused to allow him the smallest voice in public affairs. The betrothal in 1180 of Alexius with Agnes, daughter of Louis VII. of France, a child of nine, was quashed, and he was married to Irene, daughter of Andronicus. The latter was now formally proclaimed as co-emperor, and not long afterwards, on the pretext that divided rule was injurious to the Empire, he caused Alexius to be strangled with a bow-string. (J. B B.)

ALEXIUS III. (Angelus), emperor of the East, was the second son of Andronicus Angelus, nephew of Alexius I. In 1195, while his brother Isaac II. was away hunting in Thrace, he was proclaimed emperor by the troops; he captured Isaac at Stagira, in Macedonia, put out his eyes, and kept him henceforth a close prisoner, though he had been redeemed by him from captivity at Antioch and loaded with honours. To compensate for this crime and to confirm his position as emperor, he had to scatter money so lavishly as to empty his treasury, and to allow such licence to the officers of the army as to leave the empire practically defenceless. He consummated the financial ruin of the state. The empress Euphrosyne tried in vain to sustain his credit and his court; Vatatzes, the favourite instrument of her attempts at reform, was assassinated by the emperor's orders. Eastward the empire was overrun by the Turks; from the north Bulgarians and Vlachs descended unchecked to ravage the plains of Macedonia and Thrace; while Alexius squandered the public treasure on his palaces and gardens. Soon he was threatened by a new and yet more formidable danger. In 1202 the western princes assembled at Venice, bent on a new crusade. To them Alexius, son of the deposed Isaac, made appeal, promising as a crowning bribe to heal the schism of East and West if they would help him to depose his uncle. The crusaders, whose objective had been Egypt, were persuaded to set their course for Constantinople, before which they appeared in June 1203, proclaiming the emperor Alexius IV. and summoning the capital to depose his uncle. Alexius III., sunk in debauchery, took no efficient measures to resist. His son-in-law, Lascaris, who was the only one to do anything, was defeated at Scutari, and the siege of Constantinople began. On July 17 the crusaders, the aged doge Dandolo at their head, scaled the walls and took the city by storm. During the fighting and carnage that followed Alexius hid in the palace and finally, with one of his daughters, Irene, and such treasures as he could collect, got into a boat and escaped to Develton in Thrace leaving his wife, his other daughters and his empire to the victors. Isaac, drawn from his prison and robed once more in the imperial purple, received his son in state.

Shortly afterwards Alexius made an effort in conjunction with Murzuphlus (Alexius V.) to recover the throne. The attempt was unsuccessful and, after wandering about Greece, he surrendered with Euphrosyne, who had meanwhile joined him, to Boniface of Montferrat, then master of a great part of the Balkan peninsula. Leaving his protection he sought shelter with Michael, despot of Epirus, and then repaired to Asia Minor, where his son-in-law, Lascaris, was holding his own against the Latins. Alexius, joined by the sultan of Iconium (Konia) now demanded the crown of Lascaris, and on his refusal marched against him. Lascaris, however, defeated and took him prisoner. Alexius was relegated to a monastery at Nicaea, where he died on some date unknown.

See the records of Nicetas Acominatus, George Acropolites, Nicephorus Gregoras, and the sources quoted for the Fourth Crusade in the article CRUSADES. (J. B. B.)

ALEXIUS IV. (d. 1204), Byzantine Emperor, 1203–04. When Isaac II. was dethroned and blinded by his brother Alexius III., his son Alexius escaped, in 1201, to Germany, where he persuaded his brother-in-law, Philip of Suabia, and Boniface of Montferrat, the leader of the crusaders, to divert the fourth crusade to Constantinople. By 1203 Isaac was restored, with Alexius as joint emperor, but they were unable to fulfil the promises made to the crusaders that they would contribute men and money to the expedition to Jerusalem and would force the East to conform to the Western Church. In Jan. 1204 quarrels broke out between the crusaders and the Greeks, who revolted under the leadership of Murzuphlus An officer, Canabus, was put on the throne, but was imprisoned by Murzuphlus, who had Alexius strangled, while Isaac died of shock At this the crusaders, in self-defence against the Greeks, stormed and captured Constantinople a second time and elected Baldwin of Flanders as Latin Emperor. (*See* CRUSADES; also DANDOLO)

ALEXIUS V., eastern Roman emperor, was proclaimed emperor Feb. 5, 1204, during the siege of Constantinople by the Latins (fourth crusade). His name was Alexius Ducas Murzuphlus, and he was a connection of the imperial house of the Angeli. His elevation was the result of a revolution in the city against Isaac II and Alexius IV. He conducted the defence with great bravery till it became hopeless (April 12), whereupon he fled. He would then have made common cause with Alexius III. against the Latins, but was blinded by that ex-monarch and fell into the hands of the crusaders, who put him to death by casting him from the top of the Pillar of Theodosius as the murderer of Alexius IV.

ALEXIUS MIKHAILOVICH (1629–1676), tsar of Muscovy, the son of Tsar Michael Romanov and Eudoxia Streshnevaya, was born on March 9, 1629. A youth at his father's death (1645), he was committed to the care of Boris Ivanovich Morozov, who recognized the needs of his country and was accessible to Western ideas. He secured the truce with Poland and avoided complications with the Porte His domestic policy was equitable, and aimed at relieving the public burdens by limiting the privileges of foreign traders and abolishing many useless and expensive court offices. On Jan. 17, 1648, he procured the marriage of the tsar with Maria Miloslavskaya, and he himself married her sister Anna ten days later.

The Miloslavskis were typical self-seeking 17th century boyars, whose extortions made them generally detested. In May 1648 the people of Moscow rose against them, and the young tsar was compelled to dismiss both them and their patron Morozov. There were disquieting disturbances all over the tsardom culminating in dangerous rebellions at Pskov and Great Novgorod, with which the Government was so unable to cope that it surrendered, practically granting the malcontents their own terms. The metropolitan Nikon (q.v.), who had displayed tact and courage at Great Novgorod, in consequence became in 1651 the tsar's chief minister.

In 1653 the weakness and disorder of Poland, which had just emerged from the savage Cossack war, encouraged Alexius to attempt to recover from her secular rival the old Russian lands. The campaign of 1654 was an uninterrupted triumph, and scores of towns, including the important fortress of Smolensk, fell into the hands of the Muscovites. In Jan. 1655 the rout of Ochmatov arrested their progress; but in the summer of the same year, the sudden invasion by Charles X. of Sweden for the moment swept the Polish State out of existence; the Muscovites, unop-

posed, quickly appropriated nearly everything which was not already occupied by the Swedes, and when at last the Poles offered to negotiate, the whole grand-duchy of Lithuania was the least of the demands of Alexius.

Fortunately for Poland, the tsar and the king of Sweden now quarrelled over the spoil, and at the end of May 1656 Alexius declared war against him. Great things were expected of the Swedish war, but nothing came of it. Dorpat was taken, but countless multitudes were lost in vain before Riga. In the meantime Poland had so far recovered herself as to become much more dangerous than Sweden. The tsar rid himself of the Swedes by the peace of Kardis (July 2, 1661), whereby Muscovy retroceded all her conquests. The Polish war dragged on for six years longer and was then concluded by a truce, nominally for 13 years, which proved the most durable of treaties.

By the truce of Andrussowo (Feb. 11, 1667) Vitebsk, Polotsk and Polish Livonia were restored to Poland, but Smolensk and Kiev remained in the hands of the Muscovites, together with the whole eastern bank of the Dnieper. This truce was the achievement of Athanasy Orduin-Nashchokin, the first Russian chancellor and diplomatist in the modern sense, who after the disgrace of Nikon became the tsar's first minister till 1670, when he was superseded by Artamon Matveyev. Nikon had become too powerful for the tsar, and on the return of Alexius from the Polish war there arose a conflict over the question of ecclesiastical authority in the State, ending in Nikon's trial and deprivation in 1667.

Alexius had the art of discovering good advisers and the good sense to employ them. He was not a man of strong character, or he would not have submitted to the dictation of Nikon. He was naturally progressive, though in a timid way, or he would not have supported the reforms of Matveyev. He was learned in his own way, wrote verses and began a history of his own time. His last years were tranquil, in spite of the rebellion of Stenka Razin. By his first wife he had a large family, and by his second, Natalla Naruishkina, two children, the tsarevich Peter and the tsarevna Natalia.

See Robert Nisbet Bain, *The First Romanovs* (London, 1905).

ALEXIUS PETROVICH (1690–1718), Russian tsarevich, the sole surviving son of Peter I. and Eudoxia Lopukhina, was born on Feb. 19, 1690. The young tsar married the *boyarinya* Lopukhina at his mother's command. From the first, her society bored Peter unspeakably, and, after the birth (Oct. 3, 1691) of their second short-lived son Alexander, he practically deserted her. The young Alexius was ignored by his father till he was nine years old, and was privately educated. In 1703 he was ordered to the field as a private in a bombardier regiment in the army. In 1704 he was present at the capture of Narva.

In 1708 Peter sent Alexius to Smolensk to collect provender and recruits, and thence to Moscow to fortify it against Charles XII. At the end of 1709 he went to Dresden for 12 months for finishing lessons in French and German, mathematics and fortification, and, his education completed, he was married on Oct. 14, 1711, greatly against his will, to the Princess Charlotte of Brunswick-Wolfenbüttel. Three weeks later the bridegroom was hurried away by his father to Thorn to superintend the provisioning of the Russian troops in Poland. For the next 12 months Alexius was kept constantly on the move. His wife joined him at Thorn in December, but in April 1712 a peremptory ukase ordered him off to the Army in Pomerania, and in the autumn of the same year he was forced to accompany his father on a tour of inspection through Finland. Immediately on his return from Finland, Alexius was despatched by his father to Staraya Rusya and Ladoga to see to the building of new ships. This was the last commission entrusted to him. On his return to the capital, Peter, in order to see what progress his son had made in mechanics and mathematics, asked him to draw something of a technical nature for his inspection Alexius, in order to escape such an ordeal, disabled his right hand by a pistol-shot. In no other way could the tsarevich have offended his father so deeply. He had behaved like a cowardly recruit who mutilates himself to escape military service. After this, Peter employed him no more. He no longer pressed him to attend public functions. Alexius rejoiced at this welcome change, but he had cause rather to fear it.

On Oct. 22, 1715, Alexius's consort, the Princess Charlotte, died, after giving birth to a son, the Grand-duke Peter, afterwards Peter II. On the day of the funeral, Peter addressed to Alexius a stern letter urging him no longer to resemble the slothful servant in the parable, and threatening to cut him off if he did not acquiesce in his father's plans. Alexius wrote a pitiful reply to his father, offering to renounce the succession in favour of his baby half-brother Peter, who had been born the day after the Princess Charlotte's funeral. In Jan. 1716 he wrote to his father for permission to become a monk. Still Peter did not despair. On Aug. 26, 1716, he wrote to Alexius from abroad urging him, if he desired to remain tsarevich, to join him and the Army without delay.

But Alexius fled to Vienna and placed himself under the protection of his brother-in-law, the Emperor Charles VI, who sent him for safety first to the Tyrolean fortress of Ahrenberg, and finally to the castle of San Elmo at Naples He was accompanied throughout his journey by his mistress, the Finnish girl Afrosina. That the emperor sincerely sympathized with Alexius, and suspected Peter of harbouring murderous designs against his son, is plain from his confidential letter to George I. of England, whom he consulted.

Peter's agitation was extreme. The flight of the tsarevich was a reproach and a scandal He must be recovered and brought back to Russia at all hazards This task was accomplished by Count Peter Tolstoi, the most subtle and unscrupulous of Peter's servants; but terrorized though he was, Alexius would only consent to return on his father's solemnly swearing, "before God and His judgment seat," that if he came back he should not be punished, but cherished as a son and allowed to live quietly on his estates and marry Afrosina.

On Jan. 31, 1718, the tsarevich reached Moscow. On Feb. 18 a "confession" was extorted from Alexius which implicated most of his friends, and he then publicly renounced the succession to the throne in favour of the baby grand-duke Peter Petrovich. A reign of terror ensued, in the course of which the ex-tsaritsa Eudoxia was dragged from her monastery and publicly tried for alleged adultery, while all who had in any way befriended Alexius were impaled, broken on the wheel or otherwise done to death. In April 1718 fresh confessions were extorted from Alexius, now half idiotic with fright Yet even now there were no actual facts to go upon. The worst that could be brought against him was that he had "wished" his father's death. In the eyes of Peter, his son was now a self-convicted and most dangerous traitor, whose life was forfeit. But there was no getting over the fact that his father had sworn "before the Almighty and His judgment seat" to pardon him and let him live in peace if he returned to Russia. But did the enormity of the tsarevich's crime absolve the tsar from the oath? This question was solemnly submitted by Peter to a grand council of prelates, senators, ministers and other dignitaries on June 13, 1718. The clergy left the matter to the tsar's own decision. The temporal dignitaries declared the evidence to be insufficient and suggested that Alexius should be examined by torture. Accordingly, on June 19, the weak and ailing tsarevich received 25 strokes with the knout (as then administered, nobody ever survived 30), and on the 24th 15 more. He expired two days later in the guard-house of the citadel of St. Petersburg, two days after the senate had condemned him to death for "imagining" rebellion against his father, and for "hoping" for the co-operation of the common people and the armed intervention of his brother-in-law, the emperor.

See R N. Bain, *The First Romanovs* (London, 1905); Comte de Vogue, *Mazeppa. Un changement de règne* (Paris, 1884).

ALFA or **HALFA,** the North African name of a species of esparto grass. (*See* ESPARTO.)

ALFALFA, the name in the United States, Canada and certain other countries for the leguminous plant *Medicago sativa,* known elsewhere as lucerne (*see* LUCERNE).

ALFALFA WEEVIL, a snout-beetle, or weevil (*Phytonomus posticus*) of Old World origin, which feeds upon alfalfa, or

lucerne (*Medicago sativa*). Although widely distributed in Europe, where its host plant is extensively grown, it attracted little attention until it was accidentally introduced into the United States in the early years of the present century. It appeared suddenly in the vicinity of Salt Lake City, a region where the alfalfa crop is of great importance, multiplied and spread rapidly, causing great alarm to the agricultural and live-stock industries. It spread steadily at the rate of from 10 to 20m. a year, and in 1927 occurred in great numbers through the Great Basin and the Snake river watershed, in large areas of the Colorado and North Platte drainage basins, and in the territory of the Yellowstone and Sacramento rivers. It is a constant threat to the great alfalfa regions to the east, and its spread cannot be prevented by regulating the production and marketing of the crop, since it feeds on other leguminous plants, some of which are wild.

The adult weevil is dark brown in colour and about $\frac{3}{16}$in. long. In this stage it passes the winter, usually in crevices in the ground. In the spring the adults begin feeding on the earliest growth of the plant, and lay their eggs either in old, dry stems or in the living stems. In warm weather these eggs hatch in from one to two weeks, and the young larvae begin to feed on the leaves, especially on the opening tips, rapidly skeletonizing them—so rapidly, in fact, that the plant is unable to outgrow the injury When full grown, the greenish larvae spin loose cocoons from which adults emerge in the summer. The cocoons are found attached to the stems, in curled leaves or on the ground.

During the first nine years in America, the weevil not only spread rapidly but nearly destroyed the first crop of alfalfa each year. Since then there have been fluctuations in the amount of damage, due probably to climatic changes. Systematic studies have been carried on by the Federal bureau of entomology ever since the insect was first discovered, and important investigations have been made by the official entomologists of Utah and the neighbouring States. Ten species of parasites have been imported from Europe by the Federal experts, and one of these (*Bathyplectes curculionis*) is thoroughly established and has spread throughout most of the infested territory. In some localities it has been known to kill 90% of the weevil larvae; but the rate of increase of the weevil is so rapid that even this percentage does not bring about control, and artificial remedial measures must be relied upon.

Of the artificial measures, spraying or dusting the first crop at just the proper time (varying according to conditions) with powdered arsenate of calcium has been found to be the most effective, by which method it is still possible to grow alfalfa with more or less profit, in spite of the weevil. A full account of methods and machinery will be found in *Farmers' Bulletin,* No. 1,528, U.S. Department of Agriculture. (L. O. H)

ALFANO, FRANCO (1877–), Italian composer, was born at Posilipo, near Naples, March 8, 1877. He studied at Naples and Leipzig and by his numerous works for the stage has acquired a leading position among his contemporaries. He has also written orchestral and chamber works of merit. For a time he was director of the Liceo Musicale Rossini at Bologna and later went to Turin in a similar capacity. To him was entrusted the task of completing Puccini's unfinished opera *Turandot.*

ALFELD, chief town of a subdivision of the district of Hildesheim, in the Prussian province of Hanover, on the river Leine, about 15m. S S W. of Hildesheim. Pop. (1925) 7,020. It has a handsome church with twin spires. Its industries embrace paper-making, iron-founding and the production of agricultural machinery.

ALFIERI, VITTORIO, COUNT (1749–1803), famous tragic dramatist of Italy, was born at Asti in Piedmont, of rich and noble parents. His father died when he was an infant and his mother married again, but an uncle took an interest in his education and sent him in his tenth year to the Academy of Turin. By the death of this uncle he was left, at the age of 14, to enjoy without control his vast paternal inheritance, augmented by the recent accession of his uncle's fortune; but for three more years he remained at the academy, though he seems to have learned very little there except contempt for his studies and for the life which he saw about him. Eager to escape from it, he obtained leave of the king to travel, and left Turin in 1766 under the care of an English tutor, from whom, however, he soon parted.

For nearly seven years he travelled about Europe, visiting most of the capitals, and indulging in a series of amorous adventures, of which he gives some account in his interesting autobiography; but although much of his time was wasted in dissipation, he found in England the political liberty which became his ideal, and in France the literature which seems to have influenced him most profoundly. He studied Voltaire, Rousseau and, above all, Montesquieu; and his reading confirmed in him that love of freedom and hatred of all tyranny which were henceforward his most marked characteristics.

In 1772 he returned to Turin, but two more years were wasted in yet another intrigue before he found in Plutarch's *Lives*—his "book of books," as he called it—a stimulus to literary composition, and, identifying himself with the love-sick Antony, wrote a play entitled *Cleopatra,* which was acted in 1775. Well aware of its defects, he persuaded the producer to withdraw it after the second performance; but its immediate success filled him with ambition to excel as a dramatist, and, since no great tragic poet had yet arisen in Italy, he determined to devote himself to the composition of tragedies.

As a Piedmontese who had spent so many years abroad, he was gravely handicapped by his ignorance of classical Italian, and indeed his first two tragedies, *Filippo* and *Polinice,* were conceived and written in French prose. Much hard study was required before he could translate them into Italian blank verse (for which Cesarotti's version of *Ossian* served him as a model), but he had at last found an object in life, and so ardently did he devote himself to its achievement that in eight years he had 14 tragedies to his credit, ten of which were published at Siena in 1783. During the same period he found time to write many translations and original lyrics, including five odes on American independence, as well as a treatise, *Della Tirannide,* which however was not published until many years later. His first series of tragedies culminated in *Saul,* which many critics besides himself have regarded as his best play, and when he wrote it he intended it to be his last.

Meanwhile, in 1777, he had found in the Countess of Albany (*q.v.*) a new love, to whom he remained faithful for the rest of his life; and, in order to be free to follow her, in 1778 he ended his allegiance to Piedmont by making over his estate there to his sister. One of his plays, *Maria Stuarda,* was dedicated to the countess, but it was not until she had left Italy to reside at Colmar in Alsace (1784) that he was able to see her freely, and thenceforward until his death he lived with her. Immediately after Vittorio Alfieri joined her he was moved to break his previous resolution and write five more tragedies, one of which, *Mirra,* has been preferred by some good judges even to *Saul;* and it was at this time, too, that he completed his treatise *Del Principe e delle Lettere,* an exercise in the manner of Machiavelli, which was not published until 1801. From Alsace the lovers moved to Paris, and there in 1788–89 Alfieri supervised the printing of a complete edition of his tragedies by Didot.

When the Revolution began he hailed it with an ode on the taking of the Bastille; but the excesses of the populace could not fail to disgust a republican who, as Byron said of him, "was an aristocrat at heart." In 1792 he escaped with the Countess from France and settled in Florence, where they lived for the rest of his life. The property which he had left in France was confiscated, on the plea that he was an emigrant, and this fact helps to explain the hatred of all things French which found expression in his *Misogallo,* a collection of violent polemics in prose and verse, which was published in 1799, the year when the French troops first entered Florence. Although he never ceased to rage against tyranny—not only of kings and priests, but of revolutionaries as well—the last years of his life were undisturbed and he devoted them to quiet study, teaching himself Greek, and even trying to write comedies, for which he had no real gift. These, like his autobiography, his satires, and many of his lyric poems, were not published until after his death, which occurred at

Florence, Oct. 8, 1803. He was buried in Santa Croce, and there the Countess of Albany caused a monument by Canova to be dedicated to his memory seven years later. A collected edition of his works was published at Florence in 22 volumes (1805–15).

Alfieri's literary reputation rests chiefly on his 19 tragedies, which were all strictly classical in form, adhering even more closely than their models to the unity of action or interest. Subordinate episodes and verbal ornaments were ruthlessly excluded from them, and no more than four principal characters were admitted on the stage. But the genius of their author was essentially lyrical, and the situation which he treats most often and with most success—that of the hero defying tyranny—is one in which he was able to identify himself with the "splendid rebel," and use him as a mouthpiece for his passionate denunciation of tyrants or praises of freedom. For this his somewhat harsh style, *pensato e non cantato*, which was an offence to his contemporaries, is now recognized to be the most appropriate vehicle.

But plays written to serve as weapons for political warfare are rarely successful dramatically, and Alfieri too often sacrificed dramatic propriety to special pleading. It is as a precursor of the Risorgimento that he is specially honoured in Italy to-day, and it was in a section of the *Misogallo* that he first turned from generalizations about freedom to make a direct appeal to his countrymen to recover their own. By that appeal and by many of his lyrics, which he claimed to have written as spurs to arouse the new generations and make them worthy of their Roman ancestors, he certainly helped to revive the national spirit and earned the title of *Vate d'Italia* by which he is honoured to-day.

See Antoine de Latour, *Mémoires de Victor Alfieri* (French trans. Paris, 1840); Sismondi, *De la lit. du midi de l'Europe;* J. C. Walker, *Historical Memoir on Italian Tragedy* (1799); *Giorn. de Pisa,* tom. lviii.; Centofanti, *Life of Alfieri* (1842); Emilio Teza, *Vita, Giornali, Lettere di Alfieri* (1861); Antonini and Cognetti, *Vittorio Alfieri* (1898).

ALFORD, HENRY (1810–1871), English divine and scholar, was born in London on Oct. 7, 1810, of a Somersetshire family which had given five consecutive generations of clergymen to the Church of England. He was a precocious lad who wrote Latin odes and a history of the Jews before he was ten. He graduated from Trinity college, Cambridge, in 1832, being 34th wrangler and 8th classic, and in 1834 became a fellow of his college. Alford was vicar of Wymeswold (1835–53), preached at Quebec chapel in London (1853–57) and was dean of Canterbury from 1857 to his death on Jan. 12, 1871.

Dean Alford was a man of many and varied accomplishments. He published some volumes of verse, wrote some popular hymns, and was the first editor of the *Contemporary Review.* But his chief fame rests upon his monumental edition of the New Testament in Greek, which occupied him from 1841 to 1861. In this work he first brought before English students a careful collation of the readings of the chief mss., and the researches of the ripest continental scholarship of his day. Though more recent research, patristic and papyral, has largely changed the method of New Testament exegesis, Alford's work is still a quarry where the student can dig with a good deal of profit.

His *Life,* written by his widow, appeared in 1873 (Rivington).

ALFRED or **AELFRED,** known as THE GREAT (848?–900), king of England, was born at Wantage, and was the fourth son of King Aethelwulf and his first wife Osburh. He seems to have been a child of singular attractiveness and promise, and stories of his boyhood were remembered. At the age of five (853) he was sent to Rome, where he was confirmed by Leo IV., who is also stated to have "hallowed him as king." Later writers interpreted this as an anticipatory crowning in preparation for his ultimate succession to the throne of Wessex. That, however, could not have been foreseen in 853, as Alfred had three elder brothers living. It is probably to be understood as investiture with the consular insignia, or possibly with some titular royalty such as that of the under-kingdom of Kent. In 855 Alfred again went to Rome with his father Aethelwulf, returning towards the end of 856. About two years later his father died.

During the short reigns of his two eldest brothers, Aethelbald and Aethelbert, nothing is heard of Alfred. But with the accession of the third brother Aethelred (866), the public life of Alfred begins, and he enters on his great work of delivering England from the Danes. It is in this reign that Asser applies to Alfred the unique title of *secondarius,* which seems to indicate a position analogous to that of the Celtic *tanist,* a recognized successor, closely associated with the reigning prince. It is probable that this arrangement was definitely sanctioned by the witenagemot, to guard against the danger of a disputed succession should Aethelred fall in battle. In 868 Alfred married Ealhswith, daughter of Aethelred Mucill, an ealdorman of the Gaini, an unidentified district. The same year the two brothers made an unsuccessful attempt to relieve Mercia from the pressure of the Danes. For nearly two years Wessex had a respite. But at the end of 870 the storm burst; and the year which followed has been rightly called "Alfred's year of battles." Nine general engagements were fought with varying fortunes, though the place and date of two of them have not been recorded. A successful skirmish at Englefield, Berkshire (Dec. 31, 870), was followed by a severe defeat at Reading (Jan. 4, 871), and this, four days later, by the brilliant victory of Ashdown, near Compton Beauchamp in Shrivenham Hundred. On Jan. 22, the English were again defeated at Basing, and on March 22, at Marton, Wiltshire, the two unidentified battles having perhaps occurred in the interval.

In April Aethelred died, and Alfred succeeded to the whole burden of the contest. While he was busied with his brother's funeral, the Danes defeated the English in his absence at an unnamed spot, and once more in his presence at Wilton in May. After this peace was made, and for the next five years the Danes were occupied in other parts of England, Alfred merely keeping a force of observation on the frontier. But in 876 part of the Danes managed to slip past him and occupied Wareham; whence, early in 877, under cover of treacherous negotiations, they made a dash westwards and seized Exeter. Here Alfred blockaded them, and a relieving fleet having been scattered by a storm, the Danes had to submit and withdrew to Mercia. But in Jan. 878 they made a sudden swoop on Chippenham, where Alfred had been keeping his Christmas, "and most of the people they reduced except the King Alfred, and he with a little band made his way by wood and swamp, and after Easter he made a fort at Athelney, *and from that fort kept fighting against the foe*" (*Chron.*). The idea that Alfred during his retreat at Athelney was a helpless fugitive rests upon the foolish legend of the cakes. In reality he was organizing victory.

By the middle of May his preparations were complete and he moved out of Athelney, being joined on the way by the levies of Somersetshire, Wiltshire and Hampshire. The Danes on their side moved out of Chippenham, and the two armies met at Edington in Wiltshire. The result was a decisive victory for Alfred. The Danes submitted. Guthrum, the Danish king, and 29 of his chief men accepted baptism. By the next year (879) not only Wessex, but Mercia west of Watling Street, was cleared of the invader. This is the arrangement known as the peace of Wedmore (878), though no document embodying its provisions is in existence. And though for the present the north-eastern half of England, including London, remained in the hands of the Danes, in reality the tide had turned, and western Europe was saved from the danger of becoming a heathen Scandinavian power.

For the next few years there was peace, the Danes being kept busy on the continent. A landing in Kent in 884 or 885[1], though successfully repelled, encouraged the East Anglian Danes to revolt. The measures taken by Alfred to repress this revolt culminated in the capture of London in 885 or 886, and the treaty known as Alfred and Guthrum's peace, whereby the boundaries of the treaty of Wedmore (with which this is often confused) were materially modified in Alfred's favour. Once more for a time there was a lull; but in the autumn of 892 (893) the final storm burst. The Danes amounting in the aggregate to 330 sail, crossed to England in two divisions, finding their position on the Conti-

[1]Where alternative dates are given the later date is that of the *Saxon Chronicle.* But the evidence of the Continental Chronicles makes it probable that the *Saxon Chronicle* is a year in advance of the true chronology in this part.

nent becoming more and more precarious, and entrenched themselves, the larger body at Appledore and the lesser under Haesten at Milton in Kent. The fact that the new invaders brought their wives and children with them shows that this was no mere raid, but a deliberate attempt, in concert with the Northumbrian and East Anglian Danes, to conquer England. Alfred, 893 (894), took up a position whence he could observe both forces.

While he was negotiating with Haesten the Danes at Appledore broke out and struck north-westwards, but were overtaken by Alfred's eldest son, Edward, and defeated in a general engagement at Farnham, and driven to take refuge in Thorney Island in the Hertfordshire Colne, where they were blockaded and ultimately compelled to submit. They then fell back on Essex, and after suffering another defeat at Benfleet coalesced with Haesten's force at Shoebury. Alfred had been on his way to relieve his son at Thorney when he heard that the Northumbrian and East Anglian Danes were besieging Exeter and an unnamed fort on the coast of North Devon. Alfred at once hurried westwards and raised the siege of Exeter; the fate of the other place is not recorded.

Meanwhile the force under Haesten set out to march up the Thames valley, possibly with the idea of assisting their friends in the west. But they were met by a large force under the three great ealdormen of Mercia, Wiltshire and Somersetshire, and forced to head off to the north-west, being finally overtaken and blockaded at Buttington, which some identify with Buttington Tump at the mouth of the Wye, others with Buttington near Welshpool. An attempt to break through the English lines was defeated with loss; those who escaped retreated to Shoebury. Then after collecting reinforcements they made a sudden dash across England and occupied the ruined Roman walls of Chester. The English did not attempt a winter blockade, but contented themselves with destroying all the supplies in the neighbourhood. And early in 894 (895) want of food obliged the Danes to retire once more to Essex.

At the end of this year and early in 895 (896) the Danes drew their ships up the Thames and Lea and fortified themselves 20 miles above London. A direct attack on the Danish lines failed, but later in the year Alfred saw a means of obstructing the river so as to prevent the egress of the Danish ships. The Danes realized that they were out-manoeuvred. They struck off north-westwards and wintered at Bridgnorth. The next year, 896 (897) they abandoned the struggle. Some retired to Northumbria, some to East Anglia; those who had no connexions in England withdrew to the continent. The long campaign was over.

The result testifies to the confidence inspired by Alfred's character and generalship, and to the efficacy of the military reforms initiated by him. These were (1) the division of the *fyrd* or national militia into two parts, relieving each other at fixed intervals, so as to ensure continuity in military operations; (2) the establishment of fortified posts (burgs) and garrisons at certain points; (3) the enforcement of the obligations of thanehood on all owners of five hides of land thus giving the King a nucleus of highly equipped troops. After the final dispersal of the Danish invaders Alfred turned his attention to the increase of the Navy, and ships were built according to the King's own designs, partly to repress the ravages of the Northumbrian and East Anglian Danes on the coasts of Wessex, partly to prevent the landing of fresh hordes. This is not, as often asserted, the beginning of the English Navy. There had been earlier naval operations under Alfred. One naval engagement was certainly fought under Aethelwulf (851), and earlier ones, possibly in 833 and 840. Nor were new ships a great success, as we hear of them grounding in action and foundering in a storm.

Much, too, was needed in the way of civil re-organization, especially in the districts ravaged by the Danes. In the parts of Mercia acquired by Alfred, the shire system seems now to have been introduced for the first time. This is the one grain of truth in the legend that Alfred was the inventor of shires, hundreds and tithings. The finances also would need careful attention; but the subject is obscure, and we cannot accept Asser's description of Alfred's appropriation of his revenue as more than an ideal sketch. Alfred's care for the administration of justice is testified both by history and legend; and the title "protector of the poor" was his by unquestioned right.

Of the action of the witenagemot we do not hear very much under Alfred. That he was anxious to respect its rights is conclusively proved, but both the circumstances of the time and the character of the king would tend to throw more power into his hands. The legislation of Alfred probably belongs to the later part of the reign, after the pressure of the Danes had relaxed. The details of it cannot be discussed here.

Asser speaks grandiosely of Alfred's relations with foreign powers, but little definite information is available He certainly corresponded with Elias III, the patriarch of Jerusalem, and probably sent a mission to India. Embassies to Rome conveying the English alms to the pope were fairly frequent; while Alfred's interest in foreign countries is shown by the insertions which he made in his translation of *Orosius*. His relations to the Celtic princes in the southern half of the island are clearer. Comparatively early in his reign the South Welsh princes, owing to the pressure on them of North Wales and Mercia, commended themselves to Alfred. Later in the reign the North Welsh followed their example, and the latter co-operated with the English in the campaign of 893 (894). The Celtic principality in Cornwall which seems to have survived at least till 926, must long have been practically dependent on Wessex. That Alfred sent alms to Irish as well as to continental monasteries may be accepted on Asser's authority; the visit of the three pilgrim "Scots" (*i e*, Irish) to Alfred in 891 is undoubtedly authentic; the story that he himself in his childhood was sent to Ireland to be healed by St. Modwenna, though mythical, may point to Alfred's interest in that island.

The history of the church under Alfred is most obscure. The Danish inroads had told heavily upon it; the monasteries had been special points of attack, and though Alfred founded two or three monasteries and imported foreign monks, there was no general revival of monasticism under him. To the ruin of learning and education wrought by the Danes, and the practical extinction of the knowledge of Latin even among the clergy, the preface to Alfred's translation of Gregory's *Pastoral Care* bears eloquent testimony. It was to remedy these evils that he established a court school, after the example of Charles the Great; for this he imported scholars like Grimbald and John the Saxon from the continent and Asser from South Wales; for this, above all, he put himself to school, and made the series of translations for the instruction of his clergy and people, most of which still survive These belong unquestionably to the later part of his reign, not improbably to the last four years of it, during which the chronicles are almost silent.

Apart from the lost *Handboc* or *Encheiridion*, which seems to have been merely a commonplace-book kept by the King, the earliest work to be translated was the *Dialogues of Gregory*, a book enormously popular in the Middle Ages In this case the translation was made by Alfred's great friend Werferth, bishop of Worcester, the king merely furnishing a preface.

The next work to be undertaken was Gregory's *Pastoral Care*, especially for the benefit of the clergy. In this Alfred keeps very close to his original; but the introduction which he prefixed to it is one of the most interesting documents of the reign, or indeed of English history

The next two works taken in hand were historical, the *Universal History of Orosius* and Bede's *Ecclesiastical History of the English People*. The priority should probably be assigned to the *Orosius*, but the point has been much debated In the *Orosius*, by omissions and additions, Alfred so remodels his original as to produce an almost new work; in the *Bede* the author's text is closely adhered to, no additions being made, though most of the documents and some other less interesting matters are omitted. Of late years doubts have been raised as to Alfred's authorship of the *Bede* translation. But the sceptics cannot be regarded as having proved their point.

We come now to what is in many ways the most interesting of Alfred's works, his translation of Boethius's *Consolation of Phi-*

losophy, the most popular philosophical manual of the middle ages. Here again Alfred deals very freely with his original and though the late Dr. G Schepss showed that many of the additions to the text are to be traced not to Alfred himself, but to the glosses and commentaries which he used, still there is much in the work which is solely Alfred's and highly characteristic of his genius. It is in the *Boethius* that the oft-quoted sentence occurs: "My will was to live worthily as long as I lived, and after my life to leave to them that should come after, my memory in good works." The book had come down to us in two mss. only. In one of these the poems with which the original is interspersed are rendered into prose, in the other into alliterating verse. The authorship of the latter has been much disputed; but probably they also are by Alfred. Of the authenticity of the work as a whole there has never been any doubt.

The last of Alfred's works is one to which he gave the title *Blostman; i.e.,* "Blooms" or Anthology. The first half is based mainly on the *Soliloquies* of St. Augustine, the remainder is drawn from various sources, and contains much that is Alfred's own and highly characteristic of him. The last words of it may be quoted; they form a fitting epitaph for the noblest of English kings. "Therefore he seems to me a very foolish man, and very wretched, who will not increase his understanding while he is in the world, and ever wish and long to reach that endless life where all shall be made clear." Besides these works of Alfred's, the *Saxon Chronicle* almost certainly, and a Saxon *Martyrology,* of which fragments only exist, probably owe their inspiration to him. A prose version of the first 50 Psalms has been attributed to him; and the attribution, though not proved, is perfectly possible. How Alfred passed to "the life where all things are made clear" we do not know. The very year is uncertain. The arguments on the whole are in favour of 900. The day was Oct. 26. Alike for what he did and for what he was, there is none to equal Alfred in the whole line of English sovereigns, and no monarch in history ever deserved more truly the epithet of Great.

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ALFRED ERNEST ALBERT (1844–1900), Duke of Saxe-Coburg and Gotha, and Duke of Edinburgh, second son and fourth child of Queen Victoria, was born at Windsor Castle on Aug. 6, 1844. He passed a most creditable examination for midshipman in Aug. 1858, and being appointed to the "Euryalus," at once began to work hard at the practical part of his profession. In July 1860, while on this ship, he paid an official visit to the Cape. On the abdication of Otto, king of Greece, in 1862, the crown was offered to Prince Alfred, but political conventions of long standing rendered it impossible for the British Government to agree to the proposal. The prince therefore remained in the Navy, and was promoted to the rank of captain Feb. 23, 1866, being then appointed to the command of the "Galatea." On attaining his majority in 1865, the prince was created Duke of Edinburgh and Earl of Ulster, with an annuity of £15,000 granted by Parliament. While still in command of the "Galatea," the duke started from Plymouth on Jan. 24, 1867, for a voyage round the world and visited Australia and India, being received everywhere with enthusiasm. An attempt on his life at Sydney by an Irishman named O'Farrell was the only unfortunate incident. After an absence of 17 months, he returned to England.

The duke married on Jan. 23, 1874, the Grand Duchess Marie Alexandrovna, only daughter of Alexander II., emperor of Russia. He continued his naval duties after his marriage, and held successive high commands until 1893 when he received his baton as admiral of the fleet.

On the death of his uncle, Ernest II., Duke of Saxe-Coburg and Gotha, on Aug. 22, 1893, the vacant duchy fell to the Duke of Edinburgh, for the Prince of Wales had renounced his right to the succession. At first regarded with some coldness as a "foreigner," he gradually gained popularity, and by the time of his death, on July 30, 1900, he had completely won the good opinion of his subjects. The duke was exceedingly fond of music and an excellent violinist, and took a prominent part in establishing the Royal College of Music. He was also a keen collector of glass and ceramic ware, and his collection, valued at 500,000 marks, was presented by his widow to the "Veste Coburg," near Coburg. When he became Duke of Saxe-Coburg he surrendered his English allowance of £15,000 a year, but the £10,000 granted in addition by Parliament on his marriage he retained in order to keep up Clarence House. The duke had one son, who died unmarried on Feb. 6, 1899, and four daughters· Marie (queen of Roumania); Victoria Melita (Grand Duchess Cyril of Russia); Beatrice, who married Don Alphonso of Spain; and Princess Alexandra Louisa Olga Victoria of Hohenlohe-Langenburg.

ALFRED, OF BEVERLEY, Alredus, Alured or Aluredus, was sacristan of the church of Beverley in the first half of the 12th century. He wrote, apparently about the year 1143, a chronicle entitled *Annales sive Historia de gestis regum Britanniae,* in nine books, which begins with the legend of Brutus and carries the history of England down to 1129. This work was edited by T. Hearne (Oxford, 1716). Geoffrey of Monmouth and Simeon of Durham are Alfred's chief sources. Among the Cottonian mss. there is a collection of records relating to Beverley, *Libertates Ecclesiae S. Iohannis de Beverlae,* which is attributed to Alfred, but on no good authority.

ALFRED, a village in Allegany county, N.Y , U S.A., on the Erie railroad about 75 m. S.E. of Buffalo. It is situated among rugged hills, at the intersection of two valleys. The population was 603 in 1925 (State census).

On the west slope of Pine hill, 1,800 ft. above sea-level, is Alfred university (co-educational), which embraces a college (non-sectarian) and a theological seminary (Seventh-Day Baptist). The enrolment in 1926–27 was 564. On grounds adjacent to the college campus, and administered by the university trustees, are the New York State school of clay-working and ceramics (established 1900), a unique institution which confers degrees in ceramic engineering and in applied art, and a New York State school of agriculture (established 1908). Alfred university traces its history to a "select school" organized in 1836, which developed into Alfred academy, chartered 1843. Three buildings were erected on the present campus in 1846, and in 1857 a university charter was secured.

Alfred lies within the territory purchased by Robert Norris in 1791, and is said to have been named after Alfred the Great. The first settlement was made in 1807. Most of the early settlers were Seventh-Day Baptists. The village was chartered in 1887.

ALFRETON, urban district, Derbyshire, England, 14m. N. by E. of Derby, on the L.M.S. railway. Population (1921) 20,472. It lies above a small tributary of the Derwent. The church of St. Martin is Early English and later. The neighbourhood abounds in ironworks, collieries, quarries and potteries, and is thickly populated. To the north-east of Alfreton are South Normanton (population 6,996 in 1921), Blackwell (5,073) and Tibshelf (4,053); to the north Shirland, to the south Ironville, and other busy industrial villages. The foundation of Alfreton is traditionally ascribed to King Alfred

ALFURS, a general name given to tribes of low culture and mixed origin inhabiting parts of the eastern islands of the Indonesian archipelago, Halmahera, Ceram, Timorlaut and Timor and the adjacent islets. They are probably of Proto-Malay and Indonesian extraction with a strong admixture of Papuan elements; and in Ceram in particular seem to have decided affinities with the dolicho-cephalic people of Oceania. Generally speaking they use bark belts and thigh-cloths, chew betel (tobacco is not used in Ceram), cultivate sago rather than rice, are exogamous, patrilineal and ancestor-worshippers, laying out their dead in trees, but there is a good deal of variation between different groups. Thus the head-hunting (*q.v.*) cult, which is strong in Ceram, takes the form of cannibalism in Timorlaut. In Ceram the women only are tattooed; in Timorlaut both sexes. In Ceram a quasi-secret society is formed for the administration of justice, a tree spirit is invoked for aid in war, and the skull of an enemy or slave is put under the posts of buildings, while head-hunters warn victims of hostile intentions by raiding their gardens and damaging the fruit trees. In Timorlaut warriors swallow a butterfly to obtain courage (*see* METEMPSYCHOSIS), and trial by ordeal of battle is practised. A bamboo-headed spear is still used in Ceram.

ALGAE. The algae comprise seaweeds, pond-scums, and a great variety of microscopic plants inhabiting fresh and salt waters in countless numbers. Many are found in or on the soil or on rocks and tree-trunks, and no region of the earth is devoid of them (see *Occurrence and Distribution,* p. 601). The Latin *alga* means seaweed and only later acquired its present wider meaning. The algae belong to the lowest division (Thallophyta) of the vegetable kingdom, and are distinguished from the majority of higher plants by their simple reproductive organs and by the fact that their vegetative body as a general rule has a relatively simple construction; it is usual to speak of the body of the bigger algae as a *thallus.* All algae are holophytic; *i.e.,* they contain chlorophyll which enables them to use the energy of sunlight and to build up in the process of photosynthesis the organic compounds forming their body from carbon dioxide, water, and other simple substances This distinguishes them from the fungi, the other subdivision of the Thallophyta. On the other hand it is very difficult to separate the algae from those groups of Flagellata which are holophytic (see *Phylogeny,* p 600, and PROTOPHYTA). Most algae can only be studied with the help of a microscope, although no very high powers are necessary to make out the essential features.

STRUCTURE AND REPRODUCTION

The algae exhibit a diversity of form not found in any other group of plants, ranging from one-celled organisms through manifold colonial types to simple or branched rows of cells (filaments) and onwards to elaborate massive growths attaining dimensions and complexities of structure that sometimes vie with those of flowering plants. The group is of great interest to the evolutionist, because it affords all possible stages in the evolution of a plant-body.

Unicellular and Colonial Forms.—Simplest are the unicellular individuals which are commonly spherical or oblong and usually enveloped by a firm cell-wall. The protoplasm of such cells resembles that of other plants in possessing a nucleus and one or more chromatophores containing chlorophyll and other pigments. Many unicellular algae (*e.g., Chlamydomonas,* fig. 1, A) move freely with the help of delicate prolongations of the protoplasm, the cilia, which arise usually at the front end and push the cell through the water by a movement somewhat like that of the arms of a human being whilst swimming. Motile individuals may be aggregated into colonies of diverse shape (*Pandorina,* fig. 1, B; *Volvox,* fig. 2, A), moving by the united action of all the cilia. The cells of these algae are often provided with a red streak or dot, the eye-spot, and two or more pulsating vacuoles near the front end, structures which they have in common with many unicellular animals.

Multiplication is effected by successive divisions of the protoplasm into 2, 4, 8, etc., parts, which secrete new membranes and gradually acquire all the parent's characteristics; in the colonial types each cell may divide in this way to produce a new colony. Reproduction is often preceded by withdrawal of the cilia and cessation of movement. In numerous unicellular and colonial algae this motionless state is the usual one. Naked motile cells (*zoospores, see* below) may be formed as a means of reproduction (*Chlorococcum*) or the power of movement is altogether suppressed and the new individuals are motionless from the first (*e.g., Chlorella,* fig. 1, C and the colonial *Scenedesmus,* fig. 1, D). At times the progeny of a motile unicell (*e.g., Chlamydomonas*) fail to acquire cilia and remain encased within the mucilaginous membrane of the parent; this may happen to successive generations and result in the formation of large jelly-like masses, from which the contained cells may ultimately escape as swarmers. In some algae (*Tetraspora, Gloeocapsa,* fig 1, E) this palmelloid state is the normal one. There is little doubt that the motionless have in most cases evolved from motile types in one or other of the ways just indicated.

Filamentous Forms.—Many pond-scums and small seaweeds are filamentous, consisting sometimes of a simple row of similar cells (*Ulothrix,* fig. 1, F; *Tribonema,* fig. 2, P), although in most there is repeated branching; all the branches may be alike (*Ectocarpus,* fig. 1, H) or some may stand out as main axes bearing smaller lateral branches, which often arise in bunches (*e.g., Batrachospermum,* fig. 4, A). Filamentous algae commonly reproduce by *zoospores, i.e.,* naked ciliated bodies formed (with or without previous division) from the protoplasm of ordinary (fig. 1, G) or specially enlarged (fig. 3, A) cells and liberated through a hole in the wall. The close similarity of these zoospores to the motile individuals of the same class warrants the assumption that the filamentous algae have evolved from such motile unicells, the method of their origin being illustrated by the way in which the zoospores proceed to produce new filaments Their movements may continue for half an hour up to two or three days; but ultimately they settle down on some firm substratum, withdraw the cilia, and secrete a membrane. The end in touch with the substratum spreads out into a lobed holdfast (fig. 1, P), whilst the other rapidly lengthens and divides to form the thread, which in quiet water soon breaks away from its holdfast and floats freely. In rivers or in the sea the attachment is more permanent. In all filamentous forms, however, propagation by detached pieces of the threads (fragmentation) is frequent.

In many filamentous algae the thallus is composed of two branched systems, the one creeping upon some substratum and bearing the other which floats out into the water (*e.g., Stigeoclonium,* fig. 2, D, and many of the simpler seaweeds). By suppression of the projecting system purely prostrate forms result, in some of which the branching is so dense that the threads fit together to form one-layered discs (fig. 2, E). All these and many other smaller algae are commonly found attached to larger ones or to aquatic flowering plants; *i.e.,* they are *epiphytes.*

Every cell of the simpler filamentous algae can enlarge and divide to form new cells, thus leading to a lengthening of the thread, but in the branched types such growth is often restricted to definite regions (*e.g.,* at the bases of the hair-like tips in many brown seaweeds, fig. 1, H) or confined to the end cell of each branch (*Cladophora*).

Structure of Seaweeds.—Such apical growth is usual in many filamentous seaweeds, most of which possess a more elaborate structure than the freshwater forms The segments cut off from the apical cell often divide lengthwise as well as crosswise, so that the filament consists of several longitudinal series of cells which

commonly show a definite arrangement in tiers (*e.g., Sphacelaria,* fig. 1, I). In the older parts of many filamentous seaweeds a further complication of structure results from the outgrowth of cortical threads, either from the basal cells of the branches (*Batrachospermum,* fig. 4, A') or merely from the superficial cells of the thread itself; these apply themselves closely to its surface and form a dense small-celled investment which may become many layers thick and completely hide the original thread.

The thallus of some seaweeds is built up by the close juxtaposition of many filaments. In such there is a central cord or axis consisting of numerous longitudinal threads which are often more or less intertwined and which bear large numbers of short branches, projecting approximately at right angles and uniting to form a surface of varying degrees of compactness (fig. 1, J). Many of these forms appear to the naked eye as rather thick little branched threads (*Nemalion, Castagnea*), but seaweeds of quite a different outward shape may possess the same construction.

Many seaweeds are flattened and leafy, but such forms have doubtless originated from filamentous types in the course of evolution. Some in fact begin life as a simple filament and the derivation from a branched thread may even be decipherable in sections of the mature alga. In *Ulva* (sea lettuce) and *Porphyra* the thalli are thin flat sheets composed of uniform cells without localized growth, but in carrageen (fig. 4, F) and the brown *Dictyota* there are special apical cells at the tips of the numerous flattened branches and these have a firmer texture, being composed of three or more layers of cells, the inner ones usually much larger than the outer (*see* fig 3, J).

The most complex structure is found in the large brown seaweeds (Laminariales and Fucales) Here it is usually possible to distinguish stalk and blade (*e g, Laminaria,* fig 1, K) and the latter may show a central thickened region (midrib) as in the Bladderwrack. In *Lessonia* (fig. 3, G) the stalk may have the thickness of a man's thigh and bears at its apex numerous long blades, the whole resembling a small tree. The bulky thalli, which are often several yards from base to apex, are attached by elaborate holdfasts, fingerlike in Laminariales, suckerlike in Fucales, and often clinging tenaciously to the rocks In sections of the stalks it is easy to distinguish a central medulla of very irregularly arranged and prevalently elongate cells serving as a strengthening cord and for the conduction of food-substance, a wide cortex of broader cells storing food-reserves, and a superficial assimilatory region of small cells with many chromatophores The surface cells at times divide abundantly and thus lead to the progressive increase in thickness of the stalk. The most striking of these large forms is *Sargassum* (fig. 1, L), where the cylindrical stalks bear numerous leafy outgrowths provided with a midrib and bearing in their axils small branch-systems, either terminating in air-bladders or containing reproductive organs

Most algae possess a slimy feeling owing to the mucilaginous quality of the cell-walls This feature is specially pronounced in the larger seaweeds and particularly in those inhabiting the stretch of shore between tidelevels, where the capacity of mucilage to absorb and retain moisture no doubt constitutes a protection against drying.

Chromatophores.—The chlorophyll and other pigments that give different algae their distinctive colours are (except Myxophyceae, *see* below) contained in special chromatophores, which are of diverse shape and size and in some groups are of great importance for the identification of genera and species. They are usually parietal (*i.e.,* located in the protoplasm just beneath the cell-walls, fig. 1, C and F), but in some green and red forms they are axile (*i.e.,* in the centre of the cell, fig. 2, G). In green algae the cells commonly contain only one or a few large chromatophores, but in the other classes they are usually more numerous and simpler in form, often appearing as little lens-shaped bodies (fig. 2, P). Embedded in the substance of the chromatophore are often found conspicuous rounded bodies, the *pyrenoids* (fig. 1, A and F), which consist of protein. Their exact purpose is not yet clear. In the green algae the pyrenoids are usually surrounded by starch, so that treatment with iodine renders them very conspicuous.

Asexual Reproduction.—The purely vegetative multiplication of algae by fragmentation of the threads has already been mentioned and fragments of the thallus may even, in the more elaborate forms under suitable conditions, give rise to a new organism. In most algae, however, a more specialized method (asexual reproduction), involving the liberation of spores formed from the entire or subdivided protoplasm of the cells, occurs at certain times. Many produce ciliated zoospores (*cf.* above) which are always without a wall and vary in character in the different classes; in more advanced types (*e.g., Ectocarpus,* fig. 3, A) they are produced within larger cells (sporangia), often differing in shape from the others and sometimes restricted to definite parts of the body. The zoospores may at times fail to develop cilia, secreting a thin wall already prior to their liberation. Such aplanospores are clearly zoospores which have lost the power of movement, and possibly illustrate the mode of origin of the motionless spores found in many algae lacking zoospores altogether. Thus, in most red seaweeds the sporangia produce four such motionless spores (tetraspores, fig. 4, C).

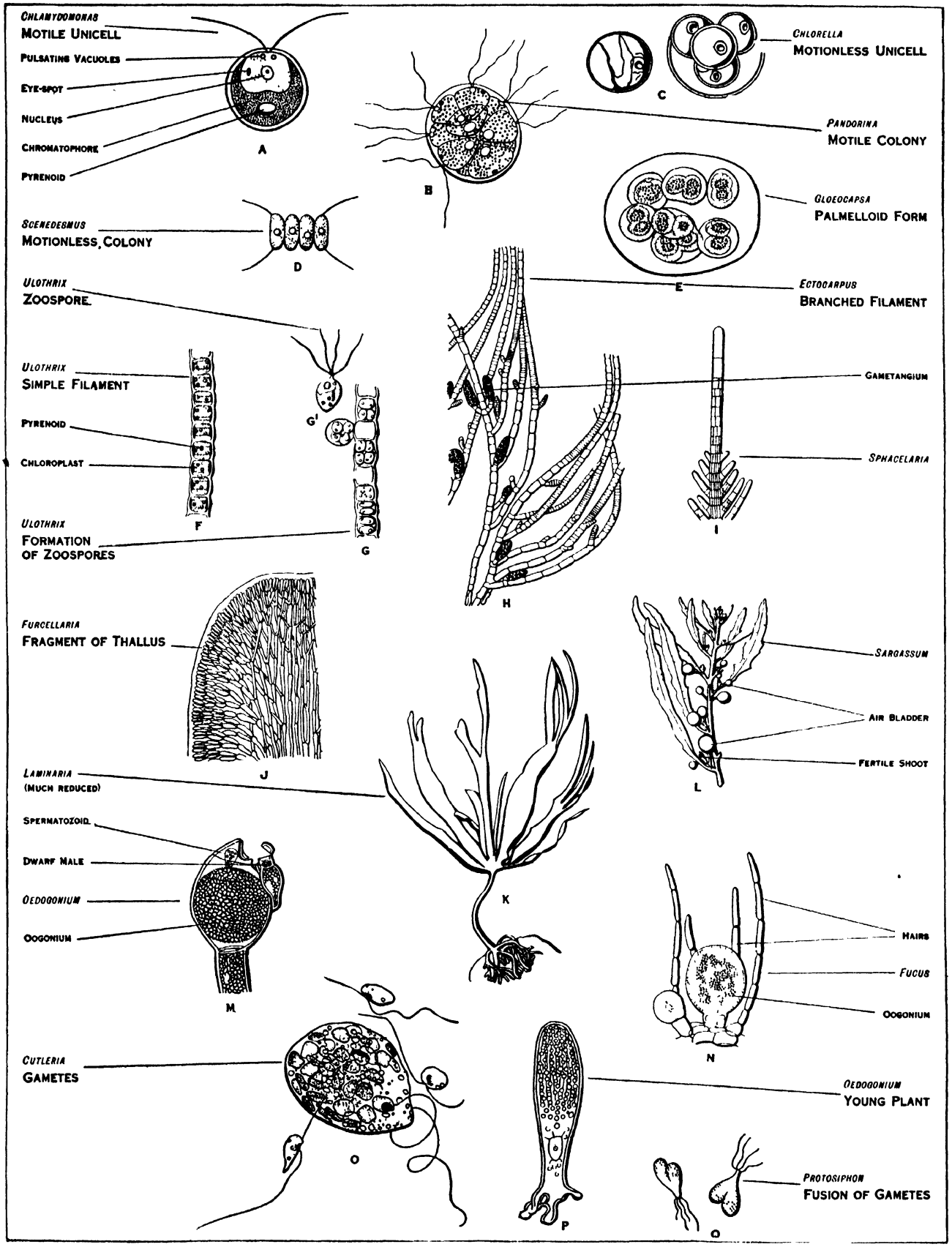
Sexual Reproduction.—A large number of algae exhibit sexual reproduction and all stages in its evolution may be found within the group. In the simplest cases (*e g Ulothrix, Ectocarpus*) the sexual cells or gametes, except for smaller dimensions, essentially resemble the zoospores and are formed in the same way. After a period of movement they meet in pairs and gradually fuse (fig. 1, Q) their nuclei fusing at the same time Often the fusing gametes are identical in all respects (isogamy), although probably always derived from distinct individuals In other cases there are two kinds of gametes (anisogany) which may either merely differ in behaviour, one coming to rest before fusion occurs (*e g, Ectocarpus*), or more commonly the passive gamete is larger and more liberally supplied with chromatophores than the other (*e g., Cutleria,* fig 1, O).

The advanced algae exhibit greater differences between the sexual cells (oogamy), the female or ovum being large, motionless, and provided with abundant chromatophores, the ciliated male or spermatozoid minute, actively motile, and consisting mainly of a nucleus with a thin covering of protoplasm (*e g, Vaucheria, Fucus*). Ova and spermatozoids are formed within special cells (sexual organs) of diverse types; the oogonia (fig 1, M and N; 2, J) harbouring one or, more rarely, several ova, are larger than the antheridia, which mostly produce many spermatozoids of a pale colour (often yellow) As a general rule the ovum remains inside the oogonium whose wall develops an aperture through which the spermatozoid swims and fuses with (*i e,* fertilizes) the ovum. The red seaweeds have motionless male cells which are drifted by currents to the female organs (fig. 4, B). The unicellular sexual organs of most algae offer a sharp contrast to those of Bryophyta (liverworts and mosses).

The sexual cells are always devoid of a membrane, but after fusion the zygote soon secretes a thin wall and in seaweeds immediately proceeds to divide to form a new individual; in freshwater algae, however, the membrane is usually thick and a resting spore, often with yellow or red contents, results. Sexual cells may occasionally develop into new individuals without fusion, but in the oogamous types this is only rarely observed (*Cutleria, Chara*).

The Life-cycle.—The marked polymorphism, formerly ascribed especially to the simpler algae, is now disproved. A few occasionally assume forms differing considerably from the normal. Thus, various filamentous algae at times pass into a palmelloid condition, resembling that described for *Chlamydomonas.*

The alternation between sexual (gametophyte) and asexual (sporophyte) individuals, which is such a prominent feature of the life-cycle of the higher plants, is exhibited in varied ways among the algae. The green forms mostly show no clear alternation, the sexually formed spores, on germination, usually producing a few (often four) zoospores or aplanospores which form the new individuals In *Coleochaete* there is more extensive division of the spore, a mass of 16 or 32 cells being formed, each of which can produce a new plant. This mass of cells is sometimes called a sporophyte, the ordinary *Coleochaete*-disc (fig. 2, E) bearing the sexual organs, being the gametophyte; but since reduction in chromosome-number (*see* CYTOLOGY) occurs at the first



A, B, E, AND Q FROM ENGLER AND PRANTL, "PFLANZENFAMILIEN," BY PERMISSION OF WILHELM ENGELMANN C, F, G, H, J, L, M, O FROM OLTMANNS "MORPHOLOGIE U BIOLOGIE D ALGEN," BY PERMISSION OF GUSTAV FISCHER D AND P FROM WEST AND FRITSCH, "BRITISH FRESHWATER ALGAE" BY PERMISSION OF CAMBRIDGE UNIVERSITY PRESS K FROM FRITSCH AND SALISBURY, "AN INTRODUCTION TO THE STRUCTURE AND REPRODUCTION OF PLANTS," BY PERMISSION OF G BELL AND SONS, LTD N FROM HAUCK, "MEERESALGEN," BY PERMISSION OF EDUARD KUMMER. ALL EXCEPT K AND L CONSIDERABLY MAGNIFIED

FIG. 1.—STRUCTURE AND REPRODUCTION OF UNICELLULAR, COLONIAL AND FILAMENTOUS FORMS

Algae, the botanical group which includes seaweeds, pond-scum, and a great variety of microscopic plants, inhabit fresh and salt water, are found on or in the soil and on rocks and tree trunks in every region of the world. They comprise, with the fungi, the lowest division of the vegetable kingdom (Thallophytes). Algae contain a green substance called chlorophyll which enables them in the presence of sunlight to build up their bodies from carbon dioxide, water and other simple substances. Fungi, having no chlorophyll, cannot do this

division in the fertilized ovum (as in all green algae), the sporophyte lacks the double chromosome-number usually regarded as characteristic of it. The simpler red seaweeds (Nemalionales) show the same features, the sporophyte here being represented by a bunch of threads that sprout out from the female organ after fertilization.

Among brown seaweeds many instances of alternation are known, where the asexual and sexual individuals differ in their chromosome-number in the same way as in higher plants. In some (*Pilayella, Dictyota*) the two generations are identical, except for this and for the kinds of reproductive structures they bear (homologous alternation). In *Laminaria* and its allies, however, they are sharply distinct (antithetic alternation), the sporophyte being an elaborate plant (fig. 1, K), the gametophyte a filament of microscopic dimensions (fig. 3, H). In *Cutleria,* on the other hand, the ribbon-like thalli of the sexual individuals are more conspicuous than the flat crusts of the asexual (fig. 3, F). Certain facts appear to indicate that, even in these cases, the two generations may originally have been alike. Most red seaweeds (except Nemalionales) show a true homologous alternation, the sporophyte with tetraspores (fig. 4, C) and the gametophyte bearing sexual organs closely resembling one another; but there is the curious complication that the fertilized ovum gives rise to bunches of threads which produce carpospores, and it is from these that the tetrasporic plants arise. In these forms there are thus two different sporophytes arising from one another, the second producing the gametophyte.

CLASSIFICATION OF ALGAE

The various classes of algae are essentially distinguished by the pigments in their chromatophores, the kinds of reserve-foods stored after photosynthesis, and the nature of their reproductive structures. They are:—I. Isokontae (Chlorophyceae), the green algae; II. Charales, the stoneworts; III. Heterokontae, the yellow-green algae; IV. Bacillariales (*q.v.*), the diatoms; V Phaeophyceae, the brown algae; VI. Rhodophyceae, the red algae; VII. Myxophyceae (Cyanophyceae), the blue-green algae. There are, however, various groups of Flagellata (*e.g.,* Chrysomonadineae, Peridinieae) which include some algal forms and should no doubt rank as algae (*see* PROTOPHYTA), but the scope of this article is restricted to the above classes, the majority of whose members are true algae.

Green Algae.—I. The ISOKONTAE (CHLOROPHYCEAE) include a wide range of forms which are mainly freshwater or terrestrial, though most Siphonales are marine. They are readily recognized by their dark green colour and the storage of starch (coloured blue by iodine). The chromatophores are here chloroplasts containing the same pigments (chlorophyll, etc.) as in higher plants, though often possessing an elaborate shape and frequently provided with pyrenoids surrounded by starch. The motile stages (including zoospores and gametes) bear equal cilia (often two or four) attached to the front end. Cellulose frequently predominates in the cell-wall. The majority of Isokontae are isogamous and the gametes, except in the few oogamous types, are produced in the ordinary cells.

The motile forms are classed as VOLVOCALES, which include the unicellular *Chlamydomonas* (fig. 1, A) and various colonial types such as *Pandorina* (fig. 1, B), *Eudorina* (with 32 spherical cells arranged round the edge of a mucilage-sphere), and *Volvox* (fig. 2, A), where the colonies are composed of several thousand cells, all four often abundant in small pools. In *Volvox* the production of new colonies is restricted to special larger cells, and both this genus and *Eudorina* are oogamous. The Volvocales also include palmelloid forms, such as *Tetraspora* whose delicate green mucilage-masses, with the cells in groups of four, are common attached to water-plants in spring.

The motionless CHLOROCOCCALES (=Protococcales) comprise *Chlorococcum* (on damp soil), *Chlorochytrium* with large cells inhabiting the air spaces of the duckweed, and *Trebouxia* (=*Cystococcus*) which is found in many lichens and possesses an axile chloroplast. These three unicellular forms reproduce by zoospores, but the latter are lacking in *Chlorella* (fig. 1, C), which is common in contaminated waters (*e.g.,* sewage) and also occurs as "green cells" in various animals (*Hydra,* etc.), and *Micractinium* (fig. 2, B), whose free-floating cells bear long delicate bristles. Many are colonial, *e.g., Scenedesmus* (fig. 1, D), the flat plates of *Pediastrum* with marginal cells produced into short processes, and the "water-net" (*Hydrodictyon,* fig. 2, C).

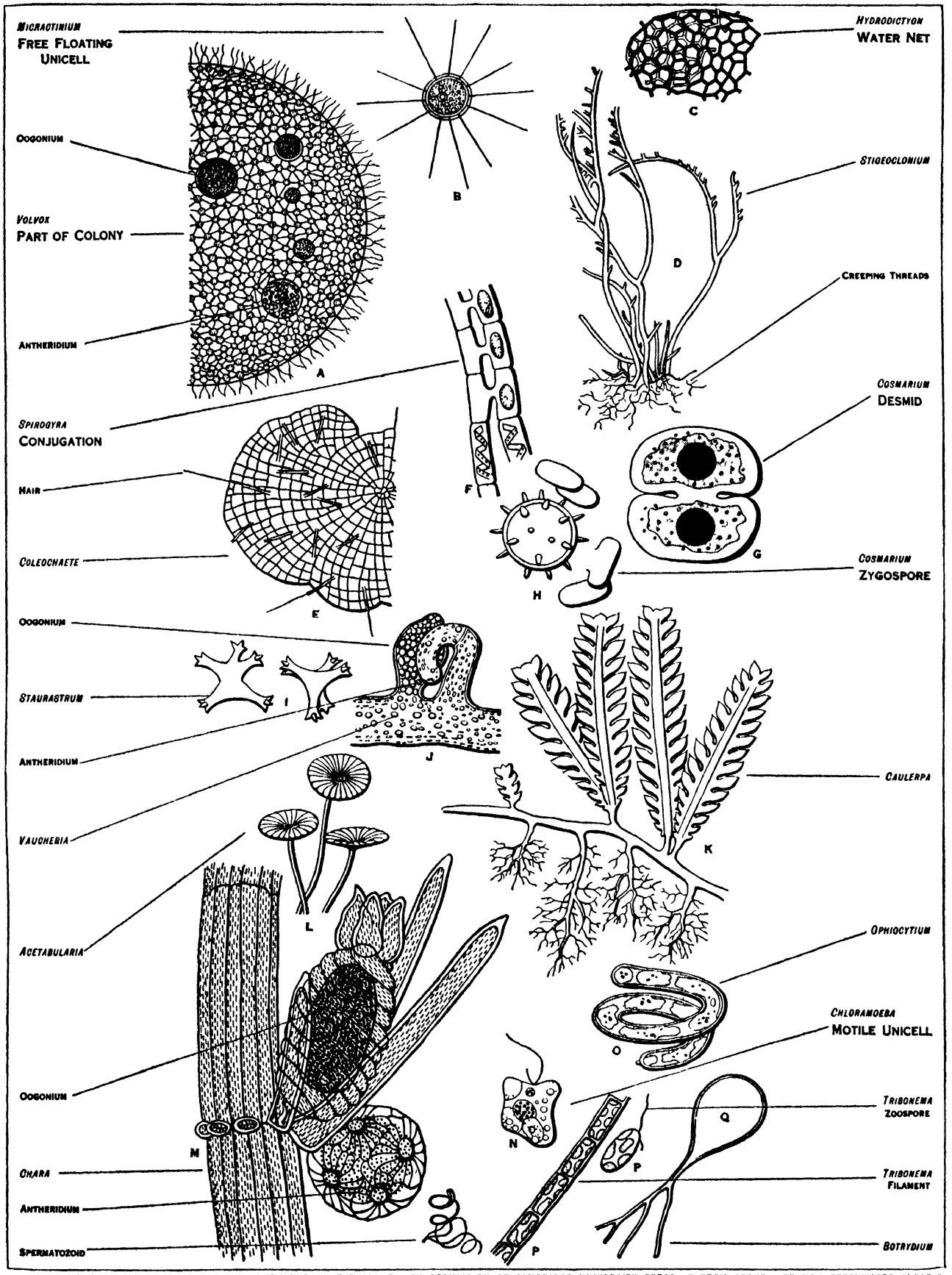
The ULOTRICHALES include unbranched filamentous forms, such as *Ulothrix* (fig. 1, F), not uncommon in streams, and *Hormidium,* forming a weft on damp soil, both with a curved parietal chloroplast in their cells, as well as *Prasiola* which is terrestrial and has an axile chloroplast. The filaments of the last commonly undergo extensive division by longitudinal walls, resulting in leafy expanses which may be very abundant where organic matter abounds (*e.g.,* near the penguin rookeries in the Antarctic). Somewhat similar are the flat sheets of the sea lettuce (*Ulva*) which are common objects on the sea-shore; but here the chloroplast is parietal. The Cladophoraceae, which are usually branched, have large cells containing many nuclei and for this reason are often referred to the Siphonales. *Cladophora,* with thick cell-walls and an elaborate net-like chloroplast is abundant in well aerated pools and streams, and also occurs on rocks in the sea.

In the CHAETOPHORALES the thallus is differentiated into prostrate and projecting systems, well seen in *Stigeoclonium* (fig. 2, D), where, as often in this group, the branches terminate in long hairs. *Draparnaldia,* which like *Stigeoclonium* is frequent in slow-moving waters, differs in possessing distinct main axes with large clear cells having a scanty chloroplast, while the bunched laterals are deep green. *Trentepohlia,* found as orange tufts on rocks and trees especially in hilly country, has its cell-sap coloured by haematochrome and possesses special zoosporangia. The group also includes many prostrate epiphytes, *e g , Aphanochaete* (frequent on *Cladophora* or *Oedogonium*) which is markedly anisogamous, and *Coleochaete* (fig. 2, E), whose cells bear curious sheathed hairs and which is oogamous. The common unicellular *Pleurococcus,* found on tree-trunks, etc., is probably an extremely reduced member of this group.

The OEDOGONIALES with big cells containing a netlike chloroplast, reproduce abundantly by large zoospores which bear a ring of numerous cilia and are formed singly in the cells. They include the unbranched *Oedogonium* and the richly branched *Bulbochaete,* where each cell bears a long hair with an inflated base. These are oogamous forms, often producing their flat antheridia in special "dwarf-male" filaments which are found attached on (fig. 1, M) or near the swollen oogonia.

The CONJUGATAE, which are widely distributed in freshwater, are distinguished by their elaborate chloroplasts with prominent pyrenoids, by lacking asexual reproduction, and by a peculiar sexual process (conjugation) in which the gametes are constituted by the contents of the ordinary cells. They comprise a filamentous series (Zygnemales), including *Spirogyra* (with spiral chloroplasts) (fig. 2, F) and *Zygnema* (with two star-shaped chloroplasts in each cell), but are more extensively represented by the unicellular Desmids. The cells of the latter exhibit a great variety of beautiful and symmetrical shapes, and are commonly divided by a median constriction into two semicells, each harbouring one or two complex chloroplasts; examples are furnished by *Closterium* with semilunar cells, *Cosmarium* (fig. 2, G), and *Staurastrum* (fig. 2, I), where the semicells are produced in two or more arms. A few Desmids form threadlike colonies. During conjugation in the Zygnemales, opposite cells of two parallel threads become connected by tubes (fig. 2, F), whereupon the protoplasm of the one glides over into that of the other and fuses with it to form a zygospore (*Spirogyra*), or the protoplasmic masses meet in the tube and form the zygospore there (often in *Zygnema*). In Desmids the protoplasts escape from two adjacent individuals and fuse to form a zygospore which lies between the empty halves of the parent cells (fig. 2, H). Both Oedogoniales and Conjugatae are highly specialized.

The SIPHONALES are coenocytic, *i e.,* their large multinucleate bodies possess few or no septa. The only freshwater form, *Vaucheria,* shows this clearly, its branched, rather coarse filaments containing numerous nuclei and lens-shaped chloroplasts in the lin-



A-F, H J, O R FROM WEST AND FRITSCH, "BRITISH FRESHWATER ALGAE," BY PERMISSION OF CAMBRIDGE UNIVERSITY PRESS G FROM COOKE, "BRITISH FRESHWATER ALGAE," BY PERMISSION OF KEGAN PAUL, TRENCH, TRUBNER AND CO K, L, AND N FROM ENGLER AND PRANTL, "PFLANZENFAMILIEN," BY PERMISSION OF WILHELM ENGELMANN M FROM OLTMANNS, "MORPHOLOGIE U. BIOLOGIE D ALGEN," BY PERMISSION OF GUSTAV FISCHER. ALL EXCEPT C, L AND M CONSIDERABLY MAGNIFIED

FIG. 2.—THE GREEN AND YELLOW-GREEN FORMS, THE MORE COMMON FRESHWATER AND TERRESTRIAL ALGAE

The chief groups of Algae are distinguished by the pigments they contain. The Green Algae are the simplest having no other pigment than the green chlorophyll. Green Algae are mainly freshwater or terrestrial and are recognized by their dark green colour and storage of starch. The Yellow-green Algae, mainly found in freshwater, are distinguished by absence of starch and storage of oil

ing protoplasm which surrounds a huge and continuous vacuole. The marine forms mostly show a more elaborate structure. Thus, the *Caulerpas* of warmer seas have a thallus differentiated into a creeping stem (up to a foot long) anchored by branched rootlets and bearing leaflike outgrowths, which in their varied form and arrangement simulate the shoots of diverse higher plants (fig. 2, K). Other Siphonales (Codiaceae) resemble certain brown and red seaweeds in having a body built up of numerous closely placed and often intertwined threads like those of *Vaucheria, e g , Codium* and *Halimeda,* the latter with a flat segmented thallus encrusted with lime. In another family (Dasycladaceae) an erect main axis bears compact whorls of branches between which there is often extensive deposition of carbonate of lime; one of the most striking forms is the Mediterranean *Acetabularia* (fig. 2, L), where the whole plant is encased in lime Many similar calcareous forms are known as fossils. The Siphonales are mostly isogamous or anisogamous, producing their gametes in special gametangia; but *Vaucheria* is oogamous with antheridia and oogonia situated side by side on the filament (fig. 2, J).

Stoneworts.—II. The CHARALES (stoneworts), which grow submerged in fresh and brackish waters, are so complex, especially in their reproductive organs, that they can have but a very remote relationship with the green algae. The slender cylindrical axes bear whorls of short branches (often called leaves), which are separated by long internodes and produce occasional branches in their axils. The popular name is due to the considerable deposition of lime in the superficial membranes. All the cells contain numerous small chloroplasts. The segments cut off from the apical cell divide into an upper half forming a node and a lower half forming an internode; the latter lengthens greatly but remains undivided, while the node becomes segmented by vertical walls, the peripheral cells growing out into "leaves" which, except for their limited growth, show the same structure as the "stems." In *Chara* threads sprout out from the lowest nodes of the leaves and closely invest the stem, but in *Nitella* this cortex is lacking.

In spite of prolific vegetative reproduction sexual organs are formed abundantly. They usually arise close together at a node (fig. 2, M). The large oogonia are completely invested by five green spiral threads whose tips form a symmetrical group (corona) at the apex. The spherical antheridium has a wall composed of eight somewhat curved "shields" which at maturity acquire a yellow or red colour; to the middle of the inner (concave) surface of each shield is attached a rod-shaped manubrium carrying a number of long coiled threads, in each compartment of which a spermatozoid is formed. At maturity the whole structure falls to pieces and the spermatozoids are set free. The fertilized ovum acquires a thick wall and rests prior to its germination, which is complex.

Yellow-green Algae.—III. The HETEROKONTAE are mainly found in freshwater, though the unicellular *Halosphaera* is of widespread occurrence in marine plankton. They are distinguished by the yellow-green colour, the absence of starch, and the storage of oil. The chloroplasts contain much xanthopyll (blue with nitric acid), are commonly disc-shaped, and never possess pyrenoids. The motile stages are provided with two very unequal cilia attached at the front end (fig. 2, N) The cell-walls are often rich in pectic substances. Sexual reproduction is rare and always isogamous, and both zoospores and gametes are formed in the ordinary cells.

The Heterokontae, though represented by far fewer genera and species than the Isokontae, exhibit much the same range of form. The motile unicell is illustrated by the rare *Chloramoeba* (fig. 2, N), whose cells are without a wall, but there are no motile colonies. Various palmelloid types are known, the commonest being *Botryococcus,* an abundant plankton form, in which the mucilage of the rather irregular colonies is often so dense that the contained cells are difficult to detect. Motionless unicells are seen in *Chlorobotrys* (a rare moorland form), *Halosphaera,* and the multinucleate *Ophiocytium* (fig. 2, O), which is common in stagnant pools. Its curved cells have a wall composed of two very unequal pieces, the smaller becoming detached as a lid when zoospores or aplanospores are to be liberated. *Tribonema* (= *Conferva,* fig. 2, P), a common freshwater form, has filaments with long narrow cells which have a wall composed of two overlapping pieces and many disc-shaped yellowish green chloroplasts. The only siphoneous form is *Botrydium* (fig. 2, Q), not uncommon on damp mud; when the latter dries, all the protoplasm withdraws into the underground rhizoid and divides into a number of thick-walled cysts.

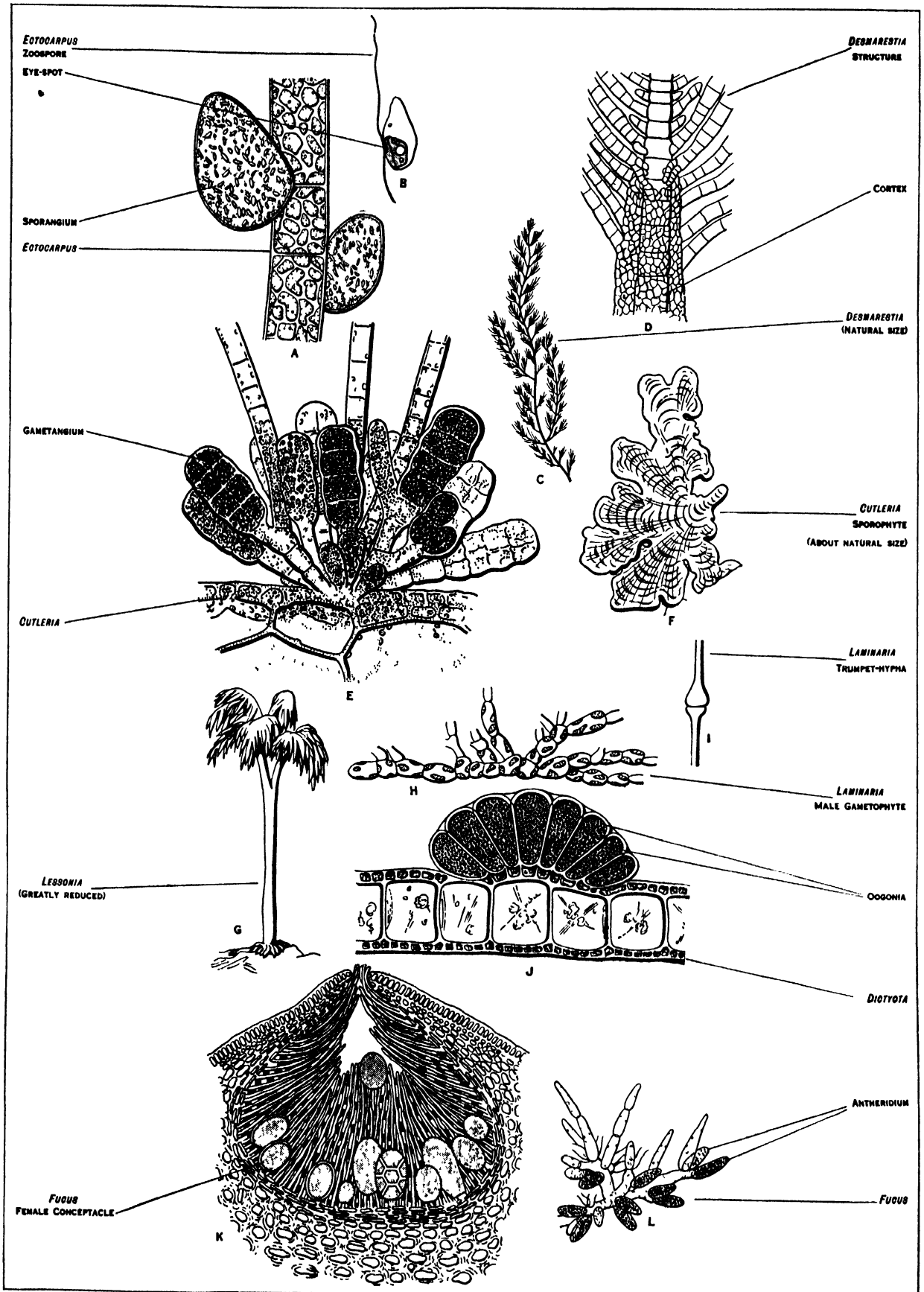
Diatoms.—IV. BACILLARIALES, which are abundant in all kinds of situations, are a specialized class of unicellular and colonial forms whose silicified wall is composed of two overlapping pieces. They are dealt with in a separate article.

Brown Seaweeds.—V. PHAEOPHYCEAE (brown seaweeds) are more especially characteristic of the colder seas. Their colour is due to fucoxanthin which accompanies the usual pigments in the chromatophores; there are generally several of the latter of varied shape in each cell. The products of photosynthesis are fucosan (red with vanillin dissolved in concentrated hydrochloric acid) and fat; opinions differ as to the nature of the former. The zoospores are formed in special sporangia and, except in the most advanced oogamous forms, the sexual organs are multicellular (fig. 1, H). The zoospores and gametes have two cilia attached to one side of the body, one directed forwards, the other backwards (fig. 3, B); near the attachment of the cilia there is a conspicuous eye-spot.

The simplest Phaeophyceae are the ECTOCARPALES, the palmelloid forms previously included in this class being now referred to the Chrysophyceae (*see* PROTOPHYTA). *Ectocarpus,* whose brown tufts or tresses are commonly seen in rock-pools, is like a brown *Stigeoclonium* having prostrate and projecting systems; each branch of the latter grows by the division of a series of flat cells situated below the terminal hair (fig 1, H). Numerous zoospores (fig. 3, B) are produced in large (unilocular) sporangia (fig. 3, A), while the gametes which are quite similar arise singly in the compartments of elongate gametangia (plurilocular sporangia, fig. 1, H). In *Pilayella* sporangia and gametangia are interspersed between the ordinary cells. The gametes, though alike in form, may differ in behaviour, some soon ceasing to move and being sought out by others which retain their activity. In *Giffordia,* with two kinds of gametangia, there is marked anisogamy. The sexual individuals of *Pilayella* (see *Life-cycle,* p. 592) are found in spring, the asexual in summer; both bear plurilocular sporangia, those of the latter liberating zoospores which give rise to a new asexual generation without the intervention of a sexual one.

Many Ectocarpales are far more complex, though all can be related to *Ectocarpus.* A few examples must suffice. *Desmarestia* (fig. 3, C) has main axes, from 1½–4 feet long, bearing numerous short stiff branches which in winter and spring end in feathery tufts, but in summer are bare. The large cells of the axis (fig. 3, D) each produce a pair of short branches, from the lowest cells of which threads grow out in profusion and become matted together to form a wide "cortex" which grows very thick in the older parts. The branched gelatinous threads of *Castagnea* and the irregular jellylike lumps of *Leathesia,* common on larger seaweeds, are built up of numerous filaments in dense juxtaposition at the surface, but more loosely arranged in the interior. Of a different type are the bladderlike thalli of *Asperococcus* and the long occasionally constricted tubes of *Scytosiphon,* which arise by longitudinal division in the cells of the primary thread followed by the development of a central air-cavity. Many Ectocarpales (*Elachista, Myriotrichia*) form small epiphytic cushions or tufts.

The cylindrical threads of the SPHACELARIALES possess a prominent apical cell which cuts off segments parallel to its base (fig. 1, I). These, without further elongation, divide abundantly and often very regularly by transverse and longitudinal walls; the older parts are, however, often covered by a dense small-celled cortex. The numerous branches mostly remain quite short and by their arrangement determine the habit of the plant. *Sphacelaria* is a bushy form, rarely exceeding one or two inches in height with feathery arrangement of the branches. *Cladostephus* is larger and has whorled branches. The former multiplies abundantly by means of triangular or three-armed propagules. The reproduction of Sphacelariales resembles that of Ectocarpales; some are anisogamous like *Giffordia.*



A AND J FROM ENGLER AND PRANTL, "PFLANZENFAMILIEN," BY PERMISSION OF WILHELM ENGELMANN B I FROM OLTMANNS, "MORPHOLOGIE U BIOLOGIE D ALGEN," BY PERMISSION OF GUSTAV FISCHER. K AND L FROM FRITSCH AND SALISBURY, "AN INTRODUCTION TO THE STRUCTURE AND REPRODUCTION OF PLANTS," BY PERMISSION OF G. BELL AND SONS, LTD. ALL EXCEPT C, F AND G CONSIDERABLY MAGNIFIED

FIG. 3.—BROWN ALGAE, MORE ESPECIALLY CHARACTERISTIC OF THE COLDER SEAS

The Brown Algae have a yellowish to brown pigment in addition to the chlorophyll, which gives them various shades from olive to yellow and brown. There are a dozen or more orders in this group, the largest of which are the Ectocarpales which consist of very simple forms of filaments, the Laminariales or kelps, and the Fucales which include rock weeds and Sargassum

Cutleria, the principal genus of CUTLERIALES has a branched ribbon-like thallus, several layers of cells thick, the ultimate segments ending in a fringe of hairs, each exhibiting at its base a dividing zone like that of *Ectocarpus.* The dark dots on the unisexual thalli correspond to groups of hairs bearing gametangia (fig. 3, E), the female having large deep brown compartments, the male small pale yellow ones. Both gametes are motile (fig. 1, O). After fusion they produce a flat crustlike thallus (*Aglaozonia*-stage, fig. 3, F), several layers of cells thick and bearing a dense row of sporangia on the upper surface. The zoospores ordinarily give rise to the *Cutleria*-plant, but this regular alternation does not always occur, either generation being capable of reproducing itself.

Oogamous Forms.—The remaining brown seaweeds are oogamous. Among these the LAMINARIALES alone possess zoospores which are produced in densely crowded sporangia occupying the surfaces of the blades. This group includes the largest seaweeds, which are often very elaborate in form and structure. One of the simplest is *Chorda filum,* whose unbranched whiplike thalli may be several yards long, whilst barely a quarter of an inch thick. In *Laminaria* there is a long stalk terminated by a blade which is entire (*L. saccharina*) or divided into fingerlike segments (*e.g., L. digitata,* fig. 1, K). New blades arise periodically by a gradual widening at the top of the stalk, the old blade being slowly destroyed by the waves. The divided blades of *Laminaria digitata,* etc., arise by the formation in the new growth of several long slits which ultimately reach the free edge. This explains the development of such an elaborate form as *Lessonia* (fig. 3, G), the young stages of which resemble a *Laminaria* with a simple blade; by progressive splitting and the development of separate stalks to the segments the large treelike growth (10–12 ft. high) ultimately arises. *Macrocystis,* the giant of the southern seas, develops in much the same way. Here the slender stalk, which is up to 60 yd long, trails out from its attachment to the rocks to the surface of the water, where it bears two long rows of narrow blades, floating with the help of air-bladders at their base. *Nereocystis,* which is like a huge *Laminaria digitata* and occurs on the Pacific shores of America, has an immense air-bladder at the top of the stalk. *Alaria,* a much smaller form whose blade has a midrib, has narrow outgrowths on the stalk to which the sporangia are confined. Similarly, in *Macrocystis* the latter are found on simple shoots arising from the base of the stalk.

The complex internal structure has already been described; of special interest are the sieve-tubes, closely resembling those of higher plants, found in the inner cortex of *Macrocystis* and *Nereocystis.* The medulla in all cases contains numerous "trumpet-hyphae" (fig. 3, I) with a marked dilation at the septa which show a sievelike pitting.

The gametophytes are microscopic filaments bearing either antheridia producing a single, almost colourless, spermatozoid (fig 3, H), or oogonia with a single ovum.

Dictyota, which is typical of the DICTYOTALES, has a forked band-shaped thallus growing by an apical cell The asexual individuals bear at intervals spherical sporangia, each producing four motionless spores These give rise to male or female individuals. Oogonia and antheridia are formed in compact groups on the surface, the former (fig. 3, J) unicellular and producing each one ovum, the latter of the usual septate type; the male cells have only a single apical cilium. In *Padina,* which is rarer, the thalli are fan-shaped with an inrolled margin and exhibit a prominent concentric zoning.

The FUCALES, although not nearly so large, are quite as complex as the Laminariales There is no asexual propagation, but sexual reproduction is very prolific. The sexual organs are borne amidst numerous hairs on the inner surface of round cavities (conceptacles) (fig. 3, K), which appear as swellings on the thalli and open to the exterior by a small aperture. The large oogonia (fig. 1, N) produce eight (*Fucus*), four (*Ascophyllum*), two (*Pelvetia*), or only one ovum (*Himanthalia*), while the antheridia, borne in large numbers on branched hairs (fig. 3, L), form minute spermatozoids. Male and female organs occur on distinct individuals or, more rarely (*Pelvetia*) in the same conceptacle. The gametes are extruded from the conceptacles in a drop of mucilage during low tide, and fertilization takes place when the sea returns. The fertilized ovum grows direct into a new plant. The conceptacles are generally restricted to the tips, although *Fucus* and others have similar, but smaller, barren conceptacles scattered over the whole thallus.

In the bladderwrack (*Fucus*) the flat segments have a thick midrib which persists as a stalk in the older parts of the plant; several species have paired air-bladders. *Pelvetia,* which is much smaller, has narrow branches which are deeply channelled, while the irregularly swollen tips render fertile plants very conspicuous. The long straplike thalli of *Ascophyllum,* dilated at intervals by air-bladders, bear numerous short branches which arise from marginal slits and in the upper parts of the plant contain the conceptacles. In *Himanthalia* the thallus is roughly of the shape of a top and about an inch across, but periodically the upper surface gives rise to a forked straplike outgrowth, as much as a yard long and studded with conceptacles. The distribution of these forms on the sea-shore is dealt with below *Sargassum* (fig. 1, L) has already been described. The internal structure of Fucales is similar to that of Laminariales, though somewhat simpler

A seventh group of brown algae, the Tilopteridales, are rare and too incompletely known to be considered here

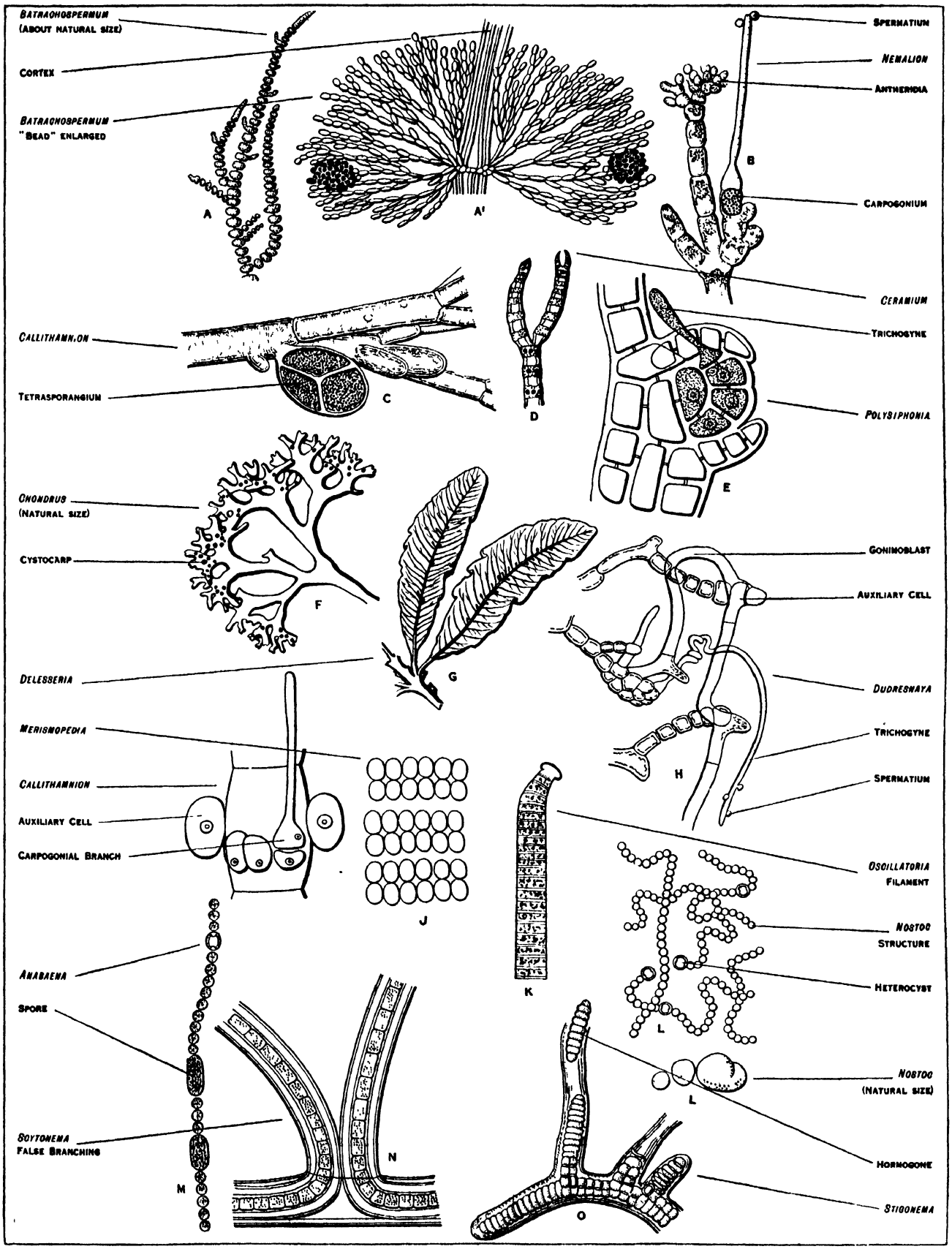
Red Seaweeds.—VI. RHODOPHYCEAE (red seaweeds) are a highly specialized class, mainly confined to the sea. The marine forms are usually coloured various shades of red or purple, while the freshwater ones are often bluish. The chromatophores, of which several are found in each cell, contain a red (phycoerythrin) and a blue (phycocyanin) accessory pigment, and the different colours are due to the varied proportions in which these two pigments occur. Pyrenoidlike bodies are frequently found in the less specialized forms. The product of photosynthesis consists of small doubly refractive granules of Floridean starch (brownish or reddish with iodine). The thick, mucilaginous cell-walls are usually provided with conspicuous pits connecting the protoplasm of adjacent cells. No red seaweed has any motile reproductive cells.

The simple BANGIALES, whose cells have an axile star-shaped chromatophore and are without pits, include *Bangia,* with unbranched threads whose cells are longitudinally divided, and *Porphyra,* with a flat *Ulva*-like thallus, both marine. Their relation to other red algae is not clear. They reproduce asexually by liberation of the contents (monospores) of ordinary cells, while their sexual reproduction is not unlike that of the Nemalionales (*see* below).

The large remainder of the red algae, styled FLORIDEAE, are classed in four groups distinguished by the events following upon fertilization. Their thallus exhibits diverse structure, but growth is usually apical. *Callithamnion,* one of the simplest forms, consists merely of richly branched threads with elongate cells. Many other Florideae are filamentous, though with a more elaborate structure. Thus in *Ceramium* the threads show a characteristic banding (fig. 4, D), due to the formation of a small-celled cortex around the upper end of each principal cell. In *Polysiphonia* the segments of the apical cell divide with great regularity by longitudinal walls, forming characteristic tiers with a deeply coloured central cell shimmering through the peripheral ones. *Batrachospermum,* the "frog-spawn alga," found in slowly moving streams, has soft threads resembling a string of beads, each constituted by a whorl of branches (fig. 4, A); the large cells of the main axes are overgrown by cortical threads.

In *Nemalion* or *Furcellaria* the threads are coarser and, like *Codium* or *Castagnea,* composed of numerous filaments in more or less dense aggregation (fig. 1, J). *Corallina* shows the same structure, but here the pink barrel-shaped segments are densely encrusted with lime and separated by uncalcified joints, where the central threads bear no lateral branches. Closely related are *Lithothamnion* and *Melobesia,* with strongly calcified encrusting thalli which are specially common in the warmer seas and often assist in the building of coral-reefs. Such forms are also known as fossils.

Many Florideae have a flattened thallus which may be exten-



A-C, G, H, I FROM OLTMANNS, "MORPHOLOGIE U BIOLOGIE D ALGEN," BY PERMISSION OF GUSTAV FISCHER D AND F FROM FRITSCH AND SALISBURY, "AN INTRODUCTION TO THE STRUCTURE AND REPRODUCTION OF PLANTS," BY PERMISSION OF G BELL AND SONS, LTD E AND O FROM ENGLER AND PRANTL, "PFLANZENFAMILIEN," BY PERMISSION OF WILHELM ENGELMANN J N FROM WEST AND FRITSCH, "BRITISH FRESHWATER ALGAE," BY PERMISSION OF CAMBRIDGE UNIVERSITY PRESS ALL EXCEPT A F AND C MAGNIFIED

FIG. 4 —TYPES OF MARINE RED ALGAE AND OF BLUE-GREEN FRESHWATER ALGAE

The Red Algae have a red pigment in addition to the chlorophyll; this gives to their graceful and often delicate bodies beautiful tints and shades of red and purple. They are regarded as the most beautiful of all the marine algae. The Blue-green Algae are a very distinct class, probably an ancient group that has retained primitive characteristics. Their prevalent colour is blue-green, but other tints, such as violet and red are not uncommon. They are of wide distribution, especially in freshwater and terrestrial habitats

sively branched, *e.g.*, carrageen (*Chondrus crispus*, fig. 4, F) and *Gigartina*, the latter with numerous teatlike outgrowths which harbour the fruits. Some of the most beautiful forms belong to *Delesseria* (fig. 4, G).

Reproduction of Red Seaweeds.—The sexual organs are usually formed on the lateral branches, the rounded antheridia in groups, and the female organs (carpogonia) singly (fig. 4, B). Each carpogonium is flask-shaped and prolonged into a narrow neck (trichogyne), the ovum occupying the swollen base. Each antheridium produces a single motionless spermatium, which is conveyed by chance currents to the trichogyne. After solution of the wall the contents of the spermatium pass through the trichogyne to fuse with the female cell. The consequences of fertilization vary in the different groups.

In the NEMALIONALES (incl. *Batrachospermum* and *Nemalion*) numerous short sporogenous threads sprout from the carpogonium (*cf.* fig. 4, A'), their end-cells liberating naked carpospores which produce a new individual. These sporogenous threads are sometimes regarded as a sporophyte (*see* above). Asexual reproduction in the Nemalionales is either lacking or effected by monospores formed singly in spherical sporangia.

The remaining Florideae reproduce asexually by tetraspores developed in tetrasporangia which either project freely (fig. 4, C), or, more commonly, are embedded among the superficial cells of the thallus (fig. 4, D); they are sometimes confined to special branches. The tetrasporangia usually occur on individuals devoid of sexual organs, although in other respects similar to the sexual plants. A regular alternation of the two has been established in a considerable number of cases (*cf.* above).

In the more advanced groups the fertilized carpogonium develops filamentous outgrowths (gonimoblasts, fig. 4, H) which fuse with one or more auxiliary cells distinguished by rich protoplasmic content. At the points of fusion there arise bunches of sporogenous threads forming the carpospores, which produce the individuals bearing tetraspores. Only the protoplasm of gonimoblast and auxiliary cell fuse, their nuclei remaining far apart, so that the process gives rather the impression of a parasitism of the gonimoblast on the auxiliary cell than of a second process of fertilization. In the CRYPTONEMIALES the two or three gonimoblasts are long threads fusing repeatedly with auxiliary cells which are here located at the ends of neighbouring branches (fig 4, H). In the remaining groups (GIGARTINALES, RHODYMENIALES) the auxiliary cells are associated with the carpogonia to form so-called procarps, and the gonimoblasts are quite short. Thus, in *Callithamnion*, there are two auxiliary cells flanking a cell of the main axis (fig. 4, I, a and b) and one bears the four-celled branch which ends in the carpogonium; two masses of carpospores are formed. In *Polysiphonia* and many other cases the single auxiliary cell and the carpogonial branch become enclosed, already prior to fertilization, by a cuplike outgrowth from the adjacent cells (fig. 4, E). The enlarged envelope subsequently forms an investment around the single mass of carpospores, the whole structure being termed a cystocarp. In forms with a compact thallus the cystocarps are often embedded in the surface layers (fig. 4, F). *Corallina* and its allies produce all their reproductive organs in flask-shaped cavities (conceptacles).

Blue-green Algae.—VII. MYXOPHYCEAE (CYANOPHYCEAE) are a very distinct class distinguished by their simple cell-structure, the absence of all motile stages, and the lack of sexuality. They are probably an ancient group which has retained primitive characteristics, and enjoy a very wide distribution, especially in freshwater and terrestrial habitats. The prevalent colour is blue-green, but other tints (violet, red, etc.) are not uncommon. The pigments (chlorophyll, yellow carotin, blue phycocyanin, and a red one similar to the phycoerythrin of red algae) are simply lodged in the peripheral protoplasm, there being no definite chromatophore. The central protoplasm (central body) is colourless and perhaps constitutes a rudimentary nucleus, quite unlike that of other plants Its structure has been repeatedly investigated, but has not yet found an interpretation that meets with common consent. The products of photosynthesis are sugars and glycogen, the latter causing the brown colouration of the cells after treatment with iodine. The cells often contain numerous granules, some of which consist of protein (cyanophycin granules). The cell-wall is frequently not sharply defined.

The simpler members are colonial and grouped as CHROOCOCCALES, most of which are palmelloid with the cells embedded in abundant soft mucus (*e.g*, *Gloeocapsa*, fig. I, E); they form jelly-like masses on damp walls, rocks, etc. A different type is seen in *Merismopedia* (fig. 4, J) whose plates of deep blue cells are common in freshwater plankton.

The remaining Myxophyceae are filamentous (HORMOGONEALES). *Oscillatoria*, forming vivid blue sheets at the bottom of ponds in autumn, has simple threads (fig. 4, K), which may glide slowly through the water or exhibit slow pendulumlike movements to which the genus owes its name. Many of its allies have their threads encased in a firm mucilage sheath (*e.g*, *Lyngbya*). In *Phormidium* huge numbers of threads are agglutinated by their soft sheaths to form leathery or papery sheets which often cover rocks, etc., over considerable stretches. In *Scytonema* (fig. 4, N) the filament breaks at certain points and the two pieces push out of the sheath sideways to form paired branches. This "false branching" is common in a number of Myxophyceae. The threads of *Scytonema* and its allies exhibit occasional larger cells (*heterocysts*), which have a firm cellulose wall and whose contents are at first yellow, but ultimately disappear completely.

Heterocysts are also found in the unbranched filaments of *Nostoc* (fig 4, L) and *Anabaena* (fig. 4, M). The coiled threads of the former are embedded in large numbers in soft mucilage to form spheres or leafy expanses on damp ground or in water. In *Rivularia* and its allies the heterocysts are always situated at one end of the filament, whilst the opposite one tapers to a point or ends in a long hair. *Stigonema* (fig. 4, O) is a more robust form with several rows of cells within the sheath and showing true branching.

In a very few cases the contents of heterocysts have been found to produce a new thread, but for the most part they do not fulfil any recognizable function. Reproduction in the Myxophyceae is usually accomplished vegetatively, by fission in the colonial forms and by the detachment of short lengths of thread called hormogones in the filamentous types. The hormogones perform slow, gliding movements, whose mechanism is not fully understood. Many Hormogoneales produce resting spores, enlarged thick-walled cells with abundant granules, which may arise from any cell of a thread, though commonly located near a heterocyst (fig. 4, M).

The Myxophyceae, though so simply constructed, are successful in many habitats (*e.g*, hot springs, the frozen Antarctic lakes) where few other algae (except diatoms) can exist.

PHYLOGENY

There can be little doubt that algae originated in the water and that they preceded in their evolution the more elaborate land-plants. The different classes, as well as some prevalently flagellate groups dealt with elsewhere (*see* PROTOPHYTA), are distinguished by special pigments in the chromatophores and by the products of photosynthesis. Each class thus has its distinctive metabolism and probably represents the outcome of a separate attempt at the creation of a holophytic organism. There is little evidence of any real relationship between the diverse classes, and a common ancestry is in the light of our present knowledge improbable. In several classes the ciliated individuals and the motile reproductive cells are of a distinctive and rather uniform stamp, and this fact has led to the practically universal adoption of the view that these algal classes originated from motile unicellular organisms (Flagellates) that gradually lost their power of movement and gave rise to filaments, etc., in the way that has been above indicated. In red and blue-green algae, where no motile stages exist, a like origin from unicellular forms is assumed, though these need not necessarily have ever had the capacity of movement.

One may therefore picture the evolution of algae as having followed a number of separate lines, starting each with its unicellular ancestry and branching out in numerous special directions to develop as colonies, as palmelloid types, as filamentous forms

with diverse elaborations, etc. It is unlikely that these principal categories have ever originated directly from one another. They would rather appear to represent as many different attempts at the building of a body from the unicellular ancestry. It is significant that the same types of plant-body are repeated in different classes, since this indicates a parallelism in the evolution of the latter which has only recently been recognized. In some classes (*e.g.*, Heterokontae) evolution has not progressed far, while in others (*e.g.*, Phaeophyceae and Rhodophyceae where the simpler forms seem to be extinct) it has led to the production of highly specialized types in part of large size.

The biggest range in structure and reproduction is encountered in the green algae, although they have not attained to the complexity or dimensions of the brown and red seaweeds. The absence of the more specialized forms in this very vigorous and adaptable class is possibly due to their having migrated to the land in the remote past, although others hold that the higher plants originated from a hypothetical group of large green seaweeds now altogether extinct, and at least as complex as the brown and red forms of the present day.

OCCURRENCE AND DISTRIBUTION

Benthos.—Most algae grow permanently submerged, and are either attached (benthos) or free-floating (plankton). In freshwaters the algae of the benthos grow on stones, twigs, and larger aquatics, while the benthic seaweeds are nearly all lithophytes (*i.e.*, fixed to rocks). Few algae (*Chara, Caulerpa*) can obtain a foothold in loose sand or mud, and a rock on a sandy beach often stands covered with vegetation like an oasis in a desert. Members of the benthos may become detached from their substratum and float freely, like the tangles of filamentous algae found in ponds, or the seaweed *Sargassum,* innumerable plants of which drift into the North Atlantic from the Gulf of Mexico and the Caribbean sea and thus give rise to the Sargasso sea. Unattached species of *Fucus* are not uncommon in salt marshes, but most seaweeds are doomed when torn away from their substratum. In rivers too all algal growth, other than the plankton, is attached, either encrusting rocks and pebbles (Myxophyceae, the red *Hildenbrandtia*) or forming long tresses trailing out with the current (*Cladophora, Ulothrix,* various red algae). All benthic forms bear numerous epiphytes and their dense tangles usually harbour a wealth of smaller algae and animal life.

Zonation.—The benthos usually exhibits more or less pronounced zoning. In lakes and pools this is due to the gradual diminution in light-intensity with increasing depth of water. The epiphytes on the submerged Phanerogams often show such zoning clearly, while in deeper water the growth consists in the main of Charales, *Nitella* usually thriving at greater depths than *Chara.* Further out, where the light is reduced to a minimum, the bottom bears only diatoms and sometimes cladophoraceous forms. Zonation is much more marked on rocky shores, where the littoral zone (*i.e.*, the region between tide-levels) is of considerable extent. The highest levels are occupied by forms like *Pelvetia, Bangia, Prasiola,* etc., which are only under water for a few hours or indeed may grow at such a height, as to be merely wetted by spray and submerged only at spring tides. This spray-zone has its equivalent at the margins of large lakes, where the stones bear a growth of *Spirogyra adnata,* Myxophyceae, etc. Below the spray-zone, on northern shores, there follows a broad girdle of *Fucus,* various species of which occupy different levels; in the lower stretches they are mingled with *Ascophyllum,* while near low tide level *Himanthalia,* and Corallinaceae are often conspicuous features. In the sublittoral zone Laminariales are the dominant forms in all the colder seas. In the Mediterranean the littoral zone is specially characterized by *Corallina mediterranea.* Between tide levels are also found many green (*Ulva, Cladophora*) and red algae, but the latter, both as species and individuals, are most abundant in deeper water, where they are never exposed.

The various pigments (brown, red, blue, etc.) that accompany the chlorophyll probably serve in the first place to screen the latter against the intense illumination to which seaweeds are exposed when uncovered by the tide. The Rhodophyceae of the littoral zone usually possess a dark red, almost black colour, and the brighter tints are met with only in the permanently submerged forms. Red seaweeds are, in fact, so sensitive to strong light that in aquaria they have to be grown behind dark glass.

The accessory pigments in the chromatophores, however, also effect an alteration in the region of maximum absorption of light. While in green plants this is in the red part of the spectrum, in the case of red algae it is in the green. So that at considerable depths, where the red and yellow rays have been absorbed, while the green and blue ones are relatively undiminished, red algae can still carry on photosynthesis and will be more successful than green or brown forms. It has been thought that their characteristic colour may have been acquired as a direct response to the quality of the light, but this is a debated point. It is well known, however, that some *Oscillatorias* will take on a colour complementary to that of the light to which they are exposed. Various Myxophyceae that grow in deep water, moreover, assume a red colour. It appears, however, from recent research that other factors than the colour of the light (*e.g.*, lack of nitrogen) may bring about a change of pigmentation.

Phytoplankton.—The members of the phytoplankton are largely unicellular or colonial and are often highly adapted to a floating life. Many take the shape of flat plates (*e g., Pediastrum, Merismopedia,* fig. 4, J), others bear numerous bristles (*Micractinium,* fig. 2, B) which heighten their buoyancy, while some (*e g ,* the many Myxophyceae responsible for "water-blooms") possess structures in their cells (pseudovacuoles) which render them lighter than water. A number of plankton algae (*e g.,* Volvocales), moreover, are freely motile and can thus maintain themselves in the surface layers where alone they obtain adequate illumination.

Marine phytoplankton consists largely of Diatoms, Peridinieae, and a few Heterokontae (*Halosphaera, Meringosphaera*), although a red filamentous member of Myxophyceae (*Trichodesmium*) is sometimes abundant in the warmer seas, hence the name of the Red sea. Freshwater phytoplankton is more diverse, including apart from Diatoms and Peridinieae, many Isokontae and blue-green algae. Since the phytoplankton constitutes the diet of many smaller animals, its abundance is often intimately related to the productivity in fish of oceanic or lacustrine waters It varies considerably, both in quantity and quality, in different seasons of the year, and there is usually a more or less marked annual succession of forms (Diatoms, Peridinieae, etc), many of which appear in swarms of rather limited duration.

Periodicity.—Such periodicity is also observable in the benthos and may be very striking in ponds, where four or more distinct phases can sometimes be distinguished during the year and certain forms (*Spirogyra, Tribonema,* etc.) are commonly only present during a limited period The flora is usually poorest in the height of summer. Seaweeds likewise exhibit a periodicity, some being annuals and absent in the unfavourable season (winter or summer, as the case may be), whilst others though lasting for two or more years periodically shed parts of the thallus (*cf. Laminaria* and *Desmarestia* above). Reproduction is, moreover, commonly confined to definite periods; thus, many species of *Spirogyra* and *Oedogonium* are found fruiting mainly in spring, *Coleochaete* in the summer, the Laminariales produce their sporangia especially during the winter months, etc. Sexual reproduction in freshwater algae usually occurs during periods of bright sunshine.

Conditions of Existence.—The effect of light on the distribution of algae has already been considered. Second in importance is temperature, which probably in large part conditions the broad differences in the composition of the algal flora over the surface of the earth. In the colder seas other seaweeds are overshadowed by the large brown forms (Laminariales, Fucales), which are far less abundant in tropical and subtropical waters where red algae and Siphonales come to the front. Such regional differences are not so marked in freshwaters, although certain forms (*Cladophora*), common in temperate zones, are rare in the tropics, where moreover Myxophyceae play a bigger rôle than in colder latitudes. Some of these differences are no doubt determined by the higher oxygen-content of colder waters.

In extreme temperatures the algal flora acquires a very distinctive stamp. Thus, in hot springs the vegetation consists almost entirely of Myxophyceae and Diatoms, some of which are able to thrive at very high temperatures (80°C and more). Many algae, on the other hand, can withstand low temperatures and may be melted out from ice in a perfectly healthy condition. The frigid Antarctic lakes contain huge sheets of the blue-green *Phormidium* bearing a host of epiphytes. A peculiar flora consisting mainly of green algae occupies the surface of the perpetual snowfields of the Alps, Andes, etc., and of the polar regions. Over wide areas the snow may exhibit a red colour due in the main to the resting-cells of *Chlamydomonas nivalis,* with which other forms are associated. Yellow snow, with a different flora, occurs in the Antarctic and is also known from the Alps.

Few algae can stand appreciable variations in the concentration of the water. Freshwater forms are not very tolerant of an excess of salts and seaweeds cannot thrive in dilute water, so that in estuaries and on salt-marshes only a limited number of algae are to be found.

Endophytes and Parasites.—The majority of epiphytic algae are attached merely to the surface of their substratum, but especially among marine forms some of the threads not uncommonly penetrate the latter, either invading only the external membranes of their host or burrowing deeper, so that they become active parasites. In most cases such forms afford little outward indication of their parasitism, but in the red alga *Harveyella* (*Chorecolax*) *mirabilis* the cushionlike thalli are devoid of all colour. It is rare for algae to be parasitic on higher plants, but *Cephaleuros,* one of the Chaetophorales, attacks the leaves of various tropical Phanerogams (including tea and coffee), causing more or less serious diseases.

A number of algae (*endophytes*) live almost entirely within the interior of other plants, without as a general rule being more than space-parasites. Such are the species of *Chlorochytrium* which occur in the fronds of the duckweed, etc., the *Nostoc* found in the liverwort *Anthoceros,* and the species of *Anabaena* that inhabit *Azolla* and the roots of various higher plants. In other cases the endophyte merely lies within the thick surface membranes of its host (many marine algae). A more intimate relation (*symbiosis*) exists in the case of the "green cells" (*Chlorella* spp) found within the bodies of various lower animals, and the association of *Trebouxia, Trentepohlia,* and certain Myxophyceae with fungi to form lichens. Here the alga receives both protection and food from its partner (animal or fungus), which in turn profits by absorbing some of the products of photosynthesis of the alga.

Terrestrial Algae.—Numerous algae can exist more or less successfully out of water. The amphibious seaweeds of the littoral zone form a case in point. Somewhat similarly situated are the forms (*Botrydium, Vaucheria*) that grow on the damp mud round the edges of pools and ditches and which form resting spores as soon as the mud dries. There are, however, many algae living in and on soil, which are more highly adapted to withstand prolonged drying. The subterranean community comprises green (*Chlorococcum*) and blue-green forms, as well as diatoms, cultivated soils in general having a richer flora than natural ones. There can be no doubt that these algae fulfil an important rôle in the soil. A capacity to fix atmospheric nitrogen has been attributed to them, but no decisive proof is yet forthcoming. The gelatinous sheaths of many soil-algae, especially Myxophyceae, may well serve as a home and as a source of carbohydrate-supply for nitrogen-fixing bacteria, and herein may lie their chief importance.

The numerous subaerial algae are mainly green and blue-green, the latter playing a dominant part in the warmer humid regions of the world, where they constitute important primary colonizers of rock-surfaces and may often cover the latter for many hundreds of square yards with sheets of distinctive tint, giving a characteristic coloration to the landscape. In temperate regions green terrestrial algae are more conspicuous. Every one will be familiar with the green covering on tree-trunks, etc., due to *Pleurococcus* and other unicellular forms, which possess such a capacity to resist desiccation that they will survive months of extreme drying in a desiccator over concentrated sulphuric acid without harm. Other examples of green subaerial algae are *Zygogonium ericetorum,* one of the Conjugatae whose purple or greenish wefts cover extensive tracts of peaty soil, *Hormidium* found on clayey soils, and *Trentepohlia* whose orange tufts are particularly common in hilly districts and in the damp tropics. All these can survive long periods of drought without any appreciable change, resuming growth as soon as wet weather sets in.

Geographical Distribution.—While the broad differences in the character of the algal flora in diverse situations and in different regions of the earth are without difficulty related to special factors, the analysis of the conditions that determine local variations is still in its infancy. Such variations are patent to any one who makes a study of the algae of a limited region. Thus the algal flora of a moorland pool differs from that of one situated in meadow land, that of a lake differs according as the bottom is rocky or covered with silt, calcareous waters are poor in algal growth, etc. Similarly the vegetation of the sea-shore varies with the nature of the rocks, the extent of wave-action, the presence of currents, and the amount of detritus borne by the waves. Other differences appear to depend rather on geographical than on ecological factors. Thus, the desmid flora has a distinctive character in different parts of the world, and desmids appear to be entirely absent from the Antarctic continent, though abundant in the Arctic. Similar observations may be made with reference to the geographical distribution of seaweeds.

Uses.—Relatively few algae are of economic importance. Seaweeds are in many places employed as a convenient form of manure. A species of *Porphyra* (*P. laciniata*) and the red seaweed *Rhodymenia palmata* are used as food in some places, the former being known as dulse. Agar-agar, a substitute for gelatine, is derived from a species of *Gracilaria,* while another red seaweed, carrageen (*Chondrus crispus*), has been used as an invalid food Iodine was at one time mainly obtained from the ash of seaweeds.

Fossil Algae.—The dense incrustation of carbonate of lime found in various Siphonales and in the Corallinaceae has already been mentioned, and very similar forms are known as fossils in the Trias as well as in the Palaeozoic from the Silurian onwards. Such algae have evidently contributed to no small extent to the building of limestones, just as the *Lithothamnions,* etc. (Nullipores) are important agents in the formation of coral-reefs at the present day. Algae, which are not thus encrusted, are not so readily preserved as fossils, and of such we have little more than a fairly reliable record of their presence in earliest times; some of the forms in question are of large dimensions (*e.g.,* the Devonian *Nematophycus*) and may have been similar to Laminariales. For fossil diatoms, *see* BACILLARIALES.

BIBLIOGRAPHY.—The following three works contain an up-to-date account of the various classes of algae and afford a complete bibliography up to the time of their publication: F. Oltmanns, *Morphologie und Biologie der Algen* (Jena, 1922); G. S. West and F. E. Fritsch, *British Freshwater Algae* (1927); G. S. West, *Algae,* Cambridge Botanical Handbooks, Vol. I. (1916). A more popular account is G. Murray, *An Introduction to the Study of Seaweeds* (1895). Of general systematic works the most important are. J. B. de Toni, *Sylloge Algarum,* vol. i. *Chlorophyceae,* vol. ii. *Bacillariaceae,* vol. iii. *Fucoideae,* vol. iv. *Florideae,* vol. v. *Myxophyceae* (by A. Forti) (Padua, 1889–1907); Engler and Prantl, *Naturliche Pflanzenfamilien, Chlorophyceae* (vol. 3, 1927, by H. Printz); *Phaeophyceae* (I. Teil, Abt. 2, by F. R. Kjellman and supplement by N. Svedelius, 1897 and 1909); *Rhodophyceae* (I. Teil, Abt. 2, by Fr. Schmitz and N. Svedelius, 1897 and 1911); *Schizophyceae* (1. Teil, Abt. 1 by O. Kirchner, 1900), A. Pascher, *Susswasserflora Deutschlands, Oesterreichs, und der Schweiz* (Jena, 1912–27)—the last copiously illustrated and semi-popular. For seaweeds, *see* also W. H. Harvey, *Phycologia Britannica* (1846–55); *Nereis Boreali-Americana* (1851–58): *Phycologia Australica* (1858–63); E. Wuitner, "Les Algues marines des côtes de France," *Encyclopédie pratique du naturaliste,* VII. (1921); and L. Newton, *Handbook of British Seaweeds* (pubd. by British Museum, 1928). Many other less comprehensive systematic works, as well as the many monographs dealing with separate groups, will be found cited in one or other of the above. The biological aspects are more particularly treated in H. B. Ward and G. C. Whipple, *Freshwater Biology* (1918). (F. E. F.)

ALGARDI, ALESSANDRO (1602–1654), Italian sculptor, was born at Bologna in 1602, and attended the school of the Caracci. The turning point in Algardi's fortune was the accession

of Innocent X., of the Bolognese house of Panfili, to the papal throne in 1644. He was employed by Camillo Panfili, nephew of the pontiff, to design the Villa Doria Panfili outside the San Pancrazio gate. The most important of Algardi's other works were the monument of Leo XI., a bronze statue of Innocent X. for the capitol, and, above all, *La Fuega d'Attila* an alto-relievo in which the two principal figures are about 10ft. high. In 1650 Algardi met Velasquez, who obtained some orders for his Italian companion in Spain. Thus there are four chimneys by Algardi in the palace of Aranjuez, where also the figures on the fountain of Neptune were executed by him. The Augustine monastery at Salamanca contains the tomb of the count and countess de Monterey, which was also the work of Algardi. He was most successful in his portrait-statues and groups of children, where he was obliged to follow nature most closely. He died in Rome on June 10, 1654.

See *Le arti di Bologna disegnate da A. Caracci ed intagliati da S. Giulini, con assistenza d'Alessandro A. Algardi* (1740).

ALGAROTH, POWDER OF, a basic chloride of antimony. It was known to Basil Valentine, and was used medicinally by the Veronese physician Victor Algarotus about the end of the 16th century. It may be prepared by the addition of much water to a solution of antimony chloride, a bulky amorphous precipitate being formed, which, on standing, gradually becomes crystalline. It is soluble in hydrochloric acid and tartaric acid, but insoluble in alcohol; its possible composition is represented by $Sb_4O_5Cl_2$.

ALGAROTTI, FRANCESCO, COUNT (1712–1764), Italian philosopher and writer on art, was born on Dec. 11, 1712, at Venice and died at Pisa on May 3, 1764. He studied at Rome and Bologna, and at the age of 20 went to Paris, where he enjoyed the friendship of Voltaire and produced his *Neutonianismo per le dame,* a work on optics. Voltaire called him his *cher cygne de Padoue.* Frederick the Great made him a count of Prussia (1740) and court chamberlain (1747). Augustus III. of Poland honoured him with the title of councillor. In 1754, after seven years' residence partly in Berlin and partly in Dresden, he returned to Italy, living at Venice and then at Pisa. He was a man of wide knowledge, a connoisseur in art and music, and the friend of most of the leading authors of his time. His chief work on art is the *Saggi sopra le belle arti* ("Essays on the Fine Arts").

The best complete edition with biography was published by D. Michelessi (1791–94).

ALGARVE or the **ALGARVES,** ancient kingdom and province in the extreme south of Portugal, corresponding with the modern administrative district of Faro, and bounded on the north by Alentejo, east by the Spanish province of Huelva, and south and west by the Atlantic ocean. Population (1920) 268,294; area 1,937 square miles. The province is about 85 m. from east to west; 22 m. from north to south. The Serra de Malhão and the Serra de Monchique extend in the form of a crescent across the northern part of the province, and sweep round to the lofty promontory of Cape St. Vincent, the south-west extremity of Europe. This headland is famous as the scene of many sea-fights, notably the defeat of the Spanish fleet by the British in Feb. 1797. The coast is fringed for 30 m. from Quarteira to Tavira, with long sandy islands, through which there are six passages, the most important being the Barra Nova, between Faro and Olhão. The navigable estuary of the Guadiana divides Algarve from Huelva, and its tributaries water the western districts. From the Serra de Malhão flow the Silves and Odelouca, which unite and enter the Atlantic below the ancient town of Silves. The level country along the southern coast produces grapes, figs, oranges, lemons, olives, almonds, aloes, and even plantains and dates. The principal exports are dried fruit, wine, salt, tunny, sardines and anchovies. The only railway is the Lisbon-Faro main line, which passes north-eastward from Faro, between the Monchique and Malhão ranges. The name of Algarve is derived from the Arabic, and signifies a land lying to the west. The title "king of Algarve," held by the kings of Portugal, was first assumed by Alphonso III., who captured Algarve from the Moors in 1253.

ALGÄU or **ALLGÄU,** a small district in south-west Bavaria, belonging to the province of Suabia and Neuburg. The name formerly applied to a much larger territory, extending to the Danube on the north, the Inn on the south and the Lech on the west. The Algäu Alps contain several lofty peaks, *e.g.,* Mädelegabel (8,681 ft.). The district is celebrated for cattle, milk, butter and cheese.

ALGEBRA, according to present English usage that branch of mathematics which considers primarily the representation of numbers by means of letters. Speaking more precisely, that part of mathematics which considers the relations and properties of numbers by the aid of general symbols, usually letters ($a,b,c, \ldots x,y,z$) and signs of operation ($+,-,\times,\ldots$) and relation ($=,>,<,\ldots$). For example, the statement that the area of a rectangle is equal to the product of the number of units of length in the base multiplied by the number of units in the height, is algebraically expressed by the symbols $A=bh$, where A stands for the number of square units of area; b, for the number of linear units in the base; and h, for the number of linear units in the height. Similarly, the expression $x^2+5x=14$ states that there is a number (represented by x) such that its square, plus five times itself, is equal to 14. Algebraic symbolism and operations enter into nearly all branches of science, including the various subdivisions of mathematics. In certain cases, however, as in vector analysis (*q.v.*), the letters are not restricted to the representation of numbers. In its broader sense algebra treats of equations, polynomials, continued fractions, series, number sequences, forms, determinants, and new types of numbers. These topics will be found discussed in separate articles. It considers the fundamental theorem that every integral equation $f(x)$ with real coefficients has at least one real or complex root (*see* EQUATIONS), indeterminate equations (*see* DIOPHANTINE EQUATIONS), general algebraic equations of the third and fourth degrees, numerical higher equations (*see* EQUATIONS), and it enters into such important branches as the calculus, trigonometry and the theory of functions (*qq.v.*). As a preparation for all this work, however, there is the elementary part of the subject. It is the purpose of this present article to discuss a number of topics which will show to the general reader the nature of algebra in its initial stage, and to show the teacher why algebra is taught in the schools. This discussion will be supplemented by references to treatises which will enable the student to find the underlying philosophical principles of the science.

Changes in Scope.—If by the word *algebra* we mean that branch of mathematics by which we learn how to solve the equation $x^2+5x=14$, written in this way, the science begins in the 17th century If we allow the equation to be written with other and less convenient symbols, it may be considered as beginning at least as early as the 3rd century. If we permit it to be stated in words and solved, for simple cases of positive roots, by the aid of geometric figures, the science was known to Euclid and others of the Alexandrian school as early as 300 B C If we permit of more or less scientific guessing in achieving a solution, algebra may be said to have been known nearly 2000 years B.C , and it had probably attracted the attention of the intellectual class much earlier. The scope of all early algebra was limited to a study of equations or to the solution of problems which at present would be solved by their aid. In the 16th century, after the advent of the printed book in Europe, the field was enlarged through the efforts of men like Christoff Rudolff (*Die Coss,* 1525; 2nd ed. by Michael Stifel, Königsberg, 1553, 1554), Robert Recorde (*Whetstone of witte,* London, 1557), Rafael Bombelli (*L'Algebra parte maggiore dell' arimetica,* Bologna, 1572) and Christopher Clavius (*Algebra,* Rome, 1608), becoming more of a generalized arithmetic, the fundamental operations with numbers being duplicated with rather crude algebraic symbols. The perfecting of symbolism in the 17th century greatly extended the domain of algebra and rendered possible the development of the higher branches of the subject.

Changes in Name.—The name "algebra" is quite fortuitous. When Mohammed ibn Mûsâ al-Khowârizmî (Mohammed, son of Moses, the Khowarezmite), a native of Khowarezm (Khwarezm), wrote in Baghdad (*c.* 825), he gave to one of his works the name *Al-jebr w'al-muqâbalah.* The title is sometimes translated as "restoration and equation," but the meaning was not clear even to the later Arab writers. Of late it has been thought that al-jebr is

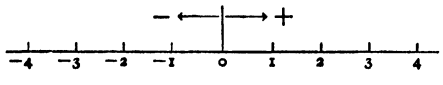
Arabic, while muqâbalah is from the Persian, and that each meant or referred to an equation. At any rate, al-Khowârizmî's work was the first to bear the title "algebra," and the treatise was so important as to cause the name to be adopted, often with strange variations in spelling, by later writers. Various other names have been given to the science, such as *arithmetica* (*see* ARITHMETIC), *Bija Ganita* (Brahmagupta's Hindu treatise, *c.* 628, the term meaning calculation with primitive elements), *T'ien-yuen* (Chinese, "celestial element"), *Kigen seihō* (one of the Japanese names, referring to "revealing unknowns"), *Fakhrî* (al-Karkhî, *c.* 1020, who gave this name to his algebra in honour of his patron, Fakhr al-Mulk), *Regola de la cosa* (Rule of the *cosa,* Lat. *causa,* Fr. *chose,* the unknown quantity), *Ars magna* ("great art," used by Cardan in 1545), the German *Die Coss* and English *Cossike arte* (both in the 16th century). Most of these names referred to the science of the equation, and this is the meaning assigned to elementary algebra in certain European languages at present, the fundamental operations with literal expressions being then included under the term "arithmetic."

Summary of the Changes in Meaning.—We may, therefore, summarize the leading steps in the growth of algebra as follows: (1) The period of the puzzle problem relating to numbers, with little or no symbolism, *c.* 1800 B.C. to A.D. 275; (2) The inclusion of the geometric problem of completing the square, thus leading to the finding of a line that would be represented by x in a modern quadratic equation; (3) The development of a systematic although a crude symbolism, applied to the theory of numbers, as in the *Arithmetica* of Diophantus (*c.* 275), this theory including certain indeterminate equations; (4) A more critical study of equations with some approach to scientific treatment, as in the period of Muslim ascendancy, *c.* 800–*c.* 1200; (5) The rise of the theory of equations, beginning with the solution of the cubic and the biquadratic in the 16th century (*see* CARDAN; TARTAGLIA); (6) The development of a convenient symbolism, chiefly in the century 1550–1650, changing algebra from a crude theory of equations to an analytic subject concerned with algebraic numbers and polynomials; and (7) The modern development of higher algebra.

ARTIFICIAL NUMBERS

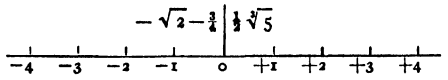
The numbers used in counting objects have long been known as *natural numbers.* Numbers that are not naturally used in counting objects are commonly called *artificial numbers,* a term that is open to certain objections. From various points of view the number $\frac{3}{4}$ is as natural as 2, and $\sqrt{5}$ as naturally comes into use as 5, although we cannot look at an object $\frac{3}{4}$ of a time nor can we pick up a book $\sqrt{5}$ times. The term is convenient, however, even though it may be as inappropriate as "imaginary" in connection with $\sqrt{-3}$, or "fraction" (in its primitive sense) in connection with $\frac{2}{2}$, $\frac{5}{2}$ $\frac{1}{2}/\frac{3}{4}$. The preceding discussion leads to a much larger and more important question as to the meaning of number itself. (*See* NUMBER; NUMBERS, THEORY OF; COMPLEX NUMBERS.)

Algebraic Scale.—If we construct a scale of integers,



1, 2, 3, 4, ..., and count backwards (to the left) by repeatedly subtracting 1, we have ... 4, 3, 2, 1, 0. The next count on the scale carries us beyond the point marked 0 on the scale, to 1, 2, 3, 4, ... in the opposite direction, just as we count 1, 2, 3, 4, ... below zero on a thermometer. For obvious reasons we find it convenient to speak of these symbols on the other side of zero as representing numbers, even though we cannot look at an object "three-less-than-zero" or "three-on-the-other-side-of-zero" times. We were led to these particular artificial numbers by subtracting as we went down the scale, and so we come to designate them a minus sign, thus giving to this sign the qualitative meaning (say "negativeness") instead of the operative one (subtraction). Such numbers are imaginary in some senses and natural in others. If we wish to emphasize the positive nature of 1, 2, ..., we may write them as +1, +2, ..., although even without any sign they are considered positive.

Further, on the algebraic scale we can represent such fractions as $\frac{1}{2}$ and $-\frac{3}{4}$, and such surd numbers as $-\sqrt{2}$ and $\sqrt[3]{5}$, so these



are as real in certain situations as the integers themselves.

If the expression a/b, in which a and b are natural numbers, does not denote a natural number, it is called a *fraction,* but since division by 0 has no meaning, the case in which $b=0$ is excluded. Integers and fractions are classified as *rational numbers.* More generally speaking, a rational algebraic fraction is the quotient of any integral function by any other integral function. Certain numbers such as $\sqrt{2}$ and $\sqrt[3]{7}$ do not come within the definition of rational numbers, and are called *irrational numbers.* In elementary algebra we also meet with certain numbers represented by the symbol $a\sqrt{-1}$, and these are called *imaginary numbers.* Numbers like $a+b\sqrt{-1}$, are called *complex numbers* (*See* NUMBER; COMPLEX NUMBERS; FRACTIONS; NUMBERS, THEORY OF.)

Algebraic Expressions.—An expression consisting of a single letter, or made up either of letters or of letters and numerals, combined so as to represent some or all of the operations of addition, subtraction, multiplication, division, involution (the finding of powers) and evolution (the finding of roots), is an *algebraic expression.* If it does not involve addition or subtraction, it is a monomial; but in the expression $a-(b+c)$, $-(b+c)$ is considered as a monomial, and so in other similar cases involving signs of aggregation (parentheses, brackets, etc.). If an algebraic expression is not a monomial, it is a *polynomial,* the binomial (two-term) and trinomial (three-term) being special types. In algebra, the letters of an expression represent numbers of some kind. In the monomial ab, a and b are *factors* of the expression. If the value of either factor, say a, is known and is to remain the same throughout the discussion of the expression, it is called a *constant;* but if it may have any value we please to give it and change from one value to another, it is called a *variable.* Constants are often represented by the first letters of the alphabet (a, b, c, ...), and variables by the last letters (... x, y, z), but this is not a universal rule especially in physical formulas. In an equation, say $2a-x=4$, x usually represents a number to be found—"the unknown quantity"—the first letters of the alphabet representing numbers supposed to be known. In the monomial $2ax^2$, we may speak of any factor as the *coefficient* of the rest of the expression, but it is customary to speak of 2 as a numerical coefficient, and of $2a$ as the coefficient of x^2, the coefficient being the first factor or factors. For example, in the expression $\frac{1}{2}(a+b)x^2y^3$, $\frac{1}{2}$ is the coefficient of $(a+b)x^2y^3$, and $\frac{1}{2}(a+b)$ is the coefficient of x^2y^3, and it is also allowable to speak of $\frac{1}{2}(a+b)x^2$ as the coefficient of y^3, and so on. In the expression x^3, 3 is the *exponent* of x, and similarly in the case of x^m. In the expression mx, the coefficient m (if it be an integer) represents the number of times that x is taken as an addend; while in the expression x^m, m (if it be an integer) represents the number of times that x is taken as a factor. In each case the meaning is later extended to permit of m being any kind of number (fractional, surd, imaginary, etc.).

Function.—An expression like $2x+5$ is called a *function* of x and is said to "depend upon" x for its value. Similarly, $2x+y^3$ is a function of x and of y. For brevity we may, in any discussion, write $f(x)$ for the function of x, and $f(x, y)$ for the function of x and y, and so on for other variables. We may then, in discussing $x-3$, for example, say that $f(1)=1-3=-2$, $f(7)=7-3=4$, $f(-2)=-2-3=-5$, $f(0)=0-3=-3$, and so on, according to the value of x which we substitute in $x-3$.

The Elementary Operations.—From the standpoint of actual use, whether in the natural sciences or in pure mathematics, there is little need for the ordinary operations involving polynomials, therefore a brief treatment of the four fundamental operations, limited chiefly to binomial operators, with a slight reference to the theory of roots, is all that is essential to the further study

of the science of algebra. The operations upon algebraic fractions were adapted from arithmetic after the introduction of the improved symbolism of the 17th century. They later became more complicated owing to the doctrine of formal discipline, the result leading to an expenditure of time quite out of proportion to the use made of them. In the 19th century the time consumed in reducing artificial fractions to lowest terms, and in operations involving polynomials was excessive.

Ratio.—In practical work a ratio is considered simply as a fraction, although fundamentally the ratio of the circumference to the diameter of a circle is a transcendental number and not a fraction, as we define the term. Practical work in a laboratory or workshop is not concerned with irrationals as such; it seeks for precision within certain designated limits, recognizing that all measurement is approximate. On this account and because of the immaturity of the pupils, elementary algebra looks upon a proportion as a fractional equation, and deals with all ratios as simple fractions, ignoring the distinction between algebraic and arithmetical fractions, and the fact that the ratio may be irrational.

Uses of Irrational Numbers.—In the solution of quadratic equations, excepting those artificially constructed to give only integral values of the unknown quantity, the roots are generally irrational, not being expressible as the quotient of a/b, where a and b are integers. This is seen in the simple quadratic $x^2=2$, where $x=\pm\sqrt{2}$. Since early arithmetic was concerned largely with rational numbers, the irrational ones were generally assigned to algebra, the branch of mathematics in which they were needed. The purpose in placing them there was soon obscured, however, the result being a much more extensive treatment of the subject than was warranted by any practical considerations. If, in a physical problem, there is need for solving the equation $x^2=243$, it is important to find the value of x to a definite degree of approximation. If it is stated that $x=\pm\sqrt{243}$, nothing is gained by writing this result as $\pm 9\sqrt{3}$. An expression like $\sqrt{2}$ and $\sqrt[3]{17}$, but (for no very good reason) not like $\sqrt{3+\sqrt{2}}$, is known as a *surd,* from a mediaeval Latin translation of an Arabic rendering of the Greek ἄλογος (*al'ogos,* irrational). Until recently the finding of the square root of a binomial surd, as of $7-4\sqrt{3}$ or of $12+2\sqrt{35}$, was a familiar operation in elementary algebra, and there is still good cause for complaint that the work in surds is excessive. With the properties of such transcendental numbers as e and π, elementary algebra is little concerned. (*See* NUMBER)

Factors.—The factorizing of polynomials has a place in the theory of equations and in the advanced study of polynomials, but its value in elementary algebra is slight. In the algebra that the pupil will use in the sciences or in the mechanical arts its legitimate place is not large The needs of the pupil are usually met by the cases of monomial factors, and of the binomial factors of expressions of the type $x^2+(a+b)x+ab$ and x^2-y^2.

The original idea, carried over from arithmetic, was that factors should be integral and rational. In practical use, however, it is often necessary to enlarge this conception, and to speak of $x-\frac{1}{a^2}$ as having the factors $x+\frac{1}{a}$ and $x-\frac{1}{a}$; of $x+\sqrt{a}$ and $x-2\sqrt{b}$ as factors of $x^2+x(\sqrt{a}-2\sqrt{b})-2\sqrt{ab}$; and of $\sqrt{a}$, $\sqrt{b}$, and $\sqrt{c}$, as factors of $\sqrt{abc}$.

The Equation.—Expressions of equality are of several types. For our present purposes it is necessary to consider only three: (1) $2+3=5$ or, after the operation has been performed, $5=5$; (2) $a+a=2a$; (3) $x+2=5$. The first is a numerical relation between known numbers, and does not represent an algebraic equation; the second represents a relationship that is true for all values of a, and hence is called an *identity,* another example being $(a+b)^2=a^2+2ab+b^2$; the third is an algebraic equation, true in this case for one and only one value of x, this value being known as the *root* of the equation. An identity is often indicated by the symbol ≡ instead of =. In the present discussion we consider only elementary algebraic equations with rational and integral terms. The general treatment with a consideration of the existence of a root is given in the article on EQUATIONS.

Linear Equations.—Considerations of analytic geometry (*q.v.*) have led to the use of the term *linear equation* to mean an equation of the first degree having any number of variables. The oldest part of elementary algebra, so far as known, relates to the solution of linear equations in one unknown, the type form reducing, through the final stage (in modern symbols) of $px=q$, to $x=k$. This type of equation is found in the Ahmes (Rhind) Papyrus (*c.* 1700–1600 B.C) and is the one found most frequently for a period of more than 3,500 years, varying merely in the language and symbols employed. Such number puzzles have been used by substantially all writers on algebra, and in modern times they have found a wide range of practical applications in the sciences, in industry and in commerce.

Linear equations of the type $ax+by+c=0$ and $a'x+b'y+c'=0$ generally have common values for x and y; that is, they are *simultaneous.* For example, the two equations $x+3y-1=0$ and $2x+9y+1=0$ have in common the roots $x=4$, $y=-1$. Each equation is, by itself, *indeterminate,* having an infinite number of roots. For example, the first of these equations, $x+3y-1=0$, is satisfied by $x=0$, $y=\frac{1}{3}$, and similarly by the pairs of values (1, 0), (2, $-\frac{1}{3}$), (3, $-\frac{2}{3}$), (4, -1), and so on; but there is only one pair which satisfies both of the equations. In modern textbooks this is made clearer by means of graphs, each equation being represented by a straight line, and these lines having, in general, one point in common. This introduction of the elements of analytic geometry into elementary algebra is helpful in understanding the meaning of roots. For example, the two equations $3x-7y=6$ and $2x-4\cdot\frac{2}{3}y=4$ are satisfied by any number of pairs of values, their graphs being coincident; while $3x-7y=6$ and $2x-4\cdot\frac{2}{3}y=5$ cannot be satisfied by any pair of values, their graphs being parallel. (*See* ANALYTIC GEOMETRY)

Simultaneous linear equations are solved by several methods, the equations as given in the textbooks being artificially constructed so as to illustrate each. These methods are sufficiently discussed in such works. If, however, only a single method is to be given for solving a pair of simultaneous equations, this method being made mechanical by much practice, that of substitution is the most satisfactory in cases that actually arise in science or industry. This method consists in finding in either equation the value of one unknown in terms of the other, and then in substituting this value in the other equation. For advanced classes the method of determinants (*q v.*) is interesting and valuable

Simultaneous linear equations with more than two unknown quantities have an interest as puzzles and some value in developing skill in manipulating algebraic expressions, and they also have value in certain technical fields and in certain commercial problems During the centuries there have been developed various devices for solving specially constructed types, but such devices and types lack generality and hence they have little value except as recreations In actual practice with real problems the method of determinants is the best The question of the possibility of solution of given sets should be considered, as in the case of simultaneous equations with two unknowns

Quadratic Equations.—An equation of the type $ax^2+bx+c=0$ in which b and c may have any finite numerical values, and a may have any finite value except zero, is a *quadratic equation* (from the Latin *quadratus,* a square). Such equations are frequently needed in solving scientific problems. There are several methods of solving such an equation, including the following: (1) Reducing to the form $ax^2+bx+c=0$; resolving into factors $(px+q)(p'x+q')=0$; equating each factor to zero; and solving the two resulting linear equations; (2) Completing the square; (3) Using a general formula, usually developed by the second method. Of these, (1) is too difficult in a practical case like $1.47x^2-0.36x+14.02=0$, however easy it may be in an artificial one like $x^2-5x+6=0$; (2) is a traditional method, essentially due to the Alexandrian school (*c.* 300 B C.); it requires the memorizing of a process—the completion of the square; and it is arithmetically difficult in practical cases; (3) requires the memorizing of a formula, but in problems that are practical it is usually the easiest of the three.

Simultaneous quadratic equations can be solved by elementary

algebra (the biquadratic not being there given) only in cases artificially constructed to admit of easy solution. The analytic explanations given in textbooks may profitably be supplemented by the use of the graph. This will serve to show the difference between a case like $2x-3y=5$, $x^2+3y^2=7$, and a case like $x^2+y=7$, $x+y^2=11$. In the former substitution reduces the problem to the solution of a quadratic; in the latter case, to the solution of an equation of the fourth degree. The nature of such equations may profitably be shown by the aid of graphs.

Ratio and Proportion.—As already stated, this subject is best treated in connection with fractional equations. Since in elementary algebra the letters represent numbers, and since it is necessary to assume at this stage that operations with irrational numbers are subject to the ordinary laws that obtain with integers, the subject offers no new features. The range of application to outdoor measurement and to simple physical problems is extensive. With this method of treatment such special names as *antecedent, consequent, means,* and *extremes* lose their importance in practical problems. Moreover, the old notation, $a:b::c:d$, may profitably give place to the more familiar and more easily understood symbols representing a fractional equation.

Variation.—The subject of variation, which formerly had a symbolism of its own, is more conveniently and clearly treated as a topic under ratio and proportion or, what is substantially the same, by the ordinary method of equations; that is, variation may be expressed by the aid of the equation $x=ky$ (direct variation) or by $xy=k$ (inverse variation).

TRIGONOMETRY, SERIES, APPLICATIONS

A movement is taking place among teachers of mathematics to encourage the consideration of the simple trigonometry of the right-angled triangle as a special chapter of algebra, following the topics of ratio and proportion. (*See* TRIGONOMETRY; LOGARITHMS.)

Elementary Series.—Amongst those inheritances from mediaeval arithmetic which found their way into the early textbooks in algebra, was the topic of progressions. This term usually covered the rules for the summation of simple types of arithmetical and geometric series, and sometimes a brief discussion of harmonic series. With the improved symbolism came the formulae relating to these sequences, and in recent years the special name *progression* has tended to give place to *series.* The subject, together with the related Binomial Theorem, is sufficiently treated in current textbooks. (*See* SERIES; NUMBER SEQUENCES; LIMIT; BINOMIAL FORMULA.) Elementary algebra contains many practical applications of equations, and modern textbooks are using these to supplement or replace the less valuable inheritances. It would be unfortunate if any attempt should be made to abolish all of this traditional material; it could never have held its place through the centuries if it had not possessed such an interest for young people as to insure the degree of permanence which we see. It has often been from the study of the interesting but impractical that the most practical mathematicians as well as the leaders in pure mathematics have been made. The most important application of elementary algebra is found in the formula. This is the part of algebra which the pupil will use most frequently in science, in mensuration, in technical work of all kinds, and in such parts of more advanced mathematics as series, determinants, trigonometry, analytic geometry, and the calculus. To the formula, therefore, it is desirable that increased attention should be given.

FUNDAMENTAL PRINCIPLES ASSUMED

There are certain axioms which are often set forth in textbooks, as the statement "If $ab=p$, then $a=p/b$," but others, equally important from the standpoint of logic are properly assumed tacitly. Such for example, are the statements that $a+b=b+a$, the commutative law of addition; that $ab=ba$, the commutative law of multiplication; that $a+b+c=(a+b)+c=a+(b+c)$, the associative law of addition; that $abc=(ab)c=a(bc)$, the associative law of multiplication; and that $a(b+c)=ab+ac$, the distributive law. Such axioms and laws seem so evidently true to the mind of the child that any exhaustive discussion of them in the early years is profitless. They may or may not be universally true; in fact, some of them are not; but they are true in the immediate and limited field of the beginner's study.

Laws of Equations.—As stated above, the axiom "If $ab=p$, then $a=p/b$" is often set forth in elementary textbooks, but it ceases to have any meaning for the pupil if $b=0$. Similarly the statement "If $a>b$, then $na>nb$" ceases to be true if n is 0 or negative; and the statement "If $a=b$, then $\sqrt[n]{a}=\sqrt{b}$" also fails unless it is understood which of the nth roots in each case is to be taken, requiring a limitation upon the meaning of the symbol $\sqrt{}$. These laws are usually stated as axioms, with a statement of the limitations to be placed upon them in the elementary field. (*See* MATHEMATICS, FOUNDATIONS OF.)

Validity of Definitions.—Just as laws of operation which appear axiomatic to the beginner are seen to be wanting in universal validity as mathematics broadens, and as the laws of equations which are true in the early stages need close scrutiny when we leave the domain of the positive integers $+1, +2, \ldots, +n$ (finite), so the definitions of the early years of instruction soon cease to have meaning, even before the pupil leaves the elementary stage. For example, ab does not mean that b is taken a times unless a is a positive integer; "minus a times" has no meaning unless and until the primitive use of "times" is changed, and similarly when a is equal to $\frac{2}{3}$, to $\sqrt{2}$, to $\log 7$ or to $\sqrt{-3}$; and a^n does not mean that a is taken n times as a factor when n ceases to be a positive integer. For this reason rigid definitions are not desirable.

Growth Imposes Consideration of Limitations.—The teacher of elementary algebra should early recognize that, as the science grows or as the pupil's knowledge increases, the early laws, axioms, definitions, postulates and significance of symbols constantly require further consideration of their limitations. For example, the statement that $a^m \div a^n = a^{m-n}$ must have the limitation imposed that m and n are positive integers and that $m>n$, unless negative and fractional exponents are admitted.

It is desirable that even the beginners in the study of algebra should see the necessity for maintaining the fundamental laws as the meaning of terms and symbols is broadened. For example, it would be unfortunate if a fractional or a negative exponent were to be so defined that $a^m a^n$ would cease to be equal to a^{m+n}, or that multiplication were to be given such a meaning that ab should not be equal to ba. As the pupil progresses in his study of mathematics he will meet with branches in which some of these laws cease to be valid, but his maturity will then permit of the necessary modifications.

HISTORY OF ALGEBRA

The earliest known treatise containing problems which would at present be called algebraic is the Ahmes Papyrus (also called, from the name of its former owner, the Rhind Papyrus) now in the British Museum, and written *c.* 1700–1600 B.C. The first of these problems reads as follows: "*Ahe* (or *hau,* transliterated by Egyptologists as ḥ'w, meaning *heap, mass* or *quantity*), its whole, its seventh, it makes 19,"—that is, $x+\frac{1}{7}x=19$. The method of solving was by estimating the result and then correcting the error



FIG. 1.—HIEROGLYPHICS EXPRESSING THE EQUATION $x\left(\frac{2}{3}+\frac{1}{2}+\frac{1}{7}+1\right)=37$

by repeated trials. The Greek mathematicians were primarily geometers, and they made various kinds of geometric constructions by which they found a line segment corresponding to the root of an equation. Euclid (*c.* 300 B.C.), for example, solved problems equivalent to $xy=k^2$, $x \pm y=a$, and to $xy=k^2$, $x^2-y^2=a^2$. The only Greek to write extensively on algebra was Diophantus (*c.* 275). He was also the first writer to introduce any algebraic symbols of special significance, these including a character to represent the unknown quantity, a symbol for subtraction, the use of initial letters for equality, square and cube, and a scheme of combinations for other powers. In the Orient there is evidence of an early interest in problems which would now be solved by

algebra, and the Chinese were able to solve the quadratic equation before the Christian era. The Hindu works of Brahmagupta (*c.* 628), Mahāvīra (*c.* 850) and Bhāskara (*c.* 1150) contain a large number of problems solved by algebraic methods, and show considerable ability in analysis. In the Muslim world, and particularly at Baghdad in the time of the caliphs, two lines of mathematical thought converged, the first from Greek sources and the second from India. The result was the preparation of such textbooks as those of Mohammed ibn Mûsâ al-Khowârizmî (*c.* 825), Abu Kamil (*c.* 900) and al-Karkhî (*c.* 1100). Of these, the algebra of al-Khowârizmî had the greatest influence upon European mathematics, being translated by Robert of Chester (*c.* 1140) and other mediaeval scholars. The Oriental writers mentioned were able to solve the quadratic equation, but whether their method originated in the East or was suggested by the Greeks is uncertain.

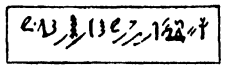
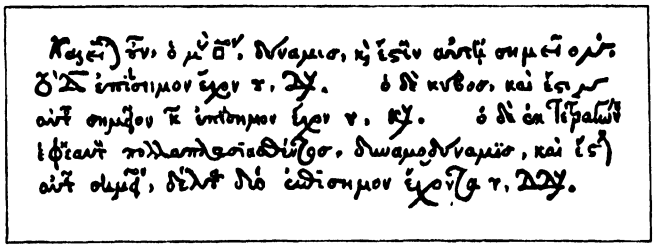


FIG. 2.—AFTER THE AHMES PAPYRUS WRITTEN ABOUT 1550 B C.
The equation of fig. 1 in heiratics, the priestly writing of the ancient Egyptians

The beginning of printing in Europe found algebraists possessed of no convenient symbolism but, as already stated, able to solve the quadratic. Italy was the centre of learning and her scholars devoted much attention to solving the cubic equation. The latter solution was finally effected, with substantial completeness, by Tartaglia (*q v*, 1535) being published by Cardan (*q v*) in his *Ars Magna* (1545). The biquadratic was solved by Ferrari (1540), a pupil of Cardan's, and was also published by the latter in the same work. The needed improvements in symbolism were generally made outside of Italy by such writers as Vieta (*q v*, *c.* 1590), Harriot (*q.v.*, *c.* 1600) and Descartes (*q v.*, 1637), with the notable extension of the exponential notation by John Wallis (*q.v.*, 1655). The proof of the insolubility of the general equation of the fifth degree by algebraic methods is due to the investigations of Ruffini (1803, 1805), Abel (*q.v.*, 1824) and Galois (*q v.*, 1831; posthumous publication, 1846). Elementary algebra may be said to have been substantially completed by the close of the 17th century, by which time higher algebra, especially through the progress made in the study of equations, symmetric functions, and series, had already begun to rank as a special branch of mathematics.



AN EXTRACT FROM A 14TH CENTURY MS. SHOWING THE SYMBOLISM THEN IN USE AND SUPPOSED TO BE A TRANSLATION OF "ARITHMETICA," WRITTEN BY THE GREEK ALGEBRAIST, DIOPHANTUS, ABOUT 300 A.D. DIOPHANTUS WAS THE FIRST TO USE EXPRESSIONS FOR KNOWN AND UNKNOWN QUANTITIES

HIGHER ALGEBRA

Much that is elementary in the sense of elemental, is not so in the sense of being adapted to the pre-university schools. Higher algebra of a sort is taught in these schools, and higher algebra of an entirely different sort is taught in the universities. In the pre-university schools the work serves as an introduction to the theory of equations, algebraic numbers, determinants, certain series, inequalities, limits and logarithms, and the simpler features of analytic trigonometry, analytic geometry and the differential calculus. In the universities it includes work in the theory of equations, the study of polynomials, combinatorial analysis, probability, matrices and various other fields. For the more important of these topics *see* AGGREGATES; ANALYSIS; ANALYTIC METHOD; BARYCENTRIC CALCULUS; BINOMIAL FORMULA; DIFFERENTIAL CALCULUS, ABSOLUTE; CALCULUS OF DIFFERENCES; COMBINATORIAL ANALYSIS; COMPLEX NUMBERS; DETERMINANT; EQUATIONS; DIFFERENTIAL FORMS. ALGEBRAIC FORMS; GRAPHICAL METHODS; GROUPS; LIMIT; LINEAR ALGEBRAS; LOGARITHMS; MATHEMATICS, FOUNDATIONS OF; MAXIMA AND MINIMA; NUMBER; NUMBER SEQUENCES; NUMBERS, THEORY OF; POLYNOMIAL; PROBABILITY AND ERROR; QUATERNIONS AND AUSDEHNUNGSLEHRE; SERIES; STATISTICS; TRIGONOMETRY.

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ALGEBRAIC FORMS. An algebraic form is a polynomial, all of whose terms are of the same degree in two or more variables. Thus ax^2+by+c is not a form, but $ax^2+byz+cz^2$, of order two in three variables x, y, z is a quadratic ternary form. A form is also called a *quantic*, this general name resembling cubic, quartic or quintic. If its order is n, it is called an n-ic. Forms in two variables are called *binary*; in four variables, *quaternary*. Forms are interesting principally because they occur in equations for unknown quantities, and, since the time of Descartes (1637), in equations of geometric loci, such as curves, surfaces, families of lines or systems of circles. Their homogeneity is closely related to the modern development of projective geometry, in which the region known as "infinity" in the older geometry has no special treatment, but is like an extra axis or plane of co-ordinates, where the *ratio* of two co-ordinates becomes infinite or zero. Ratios take the place of measured distances. To equations in one unknown there will correspond binary forms; to those in two metric variables, ternary forms, and so on. Further, just as in geometry one considers often not single loci, but simply or doubly infinite systems of curves or surfaces, so algebraic forms may contain more than one set of variables; and the sets need not all occur to the same order, nor need two sets be composed of equal numbers of variables. A problem may arise, too, calling for the use of two, three or more forms at the same time; these are then termed a *simultaneous* system.

LINEAR TRANSFORMATIONS

For one set of variables it is often useful to substitute expressions containing a second, different set. An example of this is the change of axes, or planes, of reference in analytic geometry. Those expressions are most often linear (*i.e.*, of the order one) in the new system, and the change is called a *linear transformation*. For some reason, however, expressions of the second or higher order may be used; this case is less frequent and less simple, and can be treated as a linear transformation in an increased number of variables, plus the inclusion of an additional locus in the system under discussion. By any linear transformation, if the new variables are given the same names as the old, the old form is changed into a new one. Two forms so derivable one from the other are called *equivalent under the transformation*. By this definition, any form is equivalent to all that can be derived from it by linear transformations. Consider a binary quadric:—

$$f(x)=x_1^2-x_2^2.$$

Let the transformations be

$$x_1=5y_1+6y_2,$$
$$x_2=3y_1+10y_2,$$

then
$$f(x)=(5y_1+6y_2)^2-(3y_1+10y_2)^2,$$
$$=16y_1^2-64y_2^2.$$

Call this new form $F(y)$, then

$$F(x)=16x_1^2-64x_2^2,$$

and $F(x)$ is equivalent to $f(x)$. Such a transformation may be represented, between two binary forms, by means of indeterminate coefficients or parameters α_1, α_2, β_1, β_2, thus:—

$$x=\alpha_1y_1+\beta_1y_2,$$
$$x_2=\alpha_2y_1+\beta_2y_2,$$

and it is reversible without ambiguity if the determinant $(\alpha_1\beta_2-\alpha_2\beta_1)$ is not zero, for then these two equations can be solved for y_1 and y_2.

Groups.—One reason for the employment of linear transformations is that all such form a group. (*See* GROUPS.) That is, if two linear transformations are made in succession, variables (x) into functions of (y), and the (y) into functions of variables (z), then the (x) are linear functions of the (z). The linearity is unchanged by compounding two or more linear transformations. One speaks often of equivalence under the *linear group*, meaning to exclude transformations whose determinant is zero; then the equivalence is a mutual relation. There are groups of linear transformations that do not include all such substitutions; just as there are in geometry rotations of a plane about one fixed centre, leaving a system of concentric circles unaltered. For some purposes, the group of linear substitutions whose determinant is 1 are applied; or the group of real transformations, excluding all that have any imaginary parameters. If imaginary substitutions are admitted, a quaternary quadric $x_1^2+x_2^2+x_3^2-x_4^2$ is equivalent to another $x_1^2+x_2^2-x_3^2-x_4^2$; not, however, if the group is that of *real* linear transformations. Two systems of forms in any number of sets of variables are equivalent under the group if the members of one system can be transformed into those of the other system by means of separate linear substitutions on all the different sets of variables involved. Two sets of variables that are subject to the same transformation are *cogredient*.

Equivalence of Quantics.—What happens to the coefficients of the various terms in a form, or quantic, when it is transformed into an equivalent quantic? It is seen, on trial, that the new coefficients contain the old in the first degree, but the parameters of the transformation to higher degrees, *each form to a degree equal to its order in the variables*. Under linear transformation of its variables, every form undergoes also a reverse linear transformation of its coefficients, determined or *induced* by that of the variables. These need not be described more minutely here; they require for precise statement the definition of *polars*. (*See* POLE and POLAR.) While the two forms are called equivalent when the equations that transform variables are given, to make the statement algebraically exact the coefficients of similar terms in the two forms must be equated, and these equations constitute the induced substitution. But two forms may be given with numerical coefficients. By what means may their equivalence be tested? This is the first major problem in algebraic form theory. The answer is far from complete. Sufficient conditions can be stated, but many of them are certainly redundant. The minimum set of necessary conditions is known in only a few particular cases. To find explicitly the parameters of a linear substitution from the equations of the induced substitution on the coefficients would require the solving of equations whose degree in the parameters is equal to that of the given forms in the proper variables. That calls for extraction of roots or other irrational operations. Naturally an answer is preferred which should demand only rational operations in proving equivalence or non-equivalence. Hence comes a re-formulation of the question: When two forms (or systems of forms) are equivalent, what rational functions of the coefficients, or coefficients and variables, will have the same numerical value for both forms? What rational functions of coefficients and variables retain the same value, remain invariant, under the group of linear substitutions? This question can be answered. As an exercise, the reader might verify that two binary cubics are generally equivalent, but not always two binary quartics, taken at random.

Invariant and Covariant.—An invariant or covariant (a comitant) of a given form or system is any function of the coefficients, or coefficients and variables, which is identically equal to the same function of the corresponding coefficients and variables in every equivalent form or system—equal, that is, save for a multiplicative constant depending on the parameters of the transformation. Such a constant, it can be proved, is always some power of the determinant of the substitution. These are relative invariants, but if the multiplicative constant is unity, the invariant is absolute.

BINARY FORMS

The rational invariants of a single binary form of order less than ten have been thoroughly studied and tabulated. First to be noticed was naturally the discriminant or determinant of a quadric form, for it was known to vanish when the quadric has two equal factors; and their equality could not be altered by linear transformations, therefore the determinant after transformation must be a multiple of that before the transformation. To verify this, take the quadric $ax_1^2+2bx_1x_2+cx_2^2$, the discriminant of which is $D=4b^2-4ac$. The transformation is given by the equations:—

$$x_1=\alpha_1y_1+\beta_1y_2,\quad x_2=\alpha_2y_1+\beta_2y_2$$

The transformed quadric is

$$(a\alpha_1^2+2b\alpha_1\alpha_2+c\alpha_2^2)y_1^2$$
$$+2(a\alpha_1\beta_1+b(\alpha_1\beta_2+\alpha_2\beta_1)+c\alpha_2\beta_2)y_1y_2$$
$$+(a\beta_1^2+2b\beta_1\beta_2+c\beta_2^2)y_2^2.$$

The new coefficients are, therefore,

$$a'=a\alpha_1^2+2b\alpha_1\alpha_2+c\alpha_2^2,$$
$$b'=a\alpha_1\beta_1+b(\alpha_1\beta_2+\beta_1\alpha_2)+c\alpha_2\beta_2,$$
$$c'=a\beta_1^2+2b\beta_1\beta_2+c\beta_2^2.$$

For the discriminant after the transformation we find

$$D'=4b'^2-4a'c'$$
$$=(\alpha_1\beta_2-\alpha_2\beta_1)^2\ D.$$

This invariant D is the only one that the quadric has. The binary cubic and quartic have covariants as well as invariants, easily discovered without an elaborate notation. First, it should be observed that symbols of differentiation, $\frac{\partial}{\partial x_1}$ and $\frac{\partial}{\partial x_2}$, undergo a so-called *transposed* substitution, thus:—

$$\frac{\partial}{\partial x_1}=\frac{1}{\Delta}\left(\beta_2\frac{\partial}{\partial y_1}-\alpha_2\frac{\partial}{\partial y_2}\right)$$
$$\frac{\partial}{\partial x_2}=\frac{1}{\Delta}\left(-\beta_1\frac{\partial}{\partial y_1}+\alpha_1\frac{\partial}{\partial y_2}\right),\quad \Delta=(\alpha_1\beta_2-\alpha_2\beta_1).$$

(*See* DETERMINANT.) The law for multiplication of determinants shows then a factoring, if ϕ and ψ denote any two forms:

$$\begin{vmatrix}\frac{\partial\phi}{\partial x_1}&\frac{\partial\phi}{\partial x_2}\\ \frac{\partial\psi}{\partial x_1}&\frac{\partial\psi}{\partial x_2}\end{vmatrix}=\frac{1}{\Delta^2}\begin{vmatrix}\beta_2-\alpha_2\\ -\beta_1\quad\alpha_1\end{vmatrix}\cdot\begin{vmatrix}\frac{\partial\phi}{\partial y_1}&\frac{\partial\phi}{\partial y_2}\\ \frac{\partial\psi}{\partial y_1}&\frac{\partial\psi}{\partial y_2}\end{vmatrix}=\frac{1}{\Delta}\begin{vmatrix}\frac{\partial\phi}{\partial y_1}&\frac{\partial\phi}{\partial y_2}\\ \frac{\partial\psi}{\partial y_1}&\frac{\partial\psi}{\partial y_2}\end{vmatrix}.$$

This shows that the Jacobian of any two forms is a covariant. But the two forms may be $\frac{\partial f}{\partial x_1}$ and $\frac{\partial f}{\partial x_2}$. Then the covariant is termed the *Hessian* of the form f: $f=ax_1^3+3bx_1^2x_2+3cx_1x_2^2+dx_2^3$

$$H=\frac{1}{36}\begin{vmatrix}\frac{\partial^2f}{\partial x_1^2}&\frac{\partial^2f}{\partial x_1\partial x_2}\\ \frac{\partial^2f}{\partial x_2\partial x_1}&\frac{\partial^2f}{\partial x_2^2}\end{vmatrix}=(ac-b^2)x_1^2+(ad-bc)x_1x_2+(bd-c^2)x_2^2.$$

The Jacobian of f and H is also covariant, of order three:—

$$Q=\frac{1}{6}\begin{vmatrix}\frac{\partial f}{\partial x_1} & \frac{\partial f}{\partial x_2}\\ \frac{\partial H}{\partial x_1} & \frac{\partial H}{\partial x_2}\end{vmatrix}=(a^2d-3abc+2b^3)x_1^3+, \text{ etc.}$$

These four functions, all well known in the theory of equations, are connected by an identical relation or *syzygy*: $Q^2+4H^3+Rf^2=0$. This shows that $Q+f\sqrt{-R}$ and $Q-f\sqrt{-R}$ are perfect third powers of the factors of H.

The Binary Quartic, $f=ax_1^4+4bx_1^3x_2+6cx_1^2x_2^2+4dx_1x_2^3+ex_2^4$ is more interesting and not too complicated. It has one absolute invariant, which is the ratio of two relative invariants, i and j, and two covariants, H and T.

Their explicit formulae are:—

$$i=ae-4bd+3c^2,\quad j=\begin{vmatrix}a & b & c\\ b & c & d\\ c & d & e\end{vmatrix},$$

$$H=\frac{1}{144}\begin{vmatrix}\frac{\partial^2 f}{\partial x_1^2} & \frac{\partial^2 f}{\partial x_1\partial x_2}\\ \frac{\partial^2 f}{\partial x_2\partial x_1} & \frac{\partial^2 f}{\partial x_2^2}\end{vmatrix},\quad T=\frac{1}{8}\begin{vmatrix}\frac{\partial f}{\partial x_1} & \frac{\partial f}{\partial x_2}\\ \frac{\partial H}{\partial x_1} & \frac{\partial H}{\partial x_2}\end{vmatrix}.$$

These five forms are connected by an identity or *syzygy*,

$$T^2+4H^3-iHf^2+jf^3=0$$

From this comes an important factorization, if the cubic equation, $4z^3-iz+j=0$, has three roots m_1, m_2, m_3, namely:—

$$T^2=-4(H-m_1f)\ (H-m_2f)\ (H-m_3f),$$

the factors on the right are perfect squares, a fact which aids in solving the quartic equation. The discriminant R is expressible in terms of i and j: $R=i^3-j^2$ When $R=0$, f and H have each a double factor, while T has one five-fold factor. If further i and j are both zero, the quartic f has a triple factor, and that factor occurs in H to the fourth power. Were H to vanish identically, f must be a perfect fourth power. (If H′ is formed from H as H is from f, and T′ from H and H′ as T is from f and H, then T′ differs from T only by an invariant factor.)

These details show that, for forms of higher order and in more than two variables, invariants would be unwieldy if written out in full. An abbreviated notation is a necessity for the development of the theory. The most generally used are the hyperdeterminant notation of Arthur Cayley, the Clebsch-Aronhold notation, which is practically the same, and modifications of either. Aronhold, R. F. A. Clebsch and Gordan use the following, some slight improvements having been made by E. Study.

TERNARY FORMS

If three ternary linear forms vanish for the same values of the variables, not all zero, *i.e.*, if

$$\begin{aligned}a_1x_1+a_2x_2+a_3x_3&=0\\ b_1x_1+b_2x_2+b_3x_3&=0\\ c_1x_1+c_2x_2+c_3x_3&=0,\end{aligned}$$

then their determinant, denoted by $(a_1b_2c_3)$ or merely (abc), is zero. No linear transformation will disturb this relation, hence (abc) is an invariant of the three linear forms. It is the type of all invariant combinations of symbols. If the forms are abbreviated to (ax), (bx) and (cx) respectively, and written with different sets of variables, *e.g.*, (ax), (by), (cz), then (abc) is, in another expression:—

$$\begin{vmatrix}\frac{\partial}{\partial x_1} & \frac{\partial}{\partial x_2} & \frac{\partial}{\partial x_3}\\ \frac{\partial}{\partial y_1} & \frac{\partial}{\partial y_2} & \frac{\partial}{\partial y_3}\\ \frac{\partial}{\partial z_1} & \frac{\partial}{\partial z_2} & \frac{\partial}{\partial z_3}\end{vmatrix}(ax)\ (by)\ (cz).$$

This suggests that if ternary forms of higher order are expressed symbolically as powers of linear forms, operators of this same type, denoted by $\left(\frac{\partial}{\partial x}\ \frac{\partial}{\partial y}\ \frac{\partial}{\partial z}\right)$, acting on a collection of such forms would produce invariants. The property of invariance is now located in the elementary operator. A single form may be represented by several symbols in the same problem; a ternary quadric, by $(ax)^2$, $(bx)^2$ and $(cx)^2$ indifferently. Then the operation $\left(\frac{\partial}{\partial x}\ \frac{\partial}{\partial y}\ \frac{\partial}{\partial z}\right)^2(ax)^2\,(by)^2\,(cz)^2$ will yield, when explicated,

$$2\begin{vmatrix}a_1 & a_2 & a_3\\ b_1 & b_2 & b_3\\ c_1 & c_2 & c_3\end{vmatrix}^2 \text{ or } 2(abc)^2.$$

This result, if not identically equal to zero, is an invariant of the ternary quadric; in fact, its discriminant. An invariant so symbolized can be translated into terms of the actual coefficients of the quadric if we agree that $(ax)^2$ shall mean

$$\sum_1^3 a_{ii}x_i^2+\sum_{i,k=1,\,i\neq k}^{3}a_{ik}x_ix_k$$

and that $a_{ik}=a_{ki}$. Further, any symbolic product a_1a_2 means a_{12}, and a_2^2 means a_{22}. Similar conventions yield, for a ternary cubic $(ax)^3$, $(bx)^3$, $(cx)^3$ or $(dx)^3$, the invariant:—$(abc)\ (abd)\ (acd)\ (bcd)$, which is one of the two well-known invariants of the cubic. It is obvious also that $(abc)^2\ (ax)\ (bx)\ (cx)$ will be a symbol of a covariant of the cubic form, it is commonly called the *Hessian* of the cubic.

Such a structure might, however, prove to signify identically zero when symbols are translated into actual coefficients. Such cases are $(abc)^3$ and $(abc)^2\ (ade)\ (bde)\ (cde)$. Again, the difference of two supposed invariant forms may be a zero form, in which case the expressions, apparently distinct, signify actually the same invariant. Ambiguity of expression results from the existence of zero forms, and these in turn from a few elementary identities which are essentially alike. For binary covariants containing not more than two sets of variables, these identities are combinations of the following three:—

$$\begin{aligned}(ab)\ (cx)-(ac)\ (bx)+(bc)\ (ax)&=0,\\ (ab)\ (xy)-(ax)\ (by)+(bx)\ (ay)&=0,\\ (ab)\ (cd)-(ac)\ (bd)+(bc)\ (ad)&=0,\end{aligned}$$

whatever the symbols may represent.

Equally recognizable is the possible ambiguity of symbolic formulae in invariants of ternary forms. The typical identity is this:—

$$(abc)\ (dx)-(abd)\ (cx)+(acd)\ (bx)-(bcd)\ (ax)=0,$$

or this:—

$$(abc)\ (def)-(abd)\ (cef)+(abe)\ (cdf)-(abf)\ (cde)=0$$

Geometric Considerations.—For geometric uses variables of a second kind are considered. These are line co-ordinates $(u_1u_2u_3)$, subject to *contragredient* linear transformations so adjusted to those of the *point co-ordinates* $(x_1x_2x_3)$ that, if the latter are expressed in terms of $(y_1y_2y_3)$, and the former in terms of $(v_1v_2v_3)$, then identically

$$(ux)=u_1x_1+u_2x_2+u_3x_3=v_1y_1+v_2y_2+v_3y_3=(vy).$$

The combination (ux) is called the identical covariant. Symbols a_1b_1 etc. are cogredient with the u's. When variables u and variables v are present in the same covariant expression, the above zero form may be

$$(abc)\ (ux)-(abu)\ (cx)+(acu)\ (bx)-(bcu)\ (ax)\equiv 0,$$

or $$(abc)\ (deu)-(abd)\ (ceu)+(abe)\ (cdu)-(abu)\ (cde)\equiv 0.$$

GENERAL LAWS OF STRUCTURE

The *first major problem* in the theory of forms is the determination of general laws for structure of invariants. For *binary*

forms containing one set of variables it is proved that invariant forms consist of a finite number of terms composed of symbolic factors like (ab) and (ax). For a *ternary* form structure of invariant forms, invariant comitants in one set of variables (x) and one set of contragredient variables (u), every invariant concomitant consists solely of terms containing symbolic factors of these types: (ux), (abc), (ax), (abu). Equivalent symbolic representations of any one invariant form differ by a form containing in each term one or more of the above listed zero factors. Starting from more than one fundamental form, more types of symbolic factors would be admitted; so also if a fundamental form contains both kinds of variables, x's and u's.

Set of Three Quadrics.—Among ternary forms, after quadrics and systems of two quadrics, the next in point of simplicity and geometric interest is the set of three quadrics, or, what is closely related to such a set, the ternary cubic If all invariants, covariants and contravariants are considered, together with mixed comitants containing both sets of variables, $(x_1x_2x_3)$ and $(u_1u_2u_3)$, then 34 distinct forms constitute a complete system for the rational expression of all others. The best known of these are, for the cubic f written symbolically $f=(ax)^3$, $(bx)^3$, $(cx)^3$, etc.:—

Hessian covariant, $\mathrm{H}=(abc)^2\,(ax)\,(bx)\,(cx)$;
invariant, $\mathrm{S}=(abc)\,(abd)\,(acd)\,(bcd)$;
invariant, $\mathrm{T}=(abc)^2\,(ade)\,(bdf)\,(cef)\,(def)$;
contravariant $\Sigma=(abc)\,(abu)\,(acu)\,(bcu)$, ("Cayleyan");
contravariant $\mathrm{T}=(abc)^2\,(ade)\,(bdu)\,(ceu)\,(deu)$;
discriminant $(\mathrm{T}^2-\frac{1}{6}\mathrm{S}^3)$;
mixed form $\Theta=(abu)^2\,(ax)\,(bx)$;
doubly apolar contravariant, $\Pi=6\mathrm{T}\Sigma-4\mathrm{S}\mathrm{T}$.

This contravariant Π is noteworthy as being strictly dual to f itself; *i.e.*, if variables (u) and (x) are exchanged, and invariants and contravariants derived from the altered Π, as from f, then the new Π altered by the same exchange of variables would be a multiple of the old f. The discriminant of H contains as a factor the discriminant of f. This has led to the discovery of closed systems among the comitants of the system,—closed with respect to the action of an operator δ, the "Aronhold operation." Denote in actual coefficients the two cubics—

$$f=\sum_{i+j+k=3} a_{i,j,k}\,x_1^i\,x_2^j\,x_3^k,\quad \mathrm{H}=\sum_{i+j+k=3}\alpha_{i,j,k}\,x_1^i\,x_2^j\,x_3^k,$$

then the operation δ is defined thus (for this particular theory),

$$\delta=\Sigma\left(\alpha_{i,j,k}\,\frac{\partial}{\partial a_{i,j,k}}\right);\ i.\,e.,\ \delta f\equiv\mathrm{H}$$

Then it is found that

$$\delta\mathrm{H}=\tfrac{1}{2}\mathrm{S}\cdot f$$
$$\delta\mathrm{S}=4\mathrm{T},\qquad \delta\mathrm{T}=\mathrm{S}^2,$$
$$\delta\Sigma=3\mathrm{T},\qquad \delta\mathrm{T}=\tfrac{5}{6}\mathrm{S}\cdot\Sigma,$$

and connections are discovered among mixed forms of like orders.

For a ternary form of order four, the minimum number of covariant forms in a basis has not been determined; one author, Miss E. Noether, has progressed so far in approximations as to prove that it is above 300. For simultaneous systems of a small number of quadrics such work has been carried to a finish; but for higher orders it would be sport rather than science. Connections are soonest found among forms of low degrees.

Irrational Invariants are such as satisfy equations, algebraic, differential or functional, with invariant or covariant coefficients. Forms apolar to a given form satisfy an equation linear in their coefficients; *e.g.*, the doubly apolar cubics f and Π mentioned above, so Hilbert's form $\phi=(\alpha x)^2$, irrationally covariant to a cubic $(ax)^3$, satisfies an equation $(ab\alpha)^2(ax)\,(bx)\equiv M(\alpha x)^2$, a relation discussed in vol. i of the *Transactions of the American Mathematical Society*. "Binary quartics which are multiples of their own Hessian covariants are the squares of quadrics." Combinants and semicombinants furnish another illustration. A combinant of two forms of like order, $(ax)^n$ and $(Ax)^n$ is any simultaneous covariant of the two which is unchanged, save for a factor, when the first two are replaced by $m_1(ax)^n+M_1(Ax)^n$ and $m_2(ax)^n+M_2(Ax)^n$, m_1 and m_2, M_1 and M_2 denoting any constants. One such is their Jacobian, and all others are comitants of that Jacobian, $(Aa)\,(Ax)^{n-1}(ax)^{n-1}$. A semicombinant of two forms of different orders is unchanged when the form of higher order is replaced by a homogeneous combination; *e.g.*, when binary $(ax)^4$ and $(Ax)^3$ are replaced by $(ax)^4+(m_1x_1+m_2x_2)\,(Ax)^3$ and $(Ax)^3$. These are conjectured to be useful in discussing intersections of plane curves, or of surfaces, of different orders.

Classification.—Degree and order give a two-way arrangement, *order* being the number of variable factors in every term of the homogeneous covariant; degree, the number of factors which are coefficients of the fundamental form. One problem is, *to enumerate the different invariant forms of a specified order and degree*, counting as one any two whose difference is a zero-form. This counting gives a result that increases rapidly with the degree. But invariants of lower degree can be combined, in rational integral aggregates, into such of higher degree. This indicates a reduction at each stage of the enumeration by discarding those rational and integral in lower stages. Will the final result be zero at and beyond some finite degree? It proves to be so for all forms of low order in the binary field, and for systems of two or three ternary quadrics. The third major problem is, then, that of the finiteness of reduced systems of invariant comitants.

ORDERLY PRODUCTION AND ENUMERATION

The *second major problem* is that of orderly production and enumeration. The internal structure of all invariant forms is known; and all that involve a given fundamental form or system, in a given degree, and one or more sets of variables to specified orders, can be written down mechanically. There will be some ambiguity, *i e.*, repetitions, owing to the zero forms. The third great problem concerning the totality of such invariants is commonly called Gordan's problem; from Paul Gordan who in 1869 was the first to solve it for binary forms The question arises, is there a finite basis for the entire system $\mathrm{F}_1, \mathrm{F}_2, \ldots, \mathrm{F}_l$ in terms of which all others can be represented linearly? If F is any invariant not in that basis, is there an identical equation

$$\mathrm{F}\equiv q_1\mathrm{F}_1+q_2\mathrm{F}_2+\ldots+q_{l-1}\mathrm{F}_{l-1}+q_l\mathrm{F}_l$$

with coefficients $q_1, q_2, \ldots q_{l-1}, q_l$ polynomials in the variables x_1, x_2? Gordan's various proofs, that this basis must always exist, appeared first in 1869, later, revised, in 1871, and subsequently. His proof was based on the nature of certain elementary operations which build up and knit together those invariant forms; more precisely, on the Gordan series developing a form in terms of polars and Cayleyan operations. This is given in somewhat improved form by Grace and Young (*The Algebra of Invariants*, 1903). As Jacques Deruyts has gone further, treating the enumeration problem for forms in any number of variables, and as the question of finite systems is treated with greater generality by Hilbert, the earlier methods need not be exhibited. Deruyts's method is generalized from that for binary forms used by Arthur Cayley, James J. Sylvester and Fabian Franklin; Hilbert's was entirely novel.

Semi-invariants as Sources of Invariant Forms.—Semi-invariant had been defined by Cayley and Sylvester, for binary forms, as a polynomial in coefficients and variables of one or more fundamental forms, whose specific property it is to remain unaltered (identically) when the variables undergo the substitution

$$x_1=y_1+\lambda y_2,$$
$$x_2=\qquad y_2,$$

and the coefficients undergo the corresponding linear transformation, the variables (y) being replaced afterwards by (x). Deruyts applies the same term to functions in more than two variables, unaltered by any substitution whose determinant lacks all con-

stituents below the principal diagonal. For quaternary forms such a substitution is this:—

$$\begin{aligned} x_1 &= y_1+\alpha y_2+\beta y_3+\gamma y_4 \\ x_2 &= \quad y_2+\delta y_3+\epsilon y_4 \\ x_3 &= \quad\quad y_3+\theta y_4 \\ x_4 &= \quad\quad\quad y_4. \end{aligned}$$

Like Alfredo Capelli, he considers for a quaternary system, covariants which may contain three sets of cogredient variables $(x_1x_2x_3x_4)$, $(y_1 \ldots y_4)$, $(z_1 \ldots z_4)$. Clebsch and Gordan had employed instead three unlike sets, two mutually contragredient, the other intermediate, its substitution like that of two-rowed determinants in either of the first two sets. If a covariant contains, when written in Clebsch-Aronhold symbols, π determinant factors in every term, and is of orders m_1 in the (x), m_2 in the (y), m_3 in the (z), (where $m_1 \geqq m_2 \geqq m_3$), its weights are called $\pi_1=\pi+m_1$, $\pi_2=\pi+m_2$, $\pi_3=\pi+m_3$, $\pi_4=\pi$; then it is shown that every *primary covariant* can be derived uniquely from a semi-invariant as source, which contains in every term

π_4	4-rowed symbolic determinant factors like $(a_1b_2c_3d_4)$;
$\pi_3-\pi_4$	3-rowed determinant factors with subscripts 1, 2, 3, like $(a_1b_2c_3)$;
$\pi_2-\pi_3$	2-rowed determinant factors with subscripts 1, 2, like (a_1b_2);
$\pi_1-\pi_2$	monomial factors like a_1, b_1, etc.

The number of such sources that can be written for a given set of weights $\pi_1, \pi_2, \pi_3, \pi_4$, may be denoted by $\{\pi_1, \pi_2, \pi_3, \pi_4\}$ but is subject to reduction.

This precisely defined structure of a semi-invariant is the clue to the problem: how many semi-invariants of given weights $\pi_1, \pi_2, \pi_3, \pi_4$ are linearly independent? For it is possible to count, directly or by formulae, the number of different monomial expressions, rational and entire in the coefficients, which have the prescribed weights. As they are expressed in actual coefficients (not symbolic merely) they are linearly independent. Next, they are required to satisfy the three differential equations expressing invariance under the one-way substitutions (21), (32), (43), which change the weights respectively to $(\pi_1+1, \pi_2-1, \pi_3, \pi_4)$, $(\pi_1, \pi_2+1, \pi_3-1, \pi_4)$, $(\pi_1, \pi_2, \pi_3+1, \pi_4-1)$. These involve as many conditions as there are terms of such weights; hence their number is to be subtracted from the first estimate. Then the overlapping conditions must be considered, etc. In all, the enumeration calls for as many items, additive and subtractive, as there are terms in a four-rowed determinant. This statement is for forms homogeneous in four variables. Were the forms binary, only two weights and two types of factors in semi-invariants would occur, and the results would be those of Sylvester and Franklin. For invariants (free from variables) of forms in any number of variables, the weights for the first distribution are all equal, and the calculation therefore slightly easier. But whatever the orders in variables, after the enumeration for linearly independent comitants comes the reduction for those composed of rational factors, factors which are themselves covariants of the same or lower orders. This is the "tamisage" of Sylvester and Franklin.

FINITENESS OF SYSTEM OF INVARIANTS: HILBERT'S EXTENSIONS

The *third major problem* is concerned with the finiteness of reduced systems of invariant comitants. Reduction by tamisage may show that, for degrees and orders proposed, all covariants are reducible, *i.e.*, rationally expressible in terms of those of lower degrees. Beyond certain upper limits this must always occur. While Gordan and others proved this for binary forms, Hilbert established it for any finite number of forms in any finite number of variables. His widely inclusive principal theorem relates to algebraic forms, homogeneous, rational and integral in the elements of any number of independent systems. Now invariants, as here defined, are so constructed from one or more sets of variables strictly so called, and from the coefficients of one fundamental form or from those of several independent forms. The theorem states, "If a series of forms be given, rational and integral and homogeneous in a domain of a finite number of finite sets of elements (variables or parameters), then it is always possible to find a finite *basis*, or set of forms among those given, such that every other form in the given (finite or infinite) series shall be expressible linearly in terms of those basal forms, with coefficients rational and integral in the same domain." The proof is by mathematical induction, from forms in n variables to forms in $n+1$ variables, with starting-point in the obvious truth of the statement when a single variable x is concerned. It proceeds upon the lemma that a linear function of linear functions of several variables is itself a linear function of those variables.

According to this theorem of Hilbert's, if the given series of invariants be denoted by A_1, A_2, — arranged in ascending degrees in sets of parameters concerned, then among the A's is contained a basal set $B_1, B_2, \ldots B_k$, such that every A is expressible thus:—

$$A_s = M_{s1}B_1+M_{s2}B_2+\ldots+M_{sk}B_k,$$

the M's being rational in the same domain as the given A's. But more than this is true: the M's, if not invariants, can be replaced by invariants, which in turn are either B's, or expressible in the B's just as the A's which include them. To turn the M's into invariants while leaving A's and B's unchanged is an operation most neatly carried out by Mertens' device, as follows (confining the treatment to ternary forms, for brevity):—

Assume any linear transformation of the variables involved, say x_1, x_2, x_3, and cogredient sets, with indeterminate parameters $\alpha_1, \alpha_2, \alpha_3, \beta_1, \quad, \gamma_1, \quad, \gamma_3$, viz,

$$\begin{aligned} x_1 &= \alpha_1y_1+\beta_1y_2+\gamma_1y_3 \\ x_2 &= \alpha_2y_1+\beta_2y_2+\gamma_2y_3 \\ x_3 &= \alpha_3y_1+\beta_3y_2+\gamma_3y_3. \end{aligned}$$

Calculate the induced transformations, resulting from this, upon the coefficients of the one or more fundamental forms. Those will give the old set of coefficients rationally in terms of the new, with denominators some powers of the determinant $(\alpha_1\beta_2\gamma_3)$ or Δ. Every M is thereby expressed as a form in the given domain and in the parameters (α), (β), (γ); so also the B's, and these become merely powers of Δ multiplied into functions of quantities exclusive of the (α), (β) and (γ). Now perform on every A_s, B_k and M_{sk} the operation P^{π_s},

$$P = \begin{vmatrix} \frac{\partial}{\partial\alpha_1} & \frac{\partial}{\partial\alpha_2} & \frac{\partial}{\partial\alpha_3} \\ \frac{\partial}{\partial\beta_1} & \frac{\partial}{\partial\beta_2} & \frac{\partial}{\partial\beta_3} \\ \frac{\partial}{\partial\gamma_1} & \frac{\partial}{\partial\gamma_2} & \frac{\partial}{\partial\gamma_3} \end{vmatrix}$$

where π_s is the weight of the invariant A_s. Every A_s and B_s reappears multiplied by a numerical constant (some power of 6); every M_{sk} yields an invariant and a numerical factor, and the identity is undisturbed. Accordingly, by repetitions if necessary, every A_s is expressible in terms of products of B's with purely numerical coefficients.

Powers and products of powers of the B_s constitute a subset among the A_s. The same argument applies to them, giving a second theorem due to Hilbert. There exist an unlimited series of identities among the products of powers of the basal invariants of a system, identically true when all are explicit in the original variables and coefficients of given forms. These identities are called *syzygies*, and when all significant terms are brought to one side of the identity, that side (as a function of the B_k) is a *syzygant* of the first kind among the invariants B_k. Among the syzygants of the first kind there exist then syzygants of the second

kind, etc. But by a third theorem of Hilbert's the number of kinds of syzygants upon a given system of invariants is itself a finite number. Little has been done in concrete illustration of these theorems, or in the substitution of precise limits for the "finite" numbers involved; though Hilbert himself fixed an upper bound for the number of kinds of syzygies when m is the number of independent forms in the basis of the modulus or system, and worked out details for the system of three quadric surfaces defining a twisted cubic curve.

APOLARITY

For geometry, co-ordinates or variables all of one kind are not sufficient. The theory of duality demands, in a plane, point co-ordinates and line co-ordinates; and, in three-space, points and planes are dual, while lines, dual to lines, require a third kind of co-ordinates. *Apolarity* of two forms is then an important relation. Ternary forms in contragredient sets of variables (x) and (u) are defined as apolar by the aid of an operator

$$\left(\frac{\partial}{\partial x_1}\cdot\frac{\partial}{\partial u_1}+\frac{\partial}{\partial x_2}\cdot\frac{\partial}{\partial u_2}+\frac{\partial}{\partial x_3}\cdot\frac{\partial}{\partial u_3}\right), \text{ or } \left(\frac{\partial^2}{\partial x\partial u}\right).$$

In binary forms, if $(x_1:x_2)$ and $(y_1:y_2)$ are cogredient, then $(x_1:x_2)$ and $(-y_2:y_1)$ are contragredient sets, and the operator for apolarity is $\left(\frac{\partial}{\partial x_1}\frac{\partial}{\partial y_2}-\frac{\partial}{\partial x_2}\frac{\partial}{\partial y_1}\right)$. Two forms $(ax)^n$, $(uA)^n$ of like order are simply, doubly, etc. apolar if

$$(aA)^n=0,\ i.e.\ \left(\frac{\partial^2}{\partial x\partial u}\right)^n(ax)^n(uA)^n=0,$$

or if $(aA)^{n-1}(ax)(uA)\equiv 0$, $i.e.\ \left(\frac{\partial^2}{\partial x\partial u}\right)^{n-1}(ax)^n(uA)^n\equiv 0$

(for all x and u).

Important applications of this notion to binary forms are connected with canonical or normal forms of quantics of odd order, and with a special kind of quantic of even order A binary quantic of even order $(ax)^{2n}$, is equivalent to a sum of n perfect $2n$th powers of linear forms if its catalecticant vanishes. A $(2n+1)$-ic is reducible to the sum of $n+1$ perfect $(2n+1)$th powers of linear forms, the linear factors of the canonizant. As to the latter, if the given form is

$$f(x_1, x_2)=(ax)^{2n+1}=\sum_1^{n+1}p_i(\alpha_{i1}x_1+\alpha_{i2}x_2)^{2n+1},$$

and the canonizant

$$(Ax)^{n+1}=\prod_1^{n+1}(\alpha_{i1}x+\alpha_{i2}v_2),$$

then the transvectant

$$\frac{n!}{(2n+1)!}(Aa)^{n+1}(ay)^n=\sum p_i(\alpha_i y)^n\prod_1^{n+1}(\alpha_{i1}\alpha_{k_2}-\alpha_{k1}\alpha_{i2})=0$$

is identically $=0$ on account of $n+1$ zero factors in which $i=k$. From the $n+1$ implied equations of condition, and from $(Ax)^{n+1}=0$, elimination of the $n+2$ coefficients of $(Ax)^{n+1}$ yields the canonizant in the form of a determinant. This must be resolved into its linear factors, which must all be distinct, and then the $n+1$ coefficients p_i can be determined from linear equations.

For a binary form of even order, $(ax)^{2n}$, similar reasoning shows that it is reducible to the sum of $n+1$ perfect $2n$th powers of linear forms, one of them an arbitrary linear form; or to the sum of n such powers if a determinant of n rows, the *catalecticant*, is equal to zero.

The so-called typical representation of binary forms expresses forms of odd order in terms of any two linear covariants, with coefficients automatically invariant. The symbolic identity $[(\alpha\beta)\,(ax)]^n\equiv[(a\beta)\,(\alpha x)-(a\alpha)\,(\beta x)]^n$ exhibits this, when (αx) and (βx) are the selected covariants. For a binary form of even order three quadric covariants are needed, and these can be found if the order is foregoing four; call them $(\alpha x)^2$, $(\beta x)^2$, $(\gamma x)^2$, and the form $(ax)^{2n}$. Then the expansion of a four-rowed determinant gives an identity in the symbol $(ax)^2$, and an nth power yields the desired typical representation:—

$$\begin{vmatrix}(ax)^2 & a_1^2 & a_1a_2 & a_2^2\\ (\alpha x)^2 & \alpha_1^2 & \alpha_1\alpha_2 & \alpha_2^2\\ (\beta x)^2 & \beta_1^2 & \beta_1\beta_2 & \beta_2^2\\ (\gamma x)^2 & \gamma_1^2 & \gamma_1\gamma_2 & \gamma_2^2\end{vmatrix}\equiv A(ax)^2-\{B(\alpha x)^2+C(\beta x)^2+D(\gamma x)^2\},\equiv 0$$

whence $A^n(ax)^{2n}\equiv\{B\cdot(\alpha x)^2+C\cdot(\beta x)^2+D\cdot(\gamma x)^2\}^n$.

The linear covariants constitute a most interesting meeting point of geometry and algebra. (F. Morley in *Math. Ann.* vol. 49.)

The foregoing example of an even form and quadric covariants is also an example of geometric picturing of a binary form and its comitants upon a rational algebraic curve in two or more dimensions,—in this case on a curve of the second order in a plane. For, if we set $\xi_1/(\alpha x)^2=\xi_2/(\beta x)^2=\xi_3/(\gamma x)^2$, elimination of $x_1:x_2$ gives the equation of a conic in $\xi_1:\xi_2:\xi_3$, while $(ax)^{2n}$ is transformed into a ternary n-ic, and this, equated to zero, cuts out, on that conic, a set of $2n$ points, the picture of the $2n$ zero points of $(ax)^{2n}$ in the binary domain Further, a unique curve of order n, can be determined, cutting out those $2n$ points on the conic, and itself apolar to the conic. Some use has been made of this style of picturing both on the plane conic and on the *gauche* curve of order three in three-space (F. Meyer, *Apolarität und rationale Curven*, Tübingen, 1883.)

A sample of the relations, more easily discoverable in such geometric pictures than in algebraic symbols, is this theorem on three binary quadrics. Any three linearly independent quadrics being given (no one of which is the Jacobian of the two others), every fourth quadric is linearly related to them, with constant coefficients. But there is a unique fourth quadric, determined by the requirement that its square shall be a linear combination of the squares of the first three, with constant coefficients. Then any three of these four quadrics, taken in pairs, determine three Jacobians or functional determinants, covariant quadrics, which are related to the fourth of the original set in the same way as are the first three. (Meyer, *Apolarität und rationale Curven*, p. 244) That is, if we use f_1, f_2, f_3, f_4 to denote the four quadrics, and write J_{12}, for example, for the Jacobian of f_1 and f_2,—

$$J_{12}=\begin{vmatrix}\frac{\partial f_1}{\partial x_1} & \frac{\partial f_1}{\partial x_2}\\ \frac{\partial f_2}{\partial x_1} & \frac{\partial f_2}{\partial x_2}\end{vmatrix}$$

then if there is an identical relation

$$f_4^2\equiv m_1f_1^2+m_2f_2^2+m_3f_3^2,$$

the m's denoting numbers, then there will be also an identical relation

$$f_4^2\equiv k_1J_{23}^2+k_2J_{31}^2+k_3J_{12}^2.$$

This is more interesting when it is noticed that the f's are necessarily proportional to the Jacobians of the J's:—

$$J(J_{12}, J_{23}) : J(J_{23}, J_{31})=f_2:f_3, \text{ etc.},$$

for then it exhibits connections in a finite closed system.

HISTORICAL NOTE

Prior to the year 1800 the study of algebraic forms was confined to questions of factors, multiples, powers, differentiation and elimination. Resultants, discriminants and in particular determinants were chief objects of interest. Early in the 19th century, however, the invention or formulation of projective geometry and the study of groups in the theory of equations drew attention to the operational character of mathematics as

distinguished from its static aspect. It cannot be regarded as purely accidental that algebra, with its abstract groups of transformations, followed after and eventually outran geometry with its groups of projectivities and quadric inversions. Projective geometry had been systematized and largely created between 1813 and 1840 by Jean Victor Poncelet, Plücker and M. Chasles. In 1841 the germ of a new movement in algebra appears when George Boole noticed that the discriminant of $q+\lambda Q$, a homogeneous form with one parameter, must be a multiple of the discriminant of the same after transformation $q'+\lambda Q'$; from this follows that the discriminant is an invariant. In the same year appeared an essay of C. G. J. Jacobi on functional determinants, emphasizing their invariance under linear substitutions. In 1842 Boole announced the invariance of polars. Three years later Cayley subsumed what was already known, and opened a new field of discovery, in the publication of his calculus of hyperdeterminants. This was in his view simply an extension, to symbols, of the theorem on multiplication of determinants of like order whose constituents are actual numbers. This was in 1845; but already in 1844 had been published Friedrich G. M. Eisenstein's development of the invariants of a binary cubic and quartic, and Hesse's first paper on the covariant now universally known as the Hessian. Aronhold (1849) found the invariants of the ternary cubic, and their combination in the discriminant Sylvester's 40 years' labour in this field opened in 1851, and within four years he had invented most of the technical terminology and tapped most of the rich veins of the mines of the theory of invariants. He had even then shown the invariance of resultants under substitutions of higher order, and had given examples of combinants, and had named the catalecticant.

Charles Hermite's contributions began in 1851 with his discovery of evectants, followed not long after by his law of reciprocity for invariants of binary forms, and by explicit formulae for the transformations of a quadric form into itself. Several writers realized the value of the differential equations of invariance and covariance (at present perhaps the most emphasized point of departure for the entire theory); among these were Francesco Brioschi, Sylvester and Cayley. The reference of invariant forms to *sources* is found first in the work of M. Roberts (1861), who proved, for binary forms, that the source of a product of covariants is the product of their several sources. Non-Euclidean geometry was attached to the algebraic train by Cayley (1859).

Meantime the new algebra had become accessible to wider circles by Salmon's publication of his *Higher Plane Curves* (1852) and *Modern Higher Algebra* (1859). French and Italian translations were widely circulated. In Germany it was Siegfried Aronhold who founded, in publications in 1858 and 1863, the symbolic notation which has been proved most effective for the explicit working out of invariants and their relations for particular forms and systems. It is, however, more to Clebsch, from 1861 on, that we owe the completion of this fundamental work. By its use Gordan (1868) proved the finiteness of the total system of covariants for any given binary forms, and so gave a climax to the earlier period of this new branch of algebra. Invention and discoveries have been less notable since that date, except for the climactic work of Hilbert, already described, and the systematizing publications of Study, Deruyts and the school of Sylvester. Important applications have been many, but the apparent tendency is to embody this theory as a typical and well developed part in the comprehensive theory of transformation-groups, of Sophus Lie. The most nearly complete history of this theory is Franz Meyer's *Bericht.*

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ALGEBRAIC NUMBERS: *see* NUMBER.

ALGECIRAS or **ALGEZIRAS,** a seaport and railway terminus of southern Spain, in the province of Cadiz, 6m. W. of Gibraltar, on the opposite side of the Bay of Algeciras. Pop. (1920) 19,417. The name (Arabic, "island") is derived from a small islet on one side of the harbour. The fine winter climate attracts invalid visitors, on whom the town largely depends. Early in the 20th century it became a fishing-station, the Algeciras steam-trawlers visiting the Moroccan coast, as well as Spanish and neutral waters. Whale fisheries, with a floating factory and steam-whalers operating off Algeciras, were started by Spanish and Norwegian capital in 1923–25. Farm produce and building materials supply a fleet of small coasters with cargo

Algeciras was perhaps the *Portus Albus* of the Romans, but was probably refounded by the Moors, who held it from 713 to 1344. It was then taken by Alphonso XI of Castile after 20 months' siege which attracted crusaders from all parts of Europe; among them being the English earl of Derby, grandson of Edward III. It is said that during this siege gunpowder was first used by the Moors in the wars of Europe The Moorish city was destroyed by Alphonso; it was first reoccupied by Spanish colonists from Gibraltar in 1704; and the modern town was erected in 1760 by King Charles III During the siege of Gibraltar in 1780–82, Algeciras was the station of the Spanish fleet and floating batteries. The important international conference on Moroccan affairs, which resulted in an agreement between France and Germany, was held at Algeciras from Jan 16 to April 7, 1906. (*See* MOROCCO.)

See O Jürgens, *Die Spanische Stadte* (Hamburg, 1926, bibl).

ALGECIRAS CONFERENCE. On Aug 8, 1904, a treaty was concluded in London by which France accorded absolute liberty of action to Great Britain in Egypt in return for a similar acknowledgment of French interests in Morocco. By a subsequent treaty (Oct 1904) France concluded a secret arrangement with Spain. Disturbed by these agreements and determined to "vindicate" German rights in North Africa, the Emperor William II landed at Tangier on March 31, 1905 Under his influence the sultan rejected the French scheme of reforms, and issued invitations to a conference of the powers Serious friction between France and Germany followed, resulting in the fall of Delcassé, and the triumph for the moment of German policy.

The conference met at Algeciras on Jan 16, 1906 Germany was backed by Austria, but the French claims were stoutly supported by Great Britain A scheme of reforms was drawn up (*see* MOROCCO: *History*) and duly ratified, but Germany's principal object—to place France upon the same level as the other powers—was unsuccessful, and France was able to uphold her claim to a privileged position in Morocco.

ALGER, HORATIO (1832–1899), American writer, born in Revere, Mass, Jan 13, 1832. He graduated at Harvard college in 1852, became a teacher and journalist, and in 1864 a Unitarian minister He removed to New York city in 1866, and the experiences gained in his efforts to improve the condition of street boys there are reflected in many of his writings, which include over 100 books, mostly juvenile fiction of which many hundred thousand volumes have been sold. He died in Natick, Mass., 1899.

Besides contributing extensively to newspapers and periodicals, he published *Helen Ford* (1866) a novel; *Gran'ther Baldwin's Thanksgiving, With Other Ballads and Poems* (1879), the popular "Luck and Pluck," "Ragged Dick," and "Tattered Tom," series. *See* Herbert R. Mayes, *Alger, a Biography Without a Hero* (1928).

ALGER, RUSSELL ALEXANDER (1836–1907), American soldier and politician, was born in Lafayette township, Medina county, Ohio, on Feb 27, 1836. He was admitted to the Bar in 1859 and began practice at Cleveland, Ohio, but early in 1860 removed to Michigan, where he engaged in the lumber business. Enlisting in a Michigan cavalry regiment in Sept. 1861, he rose from captain to colonel, distinguished himself in the Gettysburg

campaign, and under Sheridan in the Shenandoah valley, and in 1864 and 1865, respectively, received the brevets of brigadier-general and major-general of volunteers. After the war he invested in pine lands in Michigan and accumulated a large fortune. He served as governor of Michigan on the Republican ticket from 1885 to 1887. In 1889–90 he was commander-in-chief of the Grand Army of the Republic. From 1897 to 1899 he was secretary of war in President McKinley's cabinet. His administration of the war department during the Spanish-American War was severely criticized for extravagance, for unpreparedness, and for general inefficiency; charges which he answered in his *The Spanish-American War* (1901). The extent of his personal responsibility is uncertain. In 1902 he was appointed by the governor of Michigan, and in 1903 was elected by the State legislature, as United States senator to complete the unexpired term of James McMillan (1838–1902). He died at Washington, D.C., on Jan. 24, 1907.

ALGER, the central department of *Algeria* (*q.v.*).

ALGERIA, a country in North Africa under French dominion, bounded west by Morocco, north by the Mediterranean, east by Tunisia, and south by Italian Libya and French West Africa. North Algeria has an area of 207,915sq.km. between 37° and 34° N. lat. and 2° 10′ and 8° 50′ E. long.; it is 1,100km. long east to west, and 300–400 north to south, and so has the form of a narrow rectangle. The Saharan areas adjacent to Algeria have formed a separate administrative unit, the Southern Territories, since 1902; their area is 2,129,400sq.km., more than ten times that of North Algeria. The southernmost point in these Southern Territories, Tin Zaouaten, 20° N. lat., is 1,750km. from Algiers, while from the ocean to Tripolitania is about 1,800km. This immense area is, however, almost empty, and poor in resources at present utilizable, and it is a mere adjunct of the northern or true Algeria.

Physical Geography and Divisions.—The fundamental units, based mainly on climate, are the Tell, an area of trees and cultivation, the Steppe, with grasses and pastoral life, and the Sahara without water or trees save in oasis centres of irrigation. These are not continuous zones of constant breadth; there are wooded and cultivable patches in the Steppe and the Sahara, and arid patches in the Tell. Algeria is mainly highland, with mountain chains forming its borders and the steps of the main slopes. One must cross these mountainous borders to reach either the Mediterranean or the Sahara from the high interior, formed of mountain ridges and masses, and of plateaus or high plains with mild undulations. The highest points are Chélia (2,329 metres) in the Aurès and Lalla Khadidja (2,308 metres) in Kabylia, but the average elevation is about 900 metres and 68% of the area lies between 800 and 1,600 metres. Low plains cover only small areas near the coast in a few spots, but the coast generally is closely dominated by mountain lines, usually south-west–north-east. The slopes are usually very sharp, interrupted only by narrow breaches. The straight coastline has few shelters and deserves Sallusts' designation of *littus importuosum*. A few semicircular gulfs, of Mers-el-kebir, Arzeu, Algiers, Bougie, Philippeville and Bône end westward against mountain-masses while eastward are shore deposits due to currents from the west.

Archaean and Palaeozoic rocks occupy little space save near the coast east of Algiers where they are accompanied by volcanic extrusions. Secondary rocks, usually calcareous or marly, form the main skeleton of the Atlas chains from the sea to the Sahara. Tertiary rocks are also highly developed and include limestones, marls, sandstones, clays. Those of Oligocene or later date include fluviatile and lacustrine, as well as marine, deposits.

The Algerian chains show two series of foldings, the Tell Atlas and the Saharan or pre-Saharan Atlas, separated by a zone which narrows from west to east and is hardly folded at all.

In Algeria, west of the meridian of Algiers and Medea, the littoral massifs have a large tertiary depression on their south side; then comes the axial chain of the Tell Atlas with tertiary deposits to the south again. The Tlemsen-Saïda massif forms the third step and belongs climatically to the Tell but structurally to the main block. Beyond this to the south is the region of steppes with tertiary basins, of which the shotts fill the remnants. Finally, the Saharan Atlas forms a ridge fronting the desert. East of Algiers the zones are much less distinct. The Kabylian Tell is much higher and rougher than the Tell of Oran, and ends in the Edough massif at Bône, the end of the Tell Atlas. Beyond this, the Saharan Atlas with its north-eastward trend reaches the coast and separates the Algerian plateau from the Tunisian Sahel, with its tabular structure and its numerous small chains in the eastern part of the department of Constantine.

The North Sahara is built very simply. The Ahaggar, or central Tuareg massif, is made up of crystalline rocks surmounted



BY COURTESY OF THE CANADIAN PACIFIC STEAMSHIPS

AN ANCIENT STREET IN ALGIERS, ALGERIA, WHICH ASCENDS BY COBBLED STEPS, PREVENTING ALL CONVEYANCES, EXCEPT SMALL BEASTS OF BURDEN, FROM PASSING THROUGH, AND WALLED ON EITHER SIDE BY PLAIN WHITEWASHED HOUSES OF MOORISH ORIGIN

by extinct volcanoes (Ilamane, 2,200 metres). Around it are the sandstone plateaus called the Tazili of the Azjer and the Muydir-Ahmet. A great aureole of calcareous Cretaceous plateaus (Tademayt, El-Goléa, M'zab) separates the northward sloping Igharghar basin from that of the Saoura which slopes southward. The first has the oases of Warqla, Wad-Rir and the Zibans, the second those of Gurara, Tuat and Tidikelt. Vast dunes, the eastern and western Erg, complete the symmetry.

Climate and Hydrography.—In winter, westerly and southerly winds with rains come in from the west Mediterranean regions of low pressure. In summer the winds are from the east and north-east, and the air moves towards the superheated Sahara and is dry. The sirocco is a south wind that dries up the country. On the coast the winter temperature averages 50°–54°, the summer one 75°–79°, but the long duration of unvarying summer heat, accompanied by moist atmosphere, makes the summer very trying. Away from the sea continental conditions are very marked with strong radiation in a dry atmosphere. Average winter temperature here is 39°–43°, with much frost; summer temperature averages 79°–83° with average maxima near 95° or even 105° in the Sahara. Rainfall diminishes from January to August and increases from September to December. From June to September very little rain falls.

A zone from Dellys to the Tunisian frontier with coastal massifs gets more than 800mm. of rain (Bougie 1,036mm.). A zone along the coast from Tenes to Dellys and thence inland south of the previous one gets 600–800mm. (Algiers, 728mm.). The Oran coast west of Tenes and the remainder of the Tell get 400–600mm. (Constantine, 589mm.). The high plateaus and the pre-Saharan Atlas get 200–400mm., save on a few heights (Jelfa, 380mm.). The Saharan slope of the Atlas gets less than 200mm., that is small, irregular and accidental rainfall (Biskra, 143 mm.).

Most Algerian streams are periodic, with the rains, and many diminish from their sources downwards and may lose themselves in inland basins or in the Sahara. The Cheliff is the chief river, over 700km. long, with an outflow varying from 30–15 cubic metres during the rains to a few hundred litres in the dry season. The lacustrine hollows, shotts or sebkhas, are occupied by salt deposits where evaporation has reduced them. On the Saharan slopes oasis irrigation and hot sands absorb the streams as soon as they leave the mountains. The Zousfana, helped by the Guir, occasionally reaches Foum-el-Kheneg. Wadi Mia and Wadi Igharghar are dead rivers; fossils in fact.

Flora and Fauna.—The flora includes 3,500 species of which 500 are peculiar. Evergreen trees and shrubs predominate and the olive is the characteristic tree. The barbary fig (*Opuntia Ficus indica*), the agave (*Agave americana*) and the widespread eucalyptus are imported types. On the highlands one finds either Central European or mountain Mediterranean plants. The woods include oaks (cork oak, evergreen oak, deciduous oak) and conifers (cedars, Aleppo pines, thuja, juniper). Regions with less than 350 mm. of rain are steppes with alfalfa (*Stipa tenacissima*), chih, (*Artemisia herba alba*), esparto grass and drinn. The limit of the steppe runs approximately through Sebdu, Saida, Frenda, Tiaret, Boghari, Borj-Bu-Arrerij, Constantine and Suk-Ahras. The Saharan region has a poor xerophilous flora of peculiar species, some of which grow very rapidly after rain; the oases are characterized by the date palm, the sand dunes and ergs have a fair number of plants, the regions of clay and boulders (*Reg*) less and the regions of rock (*Hamada*) least of all.

There are few peculiar animals. The lion has recently become extinct here, the panther and hyena are still found in the woods and a monkey (*Pithecus innuus*) occurs. Jackal and wild boar are very abundant and there are various antelopes (gazelles). The Saharan fauna is highly specialized; horned vipers and scorpions are fairly common.

Population.—In 1926 the population was 6,063,496, with a municipal population of 5,981,231. Of this total 542,225 live in the Southern Territories giving a density of less than one per sq km. This figure rises to 26 in the north. The indigenous element is Berber with Arab admixture physically assimilated. Physically diverse types are seen everywhere and their origins are little known. Arab invasions have had little influence on racial types but have spread Islam and Arabic language; Berber dialects, however, survive in remote spots in Kabylia, Aurès and Saharan oases and among the Tuaregs. The Mozabites are not orthodox Muslim but belong to the Ibadite or Kharejite schism (*see* M'ZAB). Indigenous peoples number in all 5,147,872 including 532,091 in the Southern Territories, and they have increased rapidly under French rule, from less than 2,000,000 in 1830 and some 3,200,000 in 1886. The increase now reaches 400,000 in ten years or a doubling in 40 years. Three-quarters of the indigenous population live in the Tell and because of security and rain, mountain lands are more peopled than the plains (contrast Europe).

The urban element in this population comprises about 6%, much less therefore than in Tunisia or Morocco, and only 30 localities have more than 3,000 agglomerated natives in each. Outside the towns the greatest contrast is between sedentary cultivators living in houses aggregated into villages (thaddert) surrounded by gardens and planted woods, and nomad shepherds living in tents grouped into douars and moving about with their sheep and goats. There are also demi-nomads, living in gourbis more settled than the nomads, less fixed than the house-dwellers. A tendency exists to limit movements of nomads.

Europeans number 833,359, of whom 4,779 are in the Southern Territories. Nearly all live on the coast and in the Tell, largely in towns, though there is an important rural element. The distribution contrasts with that of the natives for the department of Oran has 350,841, that of Alger 307,195 and that of Constantine 170,544. In the department of Oran Europeans occupy nearly all the cultivable land; in that of Alger they are numerous around Algiers, in the Sahel and in the Mitija; in that of Constantine they are sporadic.

From 1830 to 1856 the number of Europeans grew from 600 to 169,000 by immigration, but in that period deaths of Europeans were more numerous than births. Since 1856 births have been in excess, and there were 311,000 Europeans in 1876, 477,000 in 1891 and 752,000 in 1911. The increase is about 100,000 souls in ten years. Of the Europeans in 1926 there were 657,641 French, chiefly from southern departments (Corsica, Bouches-du-Rhône, Gard, Hérault, Pyrenées Orientales), and since 1896 more of the French have been Algerian born than French born. Spaniards from Murcia, Valencia, Alicante and the Balearics are numerous in the department of Oran. Italians from Sicily and Calabria occur especially in the department of Constantine. Maltese are to be found in most towns. Other Europeans are not numerous. Up to 1889 French and non-French European elements were about equal. To understand subsequent changes one must remember that many Frenchmen in Oran have married Spanish women, that any child born in Algeria is accounted as naturalized French unless he claims other nationality in the year of his majority, and that Jews, some of ancient settlement, others coming from Spain in the 16th and 17th centuries, were naturalized *en bloc* by the Crémieu decree (1870). An Algerian people is obviously forming itself and it is becoming purposeless, as well as almost impossible, to distinguish French born from naturalized citizens.

Towns.—Algiers, the capital has a total population of 226,218, with a municipal population of 214,920 (159,649 Europeans and 55,271 natives). Oran has a municipal population of 145,183 (120,568 Europeans), Constantine 88,582 (41,496 Europeans), Bône 48,570 (31,065 Europeans), Bel-Abbes 40,245 (28,024 Europeans), Philippeville 27,580 (19,288 Europeans), Mascara 27,231 (12,822 Europeans), Mostaganem 24,739 (12,539 Europeans), Tlemsen 24,511 (9,257 Europeans), Setif 22,916 (8,666 Europeans). The oases of the Sahara often have an urban character, *e.g.*, Tugurt (12,108), Ghardaia (10,689), El-Oued (8,621), Biskra (8,489), Laghwat (6,960).

Administration.—Algeria is neither a colony in the usual sense, nor a simple aggregate of French departments; it has not complete autonomy, yet it is not entirely assimilated to France. A governor-general of Algeria, appointed by the minister of the interior, is helped by a general secretary and a council. Algeria is represented in the French parliament by three deputies for each of its three departments and by senators. It also has two local assemblies. The financial delegations are an assembly on which colonials elect 24, non-colonials 24, and Muslim natives 21 members, with a special Kabyle section in the last group. The *Conseil supérieur* is made up of elected and official elements. These two assemblies vote the local budget instituted by law in 1900 to permit Algeria to raise revenue in the usual ways, including excise and monopolies, and leaving Algeria responsible for its debts, administration, public works and so on, subject to control and veto of the French Government. France pays the military and naval expenses but Algeria paid a war contribution of 6% of its budget. That budget is now about 1,000 million francs, and has usually shown a surplus. Fiscal schemes are based on those of France, and taxes are the same for Europeans and natives.

Northern Algeria has three departments (Oran, Algér, Constantine), divided into arrondissements which include *communes de plein exercice* with administration on French lines, and *communes mixtes* with natives in large numbers. The latter divisions are often large and are under special administrators, each has a municipal council helped by native sheikhs, caids or aghas. Natives elect representatives on all local assemblies.

The Southern Territories, with a separate budget, were created by decree of Dec. 24, 1902; they are named Aïn-Sefra (capital same name), Ghardaïa (capital Laghwat), Tugurt (capital same

name) and the Oases (capital Warqla). At the head of each is a military commandant acting under the governor-general, and each is divided into circles, annexes, "communes mixtes" and native communes. Old Arab taxes have been continued and order is guarded by méharist camel corps, forming the Saharan companies.

Algiers has a university with faculties of law, medicine, science and letters which have produced much research in science, history, archaeology, linguistics, law and medicine, especially relative to North Africa. Primary and secondary schools for Europeans are on French lines. Most natives do not go beyond the primary school but there are higher schools, called Medersas, for Muslim functionaries. The knowledge and use of French has spread very widely among the natives

Landed Property.—The absence of large empty areas and the rapid occupation of reserves have created problems. Land was distinguished as *melk*, private property often unenclosed, save in Kabylia, and *arch*, tribal land owned by the sovereign for the use of the tribe. In 1863 the tribes were declared proprietors of the lands they had been using, and their delimitation and their division between the various douars was ordered with a view to division among individual members of these lesser groups. The last step was not taken and a Warnier law (1873) renewed the effort, but defective administration made another law necessary in 1897, and still another one (Aug. 4, 1926) now controls this task which it is so difficult to carry through without revolutionizing native society. Public and private state domains amount to 5,114,000 hectares, communal lands and zones of transit 4,153,000 hectares, European private property 2,400,000 hectares, affranchised private property of natives 1,813,000 hectares, *melk* lands 4,647,000 hectares, *arch* lands 2,767,000 hectares.

Free grants of land, with obligatory residence, have been the rule save under the Second Empire. Four modes of transfer are recognized by the decree of Sept. 13, 1904, namely, sale at a fixed price at public office, the usual method, sale by auction under public control, sale by private treaty and free concession. A decree of Sept. 9, 1924, has lengthened the period of obligatory residence from ten to 20 years, and the period during which the lands may be transferred only to French colonists from 20 to 40 years. The proportion of colonization land reserved to Algerians has been increased from one-third to one-half. Of 2,400,000 hectares of colonization land 700,000 have passed into European hands by private purchase, the remainder being occupied by official colonization. There are 600 European agricultural centres, 230,000 agriculturists, 90,000 proprietors. Official colonization has nearly come to an end, and can do little more than develop communications and build new hamlets at spots reached by them.

Agriculture.—Cereals are the chief crop occupying 3,000,000 hectares; native methods are very primitive, but Europeans, by preparatory work and by scientific dry farming, have much increased the yields, which, however, vary greatly with the rainfall. The yields of soft wheat are two million quintals from Europeans and 600,000 from natives, of hard wheat two million quintals from Europeans and four from natives, of barley one and a half million quintals from Europeans and six and a half from natives. Oats, maize and sorghum (*bechna*) are less important. The vine has been the chief plant cultivated by Europeans since the *phylloxera* ruined the vineyards of South France and made the vine growers go to Algeria. Vines occupy 201,000 hectares (Oran 108,000, Alger 77,000, Constantine 16,000). There are vineyards of the plains, of the hillsides and of the mountains and yields of wine vary greatly. *Phylloxera* has ravaged the Algerian vineyards which were reconstituted with American plants. Eight to ten million hectolitres of wine are produced on the average each year and the great market for this product is France. The olive is widespread and its products are used by the natives. Of six million grafted olive trees, three million are in Kabylia and four million belong to natives. The average production is 300,000 quintals of oil. Figs, oranges, apricots and almonds are also grown. The cultivation of early products owes much to the mildness of winter along the coast, and peas, beans, artichokes, tomatoes, potatoes and grapes are grown near the export harbours. Tobacco crops cover 32,000 hectares and produce 300,000 quintals of leaves, Kabylia being the chief centre of this recent development. About half the tobacco belongs to natives; part is exported, part manufactured locally. Plants for perfumery are grown near Algiers. Experiments in cotton growing were made during the American Civil War (9,000 quintals ginned cotton) and renewed since 1906 in the Cheliff valley. In 1926 this crop covered 6,700 hectares (Oran 4,000) and produced 47,000 quintals gross, yielding 13,000 quintals of ginned cotton. There are about 1,000 irrigation schemes, watering more than 200,000 hectares and using both barrage source lakes and barrage collecting reservoirs. More are being built, especially in the Cheliff valley. In the Southern Territories there are about four and a half million date palms (900,000 in Wad Rir) and the digging of artesian wells is extending areas of cultivation and revivifying old oases that had decayed.

Stockraising is important with eight to nine million sheep, four million goats, one million cattle, 200,000 horses, 300,000 asses, 150,000 mules and 150,000 camels, the camel being used as a pack animal on the steppes and more especially for riding in the Sahara. The sheep suffer from drought, cold and parasitic diseases; about one million are exported every year, chiefly for meat. Wool production is small, less than 18,000 tons.

Forests occupy three million hectares, but much of this is mere scrub. Fires and trespass of flocks are the great enemies of the forests. 200,000 quintals of cork are produced. Alfalfa covers four million hectares and gives 1,500,000 quintals for paper-pulp. The dwarf-palm yields 500,000 quintals of fibre

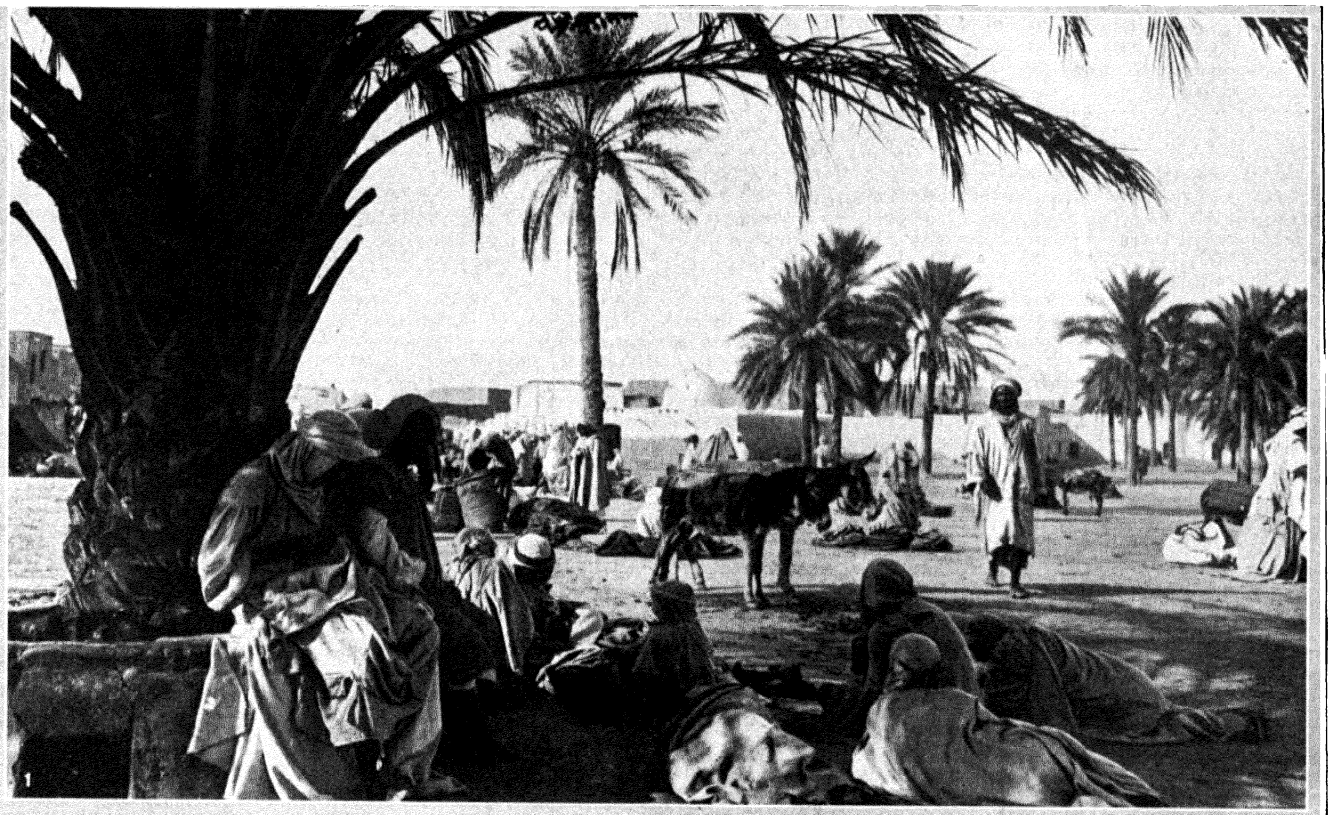
Minerals.—Algeria (Jebel-Kuif near Tebessa) with the even richer Morocco and Tunisia together lead the world for production of phosphates of lime, yielding more even than U.S.A. Algeria's share is 800,000 tons. Iron ores (1,600,000 tons) are of good quality and are found near the Tunisian frontier (Wenza, Bu-Kadra), in the Miliana region (Zaccar, Ruina) and on the Oran coast (Beni-Saf); they are mostly sent to England. Zinc (40–50 thousand tons) and lead are found in several places. Constantine is the richest of the departments in mineral products. Prospecting for mineral oil at Ain-Zeft (Dahra) and at Messila (south of Relizane) has yielded poor results and there is but an insignificant coalfield at Kenadsa in the south of Oran. Algeria therefore exports its minerals in the crude state, but their extraction has caused railway developments, the growth of centres of population in districts previously empty, and traffic at the ports.

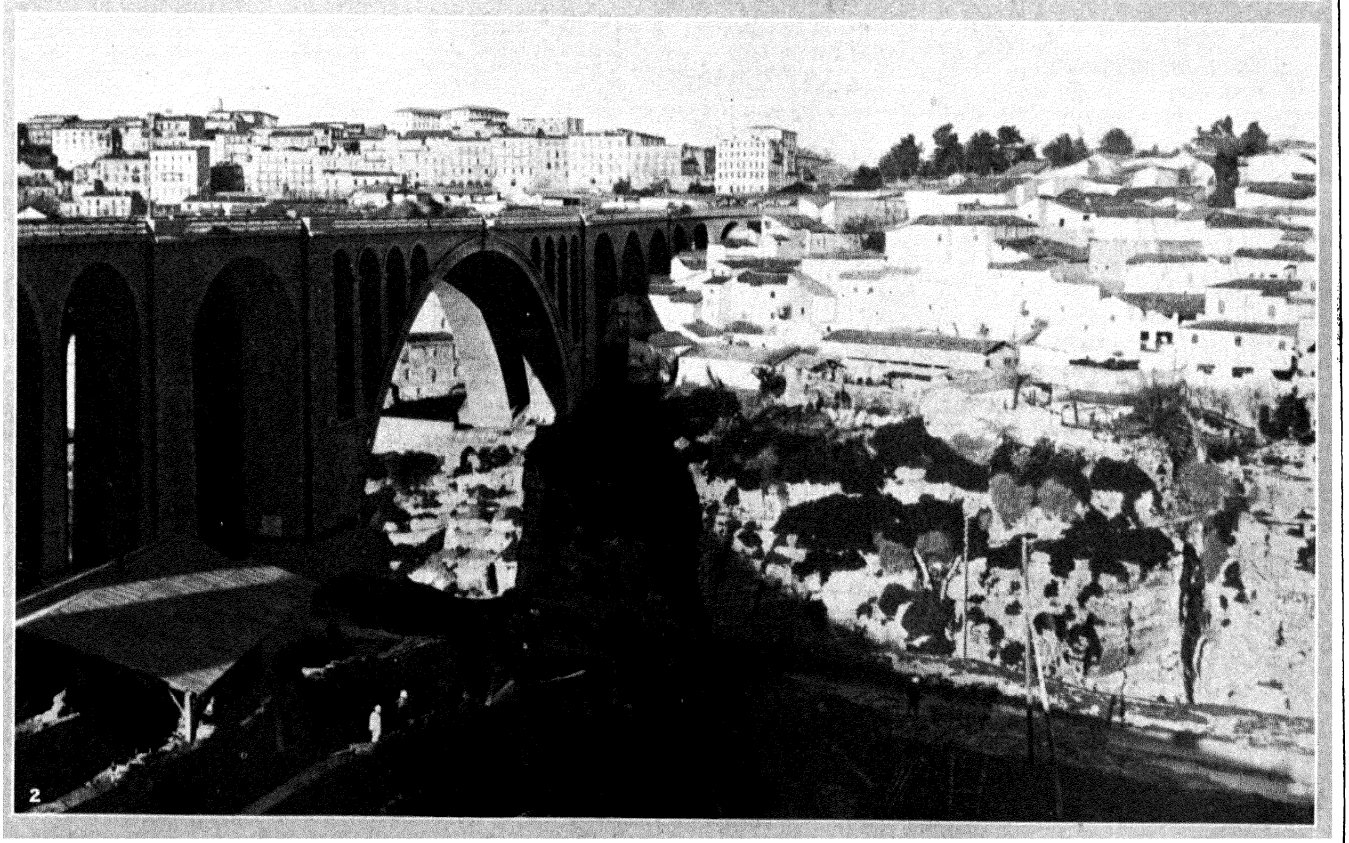
Industries.—Native industry cannot compete with European, but efforts have been made to keep up the traditional carpet-weaving. European industries include those dependent on crops *e.g.*, oil mills, distilleries and flour mills, also the making of leather, tobacco and matches, and some salting establishments. None is very highly equipped.

Communications.—4,345km. of railway, partly 1·44m., partly 1·05m. gauge, are in use and are worked partly by the P.L.M. railway of France and partly by the railway company of Algerian State railways. A central line goes from the Moroccan to the Tunisian frontier and has branches to the ports of Beni-Saf, Oran, Arzeu, Mostaganem, Tenès, Algiers, Dellys, Bougie, Philippeville, and Bône, as well as southward to Ras-el-Ma, Colomb-Béchar, Kenadsa (770km. from Oran), Tiaret, Jelfa, Aumale, Tugurt (543km. from Philippeville), Khenchela and Tebessa. An excellent network of roads supplements the railway. A trans-Saharan railway has been proposed, and automobiles now work in the Sahara.

The ports of Algiers (2,642,000 tons cargo and 2,560,000 tons shipping), Oran (2,215,000 tons cargo and 3,308,000 tons shipping), Bône (1,272,000 tons), Philippeville (294,000 tons) and Bougie (250,000 tons) are fully equipped. Secondary ports include Nemours, Beni-Saf, Mostaganem, Cherchell, Jijelli, Collo, and La Calle. By a law of 1889 only French ships may trade between France and Algeria.

Commerce.—Since 1867 there is complete reciprocity between France and Algeria in customs dues, and trade consists of the sale of Algerian agricultural products and the importation of manufactured goods, metals, coal and produce of other colonies. Wine, oil, cereals, sheep, wool, iron ore and phosphates are ex-





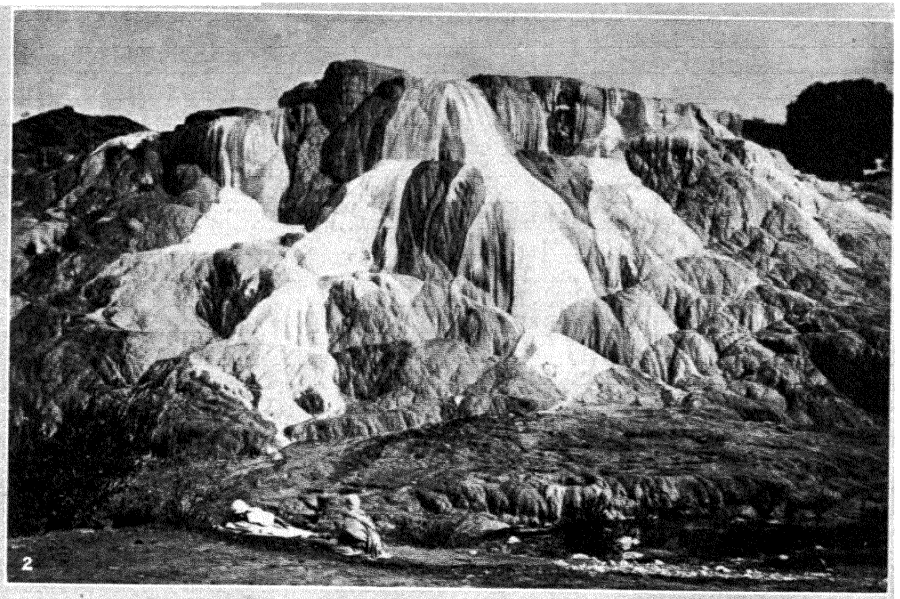
PHOTOGRAPHS BY E.N.A.

MARKET SCENE IN BOU SAADA AND GENERAL VIEW OF CITY OF CONSTANTINE

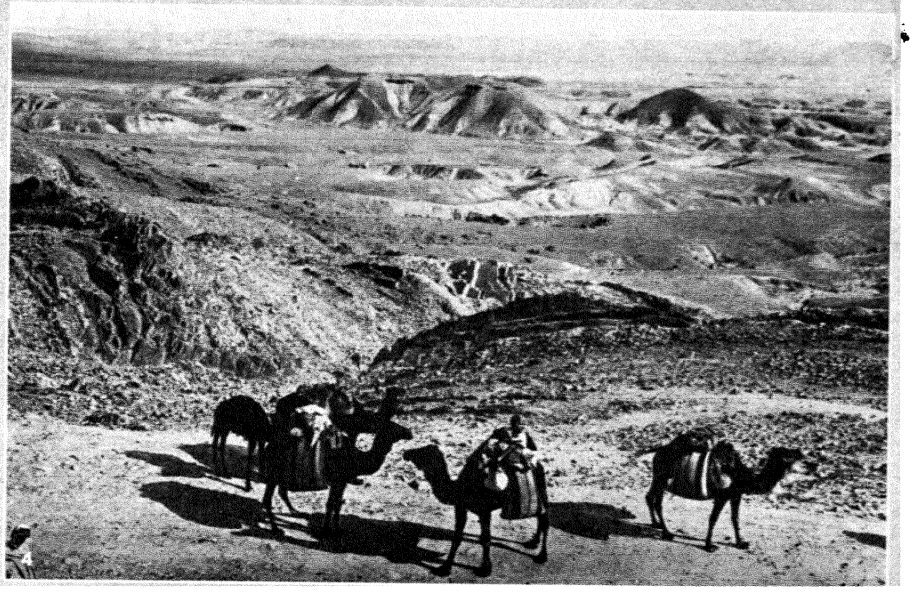
1. Bou Saada, the market in the oasis, where the natives gather to barter their wares

2. General view of Constantine in Algeria, showing the native quarter on the right







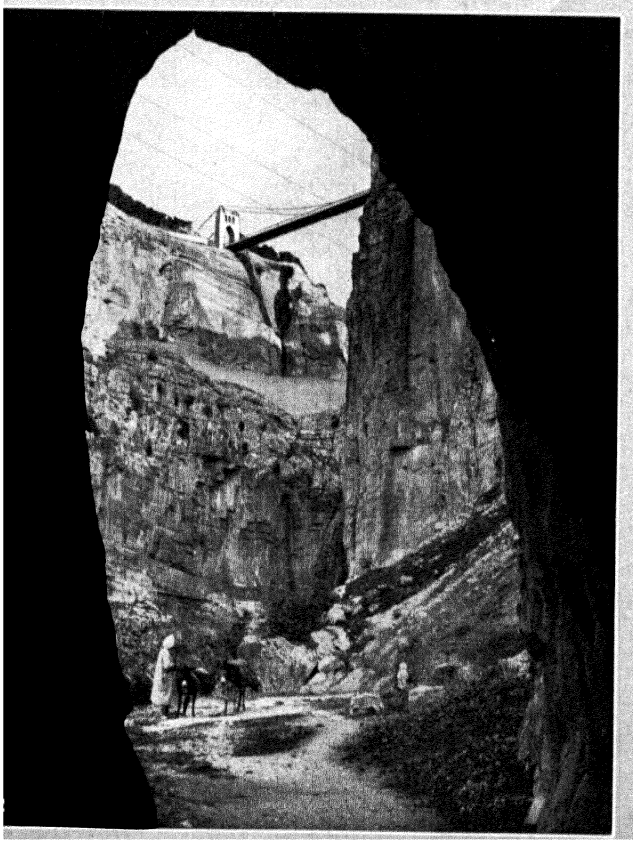


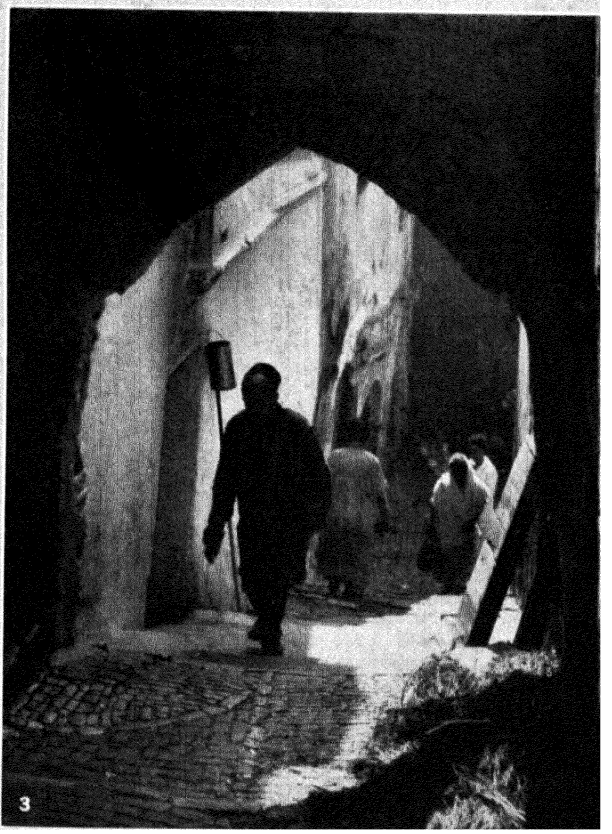
PHOTOGRAPHS (1) VISUAL EDUCATION SERVICE, (2, 3, 4) E.M.A.

URBAN AND COUNTRY SCENES IN ALGERIA

1. The ramps of the boulevard, Algiers
2. Hamman Meskoutine, showing the famous rock terraces and boiling waterfalls
3. El Kantara, showing the palm fringed Oued and the gorge
4. The Algerian Sahara, showing the wastes of Amor-Kreddon



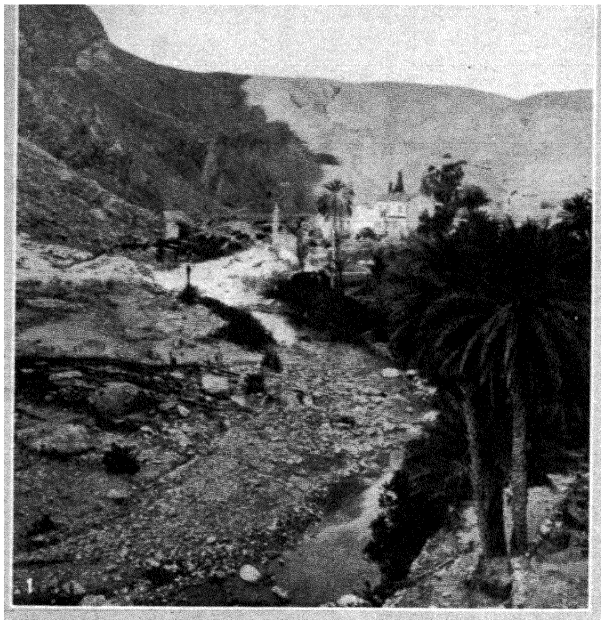


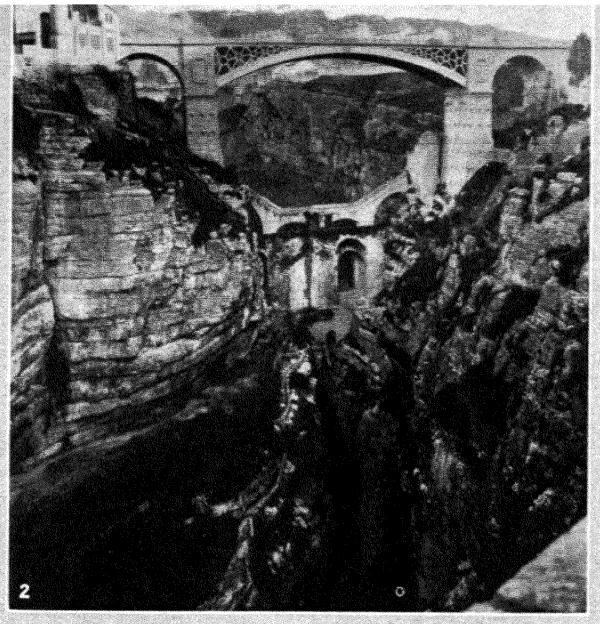


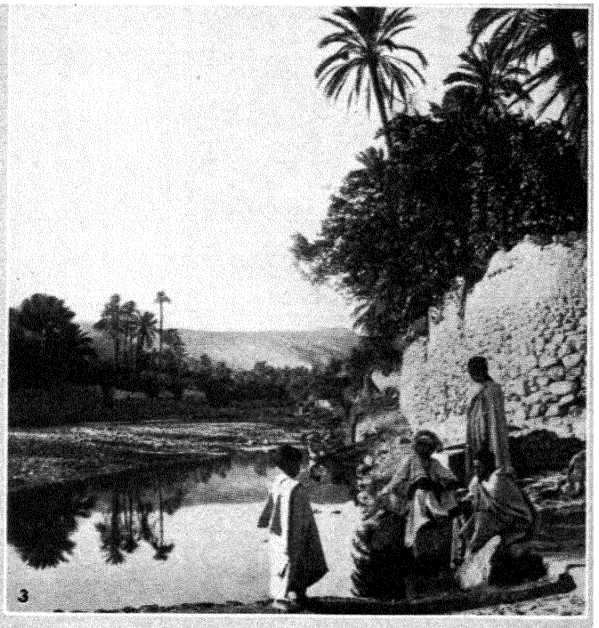
PHOTOGRAPHS: (1, 2) DONALD MC LEISH, (3) ARMSTRONG ROBERTS

ALGIERS AND CONSTANTINE

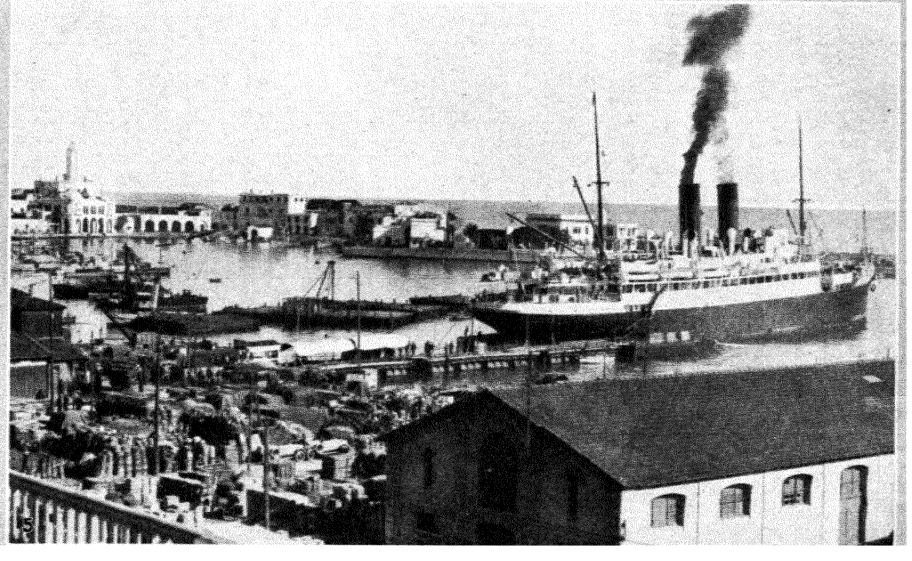
1. The inner harbor of Algiers, the capital and chief seaport of Algeria, showing the modern French city in the foreground, and the old Moorish citadel or Kasbah rising above it in the background
2. A natural archway over a road in Constantine
3. A typical street of steps in the Kasbah, the native quarter of Algiers, which climbs to 400 feet above sea level











PHOTOGRAPHS (1, 2, 3) EXCLUSIVE NEWS AGENCY, (4, 5) TOPICAL PRESS

VILLAGE AND CITY SCENES IN ALGERIA

1. El Kantara, a small village marking the oasis
2. Rummel Gorge at Constantine, about 1,000 feet deep
3. Groups of native boys near pool in Bou Saada
4. Modern French town of Algiers, built on level ground around seashore
5. Port of Algiers, showing the S.S. "Timgad" and smaller craft

ported. Imports for 1926 were worth 3,553 millions (France's share 2,849 millions), and exports 3,129 millions (France's share 2,269 millions). Algeria comes next after Great Britain, Belgium and U.S.A. as a customer of France.

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HISTORY

The history of Algeria, which constitutes the central part of Barbary or Moghreb, has almost always been bound up with that of Morocco and Tunisia, which are respectively the western and the eastern parts of that great natural region. The actual name of Algeria, or rather of the regency of Algiers, does not appear until the 16th century, when Turkish rule was established in the central Moghreb.

Northern Africa has from the most ancient times been a meeting-ground for races of different origin. According to anthropologists the native populations of Algeria, taken as a whole, belong to a Hamitic strain which is stated to have occupied the whole of North Africa, including both the eastern and the western portions, to have been represented by considerable groups in the heart of the African continent, and also to have contributed to the population of southern Europe. These peoples are generally known as Berbers; they are not, however, homogeneous, but differ considerably from one another both in bodily characteristics and facial type. The Berber dialects, which belong to the so-called Hamitic or proto-Semitic group, are still spoken in Algeria by approximately one-quarter of the native population.

Algeria During Antiquity.—The history of Algeria is the history of successive conquests: the Carthaginian, the Roman, the Vandal, the Byzantine, the Arab, the Turkish and the French. As there was no one natural centre for the whole country, political divisions were constantly changing. The Berber tribes never succeeded in combining to form a properly organized and durable State; they only ceased their internecine strife to be swallowed up in some vast empire whose centre was elsewhere than in North Africa: sometimes in Spain, sometimes in the East. The successive empires sprang up suddenly and disappeared with equal rapidity. The history of Algeria has no unity; it is not the story of a nation or of a historical community. The Berber tribes were split up like the land which they inhabited; each small settlement and each tribe had a history of its own.

The Phoenician colonization marks the beginning of the historical age in North Africa. As early as the 12th century B.C. the Phoenicians founded settlements on the African coast. In the 8th century Carthage supplanted the earlier metropolis and imposed its suzerainty on the Phoenicians of the East. During the seven centuries for which it endured, the Punic civilization penetrated more or less deeply into the Berber districts, and the Punic tongue long continued to be spoken.

After the fall of Carthage (146 B.C.) Rome governed the country through native kings. The Roman occupation was at first limited and only extended itself little by little. Complete annexation only took place under Caligula (A D. 40). Algeria constituted the provinces of Numidia and Mauretania Caesarea. Even at its height, Roman domination did not extend over the whole of present-day Algeria; the frontier passed south of the Aures, but then turned north, leaving out the steppe zone of the provinces of Algiers and Oran.

Roman colonization of the country was effected by three methods: introduction of colonists, intermarriage between Romans and natives and the transformation of natives into Romans. Probably it was the last method which everywhere gained the upper hand. By the middle of the 2nd century A D., Latinized Africans were to be found throughout the empire. The most famous authors produced by Latin Africa were Apuleius of Madaura among the pagans and St. Augustine of Thagasta among the Christians. Numerous and wealthy cities sprang up and roads were constructed. It was a period of great material prosperity, based mainly on agriculture. The wealthiest province was Constantina, which was much more completely Romanized than the rest of Algeria The main crops cultivated were wheat and olives.

For two centuries (A D. 40–238) Roman Africa enjoyed a period of complete peace, until this was destroyed by religious disturbances, native revolts, and finally the Vandal invasion, which was followed by a brief restoration of Byzantine rule.

The Middle Ages: Arabs and Berbers.—In the 12th century, what remained of Roman civilization in North Africa was finally destroyed by the Arab invasion. Algeria was thus detached from the Latin world and absorbed into that of Islam. The first Arab invasion, which took place in the 7th century, was the beginning of an era of anarchy and incessant warfare. The Berbers resisted at first and then embraced a heretical form of Mohammedanism known as Kharedjism. They were swept by the Mohammedans into the wars for the conquest of Spain and subsequently of Egypt. The second Arab invasion of North Africa, which was carried out in the 11th century by the Hilal and Soleim tribes from the Hedjaz, completed the ruin of the country. The ethnographical character of the population was not, however, so profoundly affected by the invasion as was at one time believed The invaders almost everywhere became amalgamated with the native population; the latter were, however, uprooted and thrown into confusion, and many of them took refuge in the mountainous districts or in the Sahara. In the towns and in the plains the Arabs gradually imposed their language and religion.

The Berbers nevertheless set up large and powerful empires during the middle ages. Two dynasties of a religious and reforming character were founded, that of the Almoravids and that of the Almohads, the former by the nomads of the Sahara and the latter by the Berbers of the Moroccan Atlas. Their rule extended not only to the whole of North Africa but also to Spain, and the civilizing influence of the latter country made itself felt upon them.

Three kingdoms were founded in the 13th century on the ruins of the Almohad empire: that of the Merinids of Fez, that of the Abd-el-Ouadites of Tlemsen, and that of the Hafsides of Tunis. The three kingdoms corresponded approximately to the modern Morocco, Algeria and Tunis, but their Mohammedan sovereigns never succeeded in establishing their authority firmly over the territories in which their suzerainty was more or less recognized. Their history consists in incessant struggles between dynasties, chronic insurrections and disturbances, raids and the sacking of towns. By the beginning of the 16th century the Berber communities were hopelessly disintegrated and incapable of joint action; anarchy had reached its high-water mark and the ruin of the country was complete. From that time onwards North Africa was contested for by the two dominant foreign influences in the Mediterranean: that of the Spaniards and Portuguese and that of the Ottoman Turks.

The Turkish Period (1518–1830).—Once they had reconquered the Iberian peninsula the Spaniards and Portuguese continued the struggle against the Mohammedans in North Africa. Cardinal Ximenes regarded the conquest of Algeria as necessary for the expansion of Spain. Oran was captured in 1509 and Algiers in 1510; on a small island in the harbour of Algiers the victors built a fortress, the Peñon, the guns of which could sweep the

town from a distance of 300yd. Spain was soon mistress of a large part of the coast of Algeria.

The Spanish successes were not, however, lasting. The natives, wishing to be delivered from the Spaniards, called in two Greco-Turkish corsairs, the brothers Barbarossa. The first, Aroudj, captured Algiers and Tenes, and destroyed the dynasty of the Abd-el-Ouadites of Tlemsen. His brother, Kheir-ed-Din, succeeded him, and was the real founder of the regency of Algiers. He did homage for the conquered country to the sultan of Constantinople, who conferred on him the title of Beylierbey (Bey of Beys), and authorized Turks to serve under his banner. In 1529 Kheir-ed-Din captured the Peñon and built a mole to connect it with the mainland, thus forming the famous harbour which until 1830 was the impregnable stronghold of the corsairs. Charles V. attacked Algiers in 1541 but failed lamentably. The Spaniards only retained Oran, which was taken by the Turks in 1708, recaptured by the Spaniards in 1732, and finally abandoned by them in 1791.

The first period of the Turkish rule in North Africa (1518–87) ended with the reign of Euldj-Ali, the last and the most notable of the African Beylierbeys. It was followed by the period of the triennial pashas (1587–1659), and then by that of the deys (1659–1830). The three phases imply something more than a mere change of title of the rulers of the regency; they represent an increase in the independence of Algeria from Constantinople, and also a growing anarchy. The real rulers of the regency were the *odjak*, or militia, and the *taiffe* of the *rais*, or corporation of corsairs. The militia was a military corps recruited in Asia Minor which governed itself on the most democratic lines; its members, the janissaries (*q.v.*), all received equal pay and were promoted by seniority only. The *rais* or corsair captains were mostly of Christian origin. The internal history of Algeria at this period consists entirely in the unending strife between these two rival powers, the *odjak* and the *rais* The Turks governed the native tribes by setting them one against the other. They gained the support of certain tribes known as the *makhzen* tribes, which were liable for military service but not for taxation. The remaining tribes, known as the *raias*, bore the whole burden of taxation. The Turks did not interfere with the manners and customs of the natives, but only required them to pay taxes and allow them free passage through their territory. In theory the tribes were governed either by the Beylik of Medea or Titteri, that of Constantine, or that of Mascara, the capital of the last being later transferred to Oran. Most of them, however, were never really reduced to subjection.

For 300 years Algiers was the headquarters of piracy, the meeting-place of sea-robbers, and the terror of all civilized countries, which it defied with audacity born of long impunity. The punitive expeditions of the European Powers against the Algerians were generally undertaken haphazard and after insufficient preparation. Bombardments and blockades produced no lasting result. The principal expeditions were those of Duquesne (1683), Marshal d'Estrées (1688), O'Reilly (1774) and Lord Exmouth (1816).

ALGERIA UNDER THE FRENCH

The settlement of the French in Algiers opened a new period in the history of North Africa. In the 16th century traders from Marseille set up coral fisheries on the Barbary coast, at Bône, at Calle and at the Bastion de France. France had maintained more continuous relations with the regency than any other Christian nation. A dispute arose with the dey in connection with the wheat supplied to the directoire by two Jews of Algiers, Bakri and Busnach. In the course of the negotiations which were undertaken to settle the question, the dey Hussein struck Deval, the French consul, with a fly-whisk (April 1827). The dispute became so bitter that after a blockade lasting three years it was decided to send an expedition. The command of the army was entrusted to Gen. de Bourmont, and that of the fleet to Admiral Duperré. A French force of 37,000 men landed at Sidi-Ferruch on June 14, 1830, and Algiers capitulated on July 5.

The French found, however, that although they had put an end to Turkish rule in Algeria, they were not yet in possession of the country. It had to be wrested yard by yard from the native population. This task was not undertaken without much hesitation. The July monarchy wavered for some years between the idea of conquering the country completely, occupying a part of it and evacuating it altogether. A section both of parliament and the press urged that Algiers should be given up. It was not until July 22, 1834 that a decree was issued appointing a governor-general of French possessions in North Africa. From 1834 to 1840 an attempt was made to confine the occupation to a few points on the sea-board, Algiers, Oran, Bougie and Bône, with the districts immediately surrounding them. There were frequent changes in the command of the army, and governors succeeded one another rapidly. In the course of ten years the successive governors were Bourmont, Clauzel, Berthezène, Rovigo, Voirol, Drouet d'Erlon, Clauzel again, Damrémont and Valée. The ablest of these early governors was Clauzel, but he had neither the time nor the troops necessary to carry out his plans.

The resistance of the natives in the province of Constantine centred round the bey Ahmed, and in the rest of Algeria round Abd-el-Kader. An expedition against Constantine, undertaken in 1836, was a failure, and success was not achieved until the next year. In 1838 Marshal Valée organized the province of Constantine. The administration was entrusted to important native chiefs who were subject to the authority of the commandant of the province.

Abd-el-Kader was a marabout of the district of Mascara, who in his early days was of little importance. The French at first tried to work with him, but the treaty signed by Gen. Desmichels (1834) and the treaty of Tafna (1837) greatly increased his prestige among the natives. Abd-el-Kader, who possessed real military and diplomatic gifts, was the most formidable adversary whom the French ever encountered in Algeria. He attempted to create an administration, a regular army, and a system of taxation. His final downfall was largely due to the natives themselves, who refused to sink their private quarrels and accept his leadership. In 1839 Abd-el-Kader, maintaining that the expedition which had linked up Constantine with Algiers was a violation of the treaty of Tafna, proclaimed a holy war and ravaged the prosperous settlements which the French colonists had established in the Mitidja.

The Government then decided to prosecute the war in Africa with vigour, and sent out Bugeaud (1841–47). His arrival put an end to the long period of vacillation and uncertainty. Bugeaud was a man of energy and persistence and a first-class soldier. He was the real creator of the African army. He abandoned the system of small forces in block-houses, where they were decimated by sickness and by the boredom of inactivity. Instead, he sent out flying columns in all directions, burdened with the least possible baggage so that they could strike quickly and attack the material interests of the enemy by carrying off his cattle and his crops. The war against Abd-el-Kader was long and wearisome. The principal events were the capture of Takdempt, Abd-el-Kader's stronghold (1841), the taking of Smala by the duc d'Aumale (1842), Bugeaud's victory at Isly over a Moroccan army (1844) while the prince de Joinville was bombarding Tangiers and Mogador and finally the surrender of Abd-el-Kader to Lamoricière (1847).

Bugeaud also set up the department for native affairs and Arab bureaux, which was established by the ministerial order of Feb. 1, 1844. The department, which was now staffed with officers well acquainted with the language, institutions and customs of the population, had to administer the country and supervise the native chiefs. Bugeaud regarded colonization as a necessary auxiliary to conquest. His aim was to transform Algeria into a French territory by rural colonization. He permanently settled 40,000 French colonists in Algeria. Bugeaud's colleagues were Lamoricière, Bedeau, Changarnier and the duc d'Aumale for military affairs, Daumas, Léon Roches, Lamoricière and Cavaignac for native affairs, and Guyot for colonization. He had what his predecessors had lacked: time, full powers and an army of 100,000 men. By 1848 the conquest of Algeria could be regarded as accomplished.

Algeria is so near to France that it has always quickly reflected events occurring either in the domestic or foreign affairs of that

country. Thus the revolution of 1848 led to important changes in the organization of Algeria. It was declared a French territory, and was divided into departments similar to those of France, each administered by a prefect. New colonists, largely recruited from the unemployed of Paris, were sent out. Algeria was included in the French customs system by the Act of Jan. 11, 1851.

After the *coup d'état* Gen. Randon (1851–57) was appointed governor-general. He completed the conquest of Algeria by the subjection of Kabylia of the Djurjura (1857), which was the only part of the Algerian Tell not yet under French influence. Here he constructed the Fort-Napoléon (Fort-National) as a "thorn in the flesh" of the country. The policy of colonization was continued, and the first railways constructed

In 1858 the governor-generalship was abolished and replaced by a ministry of Algeria and the colonies. This office, however, only had a brief existence; it was held by Prince Jérôme Napoléon and the comte de Chasseloup-Laubat. The governor-generalship was re-established by the order of Nov. 24, 1860. The new governor-general was Marshal Pélissier (1860–64) who was succeeded on his death by Marshal de MacMahon (1864–70). The emperor Napoleon III. had views of his own about Algeria, which he explained in two open letters in 1863 and 1865. He said that Algeria was an Arab kingdom, and he did not encourage colonization. In place of Bugeaud's policy of populating the country, he adopted the policy of economic development by great financial companies. These views were embodied in the senatorial decree of April 22, 1863, which gave the tribes ownership of the lands which they held by no matter what right, and in the senatorial decree of July 14, 1865, which declared the natives French subjects and gave them facilities for acquiring rights of citizenship. Napoleon III.'s innovations were on the whole unpopular. State property in Algeria suffered, and colonization was hampered and discouraged.

The revolt of the Ouled-Sidi-Cheik (1861–83) in the south Oran district did not affect the rest of Algeria. Its long duration is to be explained by the fact that the adjoining country, Morocco, was in a state of anarchy, and the insurgents were thus able to find in it both a refuge and support. As a result of the famine from which the native population suffered in 1868 and the agricultural enquiry carried out by the comte le Hon, a draft constitution was drawn up by Armand Béhic, according to which Algeria would have obtained a considerable measure of autonomy

The revolution of Sept. 4, 1870 was followed in Algeria by a period of agitation and disturbance which produced the most deplorable effect upon the native population. A series of orders were promulgated which aimed at the complete assimilation of Algeria to France, in accordance with the demands put forward by the colonists on the fall of the empire One of the decrees naturalized the Algerian Jews *en bloc*. The native insurrection which broke out in March 1871 and lasted until Jan., 1872 was not a rising of oppressed peoples against the oppressor, or a national struggle for freedom, since no nation existed; still less was it a religious war. It was simply the result of the defeats which France had suffered in Europe and of the anarchy which ensued. The leaders were the great native chiefs who felt their interests and privileges to be in danger, particularly Mokrani, bach-aga of Medjana. It raged most severely in the province of Constantine and Kabylia. The revolt was put down with severity; the insurgent tribes had to pay a heavy indemnity, and their lands were sequestrated

The governor-generalship, which had been abolished in 1870, was re-established in 1871. Algeria now had a civilian governor-general coming under the ministry of the interior instead of the ministry of war. The post was entrusted to Admiral de Gueydon, a broad-minded and energetic man and an excellent administrator. He was a strong partisan of colonization, which was energetically resumed. The Native Property Act of 1873 was intended to facilitate the acquisition of Mohammedan lands by Europeans. The colonization policy was pursued under the governorship of Gen. Chanzy (1873–79). In 1881 the European population reached the figure of 376,000, of whom 140,000 were settled on the land.

From 1881 to 1896 the policy of complete assimilation of Algeria to France once more prevailed. The civil lands were greatly extended so as to cover the whole of the Tell and a large part of the higher plateaux. The districts which were almost entirely inhabited by natives were given the name of mixed communes, and civilian administrators were appointed to deal with them instead of the officers of the Arab bureaux. Finally, by the *décrets de rattachement* of Aug. 26, 1881, Algerian affairs were allotted to the various ministries of France itself, so that the position of the governor was reduced merely to that of an agent for the transmission of instructions. The disadvantages of this system were not long in making themselves felt; attention was drawn to them in the able reports of Burdeau in 1892 and Jonnart in 1893, and in the speeches of the governor-general, Jules Cambon (1891–97). The senate appointed a committee known as the *Commission des XVIII.*, which sat from 1892 until 1896 under the chairmanship of Jules Ferry, in order to study the changes which should be introduced in the legislation and organization of Algeria. It declared definitely against the system of attachment to French ministries

An order issued on Dec. 31, 1896 revoked the orders of 1881 and restored the governor-general's powers so that he once more became the head of the administration of Algeria The decentralization was completed by the orders of Aug. 23, 1898, which established the system still in force. The powers of the governor were defined, the Superior Council was reorganized, and in addition to that body, which was composed of officials and elected members, there was set up a new assembly, nearly all of whose members were elected. This body, which is known as the Algerian financial delegations, has three sections providing separate representation for colonists, non-colonists and natives. The Act of Dec. 19, 1900 entrusted the two bodies mentioned above with the right of voting the budget, subject to the supervision of the home government and of parliament. A separate budget for Algeria was instituted, the expenditure being divided into obligatory and optional expenditure. Civil personality was conferred on the colony, and it was empowered to contract loans. The intention of these measures was to give the Algerians the opportunity of managing their own affairs. By the Act of Dec. 24, 1902 the southern territories were transformed into an administrative unit distinct from north Algeria, and were also granted civil personality and a separate budget. This measure was necessitated by the fact that since 1900 the territory of Algeria had been considerably extended towards the south, owing to the occupation of the oases of Touat, the pacification of the central Sahara and the joining up of North Africa and the Sudan.

The system set up in 1898–1900 has, generally speaking, worked well The policy followed has been, while maintaining the right of suzerainty of the home country, to provide the colony with a suitable administrative system not by automatically transferring to it the legislation and institutions of France but by adapting them in a careful and practical way. The governors-general of Algeria since 1898 have been either civil servants or members of parliament on mission. Their names are as follows: Laferrière (1898), Jonnart (1900), Révoil (1901), Jonnart again (1903), Lutaud (1911), Jonnart for a third time (1918), Abel (1919), Steeg (1921), Viollette (1925) and Bordes (1927). Many of the governors-general have been able statesmen; but it is regrettable that their terms of office should have been so short.

The policy adopted towards the native population has throughout the 20th century constantly progressed in the direction of greater liberality. Native conscription was instituted by the order of Feb. 3, 1912; this accelerated the movement and led to the almost complete abolition of the system under which certain acts constituted offences in the case of natives only, and natives were tried by special courts. During the World War of 1914–18 the Algerian natives showed the utmost loyalty in spite of all foreign incitement to rebel. They furnished 173,000 fighting men and 119,000 workers and the losses in killed and missing amounted to 25,000 soldiers. The Arab taxes were abolished by the order of Nov. 30, 1918; all inequalities and privileges in the matter of taxation have now disappeared. Under the Act of Feb. 4, 1919, concerning the admission of natives to political rights which was drafted by Governor-General Jonnart, they are represented in all the deliberative assemblies of Algeria by elected members possess-

ing the same rights as the French members. The electorate has also been considerably extended

The policy of populating the country with French colonists has been pursued as far as circumstances permitted. A new nation is being created in Algeria by fusion between the French elements and the various foreign elements, mainly Spanish, who were more or less automatically naturalized by the Act of June 26, 1889. Two thousand lives were lost and £5,000,000 worth of damage done in floods in western Algeria in Nov 1927. In 1928 there were further floods In that year preparations were begun for celebrating in 1930 the centenary of the French occupation.

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ALGHERO, seaport and episcopal see, province of Sassari, West Sardinia, 21m S.W. by rail from Sassari. Pop. (1921) 12,280. The cathedral is 12th century; the see dates from 1503. Founded by the Doria family of Genoa about 1102, it was occupied by the house of Aragon in 1354, who held it until it fell to the house of Savoy with the rest of Sardinia in 1720 Catalonian is still spoken here. The district produces good wine. Seven miles N.W. is the fine natural harbour of Porto Conte, secure in all weather, and on the west of this harbour is the Capo Caccia, with two stalactite grottoes. The important prehistoric necropolis of Anghelu Ruju is 6½m. N. of Alghero.

ALGIDUS MONS, the east part of the ridge of the larger crater of the Alban volcano (*see* ALBANUS MONS), traversed by a narrow opening (now called the Cava d'Aglio) used for the Via Latina. There was a temple to Diana, the site of which is unknown.

ALGIERS, capital of Algeria, the seat of the governor-general, and of the Algerian assemblies, of a court of appeal, of the XIX Army Corps and of an archbishop. It is built on the west side of the bay of Algiers, 36° 47′ N., 3° 4′ E., on the slopes of the Sahel hills parallel to the coast and backing on to Mt. Buzareah. The growth of the town has been conditioned by the scarps which approach the coast very closely and by military necessities. Turkish Algiers was triangular, with the Casbah as its apex and a line of rocky sea-cliffs, now the boulevard de la République, as the base. The two other sides are marked by great flights of steps built in the ditches of the Turkish ramparts and leading up, the one to the mosque of Sidi-Abderrahman, the other behind the theatre. French Algiers has grown piece-meal. Buildings now stretch almost without a break for 16km. from north to south.

Modern Algiers is a large city of European type with regular, often arcaded, streets. Many mosques, Janissary-barracks and several fine Moorish houses have gone. The border of the harbour is formed by the boulevard de la République, continued north by the boulevard de France and south by the boulevard Carnot. The arches supporting the boulevards stand 15 metres above the quays. The chief official and commercial buildings of Algiers are on these boulevards. The north end of the boulevard de la République, la place du Gouvernement, was long the centre of the town with the roads Bab-el-Oued, Bab-Azoun and la Marine starting from it. The suburb of Bab-el-Wad is peopled mainly by Spaniards and farther north is the suburb of S. Eugène dominated by the basilica of Notre Dame d'Afrique. West of the place du Gouvernement a short street leads to the modern cathedral (1845–60) on the site of a mosque, the governor's winter palace, and the old palace of the archbishops, the remains of the Jénina or palace of the Dey. Near by is the National Library, in one of the finest Moorish houses of Algiers (1798) The area between the sea, the rue de la Marine and the rue Bab-el-Oued is the Algiers of the conquest and is full of old houses on narrow streets. The busy rue Bab-Azoun leads to the square de la République whence start the rue d'Isly and the rue Dumont-d'Urville, the busiest of Algiers' centres of commerce.

The highest part of Algiers, on steeply scarped hills, has preserved best its native character, but it has been disfigured by the cutting of the rue Randon and rue Marengo.

The Casbah fortress, 118 metres above sea-level, belongs to the 16th century and was the residence of the two last Deys, who left Jénina for it Here Dey Hussein struck the French consul with a fly whisk on April 30, 1827, whence followed the capture of Algiers and the end of Turkish rule.

Mustapha, once a suburb, then a separate commune, but now reunited to Algiers, has grown very much since the fortifications between it and Algiers were demolished, and the two are now continuous The lower streets are populous and industrial, the upper ones have villas with fine sea-views Here also are the Governor's summer palace, the university, and the museums.

Kheir-ed-Din created the old Turkish port of Algiers by building a jetty to join the Peñon islet to the mainland. This islet retains the lighthouse, the admiralty building, various buildings of the Turkish period and some of the period of Spanish dominance, and extends north and east of the shallow pool where fishing boats, pleasure boats and torpedo boats are moored To the south of this pool lies the immense stretch of water of the modern port.

Algiers ranks next after Marseille among French ports for tonnage cleared, thanks to vessels calling for coal, and next after Marseille and le Havre for number of ships. In 1926, 1,261,796 tons of merchandise (44% of Algeria's total) were landed and 1,380,056 tons (29% of Algeria's total) exported. Tonnage cleared totalled 2,562,241 tons. Algiers imports coal, cotton goods, metal objects, waggons and automobiles, and exports wine, sheep, skins, fresh vegetables, grapes, potatoes and iron ores. The regular service to Marseille involves a voyage of 497 knots or at present 26 hours, and Algiers is thus 40 hours from Paris.

The importance of Algiers is steadily increasing both from the political and business point of view, and as a place of residence.

The total population (1926) is 226,218, with a municipal population of 214,920 (French 134,628; other Europeans 25,021; natives 55,271). With the suburbs which are continuous with Algiers (Buzareah, 2,619; El Biar, 6,988; Hussein Dey, 10,276; S. Eugène, 7,044; Maison Carrée, 14,648), the city has 256,495 inhabitants (187,416 Europeans and 69,079 natives).

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History.—In Roman times a small town called Icosium existed where is now the marine quarter of the city. Roman cemeteries existed near the present streets of Bab-el-Oued and Bab-Azoun. Bishops of Icosium are mentioned as late as the 5th century. The present city was founded in 944 by Bulukkin b. Zeiri, the

founder of the Zeirid-Sanhaja dynasty, which was overthrown by Roger II. of Sicily in 1148. (*See* FATIMITES.) The Zeirids had before that date lost Algiers, which in 1159 was occupied by the Almohades, and in the 13th century came under the dominion of the Abd-el-Wahid, sultans of Tlemçen. Nominally part of the sultanate of Tlemçen, Algiers had a large measure of independence under amirs of its own, Oran being the chief seaport of the Abd-el-Wahid. The islet in front of the harbour, subsequently known as the Peñon, had been occupied by the Spaniards as early as 1302. Thereafter a considerable trade grew up between Algiers and Spain. Algiers, however, continued of comparatively little importance until after the expulsion from Spain of the Moors, many of whom sought an asylum in the city. In 1510, following their occupation of Oran and other towns on the coast of Africa, the Spaniards fortified the Peñon. In 1516 the amir of Algiers, Selim b. Teumi, invited the brothers Arouj and Khair-ed-Din (Barbarossa) to expel the Spaniards. Arouj came to Algiers, caused Selim to be assassinated, and seized the town. Khair-ed-Din, succeeding Arouj, drove the Spaniards from the Peñon (1530) and was the founder of the pashalik, afterwards deylik, of Algeria. Algiers from this time became the chief seat of the Barbary pirates. In Oct. 1541 the emperor Charles V. sought to capture the city, but his army was defeated by the Algerians under their pasha, Hassan. Repeated attempts were made by various European nations to subdue the pirates, and in 1816 the city was bombarded by a British squadron under Lord Exmouth, assisted by Dutch men-of-war, and the corsair fleet burned. The piracy of the Algerians continued until 1830. On July 4 in that year a French army under General de Bourmont attacked the city, which capitulated on the following day. (X.)

ALGOA BAY, a wide, shallow bay between Capes Recife and Padrone, South Africa, formed by erosion of rocks of the Bokkeveld and Uitenhage series by the sea, which has left a belt of more resistant Table mountain sandstones projecting eastwards, and forming the south-west border of the bay. In the bay are St. Croix island, 33° 47′ S., 25° 46′ E., and Bird island, the latter yielding guano. The shores are fringed with sand dunes, which contain abundant Strandlooper remains. In 1820, British emigrants landed here and founded Port Elizabeth. Vessels drawing up to 21ft. can discharge cargo at the jetty in calm weather. Larger ships have to anchor in the bay, and discharge into tugs and lighters.

ALGOL, a well known variable star, also designated β Persei. Its fluctuation of brightness was noticed by G. Montanari in 1669; but the Arabic name, which signifies the Demon, seems to hint that the behaviour may have been known in ancient times. The brightness varies regularly between magnitudes 2·1 and 3·2. In 1782 John Goodricke found that the variation of light was periodic and determined the period $2^d20^h49^m$; he suggested that the variation might be due to partial eclipses of the star by a dark body revolving round it. This hypothesis was generally accepted but it remained speculative until 1889, when H. C. Vogel demonstrated its truth in a way that can scarcely be doubted.

By spectroscopic measures of the velocity in the line of sight it was shown that the bright star was travelling round an orbit in the period named. Clearly there must be an unseen mass controlling its motion. Further the reduced light occurs when the bright star is most remote from us; that is just the time when the dark companion passes between us and the bright star and is able to hide it. About 200 variable stars of the Algol type are now known in which the change of light is due to eclipses. It should, however, be understood that this is not the sole kind of stellar variability; and in fact the majority of variable stars have a different nature (*see* STAR).

Algol remains of almost constant brightness for 59 hours; the remaining ten hours of the period are occupied by the eclipse, the light gradually decreasing to not much more than a third of its normal amount and then increasing again. The eclipse is partial. (In some variables a total eclipse occurs, totality being distinguished by a period of steady light at minimum.) The comparatively long duration of the eclipse shows that we have to do with two stars whose dimensions are by no means small in comparison with the distance between them. Closer examination shows that the light is not absolutely constant during the 59 hours. The reason is that the dark component reflects (or re-radiates) light from the bright star, and thus goes through phases like the moon. Accordingly, after the eclipse is over, the total light still continues to increase a little because the "moon" is progressing from *new* to *full*. In the middle of the 59 hour interval the light dips again because there is an "eclipse of the moon"; that is to say, the bright star is then hiding its companion. The whole phenomenon is beautifully shown in the light-curve determined by J. Stebbins by means of selenium photometry.

We have spoken of the *dark* companion. In most eclipsing variables this only means comparatively dark, and the proper light of the eclipsing star is recognizable. But in Algol the companion is exceptionally dark, and it has not been possible to measure any light from it other than the reflected light above-mentioned. On theoretical grounds the companion is believed to give out less than a hundredth of the light of the principal star; but it must be noticed that Algol itself is an exceptionally bright star and its companion is actually not much fainter than our sun. From a study of the light-curve, combined with the dimensions of the orbit of the principal star obtained from spectrographic measures, a great deal can be learnt about the nature of the system; but to render the results definite an additional constant is required to be known, and through ignorance of this the dimensions formerly given have turned out to be wide of the mark.

The required datum has now been supplied by D. B. McLaughlin, who has measured the radius of Algol by an ingenious method. Near the middle of the eclipse only a crescent of the bright star is showing; this crescent will be mainly on one side of the star just before the middle phase, and on the other side after it. Now the rotation of the star causes one side to approach us and the other to recede; so that if we make measurements of radial velocity shortly before and after mid-eclipse we can determine the speed of rotation, very much as the sun's speed of rotation is determined by measuring first on the east and then on the west side of its disc. Having found the equatorial speed of rotation, we multiply by the period of rotation, and the result is the circumference of the star. In Algol the two components are close together, and there can be no doubt that the huge tidal forces will make them keep the same faces turned towards each other, so that the period of rotation must be the same as the period of revolution, viz., 2^d21^h. Knowing the circumference we can at once find the radius.

The following dimensions of the Algol system have been deduced.

Distance between centres	10,200,000km.
Radius of bright star	2,140,000km.
Radius of faint star	2,450,000km.
Mass of bright star	4·30×sun's mass
Mass of faint star	0·86×sun's mass
Density of bright star	0·16 (water=1)
Density of faint star	0·02
Luminosity of bright star	140×sun
Distance of system	35 Parsecs (115 light years).

Confidence in these results is strengthened by two checks. First, the mass and luminosity are in agreement with the mass-luminosity relation which the stars are believed to obey (*see* STAR). Second, the luminosity is that which is usual for a star of the spectral type B 8, to which Algol belongs. It will be noticed that the fainter star has the larger radius. The distance of the system found by this method might be checked by a trigonometrical determination of parallax; but very accurate measurements would be required, and it is probable that the parallax measurements hitherto published are vitiated by perturbations due to a third component of the system.

By spectroscopic measures it is found that Algol with its satellite is describing an orbit in 1·9 years; this indicates the existence of a third member of the system. It must be at a distance of 430 million kilometres from Algol. It is intermediate in brightness between Algol and its close companion, giving about a 12th of the light of the former. It takes no part in the eclipses.

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ALGONKIN, a tribe, group and family of American Indians. The tribe lived on Gatineau river east of Ottawa. The name came gradually to include related tribes or bands in Quebec and Ontario, where they now number between 3,000 and 4,000. They were friends of the French, foes of the Iroquois and British. The name was finally applied to the whole of the linguistic family of which these tribes are part. This is one of the great stocks of native North America, perhaps the largest on the continent in point of area occupied, extending around latitude 55° continuously from the Atlantic ocean to the Rocky mountains, and to the south less regularly as far as Cape Hatteras and Ohio river. This is essentially the natural region of northern woodland, whose coniferous forests the Algonkin tribes occupied almost exclusively and the deciduous ones largely.

Culturally the Algonkin lagged behind the Muskogi and Iroquois families of peoples. Where the archaeology of the north-eastern part of the continent shows distinct horizons or types, as in New York, the simpler forms can generally be identified fairly closely with historic Algonkin culture. In this area at least they therefore preceded Mound Builders and Iroquois, and in part survived them. In general the southern Algonkin tribes farmed, the northern ones were non-agricultural. Three divisions drifted into the northern Plains and became nomadic bison hunters: the Arapaho and Gros Ventre, the Blackfeet and the Cheyenne. The speech of the first two is highly specialized, indicating their separation for a long time; the Cheyenne are later comers in the Plains. In recent generations some of the Cree and Ojibwa have begun to take on the Plains type of customs.

Apart from Arapaho, Blackfoot and Cheyenne, the Algonkin languages are relatively uniform. The principal divisions are: I., Arapaho. II., Blackfoot. III., Cheyenne, nearest to the next. IV., Central-Eastern: A, Central, comprising: (1) Ojibwa type: (*a*) Ojibwa, Pottawatomi, Ottawa, Algonkin proper; (*b*) Illinois (Peoria), Miami; (2) Cree type: (*a*) Cree, Montagnais, probably Naskopi; (*b*) Menominee; (*c*) Sauk, Fox, Kickapoo, Shawnee, nearest to next; (3) Delaware type: Delaware, Mohegan, Wappinger, Pequot. B, Eastern, comprising: (1) Abnaki type: (*a*) Micmac; (*b*) Abnaki; (*c*) Pennacook; (2) Massachuset type: Massachuset, Wampanoag, Narraganset, Montauk, Nipmuk. Position in the family uncertain: Powhatan, Nanticoke and other south Atlantic coast tribes. (T. Michelson, *Bur. Am. Ethn. Rep.* xxviii. 1912.)

All the Algonkin languages are plastic, polysynthetic and highly elaborate in structure, and acquaintance with them unduly influenced early conceptions of the nature of American languages in general, many of which are much simpler. Of late it has seemed possible that the speech of the Beothuk of Newfoundland, of the Kootenay of British Columbia, and of the Wiyot and Yurok of the coast of California may prove to be remote branches of Algonkin.

In 1907 the aggregate population of tribes of admitted Algonkin affinity was estimated at 90,000, a sensible majority being resident in Canada, and Ojibwa and Cree making up a full half of the total. (A. L. K.)

ALGORISM, a name applied in the middle ages to arithmetic employing the Indo-Arabic numerals. (*See* ALGEBRA for Mohammed ibn Mûsâ al-Khowârizmî, who wrote *Liber Algorism*, "the Book of al-Khowârizmî.") It appeared in mediaeval French as *augrisme* and *augrime*, and was thence carried to England as *augrym* or *augrim*, as in Chaucer's *Astrolabe*, his *Testament of Love* and his *Clerk's Tale*. In Spanish it takes such forms as *al guarisma*. In the middle ages the abacists computed on the abacus (*q.v.*), while the algorists computed by algorism. Robert Recorde (*q.v.*) wrote in his *Ground of Artes* (*c.* 1542): "Some call it Arsemetrick, and some Augrime. . . . Both names are corruptly written: Arsemetrick for Arithmetick, as the Greeks call it, and Augrime for Algorisme, as the Arabians found it" (1646 edition). Early European writers thought that the word came from Algus, a king of India; thus in a manuscript of *c.* 1300: "Ther was a kyng of Inde the quich heyth Algor, he made this craft. And aft his name he called hit algory."

ALGUAZIL, a Spanish title often to be met in stories and plays, derived from the Arabic *"visir"* and the article *"al."* The alguazil among the early Spaniards was a judge, and sometimes the governor of a town or fortress. In later times he has gradually sunk down to the rank of an officer of the court, who is trusted with the service of writs and certain police duties. The title has also been given to inspectors of weights and measures in market-places, and similar officials.

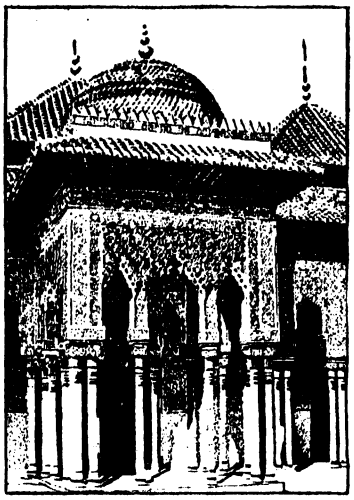
ALGUM or **ALMUG TREE.** The Hebrew words *Algummin* or *Almuggim* are translated Algum or Almug trees in the authorized version of the Bible (*see* 1 Kings x. 11, 12; 2 Chron. ii. 8, and ix. 10, 11); *almug* is an erroneous form (*see* Max Müller, *Science of Language*). The wood of the tree was very precious, and was brought from Ophir (probably some part of India), along with gold and precious stones, by Hiram, and was used in the formation of pillars for the temple at Jerusalem, and for the king's house; also for the inlaying of stairs, as well as for harps and psalteries. It is probably the red sanders or red sandal-wood of India (*Pterocarpus santalinus*). This tree belongs to the large family Leguminosae, sub-order Papilionaceae. The wood is hard, heavy, close-grained and of a fine red colour. It is different from the white fragrant sandal-wood, which is the produce of *Santalum album*, a tree belonging to another family, the Santalaceae.

ALHAMA DE GRANADA, southern Spain, province of Granada, 24m. S W. of Granada. Pop. (1920) 7,591. Alhama is on a sloping shelf of limestone over a deep gorge of the river Marchan or Alhama; the rugged peaks (6,800ft.) of the Sierra de Alhama rise behind it. On Christmas Day 1884 an earthquake destroyed fine terraces of Moorish houses and 800 people, and the town was rebuilt a little way from the old site. The baths (Arabic, *alhama*=bath) near the river, continuously used since Roman times, survived. The temperature of the hot sulphurous springs is about 112°F.; and visitors come in spring and autumn for the fine scenery and cures of rheumatism and dyspepsia. In the 15th century Alhama and the neighbouring fortress of Loja (*q.v.*), were the keys of Granada.

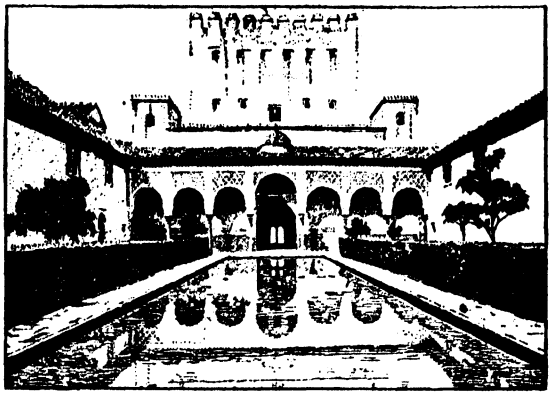
ALHAMBRA, THE, an ancient palace and fortress of the Moorish monarchs of Granada, in southern Spain, occupying a hilly terrace on the south-eastern border of the city of Granada. This terrace or plateau extends from west-north-west to east-south-east, and covers an area of about 35 acres. It is enclosed by a strongly fortified wall, which is flanked by 13 towers. (For an account of the period to which the Alhambra belongs, *see* GRANADA [city]). The palace was built chiefly between 1248 and 1354, in the reigns of Al Ahmar and his successors, but even the names of the principal artists employed are either unknown or doubtful. The splendid decorations of the interior are ascribed to Yusef I., who died in 1354. Immediately after the expulsion of the Moors in 1492, their conquerors began, by successive acts of vandalism, to spoil the marvellous beauty of the Alhambra. Charles V. (1516–56) rebuilt portions in the style of the period, and destroyed the greater part of the winter palace to make room for a structure which has never been completed. Philip V. (1700–46) Italianized the rooms, and completed the degradation by running up partitions which blocked up whole apartments, gems of taste and patient ingenuity. In 1821 an earthquake caused further damage. The work of restoration undertaken in 1828 by the architect, José Contreras, was endowed in 1830 by Ferdinand VII.; and after the death of Contreras in 1847, it was continued with fair success by his son Rafael (d. 1890), and his grandson Mariano.

The situation of the Alhambra is one of rare natural beauty; the plateau commands a wide view of the city and plain of Granada, towards the west and north, and of the heights of the Sierra Nevada, towards the east and south. The park (Alameda de la Alhambra), which in spring is overgrown with wild-flowers and grass, was planted by the Moors with roses, oranges and myrtles; its most characteristic feature, however, is the dense wood of English elms brought hither in 1812 by the duke of Wellington.

The Moorish portion of the Alhambra resembles many mediaeval Christian strongholds in its threefold arrangement as a castle, a palace and a residential annexe for subordinates. The Alcazaba or citadel, its oldest part, is built on the isolated and



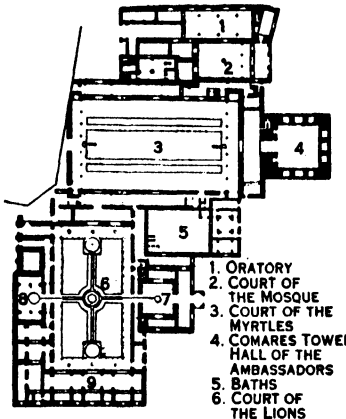
PAVILION OF PERISTYLE
COURT OF THE LIONS



COURT OF THE MYRTLES AND COMARES TOWER

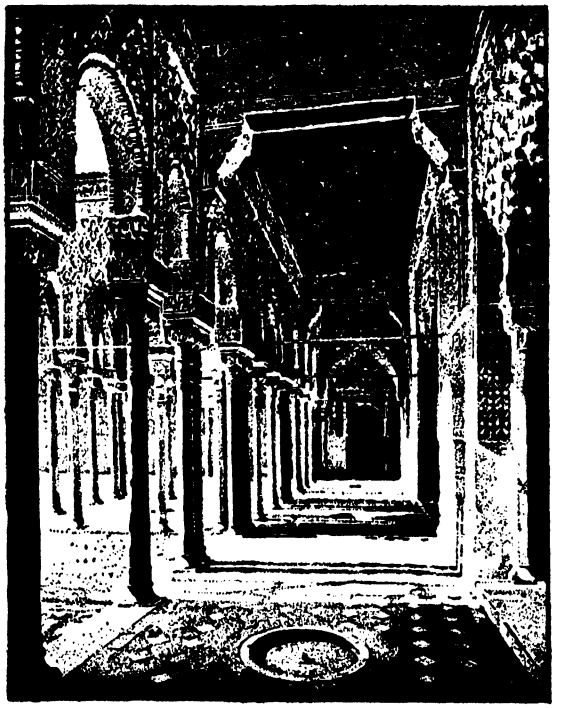


DETAIL OF WINDOWS
HALL OF THE AMBASSADORS

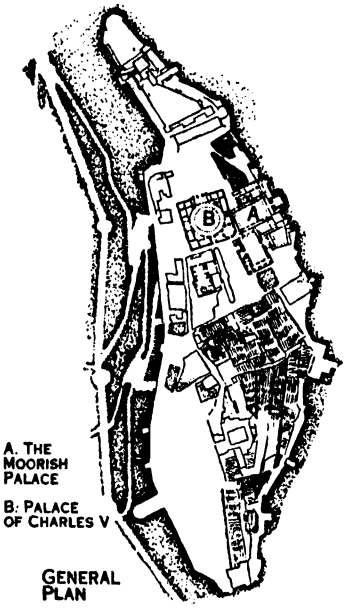


1. ORATORY
2. COURT OF THE MOSQUE
3. COURT OF THE MYRTLES
4. COMARES TOWER HALL OF THE AMBASSADORS
5. BATHS
6. COURT OF THE LIONS
7. HALL OF THE TWO SISTERS
8. HALL OF THE ABENCERRAGES
9. HALL OF JUSTICE

PLAN OF THE MOORISH PALACE



IN THE COLONNADE COURT OF THE LIONS



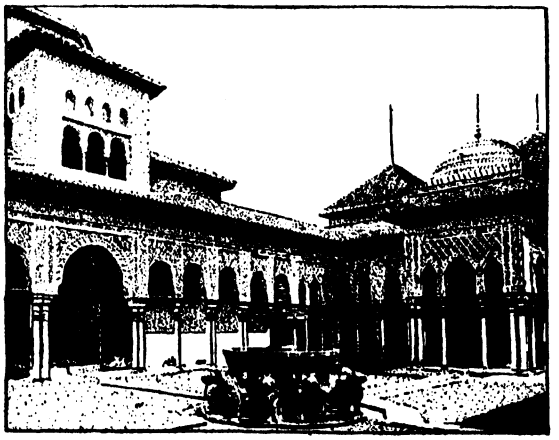
A. THE MOORISH PALACE

B. PALACE OF CHARLES V

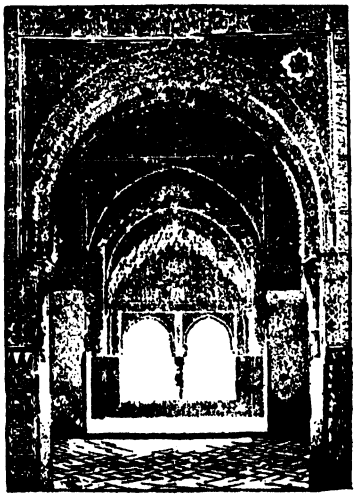
GENERAL PLAN



DETAIL OF A DOOR



COURT OF THE LIONS



WINDOWS OF LINDARAJA
HALL OF THE TWO SISTERS

PERISTYLE, DETAIL OF WINDOWS, DETAIL OF DOOR, AND WINDOWS OF LINDARAJA FROM "L'ALHAMBRA" (ALBERT MORANCE). COURT OF THE MYRTLES, THE COLONNADE, AND THE COURT OF THE LIONS FROM MAYER, "ARCHITECTURE AND APPLIED ARTS IN OLD SPAIN" (DELPHIN VERLAG)

PLANS AND DRAWINGS, FROM PHOTOGRAPHS OF THE INTERIOR OF THE ALHAMBRA

To the black-and-white of the illustration must be added the gorgeousness of colour which decks the rich plaster work everywhere. The intricate arabesques glow with gold, bright blue, pure red and touches of deep green

precipitous foreland which terminates the plateau on the north-west. Only its massive outer walls, towers and ramparts are left. Beyond the Alcazaba is the palace of the Moorish kings, or Alhambra properly so-called, and beyond this, again, is the Alhambra Alta (Upper Alhambra), originally tenanted by officials and courtiers.

Access from the city to the Alhambra park is afforded by the Puerta de las Granadas (Gate of Pomegranates), a massive triumphal arch dating from the 15th century. A steep ascent leads past the Pillar of Charles V., a fountain erected in 1554, to the main entrance of the Alhambra. This is the Puerta Judiciaria (Gate of Judgment), a massive horseshoe archway, surmounted by a square tower, and used by the Moors as an informal court of justice.

The present entrance to the Palacio Arabe, or Casa Real, is by a small door from which a corridor conducts to the Patio de los Arrayanes (Court of the Myrtles), also called the Patio de la Alberca (Court of the Blessing or Court of the Pond). This court is 140ft. long by 74ft broad, and in the centre there is a large pond set in the marble pavement, full of goldfish, and with myrtles growing along its sides. There are galleries on the north and south sides; that on the south 27ft. high, and supported by a marble colonnade. Underneath it, to the right, was the principal entrance, and over it are three elegant windows with arches and miniature pillars.

The Sala de los Embajadores (Hall of the Ambassadors) is the largest in the Alhambra, and occupies all the Torre de Comares. It is a square room, the sides being 37ft. in length, while the centre of the dome is 75ft. high. This was the grand reception room, and the throne of the sultan was placed opposite the entrance.

The celebrated Patio de los Leones (Court of the Lions) is an oblong court, 116ft. in length by 66ft. in breadth, surrounded by a low gallery supported on 124 white marble columns. A pavilion projects into the court at each extremity, with filigree walls and light domed roof, elaborately ornamented. The square is paved with coloured tiles, and the colonnade with white marble, while the walls are covered 5ft. up from the ground with blue and yellow tiles, with a border above and below enamelled blue and gold. In the centre of the court is the celebrated Fountain of Lions, a magnificent alabaster basin supported by the figures of twelve lions in white marble, not designed with sculptural accuracy, but as emblems of strength and courage.

The Sala de los Abencerrajes (Hall of the Abencerrages) derives its name from a legend according to which Boabdil, the last king of Granada, having invited the chiefs of that illustrious line to a banquet, massacred them here. This room is a perfect square, with a lofty dome and trellised windows at its base. The roof is exquisitely decorated in blue, brown, red and gold, and the columns supporting it spring out into the arch form in a remarkably beautiful manner. Opposite to this hall is the Sala de las dos Hermanas (Hall of the two Sisters), so-called from two very beautiful white marble slabs laid as part of the pavement. There is a fountain in the middle of this hall, and the roof—a dome honeycombed with tiny cells, all different, and said to number 5,000—is a magnificent example of the so-called "stalactite vaulting" of the Moors.

The original furniture of the palace is represented by the celebrated vase of the Alhambra, a splendid specimen of Moorish ceramic art, dating from 1320, and belonging to the first period of Moorish porcelain

Of the outlying buildings in connection with the Alhambra, the foremost in interest is the Palacio de Generalife or Gineralife (the Moorish *Jennat al Arif*, "Garden of Arif," or "Garden of the Architect"). This villa probably dates from the end of the 13th century, but has been several times restored The Villa de los Martires (Martyrs' Villa), on the summit of Monte Mauror, commemorates by its name the Christian slaves who were employed to build the Alhambra, and confined here in subterranean cells.

See *Plans, Elevation, Sections and Details of the Alhambra; from drawings taken on the spot by J. Goury and Owen Jones; with a complete translation of the Arabic inscriptions and a historical notice of the Kings of Granada, by P. de Gayangos.* These two magnificent folios, though first published in London between 1842 and 1845, give the best pictorial representation of the Alhambra; Rafael Contreras, *La Alhambra, El Alcázar, y la gran Mezquita de Occidente* (Madrid, 1885); *The Alhambra*, by Washington Irving, was written in 1832, and rewritten in 1857. A well-illustrated edition was published in London in 1896.

ALHAMBRA, a city of Los Angeles county, California, U.S.A., at the entrance to the San Gabriel valley; bounded by the cities of Los Angeles, South Pasadena, and San Gabriel, and by the east side industrial area which adjoins Los Angeles. It is served by the Southern Pacific and the Pacific Electric railways, and is connected with Los Angeles by five boulevards. The population was 9,096 in 1920; and by 1927 the enrolment in the public schools would imply a population of at least 30,000. Alhambra is primarily a residential city, but provision is made for industrial development in a segregated district. The principal manufactures are equipment for petroleum refineries, power apparatus, clay products, electrical goods, and beeswax and bee-keepers' supplies. The city was incorporated in 1903, and adopted a commission-manager form of government in 1914. The name was given by Benjamin D. Wilson (after whom Mt. Wilson was named) when he set aside a tract for a city out of his vast ranch holdings; and the prevailing Spanish-Moorish type of architecture is in harmony with the name. On the outskirts of Alhambra is the San Gabriel mission (founded 1771 by the Franciscans).

ALHAZEN (ălhah'zĕn) [ABU ALI AL-HASAN IBN ALHASAN], Arabian mathematician of the 11th century, was born at Basra and died at Cairo in 1038. He is to be distinguished from another Alhazen who translated Ptolemy's *Almagest* in the 10th century. Having boasted that he could construct a machine for regulating the inundations of the Nile, he was summoned to Egypt by the caliph Hakim; but, aware of the impracticability of his scheme, and fearing the caliph's anger, he feigned madness until Hakim's death in 1021.

Alhazen was the first great discoverer in optics after the time of Ptolemy. According to Giovanni Battista della Porta, he first explained the apparent increase of heavenly bodies near the horizon, although Bacon gives the credit of this discovery to Ptolemy. His treatise on optics was translated into Latin by Witelo (1270), and afterwards published by F. Risner in 1572, with the title *Opticae thesaurus Alhazeni libri VII., cum ejusdem libro de crepusculis et nubium ascensionibus.* Works on geometrical subjects were found in the *Bibliothèque nationale de Paris* in 1834 by E. A Sédillot; other manuscripts are preserved in the Bodleian Library at Oxford and in the library of Leyden.

BIBLIOGRAPHY.—*See* Casiri, *Bibl. Arab. Hisp. Escur.*; J. E. Montucla, *Histoire des mathématiques* (1758); and E. A. Sédillot, *Matériaux pour l'histoire des sciences mathématiques.*

ALI, in full, 'ALI BEN ABU TALIB (*c.* 600–661), the fourth of the caliphs or successors of Mohammed, was born at Mecca about the year A.D. 600. His father, Abū Talib, was an uncle of the prophet, and Ali himself was adopted by Mohammed and educated under his care. As a mere boy he distinguished himself by being one of the first to declare his adhesion to the cause of Mohammed, who some years afterwards gave him his daughter Fatima in marriage. When Mohammed died without male issue, a few emigrants thought Ali to have the best claim to succeed him. Abu Bekr, Omar, and Othman, however, occupied this position before him, and it was not until A.D. 656, after the murder of Othman, that he assumed the title of caliph. Almost the first act of his reign was the suppression of a rebellion under Talha and Zobair, who were instigated by Ayesha, Mohammed's widow, a bitter enemy of Ali, and one of the chief hindrances to his advancement to the caliphate. The rebel army was defeated at the "Battle of the Camel," near Basra, the two generals being killed, and Ayesha taken prisoner. Ali soon afterwards made Kufa his capital. His next care was to get rid of the opposition of Moawiya, who had established himself in Syria at the head of a numerous army. A prolonged battle took place in July 657 in the plain of Siffin (Suffein), near the Euphrates; the fighting was at first, it is said, in favour of Ali, when suddenly a number of the enemy, fixing copies of the Koran to the points of their spears, exclaimed

that "the matter ought to be settled by reference to this book, which forbids Moslems to shed each other's blood." The superstitious soldiers of Ali refused to fight any longer, and demanded that the issue be referred to arbitration (*see* CALIPHATE, section B. 1). Abu Musa was appointed umpire on the part of Ali, and 'Amr-ibn-el-Ass, a veteran diplomatist, on the part of Moawiya. It is said that 'Amr persuaded Abu Musa that it would be for the advantage of Islam that neither candidate should reign, and asked him to give his decision first. Abu Musa having proclaimed that he deposed both Ali and Moawiya, 'Amr declared that he also deposed Ali, and announced further that he invested Moawiya with the caliphate. This treacherous decision (658), (but *see* CALIPHATE, *ib.*) greatly injured the cause of Ali, which was still further weakened by the loss of Egypt. After much indecisive fighting, Ali found his position so unsatisfactory that according to some historians he made an agreement with Moawiya by which each retained his own dominions unmolested. It chanced, however —according to a legend, the details of which are quite uncertain —that three of the fanatic sect of the Kharijites had made an agreement to assassinate Ali, Moawiya and 'Amr, as the authors of disastrous feuds among the faithful. The only victim of this plot was Ali, who died at Kufa Jan. 24, 661, of the wound inflicted by a poisoned weapon. A splendid mosque called Meshed Ali was afterwards erected near the city, but the place of his burial is unknown. He had eight wives after Fatima's death, and in all, it is said, thirty-three children, one of whom, Hassan, a son of Fatima, succeeded him in the caliphate. His descendants by Fatima are known as the Fatimites (*q.v ; see* also EGYPT: *History*, Mohammedan period). The question of Ali's right to succeed to the caliphate is an article of faith which divided the Mohammedan world into two great sects, the Sunnites and the Shiites, the former denying, and the latter affirming, his right. The Turks, consequently, hold his memory in abhorrence; whereas the Persians, who are generally Shi'as, venerate him as second only to the prophet, call him the "Lion of God" (Sher-i-Khudā), and celebrate the anniversary of his martyrdom Ali is described as a bold, noble, and generous man, "the last and worthiest of the primitive Moslems, who imbibed his religious enthusiasm from companionship with the prophet himself, and who followed to the last the simplicity of his example." It is maintained, by the other school, that his motives were throughout those of ambition rather than piety, and that, apart from the tragedy of his death, he would have been an insignificant figure in history. (*See* CALIPHATE)

BIBLIOGRAPHY —In the eyes of the later Moslems he was remarkable for learning and wisdom, and there are extant collections (almost all certainly spurious) of proverbs and verses which bear his name: the *Sentences of Ali* (Eng. trans, William Yule, Edinburgh, 1832); H L. Fleischer, *Alis Hundert Sprüche* (Leipz., 1837), the *Divan*, by G. Kuypert (Leyden, 1745, and at Bulak, 1835), C. Brockelmann, *Gesch. d. arabisch. Lit.* (vol. i., Weimar, 1899).

ALI, known as **ALI BEY** (1766–1818), the assumed name of DOMINGO BADIA Y LEBLICH, a Spanish traveller. Pretending to be a descendant of the Abbasids, Badia in 1803 set out on his travels. Under the name of Ali Bey el Abbassi, and in Muslim costume, he visited Morocco, Tripoli, Egypt, Arabia and Syria. He made the pilgrimage to Mecca, at that time in the possession of the Wahabites In 1814, Badia published in Paris an account of his travels under the title of *Voyage d'Ali Bey en Asie et en Afrique, etc.* A few years later he set out again for Syria under the assumed name of Ali Othman and, it is said, accredited as a political agent by the French Government. He reached Aleppo, and there died, not without suspicion of having been poisoned.

An account of his Eastern adventures was published in London in 1816 entitled *Travels in Morocco, Tripoli, Cyprus, Egypt, Arabia, Syria and Turkey, between the years 1803 and 1807.*

ALI, known as **ALI PASHA** (1741–1822), Turkish pasha of Iannina, surnamed Arslan (the lion), was born at Tepeleni, Albania. His father, hereditary bey of Tepeleni, was killed by neighbouring chiefs when Ali was 14. His mother formed a brigand band to secure revenge and restitution. In the wild brigand school Ali proved an apt pupil, and recovered Tepeleni. He was then commissioned by the Turkish Government to chastise the rebellious pasha of Scutari, whom he defeated and killed. He was then appointed lieutenant to the derwend-pasha of Rumelia, with a commission for the suppression of brigandage, and seized the opportunity to enrich himself by levying a tax on the brigands for immunity, at the same time securing indemnity for the malpractice by judicious bribes at Constantinople. In 1788 he was made pasha of Iannina.

By a combination of cunning and severity Ali made himself all-powerful in central Albania, and began to contemplate the establishment of a sea power including Albania, Greece and Thessaly which should rival in the eastern that of the dey of Algiers in the western Mediterranean. For a brief period in 1797–98 it seemed that this might be accomplished with the help of the French, who had occupied the Ionian islands, and gave Ali permission to suppress the "aristocratic" tribes of the coast. In the confused events which followed Ali abandoned his flirtation with France and French ideas, foreseeing the ultimate defeat of France. He retained the confidence of the sultan, who confirmed him in possession of the whole of Albania, and made him vali of Rumelia. In 1803 he was master of Epirus, Albania and Thessaly, while the pashaliks of Morea and Lepanto were in the hands of his sons Veli and Mukhtar. He held all the coastal towns which had once been Venetian, except Parga, which remained French in spite of a brief renewal of Ali's alliance with Napoleon in 1807. In 1814 the Pargiots rose against the French garrison, and handed it over to the British to save it from Ali, who had bought from the French commandant a promise of surrender. Ali now sent a mission to London, which was, in the end, successful. The Pargiots were compensated and removed to the Ionian islands, and the Turks took possession.

But Ali's fall was near. The Sultan Mahmud II. found a pretext in Ali's attempt to secure the murder of Pasha Bey in the precincts of the palace at Constantinople. Hurshid Pasha, the grand vizier, was entrusted with his deposition. After a polite interview with Hurshid, Ali was stabbed in the back as he left the tent.

Ali's court at Iannina was the centre of a sort of barbarous culture, in which astrologers, alchemists and Greek poets played their part, and was often visited by travellers Amongst others, Byron came, and has left a record of his impressions in "Childe Harold's Pilgrimage," less interesting and vivid than the prose accounts of Pouqueville, T. S Hughes and William M Leake. Leake (iii. 259) reports a reproof addressed by Ali to the French renegade Ibrahim Effendi, who had ventured to remonstrate against some particular act of ferocity: "At present you are too young at my court to know how to comport yourself. . . . You are not yet acquainted with the Greeks and Albanians; when I hang up one of these wretches on the plane-tree, brother robs brother under the very branches. if I burn one of them alive, the son is ready to steal his father's ashes to sell them for money. They are destined to be ruled by me; and no one but Ali is able to restrain their evil propensities." This is perhaps as good an apology as could be made for his character and methods. To the wild people over whom he ruled, none was needed. He had their respect, if not their love; he is the hero of a thousand ballads; and his portrait still hangs among the *ikons* in the cottages of the Greek mountaineers.

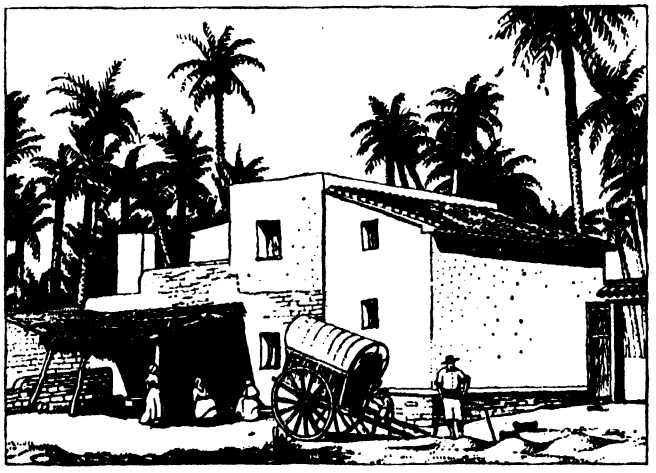
BIBLIOGRAPHY.—Apart from the scattered references in the published and unpublished diplomatic correspondence of the period, contemporary journals and books of travel contain much interesting material for the life of Ali Of these may especially be mentioned François C. H. L. Pouqueville, *Voyage en Morée, à Constantinople en Albanie, etc.* (1805), of which an English version by A Plumptre was published in 1815; ib. *Voyage dans la Grèce* (1820, 1821) Pouqueville, who spent some time as French resident at Iannina, had special facilities for obtaining first-hand information, though his emotionalism makes his observations and deductions at times somewhat suspect. Very interesting also are Thomas Smart Hughes, *Travels in Greece and Albania* (2nd ed. 1830); John Cam Hobhouse (Lord Broughton), *A Journey through Albania, etc. . . . during the years 1809–10* (1813 a new ed. 1855); William Martin Leake, *Travels in Northern Greece* (1845). *See* also Pouqueville's *Hist. de la régénération de la Grèce, 1740–1824* (1824, 3rd ed., 1825); R. A Davenport, *Life of Ali Pasha, vizier of Epirus* (1861); and the chapter by W Alison Phillips on "Greece and the Balkan Peninsula," vol. x chap. vi. of *Cambridge Modern History.*

ALIAGA, a municipality (with administrative centre and 14 *barrios* or districts) of the province of Nueva Ecija, Luzon, Philippine islands, almost due west from the capital Cabanatuan and about 70m. N. by W. of Manila. Pop. (1918) 12,703, of whom 6,428 were male, 6,271 female. The white population numbered four. Literacy (based on ages from ten years up, 1918) 56·6%. It has a comparatively cool and healthful climate, and is pleasantly situated about midway between the Pampanga Grande and Pampanga Chico rivers, and in a large and fertile valley, of which the principal products are corn, rice, sugar and tobacco. The four languages spoken are Tagalog, Ilocano, Pampango and Pangasinan. There were five schools of all sorts in 1918. In 1848 Aliaga was transferred from the province of Pampanga to that of Nueva Ecija. Civil Government under the United States was organized in 1901. (J. A. R.)

ALIAS, a term used to connect the different names of a person who has passed under more than one, in order to conceal his identity or for other reasons, or to describe compendiously an adopted name.

ALIBI, in law, the defence resorted to in criminal prosecutions, where the person charged alleges that he was so far distant at the time from the place where the crime was committed that he could not have been guilty. An alibi, if substantiated, is the most conclusive proof of innocence. (*See* CRIMINAL LAW.)

ALICANTE, capital of the province of that name, episcopal see with modern cathedral, rising in a crescent from the bay up the low surrounding hills with white flat-roofed houses ending in an old citadel on bare rock (400ft.). Pop. (1920) 63,908. A dry and equable climate makes it a health-resort, and large suburbs have been built since 1905. The bays afford good anchorage, and large harbour works since 1902 have improved what is one of the chief ports of Spain. The trade of Alicante consists in the manufacture of cotton, linen and woollen goods, cigars, confectionery and castor oil; the importation of coal, iron, machinery, manures, timber, oak staves and fish; and the exportation of lead, fruit, farm produce and red wines, which are sent to France



A CHARACTERISTIC OLD FARMHOUSE ON THE OUTSKIRTS OF ALICANTE, CAPITAL OF THE SPANISH PROVINCE OF THAT NAME, IN THE HEART OF THE DATE-RAISING COUNTRY OF SOUTH-EASTERN SPAIN

for blending with better vintages. Fine marble is procured in the island of Plana near the coast.

Alicante was the Roman *Lucentum;* but, despite its antiquity, it has few Roman or Moorish remains. In 718, it was occupied by the Moors, who were only expelled in 1304, and made an unsuccessful attempt to recapture the city in 1331. Alicante was besieged by the French in 1709, and by the Federalists of Cartagena in 1873.

BIBLIOGRAPHY.—M. R. Garcia and A. Montero y Perez, *Ensayo biográfico bibliográfico de escritores de Alicante y de su provincia* (Alicante, 1890).

ALICANTE, seaboard province, south-eastern Spain, formed (1833) from parts of the provinces of Valencia and Murcia. Pop. (1920) 512,186; area, 2,240sq.m.; density per sq.m., 237. In the north and west there are extensive calcareous mountain ranges cut by deep ravines; further south the land is more level with fertile valleys. On the coast, unhealthy salt marshes alternate with pleasant and productive *huertas* or gardens, such as those of Alicante and Denia. The Segura, the only large river, flows from the highlands of Albacete through Murcia and Orihuela. The scanty torrential rainfall makes irrigation from the Segura with its network of canals important. 40% of the area is cultivated, nearly a quarter being devoted to vines, the most important culture, producing wine and raisins from stocks immune against the phylloxera. The wine is famous in Spain and inferior kinds are sent to France to be mixed with claret. Cereals (barley first in importance, rice second) are profitable only in such irrigated lands as the Huerta de Orihuela; wheat and barley are imported from Algeria and maize from Argentina. Olives, almonds, oranges (especially in the Segura valley and on the coast), carobs and date-palms are grown in large plantations. The fruit-trees (1923), estimated at 2,500,000, gave produce worth over thirteen million pesetas, the almond, the characteristic fruit-tree of Alicante, representing six millions. Oranges are sent to England, Germany, Holland and Belgium, and other fruits to the interior of Spain. In sericulture, Alicante is second only to Murcia (1925). Stock-raising is not important, and the roads are mostly poor. Except in the Orihuela district, most of the land is in small properties and fertility and skill in cultivation have made the population dense even apart from Alicante and Alcoy. The annual value of agricultural produce is about 163 million pesetas. Mineral products include superphosphates, salt and rock-salt. Hydrochloric, nitric and sulphuric acids are made in quantities. Fine cloths, silk, cotton and woollen fabrics, lace, paper, hats, leather, earthenware, soap, oil and brandy are made. Fisheries of tunny and anchovy are active. The dialect is a variety of the Valencian. In 1920, 53·95% of the population was returned as illiterate. The principal towns (separately described) are Alicante, the capital (pop. 1920, 63,908), Crevillente (11,216), Denia (12,612), Elche (33,167), Novelda (11,994), Orihuela (37,180), and Villena (16,544).

ALICE MAUD MARY, Grand Duchess of Hesse-Darmstadt (1843–1878), second daughter and third child of Queen Victoria, was born at Buckingham Palace on April 25 1843. In the summer of 1860, at Windsor Castle, Princess Alice first met her future husband, Prince Louis of Hesse. In the following year, the House of Commons unanimously voted a dowry of £30,000 on her marriage and an annuity of £6,000 to the princess. In Dec. 1861, Princess Alice nursed her father with the utmost care during his short illness, and after his death devoted herself to comforting her mother. Her marriage took place at Osborne, on July 1, 1862.

The princess unconsciously wrote her own biography from this period in her constant letters to Queen Victoria, a selection of which, edited by Dr. Carl Sell, were printed in 1883. These letters give a complete picture of the daily life of the duke and duchess, and they also show the intense love of the latter for her husband, her mother and her native land. She visited England every year, and it was at her special request that when she died her husband, who succeeded to the throne of the duchy in 1877, laid an English flag upon her coffin. In Nov. 1878 her children and her husband contracted diphtheria, and one of the children died. The duchess, worn with sorrow and anxiety herself contracted the disease after the others had recovered, and died on Dec. 14. She left one son and four daughters: Ernest Louis, late reigning Grand Duke of Hesse (abdicated 1918); Victoria Alice, married Prince Louis of Battenberg, marquis of Milford Haven; Elizabeth Feodorovna, Grand Duchess Sergius of Russia, assassinated Sept. 1918; Irene, Princess Henry of Prussia; Alexandra Feodorovna, tsaritsa of Russia, killed July 16, 1918.

See Carl Sell, *Alice: Mittheilungen aus ihrem Leben und Briefen, etc.* (Darmstadt, 1883), with English translation by the Princess Christian, *Alice: biographical sketch and letters* (1884).

ALICE SPRINGS, a telegraph station on the overland telegraph line (Adelaide–Port Darwin) in the central southern portion of the Northern Territory, Australia. Situated near the centre of the Macdonnell ranges, 994m. from Adelaide and

1,105m. from Port Darwin, it lies virtually in the centre of the continent. Heavitree Gap, the largest and most conveniently situated of the characteristic gorge-like passes through the ranges, lies 4m. to the south, and upon this gap the telegraph line and a considerable stock-route traffic converge. Through this gap also will run the new railway line from Oodnadatta to Alice Springs now under construction. Alice Springs (altitude 1,926ft.) stands on the central Australian platform (average elevation *c.* 2,000ft.). The climate, hot in summer but fine and bracing in winter, suffers from the extremes associated with very continental position. (Mean annual temp.: 69·8°; annual range: 31·5°; diurnal range: 40–50°, sinking at times to 8–10° below freezing point in winter nights. The rainfall [average annual: *c.* 11in.] is erratic, variation 27·21–4·3in.)

In spite of such uncertainties of climate, and of its remoteness, Alice Springs is destined to become the centre of an extensive pastoral area, and the mineral resources (gold, mica, etc.) of the region are probably considerable.

ALIDADE, or sight rule, a ruler provided with sights and used as an accessory with the plane-table (*q.v.*) employed for topographic survey. (*See* SURVEYING.)

ALIEN is defined by the British Nationality and Status of Aliens Act 1914–22 as a "person who is not a British subject." He is one who either owes allegiance to a foreign sovereign or is stateless. *Calvin's Case* (1608) decided that natives of Scotland born before the union of the Crowns were aliens in England, but that, since allegiance is to the person of the king, those born subsequently (*post-nati*) were English subjects. But in *Isaacson v. Durant* (1886) the Court held that allegiance was due to the king, in his political and not in his personal character. Consequently, upon the separation of the Crowns of England and Hanover on the accession of Queen Victoria, Hanoverians ceased to owe allegiance to the British Crown and became aliens; and those born after the separation of the kingdoms were *a fortiori* in the same position.

Formerly, aliens in England suffered many disabilities. At common law an alien could not hold landed property, not even under lease. Until the reign of Edward I., when by charter aliens were permitted to rent houses, foreign merchants lived in lodgings. By 32 Hen. VIII. c. 16 alien artificers or handicraftsmen were forbidden to lease a dwelling house or shop. By the Naturalization Act, 1844, however, aliens were permitted to hold land or houses for residence or business for a term not exceeding 21 years, and also to take and hold personal property. They were incapable of inheriting real estate and of transmitting it by descent. By 11 & 12 William III. c. 6, natural-born subjects might derive title by descent through an alien ancestor. At common law an alien, whether the subject of a friendly or enemy state, possesses no legal right to enter British territory, but during his residence within the British dominions he owes a local allegiance to the Crown to the same extent as a British subject. Thus he is subject to British law, including that of treason. He was incapable, even when naturalized by the Act of Naturalization, of being a member of the Privy Council or of either House of Parliament, and this is still the law as to persons naturalized otherwise than under the Acts of 1870 and 1914. He was also incapable of holding any municipal office or of voting at parliamentary or municipal elections or of filling any office or place of trust, civil or military. Many of these disabilities were removed by the Naturalization Act 1870, the provisions of which were substantially re-enacted by the British Nationality and Status of Aliens Act 1914–22. By s.17 of this Act an alien may take, acquire, hold, and dispose of real and personal property as if he were a natural-born British subject; and a title to real and personal property may be derived through, from, or in succession to an alien in the same manner as through, from, or in succession to a natural-born British subject, provided that this section shall not operate so as to (1) confer any right on an alien to hold real property situated out of Great Britain; or (2) qualify an alien for any office or for any municipal, parliamentary, or other franchise; or (3) qualify an alien to be the owner of a British ship; or (4) entitle an alien to any right or privilege as a British subject, except such rights and privileges in respect of property as are hereby expressly given to him; or (5) affect any estate or interest in real or personal property to which any person has or may be entitled, either mediately or immediately, in possession or expectancy, in pursuance of any disposition made before May 12, 1870, or in pursuance of any distribution by law on the death of any person dying before that day. But an alien may purchase a British ship, and if she is built in England to be delivered to him abroad, she is not a "British ship" within the Merchant Shipping Act 1894. By the Representation of the People Act 1918 an alien is not entitled to be registered or to vote as a parliamentary or local government elector. By s.18 of the Nationality Act of 1914 an alien is triable in the same manner as a natural-born British subject. Formerly he was entitled to be tried by a mixed jury of British and aliens (but not since 1554 for treason). This right was abolished by the Act of 1870. By the Juries Act 1870 an alien who has been domiciled in England for ten years may, if not otherwise disqualified, serve on juries and inquests, but by the Alien Restriction Act 1919 no alien may sit upon a jury in any judicial or other proceeding if challenged by any of the parties. By the Army Act 1881 an alien may with the consent of the Crown enlist in H.M. regular forces, but may not hold higher rank than that of a warrant or non-commissioned officer.

It seems to be a rule of general public law that an alien can be sent out of the realm by exercise of the Crown's prerogative; but in modern English practice, whenever it seems necessary to expel foreigners (*see* EXPULSION), a special Act of parliament has to be obtained for the purpose, unless the case falls within the Extradition Acts or the Aliens Act 1905. The Acts of 1905, 1914 and 1919 prohibit the landing in Great Britain of undesirable alien steerage passengers, called in the Act "immigrants," from ships carrying more than 20 alien steerage passengers, called in the Act "immigrant ships"; nor can alien immigrants be landed except at certain ports at which there is an "immigrant officer," to whom power of prohibiting the landing is given, subject to a right of appeal to the immigration board of the port. The Act contains a number of qualifications, and among these empowers the Secretary of State to exempt any immigrant ship from its provisions if he is satisfied that a proper system is maintained to prevent the immigration of undesirable persons. The principal test of undesirableness is not having or being in a position to obtain the means of supporting one's self and one's dependants, or appearing likely from disease or infirmity to become a charge on the rates, provided that the immigrant is not seeking to avoid prosecution or punishment on religious or political grounds, or persecution, involving danger of imprisonment or danger to life or limb, on account of religious belief. Lunatics, idiots, persons who from disease or infirmity appear likely to become a detriment to the public otherwise than through the rates, and persons sentenced in a foreign country for crimes for which they could be surrendered to that country, are also enumerated as undesirable. Power is also given to the Secretary of State to expel persons sentenced as just mentioned, or, if recommended by the court in which they have been convicted, persons convicted of felony or some offence for which the court has power to impose imprisonment without the option of a fine, or of certain offences against the police laws; and persons in receipt of any such parochial relief as disqualifies them for the parliamentary franchise, or wandering without ostensible means of subsistence, or living under insanitary conditions due to overcrowding.

The powers conferred by the Aliens Restriction Act 1914 for the exclusion, control, and deportation of aliens during a state of war or national emergency are by the Aliens Restrictions (Amendment) Act 1919 made permanent and further restrictions are imposed. Under the Act of 1914 by Order in Council aliens may be prohibited from landing or from embarking in Great Britain either generally or at certain places, may be deported, required to reside or remain, or forbidden to reside or remain in certain places, and required to comply with such provisions as to registration, change of abode, travelling, or otherwise as may be made by Order in Council. Under the Act of 1919 aliens inciting to sedition H.M. forces are liable on indictment to penal servitude or on sum-

mary conviction to imprisonment not exceeding three months, and for promoting industrial riot on summary conviction to imprisonment for a similar period. No alien may hold a pilotage certificate except certain certificates issued to masters or mates of French nationality. No alien may act as master, chief officer, or chief engineer of a British vessel or as skipper or second hand of a British fishing boat registered in Great Britain, except in the case of a vessel or boat employed habitually between ports outside Great Britain. Aliens certified by the Admiralty for good service are exempt from these restrictions. No alien may be employed in any capacity on board a British ship at a lower rate of pay for his rating than that current on British ships. Aliens, other than former enemy aliens habitually employed afloat in any capacity or in any climate for which they are specially fitted are exempt from the above restrictions except that relating to pay. No alien may be employed on a British ship registered in Great Britain unless he has produced satisfactory proof of his nationality. No alien may be appointed to any office or place in the Civil Service nor may he assume or use or continue the assumption or use of any name other than that by which he was ordinarily known on Aug. 4, 1914, nor carry on business in any name other than that in which he carried on business at the said date without the consent of the Secretary of State. The Trading with the Enemy (Amendment) Act 1918 applies for a period of five years from the termination of the war . . . and thereafter until parliament otherwise determines. By s. 2 no banking business may be carried on in Great Britain (a) by a company which is an enemy-controlled corporation within the meaning of the Act, or (b) by a firm or individual if the business carried on is one with respect to which an order for the winding-up thereof could have been made under s.1 of the Trading with the Enemy Act, 1916.

Enemy aliens during the time of war have no civil rights or privileges, unless they are here under the protection and by permission of the Crown. Thus an enemy alien who had registered under the Aliens Restriction Act 1914 as an enemy alien was held entitled to sue. And since an enemy alien can be sued here, he can appear and be heard in his defence, and if judgment proceed against him the appellate courts are as much open to him as to any other defendant.

Formerly aliens acquired British nationality by special Acts of parliament or became denizens by grants of letters of designation by the Crown; although both these processes are still available, aliens usually have since the Act of 1844 applied to the Home Secretary for certificates of naturalization (*see* NATURALIZATION).

See Pitt Cobbett, *Cases and Opinions on International Law*, vol. ii. 4th ed. (1922); J. A. Foote, *Private International Law*, 5th ed. (1925); L. F. L. Oppenheim, *International Law*, vol. ii., 4th ed. (1926).

(H. H. L. B.)

ALIENATION, the act or fact of being estranged, set apart or separated. In law the word is used for the act of transfer of property by voluntary deed and not by inheritance. In regard to church property the word has come to mean, since the Reformation, a transfer from religious to secular ownership. "Alienation" is also used to denote a state of insanity (*q.v.*).

ALIEN CORPORATION, a corporation doing business in one country but having its organization and charter in another country, *e.g.*, a Canadian, English or French corporation doing business in the United States. The various State statutes do not make any distinction between corporations incorporated in foreign countries and those incorporated in other States of the Union, denominating all "foreign corporations" as distinguished from its own corporations known as "domestic corporations."

ALIEN-HOUSES, religious houses in England belonging to foreign ecclesiastics, or under their control; generally they were built where property had been left by donors to foreign orders in order to purchase prayers for their souls. There were more than 100 in England; many were suppressed by Henry V. and the rest by Henry VIII.

ALIENIST, one who specializes in the study of mental diseases, which are often included in the generic name "Alienation." (*See* INSANITY.)

ALIGARH, a city and district of British India in the Agra division of the United Provinces. The city (pop. 66,963 in 1921) is also known as Koil. There are several flour-mills, cotton-presses and an important dairy farm. Aligarh fort, situated on the Grand Trunk road, consists of a regular polygon, surrounded by a very broad and deep ditch. It became a key fortress under Sindhia in 1759, and was the depot where he drilled and organized his battalions in the European fashion with the aid of De Boigne. It was captured from the Mahrattas by Lord Lake's army, in September 1803. In modern times the chief pride of Aligarh is its associations with Western education for Mohammedans. The enlightened pioneer was Sir Sayyad Ahmad Khan (d. 1898), who founded in 1864 an institute for the translation and study of Western literature. This he steadily, and in face of much orthodox opposition, developed into the Mohammedan Anglo-Oriental college and school. It attracted students from all over India and from outer Asia, and had a profound influence on the intellectual and political progress of Indian Mohammedans. In 1920 it was advanced to the status of a university.

The district of Aligarh has an area of 1,946sq m., and a population (1921) of 1,061,745. It is nearly a level plain, but with a slight elevation in the centre, between the two great rivers the Ganges and Jumna. The only other important river is the Kali Nadi, which traverses the entire length of the district from north-east to south-west. The chief trading centre is Hathras, where there are several factories for ginning and pressing cotton.

ALIGNMENT, or **ALINEMENT,** the way in which the line runs (from Fr. *à* and *ligne*, the Lat. *linea*, a line); an expression used in surveying, drawing, and in military arrangements, the alignment of a regiment or a camp meaning the situation when drawn up in line or the relative position of the tents. The alignment of a rifle has reference to the way of getting the sights into line with the object, so as to aim correctly.

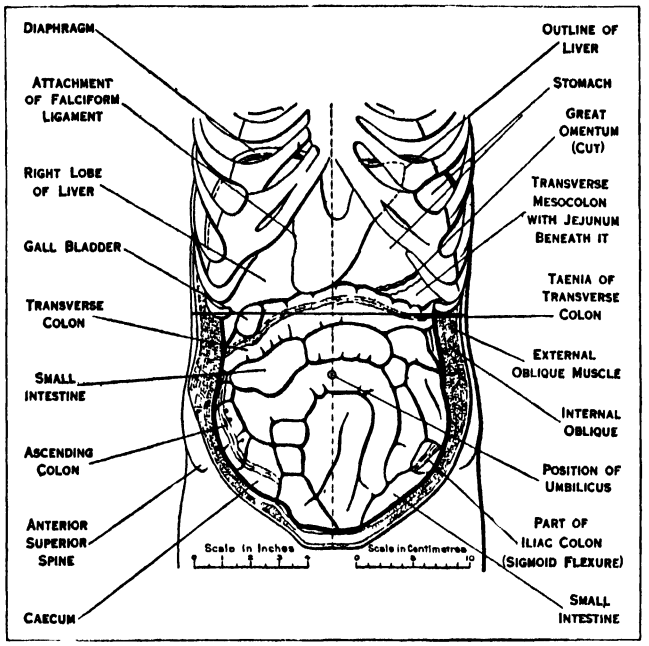
ALIMENT, a synonym for "food," literally or metaphorically. The word has also been used in the same legal sense as ALIMONY (*q v.*). Aliment, in Scots law, is the sum paid or allowance given in respect of the reciprocal obligation of parents and children, husband and wife, grandparents and grandchildren, to contribute to each other's maintenance. The term is also used in regard to a similar obligation of other parties, as of a sequestrated estate to aliment the bankrupt, the payments by parishes to paupers, etc. Alimentary funds, whether of the kind above mentioned, or set apart as such by the deed of a testator, are intended for the mere support of the recipient, and are not attachable by creditors.

ALIMENTARY CANAL, in anatomy. The alimentary canal is the digestive tract from the mouth to the anus. It is some 25 to 30ft. long, and the food, in its passage, passes through the following parts one after the other: mouth, pharynx, oesophagus, stomach, small intestines, caecum, large intestines, rectum and anus. Into this tube at various points the salivary glands, liver and pancreas pour their secretions by special ducts. As the mouth (*q.v.*) and pharynx (*q.v.*) are separately described, the detailed description will here begin with the oesophagus or gullet.

The *oesophagus*, a muscular tube lined with mucous membrane, stretches from the lower limit of the pharynx, at the level of the cricoid cartilage, to the cardiac orifice of the stomach. It is about 10in. long (25 cm.) and ½in. to 1in. in diameter. At first it lies in the lower part of the neck, then in the thorax, and lastly, for about an inch, in the abdomen. As far as the level of the fourth or fifth thoracic vertebra it lies behind the trachea, but when that tube ends, it is in close contact with the pericardium, and, at the level of the tenth thoracic vertebra, passes through the oesophageal opening of the diaphragm (*q.v.*), accompanied by the two vagi nerves, the left being in front of it and the right behind. In the abdomen it lies just behind the left lobe of the liver. Both in the upper and lower parts of its course it lies a little to the left of the mid line. Its mucous membrane is thrown into a number of longitudinal pleats to allow stretching.

The *stomach* is an irregularly pear-shaped bag, situated in the upper and left part of the abdomen. When moderately distended the thick end of the pear or *fundus* bulges upward and to the left, while the narrow end is constricted to form the *pylorus*, by means

of which the stomach communicates with the small intestine. The *cardiac orifice,* where the oesophagus enters, is placed about a third of the way along the upper border from the left end of the fundus, and, between it and the pylorus; the upper border is concave and is known as the *lesser curvature.* From the cardiac to the pyloric orifice, round the lower border, is the *greater curvature.* The stomach has in front of it the liver (*see* fig. 1), the



FROM CUNNINGHAM, "TEXTBOOK OF ANATOMY"

FIG 1.—DIAGRAM OF THE ARRANGEMENT OF THE INTERNAL ORGANS AS SEEN ON REMOVAL OF FRONT ABDOMINAL WALL

diaphragm and the anterior abdominal wall, while behind it are the pancreas, left kidney, left adrenal, spleen, colon and mesocolon. When the stomach is empty it contracts into a tubular organ, and the transverse colon ascends to occupy the vacant space.

The *pylorus* is an oval opening, averaging ½in. in its long axis but capable of considerable distension; it is formed by a special development of the circular muscle layer of the stomach, and during life is tightly closed, except during the periodic escape of gastric contents into the duodenum. The mucous membrane of the stomach is thrown into pleats or rugae when the organ is not fully distended, while between these it has a mammillated appearance.

Superficial to the mucous coat is a submucous, consisting of loose connective tissue, while superficial to this are three coats of unstriped muscle, the inner oblique, the middle circular and the outer longitudinal. The peritoneal coat is described in the article on the coelom and serous membranes.

The *small intestine* is a tube, from 22 to 25ft long, beginning at the pylorus and ending at the *ileo-caecal valve;* it is divided into duodenum, jejunum and ileum.

The *duodenum* is from 9 to 11in. long and forms a horseshoe or C-shaped curve, encircling the head of the pancreas It differs from the rest of the gut in being retroperitoneal. Its first part is horizontal and lies behind the fundus of the gall-bladder, passing backward and to the right from the pylorus. The second part runs vertically downward in front of the hilum of the right kidney, and into this part the pancreatic and bile ducts open. The third part runs horizontally to the left in front of the aorta and vena cava, while the fourth part ascends to the left side of the second lumbar vertebra, after which it bends sharply downward and forward to form the duodeno-jejunal flexure.

The *jejunum* forms the upper two-fifths of the rest of the small intestine; it, like the ileum, is thrown into numerous convolutions and is attached by the mesentery to the posterior abdominal wall. (*See* COELOM and SEROUS MEMBRANES.)

The *ileum* is the remaining three-fifths of the small intestine, though there is no absolute point at which the one ends and the other begins. Speaking broadly, the jejunum occupies the upper and left part of the abdomen below the subcostal plane (*see* ANATOMY: *Superficial and Artistic*), the ileum the lower and right part. At its termination the ileum opens into the large intestine at the ileo-caecal valve

The *caecum* is a blind sac occupying the right iliac fossa and extending down some 2 or 3in. below the ileo-caecal junction. From its posterior and left surface the *vermiform appendix* protrudes, and usually is directed upward and to the left. This worm-like tube is blind at its end and is usually 3 or 4in. long. Its internal opening into the caecum is about 1in below that of the ileum. On transverse section it is seen to be composed of (1) an external muscular coat, (2) a submucous coat, (3) a mass of lymphoid tissue, which appears after birth, and (4) mucous membrane. In many cases its lumen is wholly or partly obliterated, though this is probably due to disease. Guarding the opening of the ileum into the caecum is the *ileo-caecal valve,* which consists of two cusps projecting into the caecum; of these the upper forms a horizontal shelf, while the lower slopes up to it obliquely. At birth the caecum is a cone, the apex of which is the appendix; it is bent upon itself to form a U, and sometimes this arrangement persists throughout life.

The *ascending colon* runs up from the caecum at the level of the ileo-caecal valve to the hepatic flexure beneath and behind the right lobe of the liver; it is about 8in. long and posteriorly is in contact with the abdominal wall and right kidney It is covered by peritoneum except on its posterior surface (*see* fig. 1).

The *transverse colon* is variable in position, depending largely on the distension of the stomach, but usually corresponding to the subcostal plane (*see* ANATOMY: *Superficial and Artistic*). On the left side of the abdomen it ascends to the splenic flexure, which may make an impression on the spleen (*see* DUCTLESS GLANDS), and is bound to the diaphragm opposite the 11th rib by a fold of peritoneum. The peritoneal relations of this part are discussed in the article on the coelom and serous membranes.

The *descending colon* passes down in front of the left kidney and left side of the posterior abdominal wall to the crest of the ilium; it is about 6in. long and is usually empty and contracted while the rest of the colon is distended with gas; its peritoneal relations are the same as those of the ascending colon, but it is more likely to be completely surrounded.

The *iliac colon* stretches from the crest of the ilium to the inner border of the psoas muscle, lying in the left iliac fossa, just above and parallel to Poupart's ligament. Like the descending, it is usually uncovered by peritoneum on its posterior surface. It is about 6in. in length.

The *pelvic colon* lies in the true pelvis and forms a loop, the two limbs of which are superior and inferior while the convexity reaches across to the right side of the pelvis In the foetus this loop occupies the right iliac fossa, but, as the caecum descends and enlarges and the pelvis widens, it is usually driven out of this region. The distal end of the loop turns sharply downward to reach the third piece of the sacrum, where it becomes the rectum. Formerly the iliac and pelvic colons were spoken of as the *sigmoid flexure.*

The *rectum,* according to modern ideas, begins in front of the third piece of the sacrum. It ends in a dilatation or *rectal ampulla,* which is in contact with the back of the prostate in the male and of the vagina in the female and is in front of the tip of the coccyx. The rectum is not straight, as its name would imply, but has a concavity forward corresponding to that of the sacrum and coccyx.

At the end of the pelvic colon the mesocolon ceases, and the rectum is then only covered by peritoneum at its sides and in front; lower down the lateral covering is gradually reflected off and then only the front is covered. About the junction of the middle and lower thirds of the tube the anterior peritoneal covering is also reflected off on to the bladder or vagina, forming the *rectovesical pouch* in the male and the *pouch of Douglas* in the female. This reflexion is usually about 3in. above the anal aperture.

The *anal canal* is the termination of the alimentary tract, and runs downward and backward from the lower surface of the rectal ampulla between the levatores ani muscles. It is about an inch long and its lateral walls are in contact.

Structure of the Intestine.—The intestine has four coats: serous, muscular, submucous and mucous. The serous or peritoneal coat has already been described wherever it is present. The muscular coat consists of unstriped fibres arranged in two layers, the outer longitudinal and the inner circular (*see* fig. 2). In the large intestine the longitudinal fibres, instead of being arranged evenly round the tube as they are in the small, are gathered into

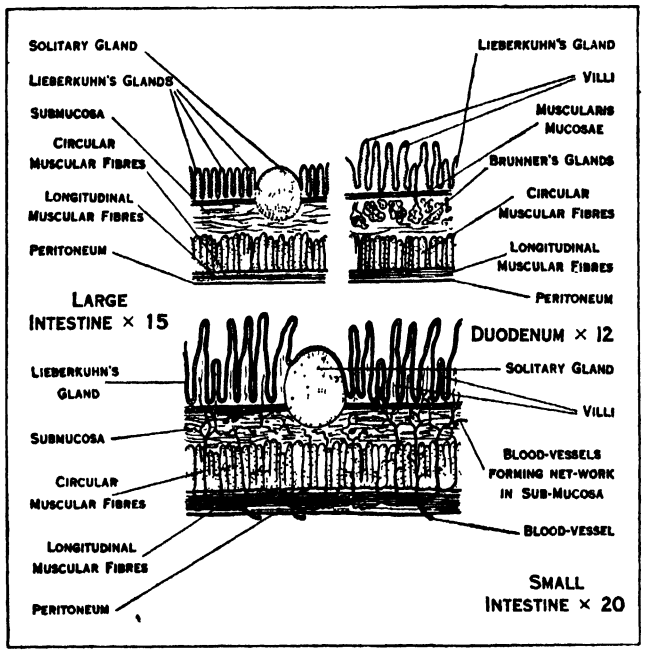
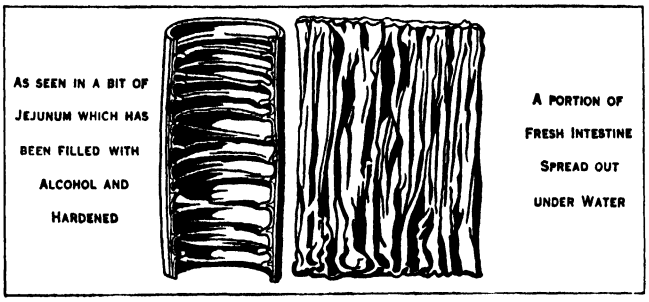


FIG. 2.—DIAGRAM SHOWING STRUCTURE OF THE INTESTINAL WALL Upper left is the large intestine; upper right is the duodenum, or first portion of the small intestine; below is the small intestine

three longitudinal bands called *taeniae* (*see* fig. 1); by the contraction of these the large intestine is thrown into a series of *sacculi* or slight pouches. The taeniae in the caecum all lead to the vermiform appendix, and form a useful guide to this structure In the rectum the three taeniae once more become evenly arranged over the whole surface of the bowel, but more thickly on the anterior and posterior parts. The circular layer is always thicker than the longitudinal; in the small intestine it decreases in thickness from the duodenum to the ileum, but in the large it gradually increases again, so that it is thickest in the duodenum and rectum.

The submucous coat is very strong and consists of loose areolar tissue in which the vessels break up.

The mucous coat is thick and vascular (*see* fig. 2); it consists of an epithelial layer nearest the lumen which forms the intestinal glands (*see* EPITHELIAL, ENDOTHELIAL AND GLANDULAR TISSUES). External to this is the *basement membrane,* outside which is a layer of retiform tissue, and this is separated from the submucous coat by a very thin layer of unstriped muscle called the *muscularis mucosae.* In the duodenum and jejunum the mucous membrane is thrown into a series of transverse pleats called *valvulae conniventes* (*see* fig. 3); these begin about an inch from the pylorus and gradually fade away as the ileum is reached. About 4in. from the pylorus the common bile and pancreatic ducts form a papilla, above which one of the valvulae conniventes makes a hood and below which a vertical fold, the *frenulum,* runs downward. The surface of the mucous membrane of the whole of the small intestine has a velvety appearance, due to the presence of closely-set, minute, thread-like elevations called villi (*see* fig. 2). Throughout the whole length of the intestinal tract are minute masses of lymphoid tissue called *solitary glands* (*see* fig. 2); these are especially numerous in the caecum and appendix, while in the ileum they are collected into large oval patches, known as *agminated glands* or *Peyer's patches,* the long axes of which, from ½in. to 4in. long, lie in the long axis of the bowel. They are always found in that part of the intestine which is farthest from the mesenteric attachment. In the interior of the rectum three shelf-like folds, one above the other, project into the cavity and correspond to the lateral concavities or kinks of the tube. They are not in the same line and the largest is usually on the



FROM CUNNINGHAM, "TEXT-BOOK OF ANATOMY"

FIG. 3.—CIRCULAR FOLDS IN THE MUCOUS MEMBRANE OF THE SMALL INTESTINE THAT INCREASE THE SECRETORY AND ABSORBENT SURFACE

right side. They are known as the *plicae recti* or *valves of Houston.* In the anal canal are four or five longitudinal folds called the *columns of Morgagni.* (For further details, *see* Quain's *Anatomy,* 1896; Gray's *Anatomy,* 1926; Cunningham's *Anatomy,* Edinburgh 1922).

Embryology.—The greater part of the alimentary canal is formed by the closing-in of the entoderm to make a longitudinal tube, ventral and parallel to the notochord. This tube is blind in front and behind (cephalad and caudad), but the middle part of its ventral wall is for some distance continuous with the wall of the yolk-sac, and this part of the canal, which at first opens into the yolk-sac by a very wide aperture, is called the *mid gut.* The part in front of it, which lies dorsal to the heart, is the *fore gut,* while the part behind the aperture of the yolk-sac is the *hind gut.*

The pharynx, oesophagus, stomach and part of the duodenum are developed from the fore gut, a good deal of the colon and the rectum from the hind gut, while the mid gut is responsible for the rest. The cephalic part of the fore gut forms the pharynx (*q.v.*), and about the fourth week the stomach appears as a fusiform dilatation in the straight tube. Between the two the oesophagus gradually forms as the embryo elongates. The opening into the yolk-sac, which at first is very wide, gradually narrows, as the ventral abdominal walls close in, until in the adult the only

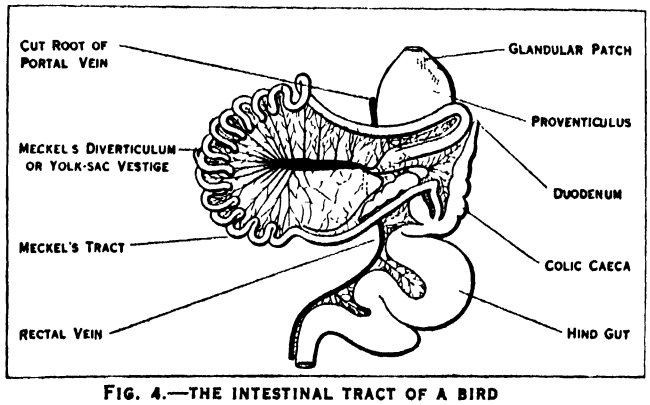


FIG. 4.—THE INTESTINAL TRACT OF A BIRD

indication of the connection between the gut and the yolk-sac is the very rare presence (about 2%) of Meckel's diverticulum. The stomach soon shows signs of the greater and lesser curvatures, the latter being ventral, but maintains its straight position. About the sixth week the caecum appears as a lateral diverticulum, and, until the third month, is of uniform calibre; after this period the terminal part ceases to grow at the same rate as the proximal, and so the vermiform appendix is formed. The mid gut forms a loop with its convexity toward the diminishing *vitelline duct,* or remains of the yolk-sac, and until the third month it protrudes

into the umbilical cord. The greater curvature of the stomach grows more rapidly than the lesser, and the whole stomach turns over and becomes bent at right angles, so that what was its left surface becomes ventral. This turning over of the stomach throws the succeeding part of the intestine into a *duodenal loop*, which at first has a dorsal and ventral mesentery (*see* COELOM AND SEROUS MEMBRANES). The intestine now grows very rapidly and is thrown into a series of coils; the caecum ascends and passes to the right ventral to the duodenum, and presses it against the dorsal wall of the abdomen; then it descends toward its permanent position in the right iliac fossa.

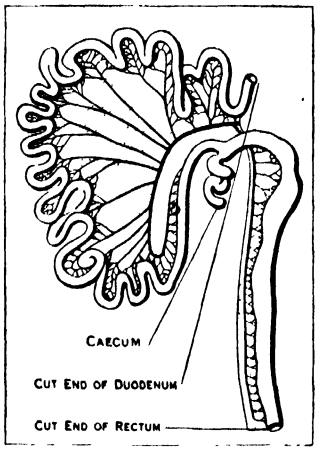


FIG 5 —THE INTESTINAL TRACT OF THE FOX

From the ventral surface on the hinder (caudal) closed end of the intestinal tube the *allantois* grows to form the placenta and bladder (*see* URINARY SYSTEM, REPRODUCTIVE SYSTEM and PLACENTA), and this region is the *cloaca* into which the alimentary, urinary and generative canals or ducts all open, but later two lateral folds appear which, by their union, divide the cloaca into a ventral and a dorsal part, the former being genito-urinary and the latter alimentary or intestinal. In this way the rectum or dorsal compartment is shut off from the genito-urinary. Later an ectodermal invagination at the hind end of the embryo develops and forms the anal canal; this is the *proctodaeum*, and for some time it is separated from the hind (caudal) end of the rectal part of the *mesodaeum* (or part of the intestinal canal formed from the mesoderm) by a membrane called the *anal membrane*. This is eventually absorbed and the digestive tract now communicates with the surface by the anus.

Comparative Anatomy.—The primitive condition of the vertebrate alimentary canal may be described as a straight, simple tube, consisting of an anterior portion, formed by an ectodermal invagination, a long median portion lined by endoderm, and a short posterior portion formed by ectodermal invagination. In the lower vertebrates the primitive tube subserved also the purpose of respiration, and traces of the double function remain in the adult structure of all vertebrates (*see* MOUTH, PHARYNX). In fish, the pharynx, or branchial region, suddenly becomes narrower, posterior to the gill-slits, to form the oesophagus; in higher animals the oesophagus, in the adult, is separated from the primitive pharyngeal region and lies dorsal to it. Probably, in the primitive vertebrata, the entire alimentary canal was lined with ciliated cells. Traces of this ciliation persist in many living forms.

The *oesophagus* is essentially merely a passage, as straight as may be, from the pharynx to the stomach, varying in length with the length of the neck and thoracic regions in different animals, and in calibre with the nature of the food. It is almost invariably lined with a many-layered epithelium, forming a tough coating, readily repaired and not easily damaged by hard food masses. There are few exceptions to this structural and functional simplicity. In fishes (*see* ICHTHYOLOGY, *Anatomy*) the swim-bladder is developed as a dorsal outgrowth of the oesophagus and may remain in open connection with it. In many birds part of the oesophagus may be temporarily dilated, forming a "crop," as for instance in birds of prey and humming birds. In the flamingo, many ducks, storks and the cormorant the crop is a permanent although not a highly specialized enlargement. Finally, in the vast majority of seed-eating birds, in gallinaceous birds, pigeons, sandgrouse, parrots and many *Passeres*, particularly the finches, the crop is a permanent globular dilatation, in which the food is retained for a considerable time, mixed with a slight mucous secretion, and softened and partly macerated by the heat of the body. Many birds feed their young from the soft contents of the crop, and in pigeons, at the breeding season, the cells lining the crop proliferate rapidly and are discharged as a soft cheesy mass into the cavity, forming the substance known as pigeon's milk.

Stomach.—Where the oesophagus passes into the stomach, the lining wall of the alimentary tract changes to a mucous epithelium, consisting of a single layer of endodermal cells, frequently thrown into pits or projecting as processes; from being chiefly protective, it has become secretory and absorbing, and maintains this character nearly to the anus. The fundamental form of the stomach is a sac-like enlargement of the canal, the whole forming an enlarged bent tube. At the distal end of the tube the intestinal tract proper begins, and the two regions are separated by a muscular constriction. In fishes the stomach may be a simple bent tube, or an expanded, globular or elongated sac. In *Batrachia* and *Reptilia* it is in most cases a simple sac, marked off from the oesophagus only by increased calibre. In the *Crocodilia*, however, the anterior portion of the stomach is much enlarged and very highly muscular, the muscles radiating from a central tendinous area on each of the flattened sides. The cavity is lined by a hardened secretion and contains pebbles and gravel for mechanical trituration of the food, so that the resemblance to the gizzard of birds is well marked. This muscular chamber leads by a small aperture into a distal, smaller and more glandular chamber. In birds the stomach exhibits two regions, an anterior glandular region, the proventriculus, the walls of which are relatively soft and contain enlarged digestive glands. The distal region (gizzard) is larger and is lined in most cases by a more or less permanent membrane which is thick and tough in birds with a muscular gizzard, very slight in the others.

In mammals, the primitive form of the stomach consists of a more or less globular or elongated expansion of the oesophageal region, forming the cardiac portion, and a forwardly curved, narrower pyloric portion, from which the duodenum arises. The whole wall is muscular, and the lining membrane is richly glandular. In many mammals one, two or three protrusions of the cardiac region occur, whilst in the manatee and in some rodents the cardiac region is constricted off from the pyloric portion. In the *Artiodactyla* the stomach is always complex, the complexity reaching a maximum in ruminating forms. In the chevrotains, which in many other respects show conditions intermediate between non-ruminant artiodactyles and true ruminants, the oesophagus opens into a wide cardiac portion, incompletely divided into four chambers. Three of these, towards the cardiac extremity, are lined with villi and correspond to the *rumen* or paunch; the fourth, which lies between the opening of the oesophagus and the pyloric portion of the stomach, is the ruminant *reticulum* and its wall is lined with very shallow "cells." The fourth or true pyloric chamber is an elongated sac with smooth glandular walls and is the *abomasum*, or rennet sac. In the camel the rumen forms an enormous globular paunch with villous walls and internally showing a trace of division into two regions. It is well marked off from the reticulum, the "cells" of which are extremely deep, forming the well-known water-chambers. In the true ruminants, the rumen forms a capacious, villous reservoir, nearly always partly sacculated, into which the food is

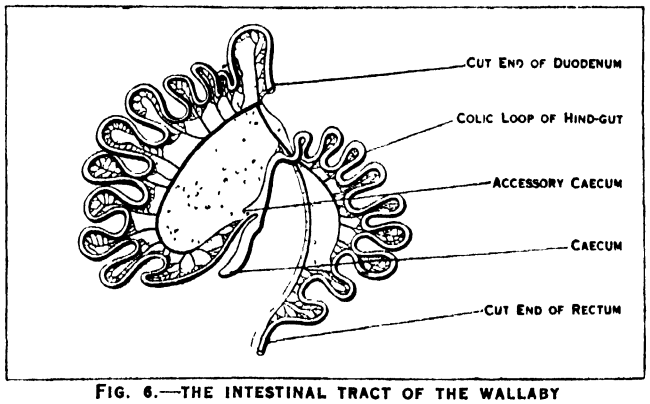


FIG. 6.—THE INTESTINAL TRACT OF THE WALLABY

passed rapidly as the animal grazes. The food is subjected to a rotary movement in the paunch, and is thus repeatedly subjected to moistening with the fluids secreted by the reticulum, as it is passed over the aperture of that cavity, and is formed into a rounded bolus. The food bolus, when the animal is lying down after grazing, is passed into the oesophagus and reaches the mouth by antiperistaltic contractions of the oesophagus. After prolonged mastication and mixing with saliva, it is again swallowed,

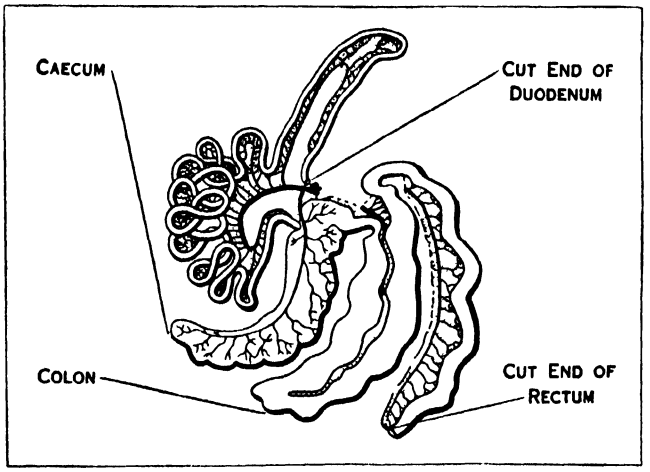


FIG. 7.—THE INTESTINAL TRACT OF THE TAPIR

but is now passed into the psalterium, which, in true ruminants, is a small chamber with conspicuous longitudinal folds. Finally it reaches the large abomasum where the last stages of gastric digestion occur.

In the *Cetacea* the stomach is different from that found in any other group of mammals. The oesophagus opens directly into a very large cardiac sac the distal extremity of which forms a long caecal pouch. At nearly the first third of its length this communicates by a narrow aperture with the elongated, relatively narrow pyloric portion. The latter is convoluted and constricted into a series of chambers that differ in different groups of *Cetacea*. In most of the *Marsupialia* the stomach is relatively simple; in the kangaroos, on the other hand, the stomach is divided into a relatively small, caecal cardiac portion and an enormously long sacculated and convoluted pyloric region, the general arrangement of which closely recalls the large caecum of many mammals.

Intestinal Tract.—It is not yet possible to discuss the general morphology of this region in vertebrates as a group, as, whilst the modifications displayed in birds and mammals have been compared and studied in detail, those in the lower groups have not yet been systematically co-ordinated.

Fishes.—In the *Cyclostomata, Holocephali* and a few *Teleostei* the course of the gut is practically straight from the pyloric end of the stomach to the exterior, and there is no marked differentiation into regions. In the Dipnoi, a contracted sigmoid curve between the stomach and the dilated intestine is a simple beginning of the complexity found in other groups. In very many of the more specialized teleosteans the gut is much convoluted, exhibiting a series of watchspring-like coils. In a number of different groups, increased surface for absorption is given, not by increase in length of the whole gut, but by the development of an internal fold known as the spiral valve. A set of organs peculiar to fish, known as the *pyloric caeca,* is present in numbers ranging from one to nearly 200 in the vast majority of fish. These are outgrowths of the intestinal tract near the pyloric extremity of the stomach, and their function is partly glandular, partly absorbing.

In the *Batrachia* the course of the intestinal tract is nearly straight from the pyloric end of the stomach to the cloaca, in the case of the perennibranchiates there being no more than a few simple loops between the expanded "rectum" and the straight portion that leaves the stomach.

In fishes, batrachians and reptiles the intestinal tract is swung from the dorsal wall of the abdominal cavity by a mesentery which is incomplete on account of secondary absorption in places. There are also traces, more abundant in the lower forms, of the still more primitive ventral mesentery.

Intestinal Tract in Birds and Mammals.—The primitive gut must be supposed to have run backwards from the stomach to the cloaca suspended from the dorsal wall of the body-cavity by a dorsal mesentery. This tract, in the course of phylogeny of the common ancestors of birds and mammals, became longer than the straight length between its extreme points and, consequently, was thrown into a series of folds. The mesentery grew out with these folds, but the presence of adjacent organs, the disturbance due to the outgrowth of the liver, and the secondary relations brought about between different portions of the gut, as the out-growing loops invaded each other's localities, disturbed the primitive simplicity. Three definite regions of outgrowth, however, are to be recognized in the actual disposition of the gut in existing birds and mammals. The first of these is the *duodenum*. The second portion is *Meckel's tract*. It consists of the part generally known as the small intestines, the *jejunum* and *ileum* of human anatomy, and stretches from the distal end of the duodenum to the caecum or caeca. It is the chief absorbing portion of the gut, and in nearly all birds and mammals is the longest portion It represents, however, only a very small part of the primitive straight gut, corresponding to not more than two or three somites of the embryo. The third portion of the gut should be termed the *hind-gut,* and lies between the caecum or caeca and the anus, corresponding to the large intestines, colon and rectum of human anatomy It is formed from a much larger portion of the primitive straight gut than the duodenum and Meckel's tract together, and its proximal portion, in consequence, lies very close to the origin of the duodenum.

Adaptations of the Intestinal Tract to Function.—The chief business of the gut is to provide a vascular surface to which the prepared food is applied so that the nutritive material may be absorbed into the system. Overlying and sometimes obscuring

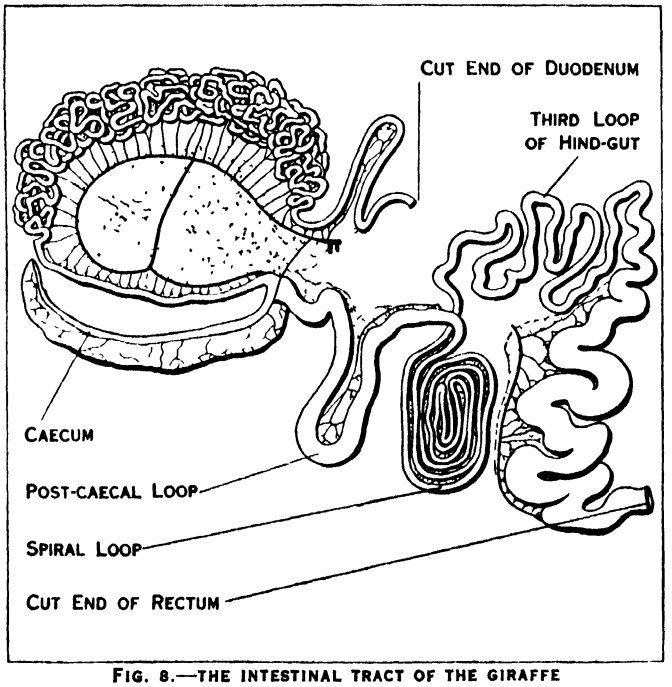


FIG. 8.—THE INTESTINAL TRACT OF THE GIRAFFE

the morphological patterns of the gut, are many modifications correlated with the nature of the food. Thus in birds and mammals alike there is a direct association of herbivorous habit with great relative length of gut. In fish-eating birds and mammals, the gut is very long, with a thick wall and a relatively small calibre, whilst there is a general tendency for the regions of the gut to be slightly or not at all defined. In fruit-eating birds the gut is strikingly short, wide and simple, whilst a similar change has not taken place in frugivorous mammals. Carnivorous birds and mammals have a relatively short gut.

The Colic Caeca.—These paired or single organs lie at the junction of the hind-gut with Meckel's tract and are homologous in birds and mammals although their apparent position differs in the majority of cases in the two groups. The caeca are hollow out-growths of the wall of the gut, the blind ends being directed forwards. They vary in size within very wide limits and there is no invariable connection between the nature of the food and

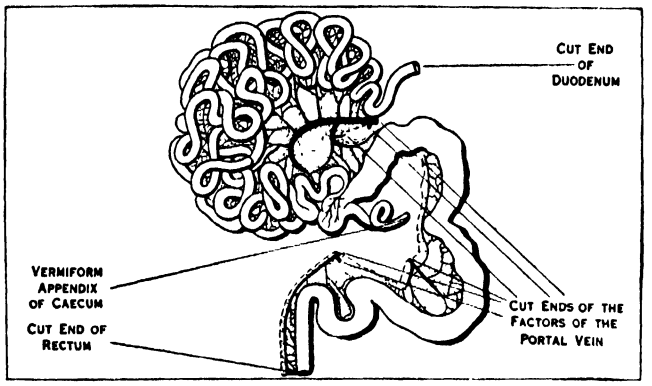


FIG. 9.—THE INTESTINAL TRACT OF THE GORILLA

the degree of their development. The caecal wall is in most cases highly glandular and contains masses of lymphoid tissue. In birds and in mammals this tissue may be so greatly increased as to transform the caecum into a solid or nearly solid sac.

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ALIMENTARY SYSTEM, DISEASES OF THE. Great advance in our knowledge of these diseases during recent years may be attributed chiefly to three factors: (1) the opportunities of observation afforded by the performance of surgical operations on the abdomen—the study, as it has been termed, of "the pathology of the living"; (2) an improved X-ray technique; (3) the introduction of biochemical tests for estimating the "physiological efficiency" of important organs such as the stomach, pancreas, and liver. The information gained by these methods has rendered diagnosis of diseases of the alimentary system more precise (*see* DIAGNOSIS), but has not proportionately advanced their treatment except by surgical operation.

The Oesophagus.—In no section of the alimentary canal have the X-rays (*see* RÖNTGEN RAYS) proved of more value in diagnosis than in the oesophagus, and the indications they afford have been rendered more precise by direct inspection of the interior of the gullet by the oesophagoscope. The commonest symptom of disease of the oesophagus is difficulty in swallowing (*dysphagia*) which results from its obstruction. This is most frequently due to cancer, which chiefly occurs in men and is generally situated at the lower end of the tube where it joins the stomach, though it may also occur at the entrance or at an intermediate point opposite the bifurcation of the trachea. Functional obstruction is much rarer and occurs at the lower end, being due either to a spasm of the muscular sphincter at the entrance to the stomach, or to a failure of the muscular ring to relax as the food passes on (so-called "*achalasia*"). However brought about, the obstruction leads eventually to "idiopathic dilatation" of the oesophagus (*oesophagectasia*).

This variety of obstruction occurs in women perhaps oftener than in men and is compatible with comparatively good health. It is treated by dilatation with bougies passed through the mouth or, sometimes, by stretching the lower end of the oesophagus by means of instruments introduced through an incision in the stomach. *Diverticula,* or pouches, are a still rarer cause of obstruction which can be recognized by X-ray examination.

The Stomach.—Cancer still remains the most serious disease of the stomach (*see* CANCER) and has increased rather than diminished in frequency in the last few years. It is commonest in men in the fifth and sixth decades of life and may be situated at the pylorus, which is the most frequent site, at the cardiac orifice (rarest), or in the body of the organ. Its early diagnosis, in time to afford a chance of cure by operation, is still a matter of difficulty, but improved X-ray technique is helping to solve the problem. The so-called "leather-bottle stomach" (*linitis plastica*) is now known to be generally due to diffuse cancerous infiltration.

Our knowledge of the next most serious disease of the stomach (gastric ulcer) has been rendered much more precise in recent years mainly by the work of the surgeons. Ulcer occurs in two forms, the acute and the chronic. Acute ulcers are usually multiple and may appear in the course of any septic infection, but when developing "idiopathically" they are most often met with in young women; chronic ulcers, on the other hand, are commoner in men of middle age, and are nearly always solitary. Acute ulcers are apt to perforate and may also cause profuse haemorrhage; chronic ulcers rarely perforate; but they, too, often bleed. The older statistics according to which "gastric ulcer" was chiefly a disease of women, were the result of including all the "acute" cases; the term as now usually employed refers to the chronic ulcer, chiefly a disease of men. The acute ulcer of young women is less often met with in recent years than it was formerly. The chief symptoms of the acute variety of ulcer are pain immediately after taking food, vomiting and, not uncommonly, haematemesis, with comparatively little disturbance of the general health. The chronic ulcer causes pain which occurs very punctually from one to two hours after meals while vomiting and haematemesis are less often met with. Some degrees of weakness, wasting, and anaemia are apt to be present. The symptoms of the chronic ulcer recur in attacks lasting a few weeks with long periods of more or less complete freedom from discomfort between.

When the chronic ulcer is situated at the pylorus it leads to gradual occlusion of the latter with consequent dilatation of the stomach; when situated in the body of the organ it may bring about an "hour-glass" constriction. The most serious change which a chronic ulcer can undergo, however, is its conversion into a cancer. The frequency with which such a transformation occurs is disputed, but that there is a real risk of it, all surgeons are now agreed, and its possibility is one of the chief arguments for the surgical treatment of all cases of chronic ulcer. On the other hand there is no place for surgery in the treatment of the acute ulcer unless perforation has taken place. Haemorrhage from an acute ulcer is rarely fatal and is now never treated by operation; the question of operation in bleeding from a chronic ulcer is still *sub judice,* but opinion is moving in favour of it, transfusion being performed first if necessary.

Chronic ulcer of the duodenum is closely akin to chronic gastric ulcer. Over 80% of the cases are in males. As in gastric ulcer the symptoms occur in attacks lasting a few weeks and often separated by long intervals of complete freedom. Pain is the chief symptom and tends to come on when the stomach is empty and to be relieved by taking more food—hence the term "hunger pain" applied to it. Vomiting is very rare and the chief complications are perforation, which is much commoner than in chronic gastric ulcer, and haemorrhage which may lead both to vomiting of blood and its passage from the bowel (*melaena*). The ulcer is usually situated on the anterior wall of the first part of the duodenum and is apt, after it has been present for a long time, to lead to narrowing of the outlet of the stomach. On the other hand chronic duodenal ulcers—unlike gastric—never become malignant.

Gastric and duodenal ulcers (*q.v.*) are sometimes spoken of together as "peptic ulcers," and our knowledge of the patho-

genesis of the peptic ulcer has advanced considerably, as the result of the work of Bolton in Great Britain and of Rosenow in America. The first stage in the development of an ulcer is the formation of a small area of necrosis in the mucosa in consequence of the lodgment in it of pathogenic streptococci. These organisms appear to reach the stomach or duodenum by the blood stream, either being swallowed or entering the blood from a focus of sepsis in the teeth, tonsils, appendix, gall-bladder, or some other source. According to Rosenow, the ulcer-forming organisms exhibit an "elective" affinity for the gastric mucous membrane while others may show a similar affinity for, say, the gall-bladder. Be this as it may, the result of the formation of an area of necrosis in the mucous membrane is that auto-digestion of the dead tissue takes place and a small acute ulcer forms. Most of these heal quickly, but in certain circumstances—for example abnormally high gastric acidity—one of them fails to heal, gradually enlarges, and becomes a chronic ulcer. The remaining organic affection of the stomach (*gastritis*) is of less frequent occurrence than was formerly supposed.

The functional disorders of the stomach which are responsible for a great deal of what is commonly called "dyspepsia" are still but ill-understood although, by means of X-ray examinations and the use of "fractional" test meals, light is gradually being thrown upon them. Two chief types of functional disorder occur, secretory and motor, and each of these may be affected in the direction either of excess or defect.

Secretory Disorders.—It is now known that the gastric juice as secreted has an acidity of about 0.5%, but that this is reduced to the optimum acidity for digestion (0.2%) by dilution and neutralization in the stomach, and that the most powerful factor in neutralization is the regurgitation of duodenal contents through the pylorus. An excessive acidity of the stomach contents therefore (*"acid dyspepsia," hyperchlorhydria*) may be due either to over-production of gastric juice or to deficiency of neutralization, or to both, and can no longer be regarded as a definite "clinical entity." Deficient acidity on the other hand (*hypochlorhydria, achylia*) may be due either to defective secretion or to excessive neutralization. The secretion of gastric juice is controlled partly by the vagus nerve and partly by chemical hormones, and may therefore be affected either by variations in the excitability of the nervous system or by the quality of the food. Excess of secretion is perhaps commoner in men, defect is more often found in women, but over-acidity is more prone to cause symptoms than under-acidity.

Motor Disorders.—These are of greater importance as a cause of dyspepsia than disorders of secretion. The stomach has two motor functions (*peristalsis* and "tone") and these may be disordered independently. Both are much under nervous influence, the vagus increasing tone and peristalsis, while the sympathetic has an opposite effect. Diminution of tone (*hypo-motility, atony*) is a commoner cause of symptoms than excess and is specially apt to occur in women. Emotional disturbances are prone to bring it about. Excess of tone and peristalsis are often associated with over-acidity, whereas deficiency of tone and acidity often, though by no means always, coincide.

The symptoms of the functional disorders of the stomach differ notably from those of the more serious organic diseases. Pain, vomiting and wasting are absent, and the patient's chief complaints are of discomfort, flatulence, acidity, and so forth. As disorder of function is largely nervous in origin, treatment must be directed in great measure to the central nervous system, but acidity can be corrected by antacids, atony by strychnine, and so on. The diet of the patient must also be adapted to the weakened organ.

The Colon.—The investigation of diseases of the colon has been facilitated by the introduction of the methods of examination by the X-rays after an opaque enema and by the sigmoidoscope. Cancer is still the most serious affection, the sigmoid and pelvic colon being its commonest sites. Treatment is by operation and, if undertaken early enough, is often successful. Ulceration of the colon is now divided into (*a*) dysenteric and (*b*) non-dysenteric. Dysenteric ulceration (*see* DYSENTERY) may be caused either by the amoeba histolytica or by dysenteric bacilli of the Shiga or Flexner type. The distinction between these different forms can be made by a bacteriological examination of the stools and by the serum agglutination test. Non-dysenteric ulceration (*ulcerative colitis*) is not very uncommon as a primary disease in Great Britain. Its symptoms are the same as those of the dysenteric variety (diarrhoea with the passage of blood and mucus, some fever, pain and tenesmus) and it can be recognized by the use of the sigmoidoscope. Nothing is yet definitely known of its bacteriology. Antidysenteric serum is a powerful aid in the treatment of acute bacillary dysentery while emetine is a specific for the amoebic form. Non-dysenteric ulceration is treated by lavage and, in severe cases, by the operation of appendicostomy.

The frequent occurrence of little pouches (*diverticula*) in the wall of the colon has been established by modern methods of investigation. Sometimes these become inflamed when the condition termed "diverticulitis" arises. It is not without danger. Much attention has been devoted in recent years to the alleged stagnation of the contents of the large bowel (colon stasis) with consequent absorption of poisons into the blood (auto-intoxication). Such stagnation is believed to be promoted by dropping or displacement of the colon or by the undue mobility of sections of it, and extensive operations have been undertaken for the correction of these conditions. While, however, auto-intoxication may sometimes take place, it is beginning to be realized that it is not nearly so frequent as was supposed and that operation for it is rarely necessary or advisable.

The Pancreas.—The pancreas is still very largely the *terra incognita* of the abdomen, mainly on account of its inaccessible position. The introduction of tests for "pancreatic efficiency," however, has helped to make the diagnosis of its diseases easier. Amongst these tests are Loewe's adrenalin mydriasis reaction, the urinary diastase test, and the estimation of the unsplit fat in the stools. Glycosuria, also, is often an indication of the failure of the internal secretion (insulin).

New-growth (cancer) is the most serious disease of the pancreas and one of the commonest. It specially affects the head of the organ and usually shows its presence by the production of obstructive jaundice.

Acute pancreatitis (haemorrhagic necrosis of the pancreas) is one of the conditions which produce what is termed an "abdominal catastrophe." It is difficult of diagnosis and is only curable by laparotomy.

Chronic pancreatitis, an interstitial inflammation or fibrosis of the organ, may result from partial obstruction of the duct, *e.g.*, by gall-stones, or from an ascending infection of it. The symptoms are very much the same as those produced by cancer.

The Liver.—Recent work has thrown a good deal of light on the nature of jaundice. It is now known that bile pigment is not produced in the liver cells but is derived from the breaking down of red blood corpuscles in the "reticulo-endothelial system"—a network of cells widely diffused in the body but especially in the spleen. The pigment so produced is picked out of the blood by the hepatic cells and transferred to the bile. Two chief varieties of jaundice are recognized: (*a*) obstructive, (*b*) non-obstructive. The former is due to any gross obstruction in the bile ducts such as may be caused by cancers or other tumours pressing upon or involving the ducts, impacted gall-stone and so forth. It is characterized by the complete absence of bile from the stools and its presence in the urine.

Non-obstructive jaundice, as it is usually called, is of two varieties—the haemolytic and the toxic. The former is due to increased destruction of red blood corpuscles and occurs to some extent in Addisonian (pernicious) anaemia and also in the rare disease known as "family jaundice"; toxic jaundice on the other hand is brought about by severe damage to the liver cells rendering them incapable of transferring bile pigment from the blood to the bile. Many poisons act on the cells in this way, such as arsenic and phosphorus, as well as the toxins of certain organisms, *e.g.*, those of yellow fever and some septic infections; poisons of "endogenous" origin may act similarly, as in acute

yellow atrophy of the liver and the toxic jaundice of pregnancy. In all forms of non-obstructive jaundice bile is present in the stools but it may or may not be present in the urine. So-called "catarrhal jaundice," formerly believed to be obstructive, is now, largely as a result of the van den Bergh test, known to be due, in part at least, to direct damage of the liver cells, although obstruction of the ducts from catarrh also plays a part in its production. Much work has recently been done on the pathology of gall-stone formation. It is generally agreed that infection of the gall-bladder is a predisposing factor, the infection being usually conveyed through the blood stream in the same way as in cases of peptic ulcer. In addition it is possible that an excess of cholesterol in the blood contributes to their formation. For the other chief diseases of the liver, cancer and cirrhosis, *see* LIVER, DISEASES OF. (R. H.)

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ALIMONY, in law the allowance for maintenance to which a wife is entitled out of her husband's estate for her support in or consequent upon a matrimonial cause. Though, as a rule, payable to a wife, it may, if the circumstances of the case warrant it, be payable by the wife to the husband. Alimony is of two kinds, (*a*) temporary (*pendente lite*), and (*b*) permanent. *Temporary* alimony, or alimony pending suit, is the provision made by the husband for the wife in causes between them to support her during the progress of the suit, and is allowed whether the suit is by or against the husband and whatever the nature of the suit may be. The usual English practice is to allot as temporary alimony about one-fifth of the husband's net income; where it appears that the husband has no means or is in insolvent circumstances, the court will refuse to allot temporary alimony. So where the wife is supporting herself by her own earnings, this fact will be taken into consideration. And where the wife and husband have lived apart for many years before the institution of the suit, and she has supported herself during the separation, no alimony will be allotted. Nor will the wife be entitled to alimony where she has sufficient means of support independent of her husband. *Permanent* alimony is that which is allotted to the wife after final decree. By the Matrimonial Causes Act, 1907, the court may, if it think fit, on any decree for dissolution or nullity of marriage, order that the husband shall, to the satisfaction of the court, secure to the wife such a gross sum of money or such annual sum of money for any term not exceeding her life, as having regard to her fortune (if any), to the ability of her husband, and to the conduct of the parties, it may deem reasonable. The court may suspend the pronouncing of its decree until a proper deed or instrument has been executed by all necessary parties. The court may also make an order on the husband for payment to the wife during their joint lives of a reasonable monthly or weekly sum for her maintenance; the court may also at any time discharge, modify, suspend or increase the order according to the altered means of the husband; the court has also power to make provision for children. Alimony is paid direct to the wife or to a trustee or trustees on her behalf, but the court may impose any restrictions which seem expedient. We may also describe as a kind of alimony the allowance of a reasonable weekly sum not exceeding £2 which in England, under the Summary Jurisdiction (Married Women) Act, 1895, may be given to a married woman on applying to a court of summary jurisdiction if she has been forced by cruelty to leave her husband or has been deserted by him.

United States.—Alimony is granted on much the same principle as in England, though in many states the courts of equity as such may grant alimony without divorce or separation proceedings independently of any statute, on the ground that the husband ought to support his wife when she lives apart from him for his fault, and since the courts of common law provide no remedy the courts of equity will. This is so in Alabama, Kentucky, North Carolina, Iowa, California, Ohio, Virginia, South Dakota and the District of Columbia. In other states alimony without such proceedings is allowed by statute, and such alimony is now very general throughout the United States. The usual grounds for the allowance of it are desertion and such conduct as would amount to legal cruelty. After divorce *a vinculo*, alimony or separate maintenance is sometimes granted on good reason. In several states alimony or maintenance is by statute allowed to the husband in certain cases out of the wife's property. This is so in Massachusetts, Virginia, Rhode Island and Iowa. In Oregon he is entitled to one-third of his wife's real estate in addition to maintenance on divorce for her fault. Judgment for alimony is considered a judgment *in personam* and not *in rem*, and can only be enforced outside the state where rendered in case the husband has been personally served with process within that state.

ALIN, OSCAR JOSEF (1846–1900), Swedish historian and politician, was born at Falun Dec. 22, 1846, and became rector of Uppsala university.

Among his numerous works the following are specially worthy of note: *Bidrag till svenska rådets historia under medel tiden* (1872); *Sveriges Historia, 1511–1611* (1878); *Bidrag till svenska statsrickets historia* (1884–87); *Den svensk-norsk Unionen* (1889–91), the best book on the Norwego-Swedish union question from the Swedish point of view; *Fjerde Artiklen af Fredstraktaten i Kiel* (1899); *Carl Johan och Sveriges yttre politik, 1810–1815* (1899); *Carl XIV. och Rikets Ständer, 1840–1841* (1893). He also edited *Svenska Riksdagsakter, 1521–1554* (1887), in conjunction with E. Hildebrand, and *Sveriges Grundlagar* (1892).

ALINGTON, CYRIL ARGENTINE (1872–), British educationist and writer, was born in Ipswich, Oct. 22 1872, and educated at Marlborough College and Trinity College, Oxford. In 1908 he was appointed headmaster of Shrewsbury School and in 1916 succeeded his brother-in-law, Edward Lyttelton, as headmaster of Eton. Dr. Alington commanded the respect and affection of his pupils and while not hostile to new ideas sought to maintain rather than modify the public school tradition. His published works include *A Schoolmaster's Apology* (1914), a brief but discursive expression of his educational ideals; two popular novels, *Strained Relations* (1922) and *Mr. Evans* (1922); some humorous verse, and collections of sermons and addresses.

ALIQUOT PART, an exact divisor of a number or quantity (that is, a divisor giving an integral quotient). For example, 2 is an aliquot part of 10, $33\frac{1}{3}$ is an aliquot part of 100, a line $2\frac{1}{2}$ in. long is an aliquot part of one that is $7\frac{1}{2}$ in. long, and $\frac{1}{4}$ is an aliquot part of 1; but $\frac{2}{3}$ is not an aliquot part of 1, the quotient of 1 divided by $\frac{2}{3}$ not being an integer.

ALIRAJPUR, an Indian State under the Bhopawar agency in central India. It lies in Malwa, near the frontier of Bombay. It has an area of 836sq m.; and a pop. (1921) of 89,364. The country is hilly, and many of the inhabitants are aboriginal Bhils.

ALISMACEAE, in botany, a family of monocotyledons belonging to the series Helobieae, and represented in Britain by the water plantain, *Alisma Plantago*, the arrow-head, *Sagittaria*, the star-fruit, *Damasonium*, and flowering rush, *Butomus*. They are marsh or water-plants with generally a stout stem (*rhizome*) creeping in the mud, radical leaves and a large, much branched inflorescence. The submerged leaves are long and grass-like, the floating leaves oblong or rounded, while the aerial leaves are borne on long, thin stalks above the water, and are often arrow-shaped at the base The flower-bearing stem is tall; the flowers are borne in whorls on the axis as in arrow-head, on whorled branchlets as in water plantain or in an umbel as in *Butomus* (*see* fig.). They are regular and rather showy, generally with three greenish sepals, followed in regular succession by three white or purplish petals, six to indefinite stamens and six to indefinite free carpels. The fruit is a head of achenes or follicles. The flowers contain honey, and attract flies or other small insects by which pollination is



A VERTICAL SECTION THROUGH THE FLOWERING RUSH AND ITS FLORAL DIAGRAM

effected. There are about 75 species in eleven genera, widely distributed in temperate and warm zones. *Alisma Plantago* (*see* fig.), a common plant in Britain (except in the north) in ditches and edges of streams, is widely distributed in the north temperate zone and on mountains.

In the United States and Canada the family is represented by about 40 native species, some three-fourths of which are arrow-heads. Among the other representatives are the cosmopolitan water plantain, two species of bur-head (*Echinodorus*), the dwarf bur-head (*Helianthium parvulum*) and the fringed water plantain or star-fruit (*Damasonium californicum*) of California. (*See* ARROW-HEAD)



THE WATER PLANTAIN, THE COMMON REPRESENTATIVE OF THE ALISMACEAE FAMILY IN GREAT BRITAIN Upper left, the flower enlarged. Upper right, its floral diagram. Lower left, vertical section through flower. Lower right, the fruit

ALISON, SIR ARCHIBALD, BART. (1792–1867), Scottish historian, was born at Kenley, Shropshire, England. His father, ARCHIBALD ALISON (1757–1839), was the author of a well-known book of *Essays* on *the Nature and Principles of Taste* (1790). The son was educated at Edinburgh university and held various high legal positions in Scotland. He spent fifteen years in collecting the materials for his *History of Europe*.

The history of the period from the beginning of the French Revolution till the restoration of the Bourbons in 1815 was completed in ten volumes in 1842. Within a few years it ran through ten editions, and was translated into many of the languages of Europe, as well as into Arabic and Hindustani. It brought together, though not always in a well-arranged form, an immense amount of information that had before been practically inaccessible to the general public A continuation of the *History*, embracing the period from 1815 to 1852, which was completed in four volumes in 1856, did not meet with the same success as the earlier work. His literary activity continued till within a short time of his death, the chief works he published in addition to his *History* being the *Principles of Population* (1840), in answer to Malthus; a *Life of Marlborough* (1847, 2nd edition, greatly enlarged, 1852); and the *Lives of Lord Castlereagh and Sir C. Stewart* (1861). Three volumes of Alison's political, historical and miscellaneous essays were reprinted in 1850. His autobiography, *Some Account of My Life and Writings*, edited by his daughter-in-law, Lady Alison, was published in 1883 at Edinburgh. His elder son, SIR ARCHIBALD ALISON (1826–1907), was a distinguished soldier who served in the Crimea and the Indian Mutiny, was second in command of the Ashanti expedition (1873–74), and led the Highland Brigade at Tel-el-Kebir. He was made full general in 1887, and became military member of the Council of India in 1889.

ALIWAL, a village in British India, Ludhiana district, Punjab, on the left bank of the Sutlej, famous as the scene of a great battle of the first Sikh War (*q.v.*). In Jan. 1846 it was held by a Sikh army, which had crossed the river and threatened Ludhiana. On the 28th Sir Harry Smith attacked, and after a desperate struggle pushed the enemy into the river, where large numbers perished, leaving 67 guns to the victors.

ALIWAL NORTH, a town situated on the left bank of the Orange river, which here forms the boundary between the Cape Province and the Orange Free State, and which is spanned by a bridge 860ft. in length; 30° 31′ S., 26° 53′ E. Pop. (1921) white 2,443, coloured 3,819. Altitude 4,350ft.; distance by rail from East London, 280 miles. Aliwal North is a trading centre for the surrounding country and for south-west Basutoland. It is also the administrative centre for the magisterial district of the same name. The town was founded in 1849 and is laid out on the usual South African rectangular plan. The streets are bordered by open water-furrows, and lined with trees. A dam, built across the Orange river, has made available for boating a six mile stretch of water, which provides the town with electric light.

Aliwal North is becoming recognized as one of the chief inland health resorts of South Africa. The climate is recommended for sufferers from lung troubles. The average relative humidity for the year is 61·5 and the average cloudiness 3·3. The temperature may rise to over 90° in summer, but the nights are cool, and in winter sharp frosts occur. A little over a mile from the town are high-temperature mineral springs yielding over a million gal. a day. The water is beneficial for rheumatism and skin diseases. A gallon contains 0·85 grains of lithium carbonate, 7·41 carbonate of lime, 1·95 sulphate of magnesium, 3·24 ammonia, 0 95 potash, 8·10 calcium chloride, 61·35 sodium chloride, 1·04 silica, 0·12 sodium bromide, 5·22 carbonic acid gas. At the springs, baths have been built, and 14ac. of pleasure grounds have been laid out.

The town was named in honour of Sir Harry Smith, governor of Cape Colony (1847–52), to commemorate the victory of Aliwal.

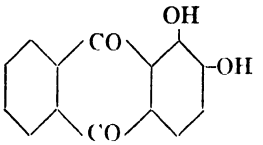
ALIZARIN, a vegetable dyestuff prepared from the root of the madder (*Rubia tinctorum*), was known to the ancients, and was prepared entirely from this source until 1868. The pure substance crystallizes in red prisms melting at 290° C. It is insoluble in water, and not very soluble in alcohol. It dissolves readily in caustic alkalis on account of its phenolic character, and it forms a yellow-coloured di-acetate. Its value as a dyestuff depends on its power of forming insoluble compounds (lakes) with metallic oxides. It is in the form of these lakes that it produces coloured effects on textile fibres. Alizarin red on wool is a complex lake of alizarin with the oxides of calcium and aluminium (*see* DYEING).

Madder contains a glucoside (*q.v.*), ruberythric acid, which is readily broken up (hydrolysed) by acids or ferments into alizarin and glucose:

$$C_{26}H_{28}O_{14} + 2H_2O = 2C_6K_{12}O_6 + C_{14}H_8O_4$$

Ruber-ythric acid — Water — Glucose — Alizarin

Alizarin has the chemical constitution 1·2 Dihydroxyanthraquinone and the structural formula



It owes its phenolic properties to the two —OH (hydroxy) groups attached to a benzene nucleus.

$$C_6H_4\begin{matrix}CO\\CO\end{matrix}O + C_6H_4(OH)_2[1\cdot2] = H_2O + C_6H_4\begin{matrix}CO\\CO\end{matrix}C_6H_2(OH)_2.$$

The first step in the synthetical production of alizarin was the discovery in 1868 of C. Graebe and C. Liebermann that on heating with zinc dust, alizarin was converted into anthracene, an aromatic hydrocarbon obtained from coal tar. They then oxidized anthracene to anthraquinone and brominated the quinone. The dibrominated product so obtained was fused with caustic potash, the melt dissolved in water, and on the addition of hydrochloric acid to the solution, alizarin was precipitated. This process, owing to its expensive nature, was soon superseded by another, discovered simultaneously by the above-named chemists and by Sir W. H. Perkin, the method being to sulphonate anthraquinone, and then to convert the sulphonic acid into its sodium salt and fuse this with caustic soda. Alizarin is also synthesised by heating catechol with phthalic anhydride and sulphuric acid at 150° C.

ALKAHEST (a pseudo-Arabic word believed to have been invented by Paracelsus), a liquid having the power of dissolving gold and every other substance, much sought after by the alchemists, who supposed it would possess invaluable medicinal qualities.

ALKALI, an Arabic term originally applied to the ashes of plants, from which by lixiviation carbonate of soda was obtained in the case of sea-plants and carbonate of potash in that of land-plants. The method of making these "mild" alkalis into "caustic"

alkalis by treatment with lime was practised in the time of Pliny in connection with the manufacture of soap, and it was also known that the ashes of shore-plants yielded a hard soap and those of land-plants a soft one. But the two substances were generally confounded as "fixed alkali" (carbonate of ammonia being "volatile alkali"), till Duhamel du Monceau in 1736 established the fact that common salt and the ashes of sea-plants contain the same base as is found in natural deposits of soda salts ("mineral alkali"), and that this body is different from the "vegetable alkali" obtained by incinerating land-plants or wood (pot-ashes). Later, Martin Heinrich Klaproth, finding vegetable alkali in certain minerals, such as leucite, proposed to distinguish it as potash, and at the same time assigned to the mineral alkali the name *natron*, which survives in the symbol, Na, now used for sodium. The word alkali supplied the symbol for potassium, K (*kalium*). In modern chemistry alkali is a general term used for compounds which have the property of neutralizing acids, and is applied more particularly to the highly soluble hydroxides of sodium and potassium, and of the three rarer "alkali metals," caesium, rubidium and lithium, also to aqueous ammonia. In a smaller degree these alkaline properties are shared by the less soluble hydroxides of the "metals of the alkaline earths," calcium, barium and strontium, and by thallous hydroxide. An alkali is distinguished from an acid or neutral substance by its action on litmus, turmeric and other indicators (*See* ALKALI MANUFACTURE)

ALKALI MANUFACTURE. The group of materials includes sodium carbonate (soda ash), caustic soda, bicarbonate of soda, soda crystals (washing soda), sodium silicate (water-glass), sulphate of soda (salt cake) and sodium sulphide Certain other substances are linked with these in manufacture, such as chlorine, which is produced simultaneously with caustic soda by certain processes, and which in turn gives rise to bleaching powder, hydrochloric acid and so forth. Alkali and chlorine are, under modern practice, inseparable, and form one comprehensive and intimately connected group of manufactures (the "heavy chemical" trade). The principal products (soda ash, caustic soda and chlorine) form raw materials for other industries.

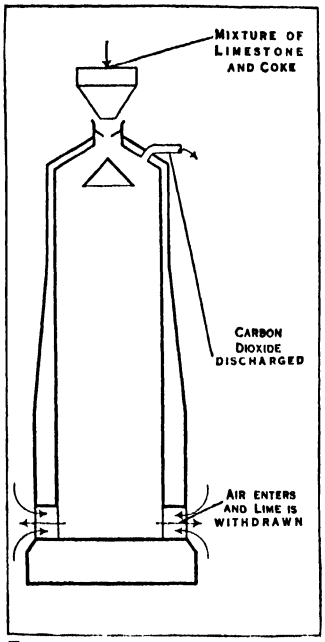


FIG 1.—DIAGRAM OF A LIME KILN
The mixture is discharged from the hopper at the top at intervals. The cone immediately below spreads the charge evenly. The carbon dioxide is drawn off through the vent shown, and the lime is withdrawn at the bottom. Kilns vary in size, some being 70 ft. high with internal diameter of 14 feet

The chief centres of alkali production are England, Belgium, France, Germany and the United States.

MANUFACTURE OF SODIUM CARBONATE

The manufacture of alkali and chlorine by modern methods requires complicated plant; but the relatively few plants in operation are highly efficient and, economically placed as regards carriage of raw materials and shipping of products, and work on a very large scale. It is to be emphasized that the industry has been very considerably standardized in recent years; the old Le Blanc "black ash" process has been replaced by the Solvay "ammonia-soda" process, the basis of which is the mutual decomposition, in water, of ammonium bicarbonate and sodium chloride (common salt).

NaCl	+	NH_4HCO_3	=	$NaHCO_3$	+	NH_4Cl
(Common salt)		(ammonium bicarbonate)		(sodium bicarbonate)		(ammonium chloride)

Raw Materials.—The raw materials required are coal (to supply power and heat), salt and limestone of good quality. Salt is the source of the sodium in the finished products. It occurs as a mineral, widely distributed over the globe, in subterranean beds of great thickness. For the purpose of alkali manufacture it is not mined, but extracted in the form of brine by pumping. This brine occurs naturally in many places and has been formed by the percolation of underground springs through the salt beds; when of a sufficient degree of saturation it is used direct. In other cases water has to be admitted artificially to the salt deposits and then, after saturation, pumped again as brine.

The limestone serves a double purpose; it is the source of the carbon dioxide gas which when combined with the sodium of the salt produces sodium bicarbonate; and it is also the source of the lime with which, as we shall see presently, the ammonia (from which the process takes its name) is recovered and returned to the cycle of operations. Only the better class of limestone is used for alkali. The stone is quarried and crushed; it is then burnt, intimately mixed with coke, in tall kilns to which a regulated quantity of air is admitted (*see* fig. 1). These kilns are periodically charged at the top; and as the charge travels downwards the lime is extracted at the bottom and the kiln gases containing the carbon dioxide, are drawn off at the top. Ammonia, which forms the key to the whole operation and is obtained principally from gas-works liquor (a residue from the distillation of coal), cannot properly be regarded as a raw material

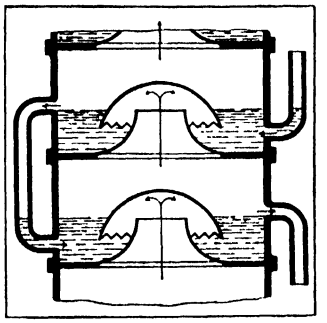


FIG 2.—SECTION OF PART OF AN AMMONIA ABSORPTION TOWER
The gas enters each compartment through funnel shaped holes which are surmounted by domes to distribute the gas evenly into the liquor. The liquor descends through the pipes, comes in contact with the gas, absorbs part of it and leaves the compartment

The Process.—The production of crude sodium bicarbonate is the central operation The brine, usually after purification to remove undesirable magnesium and calcium compounds, is pumped into the top of tall vertical iron absorption towers. Simultaneously ammonia gas and some carbon dioxide are pumped in at the bottom. The thorough contact of the falling brine and the rising gases is ensured by the internal partitioning of the vessel in such a way that the whole of the ammonia is absorbed (*see* fig. 2). This absorption gives rise to a considerable evolution of heat, so the ammoniated brine is passed through a series of coolers to reduce its temperature.

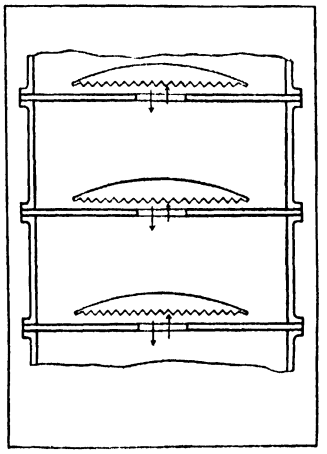


FIG 3.—PART OF AN AMMONIA-SODA PRECIPITATING TOWER
The gas rises from the bottom through holes in the partitioning plates. Each hole is surmounted by a flat dome. The liquor descends and the contact with the gas produces sufficient agitation to enable the bicarbonate so formed to be carried to the bottom with the liquor

From the coolers the liquor is pumped to the top of a system of iron towers, subdivided internally, at the bottom of which carbon dioxide gas enters; this carbon dioxide is obtained partly from the limekilns as already described and partly from a later stage of the process in which sodium bicarbonate is heated to form the carbonate. The interaction of this carbon dioxide with the ammoniated brine produces a precipitate of sodium bicarbonate and at the same time disengages a considerable quantity of heat which has to be counteracted by a system of coolers in the lower part of the towers; the reaction is reversible, and is greatly influenced by the temperature, so that the maintenance of the liquor at the correct temperature is of the first importance (*see* fig. 3).

The magma of bicarbonate and mother liquor is taken con-

tinuously from the towers and fed on to rotary vacuum filters (*see* fig. 4). Here the mother liquor is removed and the bicarbonate washed with a little water. The crude bicarbonate is then conveyed automatically to the so-called "finishing machines" for conversion to carbonate. These machines consist of hemi-cylindrical iron vessels, with mechanical agitators, and are heated from below either with producer gas or by direct coal-firing. The crude bicarbonate is fed in at one end, and in its passage along the length of the machine loses carbon dioxide, water, and any ammonia

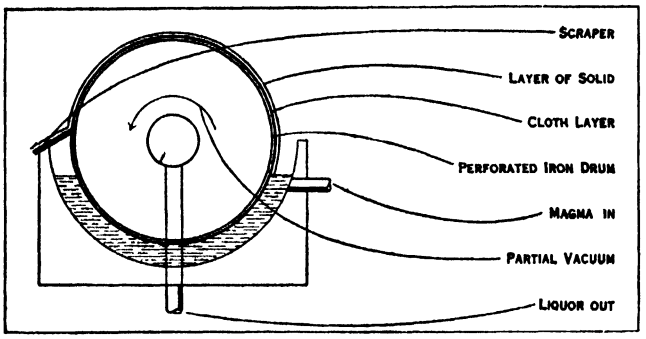


FIG. 4.—ILLUSTRATING THE PRINCIPLE OF THE ROTARY FILTER
The perforated iron drum revolves continuously and is so arranged that a partial vacuum exists within it. As the drum turns the vacuum sucks in the liquor through the cloth layer and leaves a layer of solids upon it. The scraper removes this layer from the drum, leaving the cloth clean for the next revolution

that it may contain. These gases are then returned to the towers. The product issuing from the finishing machines is sodium carbonate, and is usually referred to as "soda ash." The purity is very high, averaging 98% sodium carbonate, the remainder being mostly salt.

Uses of Soda Ash.—Almost every manufactured commodity has at some stage of its production made use of soda ash or its derivatives, the yearly world production of which has now reached some three and a half millions of tons. For example, glass of all kinds contains from 10 to 20% by weight of soda and accounts for roughly one quarter of the total consumption. There are indeed certain qualities of glass which do not use soda ash, but these are for special use and do not affect the general statement. All hard soap has been made primarily from animal or vegetable fats and caustic soda, the latter being derived directly from soda ash; this accounts for another quarter of the consumption. The textile industry accounts for one-sixth, employed in wool-scouring, cotton-scouring, calico printing, flax boiling and so on. The general chemical industry takes about one-tenth, and paper one-twentieth. The remainder is consumed in comparatively small quantities by a number of industries, a full list of which is astonishing in its length and variety. Fig. 5 gives this distribution, which is of course only approximate, in a graphic form.

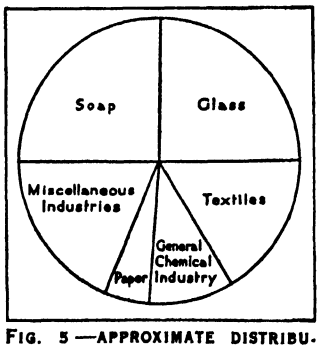


FIG. 5.—APPROXIMATE DISTRIBUTION OF SODA ASH
Almost every manufactured commodity needs soda-ash or its derivatives in its production. The annual world requirements now reach 3½ million tons

Recovery of Ammonia.—Apart from the small amount carried forward with the crude bicarbonate, which is recovered separate, the bulk of the ammonia is contained in the mother liquor separated at the filters and is in the form of ammonium chloride. This liquor is therefore distilled with lime. As, however, the liquor still contains some ammonia in combination with residual carbon dioxide it is first of all subjected to treatment with steam to eliminate these compounds.

The liquor is then fed, together with milk of lime produced by mixing lime from the kilns with water, into the top of the distiller, a tall iron tower with internal divisions: exhaust steam is admitted to the bottom, the temperature of the liquor is raised, and the ammonia distils off accompanied by some carbon dioxide. These gases together with those given off in the preliminary steam treatment are cooled and then pass to the absorption system to undergo a further round of the process. Under modern methods the loss of ammonia is extremely small. The liquor leaving the bottom of the distiller contains calcium chloride and about one-third of the salt that originally entered the process: some calcium chloride is occasionally extracted and sold, but in general it is a waste product. It also contains excess lime, grit and pebbles, the economical disposal of which is a problem still to be solved. Fig. 6 is a diagram that will serve to connect in the reader's mind the foregoing operations with some of those about to be described.

Sodium Bicarbonate.—Part of the crude bicarbonate obtained by the ammonia soda process is converted into "refined

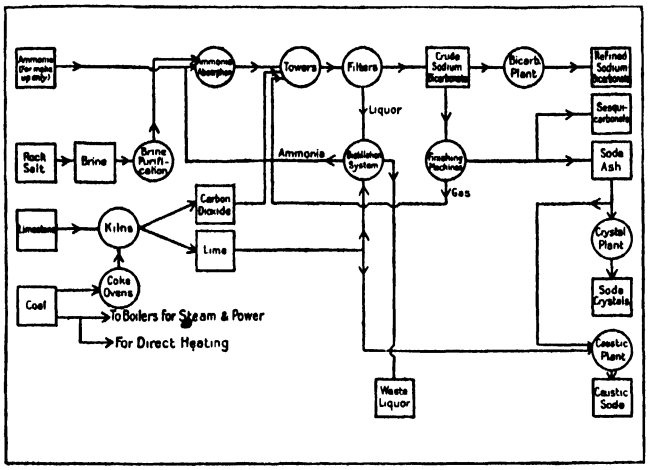


FIG. 6.—THE AMMONIA-SODA PROCESS AND PRINCIPAL PRODUCTS
The raw materials used are shown to the left. The plant and the processes are shown in continuous progression across the diagram. The resulting products are to be seen on the right

bicarbonate of soda" which is largely used in the preparation of food and drugs. The trade in it is very steady, and does not vary appreciably from year to year. It is principally used as a source of carbon dioxide gas for the manufacture of artificial mineral waters. Another source of consumption is the baking industry: baking powders contain sodium bicarbonate and a weak vegetable acid (citric, tartaric, etc.) which are prevented from reacting on one another when dry by a film or glaze of starch round the individual grains: on moistening in the process of dough making, these compounds react, carbon dioxide is evolved, and the dough "rises." The action of yeast is similar in that carbon dioxide is produced but dissimilar in that the production of the gas is due to organic fermentation. Bicarbonate of soda is also used largely in medicine and in proprietary compounds for daily use. It is one of the principal ingredients of "blue" for laundry purposes, and a large amount is consumed in the manufacture of dry soap.

Sodium Sesquicarbonate.—This is the form in which soda occurs in nature, mixed of course with more or less impurity. In composition it is intermediate between sodium carbonate and bicarbonate, and it contains some combined water:—

$$NaCO_3 + NaHCO_3 + 2H_2O = Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O$$
(Sesquicarbonate)

It is manufactured directly from crude bicarbonate, the process of heating to drive off carbon dioxide not being carried so far as for the manufacture of soda ash. It has the advantage of being a mild alkali well suited for laundry detergent purposes and is sometimes known as "concentrated soda crystals."

Soda Crystals (Washing Soda).—If soda ash be dissolved in water and the solution allowed to crystallize slowly, large transparent crystals are produced of the composition $Na_2CO_3 \cdot 10H_2O$. In this form the product is familiar to everyone as "washing soda." In practice the manufacture is not quite so simple. Soda ash is first dissolved in hot water. This solution frequently contains small amounts of iron and organic matter which are removed and the liquor is rendered colourless by the addition of small quantities

of bleaching powder. The clear settled liquor is then transferred to large steel crystallizing pans; where it gradually cools and deposits the crystals. After a few days these are fished out, dried, graded for size and packed. Their principal use is in domestic and laundry work, in the manufacture of dyestuffs, varnishes and photographic materials, and in tanning.

Sodium Silicate (Water-glass).—This familiar product is manufactured by fusing together soda ash and clean pure sand in a furnace. The latter is built of fireclay blocks with an arched roof of silica, and is heated internally by a direct flame produced by the combustion of producer gas or oil. The mixed charge of ash and sand is fed in at one end of the furnace and the molten glass is drawn off at intervals at the other. The glass may either be broken up by jets of water as it runs in a molten stream from the furnace, or it may be allowed to cool and be subsequently broken up by hand. It is then fed into a dissolver which may be either of a horizontal and rotary type, or stationary and vertical. In either case the glass is treated with a mixture of water and steam and goes into solution. The latter is then bleached, if necessary, and clarified; and is then concentrated in evaporators of modern type. The resultant viscous fluid is the "water-glass" of commerce. A familiar but minor use is that of preserving eggs; the effect is produced by the closing of the pores of the egg shell by the silicate, which results in the exclusion of air and the prevention of putrefaction. It is an excellent adhesive for all purposes and particularly for machine work in box making. In the United States particularly this application has become very widespread. It is used with remarkable effect to harden and consolidate the surface of concrete: the effect is produced by the interaction of the silicate with the lime of the concrete whereby hard calcium silicate is formed. The silicate may be applied either during the process of concrete making or to the finished concrete surface. It often forms an ingredient of soap of inferior quality. Other applications include the lining of casks, ceramics, fireproofing of wood, preservation of wood against the attacks of insects, ink making, flotation of ores, paints, silk weighting, and so on. For all these various uses there is usually available a particular grade of silicate, dependent upon the ratio of silica to soda best suited to the purpose, the degree of viscosity required and the rate of drying.

MANUFACTURE OF CAUSTIC SODA

Caustic soda can be produced in two separate ways by the conversion of soda ash direct, or by subjecting brine to the action of the electric current (electrolysis) whereby caustic soda is produced simultaneously with chlorine. Two methods may be used for the direct conversion of soda ash, that of Löwig, a now obsolete process, and the lime-caustic process.

The Lime-Caustic Process.—In this process a solution of soda ash is treated with lime, either in the form of milk of lime or by direct introduction of quicklime. The ensuing reaction causes a "double decomposition" to take place, which produces a solution of caustic soda and a precipitate of calcium carbonate.

$$\underset{\text{(soda ash)}}{Na_2CO_3} + \underset{\text{(slaked lime)}}{Ca(OH)_2} = \underset{\text{(caustic soda)}}{2NaOH} + \underset{\text{(calcium carbonate)}}{CaCO_3}$$

This reaction does not proceed to completion at once nor does the precipitate settle readily; so that a large part of the plant, after the reaction vessel, consists of time vessels and settling vats. After the liquor has passed through these, and the residual calcium carbonate has been filtered out, it passes to a series of vacuum evaporators, working usually in two or three stages, where it is concentrated by steam heat to a degree that is limited by the economics of the method. The final stage of the concentration, which results in the complete elimination of all water, is accomplished in large hemispherical iron pots heated underneath by direct firing by coal or producer gas. The final product is molten caustic soda which is run or ladled off into thin iron drums where it solidifies (*see* fig. 7).

As the conversion of soda ash can never be taken to absolute completion whatever method be employed (the reaction being a "balanced" or "reversible" one), means must be found for the removal of unchanged ash and impurities. These "salts" separate out in the earlier stages of the concentration of the liquor. The precipitated calcium carbonate (chalk) may either be sold, after drying, for agricultural use, or may be calcined and returned to the first stage of the process.

The Electrolytic Process.—This method is entirely different and depends upon the effect produced when a current of electricity is passed through brine. This is more particularly described

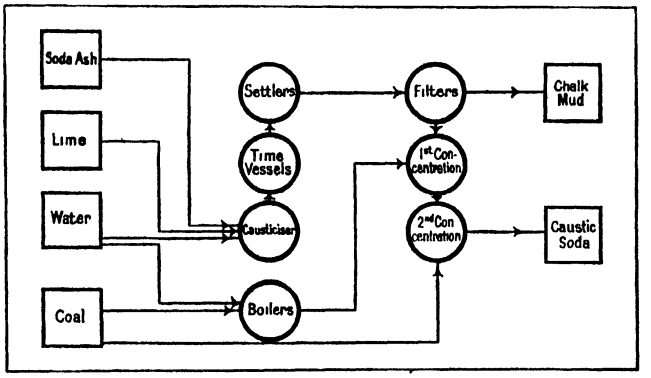


FIG. 7.—THE MANUFACTURE OF CAUSTIC SODA FROM SODA-ASH
The raw materials are shown on the left. The lines show the flow of materials through the various processes, with the finished products on the right

under the heading CHLORINE IN INDUSTRY (*q.v.*). The effect, in short, is to produce simultaneously a solution of caustic soda, chlorine gas, and hydrogen gas. The caustic solution is treated as already described; the chlorine is piped off to subsidiary plants; while the hydrogen may either be allowed to escape into the air or may be converted to ammonia or hydrochloric acid. This method is finding increased application and the caustic soda now made by it forms an appreciable proportion of the total: at the same time it is evident that the output is limited by the extent to which it may be found possible to dispose of the concomitant chlorine.

Uses of Caustic Soda.—An important consumer of caustic soda is the artificial silk trade which uses it for digesting and purifying the cellulose which forms the basis of the industry. One-third or more of the total output of caustic soda is used for this purpose, no account being taken of the caustic soda made by soapmakers themselves. The largest consumer of caustic soda is the soap industry, in which the caustic is used to decompose the animal and vegetable fats, with liberation of glycerine and production of the sodium salt of the acid of the fat; this sodium salt is in fact soap of the "hard" variety. "Soft" soaps contain potash in place of soda The textile industry uses caustic soda for a variety of purposes, one of the more familiar being the process of "mercerization" by which cotton fibre can be made to take on a gloss somewhat resembling silk. Soap and textiles account each for about one-sixth of the total consumption; and paper and oil refining for about one-eighth combined. The remainder is split up among a very large number of minor uses. Fig. 8 gives a graphic representation of these proportions, which, as for soda ash, are necessarily only approximate.

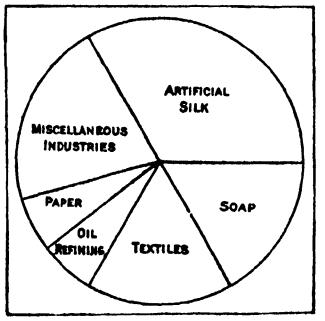


FIG. 8.—APPROXIMATE DISTRIBUTION OF CAUSTIC SODA
Caustic soda is the second most important product in the alkali industry. The two largest consumers are the soap and artificial silk industries

MANUFACTURE OF SALT CAKE

By this name is known the residue resulting from the treatment of salt with strong sulphuric acid in the manufacture of hydrochloric acid (*q.v.*). It consists of sodium sulphate with a small proportion of free sulphuric acid. Apart from the strictly utilita-

rian view, this product has an interest inasmuch as its manufacture, together with that of sodium sulphide, is the only surviving part of the celebrated Le Blanc soda process (*see* LE BLANC, NICOLAS).

In brief, the process consists of two parts, the salt-cake process, and the "black ash" process. The salt-cake process is described elsewhere (*see* HYDROCHLORIC ACID); the reaction of sulphuric acid with common salt produces hydrochloric acid and sodium sulphate (salt cake).

$$H_2SO_4 + 2NaCl = Na_2SO_4 + 2HCl$$
(Sulphuric acid) (Salt) (Sodium sulphate) (Hydrochloric acid)

The second stage involves the conversion of the salt cake to carbonate by heating with limestone and coal; the former to provide the required carbonic acid and the latter to reduce the salt cake to a form in which it will react with the limestone: thus:—

1. $Na_2SO_4 + 2C = Na_2S + 2CO_2$
(Carbon or coal) (Sodium sulphide) (Carbonic acid)
2. $Na_2S + CaCO_3 = CaS + Na_2CO_3$
(Limestone) (Calcium sulphide) (Sodium carbonate)

The mass (black ash) resulting from this furnace operation was then, after standing for a day or two, extracted with water and the liquor evaporated for the recovery of sodium carbonate. The insoluble part of the black ash formed unsightly heaps of "alkali waste" upon which much research had to be conducted before a satisfactory method of utilizing their valuable sulphur contents was discovered. Salt cake itself is a white powder and usually contains a small proportion, about 1%, of free sulphuric acid, with a smaller amount of undecomposed salt.

When the Le Blanc process was the principal source of alkali, salt cake was required in such quantity that the hydrochloric acid produced with it was more than could be absorbed in industry, so that processes were devised by Weldon and Deacon for converting a large proportion to chlorine for subsequent use in the manufacture of bleaching powder. The introduction of the ammonia soda process has completely reversed that state of affairs. Although a certain quantity of salt cake is still required, for purposes specified below, the hydrochloric acid thereby produced does not suffice for modern requirements; the quantity is therefore supplemented by direct synthesis of acid from hydrogen and chlorine, or by manufacturing a further supply of salt cake. As for chlorine, so far from it now being deliberately manufactured as an outlet for surplus hydrochloric acid, it is a matter of some difficulty to dispose of the quantity produced in the electrolytic process for making caustic soda.

Salt cake is used to a certain extent in the glass industry, where it serves as a source of sodium; for the manufacture of sodium sulphide and Glauber's salts (*qq.v.*); and, in far larger quantities, as a raw material for the sulphite process of wood pulp and paper manufacture. It is a matter of some difficulty to dispose of all the salt cake now produced; more especially as it is also obtained as a by-product of the potash industry in Germany, and further occurs naturally in Canada. (A. E. H.)

AMERICAN PRACTICE

In England and to some extent on the continent the Le Blanc soda process was the first large scale chemical development. The desired product was soda ash (sodium carbonate, Na_2CO_3) from which it was natural to proceed to sodium bicarbonate ($NaHCO_3$) soda crystals ($Na_2CO_3 \cdot 10H_2O$) and caustic soda (NaOH) and later to sodium silicate. But the raw material for soda ash was sodium sulphide (Na_2S) with sulphur as a by-product. The Na_2S was made from sodium sulphate (Na_2SO_4) and the latter in turn came from the reaction of sulphuric acid on common salt (NaCl) with hydrochloric acid as a by-product. In order to dispose of the large quantities of hydrochloric acid it was necessary to convert much of it into chlorine and bleaching powder. Thus the manufacture of such divergent products as acids, alkalis, sodium salts, chlorine and bleach all developed together in one plant, under one management, as the "alkali industry," and all the sodium compounds handled regardless of their nature became the "alkalis."

America with entirely different chemical history never had such an "alkali industry," and does not apply the term "alkali" to such a group of sodium salts. The products of the English "alkali industry" are manufactured in America by at least four distinct groups of the chemical industry, these four groups having very little in common. First, the acid manufacturer: This industry, established about 1800, is responsible for sulphuric acid, hydrochloric acid, salt cake (sodium sulphate, Na_2SO_4) and Glauber's salt ($Na_2So_4 \cdot 10H_2O$). Second, the soda industry: Established about 1870, using the ammonia soda or Solvay process exclusively, and responsible for soda ash, sodium bicarbonate, sodium sesquicarbonate, and the major part of the caustic soda. Third, the electrolytic chlorine industry, established about 1890, and responsible for chlorine, bleach, and the remainder of the caustic soda. Fourth, the specialty manufacturer responsible for sodium silicate and sodium sulphide. As to location, the first group will be near important centres of manufacture where acid consumption is large. When the condition of the market warrants it they will also convert nitre cake ($NaHSO_4$) a by-product of nitric acid manufactured into salt cake by neutralizing Otherwise it will be sold for its acid content or as a raw material for making sodium sulphide. The second group will be near large salt beds such as those of Michigan, Ohio, New York, Virginia or Kansas. The third group seeks cheap power or cheap fuel, which attracted several of them to Niagara Falls, New York, and others to West Virginia. It is not uncommon for a consumer of chlorine or chlorine and caustic soda to establish an electrolytic plant essentially to care for his own consumption In this case cheap fuel and power are not necessarily the controlling factors. A consumer of large quantities of caustic soda alone, on the other hand, would buy soda ash and convert it to caustic soda in his causticizing plant. Much of the caustic soda and the chlorine produced in America is for direct consumption and not for sale. The fourth group of specialty manufacturers may be anywhere.

Soda ash, sodium bicarbonate and trona are also produced from the natural alkaline lake brines of California, Wyoming and Canada, but the production is relatively unimportant as yet and is mainly for local consumption. Natural sodium sulphate production from Arizona, Canada, Nevada and Wyoming may possibly amount to 10% of the total sodium sulphate consumed.

Imports of all the group of sodium salts discussed in this article are negligible, and the only ones exported in any considerable quantity are caustic soda and soda ash.

Approximate production in the United States, 1920 census report: Soda ash 1,500,000 tons of which over 1,000,000 tons were for sale; sodium bicarbonate 190,000 tons, salsoda 83,000 tons, sodium sesquicarbonate 38,000 tons, caustic soda 333,000 tons, sodium silicate 336,000 tons, nitre cake 98,000 tons, salt cake 180,000 tons, Glauber's salts 42,000 tons and sodium sulphide 40,000 tons. (J. E. T.)

For modern ideas regarding alkalinity, *see* HYDROGEN-ION CONCENTRATION; INDICATORS; also ACID

BIBLIOGRAPHY.—The literature of the ammonia soda process is somewhat scanty; apart from the regular technical periodicals such as the *Journal Soc. Chemical Industry, Zeitschr. f. angew. Chemie, Zeitschr. f. phys. Chemie, etc.*, the following may be consulted: G. Lunge, The *Manufacture of Sulphuric Acid and Alkali*, vols. 2 and 3 (1909–11) (a revised edition of this work by A. C. Cumming is in course of publication). *Thorpe's Dictionary of Applied Chemistry* (revised ed. 1921, *et seq.*); H. Schreib, *Die Fabrikation der Soda nach dem Ammoniakverfahren* (1905), probably the best treatise on ammonia soda; H. Tedesco, *Studien über den Ammoniaksoda Prozess* (1910); H. Molitor, *Die Fabrikation der Soda* (1925); a general treatise on ammonia-soda; J. R. Partington, *The Alkali Industry* (1925), a book suitable, mostly, for the general reader; G. Martin, S. Smith, and F. Milsom, *The Salt and Alkali Industry, etc.* (2nd ed. 1920). Consult also the *Annual Reports on Alkali* (Government publication) and standard treatises on inorganic chemistry.

ALKALIMETRY, the determination of the quantity of free alkali (*q.v.*) in a substance. The chief laboratory method is by volumetric analysis. (*See* ACIDIMETRY and CHEMISTRY: *Analytical.*)

ALKALINE EARTHS. By the early chemists, the term *earth* was used to denote those non-metallic substances which were insoluble in water and were unaffected by strong heating;

and as some of these substances (*e.g.* lime) were found to be very similar in properties to those of the alkalis, they were called alkaline earths. The alkaline earths, lime, strontia and baryta, were assumed to be elements until 1807, when Sir H. Davy showed that they were oxides respectively of the metals, calcium, strontium and barium. The metals are never found in the uncombined condition, but occur most often in the form of carbonates and sulphates; they form oxides of the type RO, and peroxides of the type RO_2. The oxides of type RO are soluble in water, with generation of heat (*e.g.*, the slaking of lime); the resulting solution possesses a strongly alkaline reaction, due to the presence of the hydroxide $R(OH)_2$ which rapidly absorbs carbon dioxide on exposure. These oxides and hydroxides are basic in character and dissolve readily in acids with the formation of the corresponding salts. As the atomic weight of the elements increases, it is found that the solubility of the hydroxides in water increases although that of the sulphates decreases.

The metals calcium, strontium and barium oxidize rapidly on exposure. Their salts usually crystallize well, the chlorides and nitrates dissolve readily in water, whilst the carbonates, phosphates and sulphates are either very sparingly soluble or insoluble in water.

ALKALI SOILS. The term "alkali" is applied to those soils in which soluble salts have accumulated in amounts sufficient to cause injury to plant life. The toxic limit varies with the chemical composition of the soluble salts and also depends upon the variety of crop plants grown in the region. Soils of this character are usually found in regions of low rainfall, their origin being traced to the insufficiency of moisture to wash out and carry away the excess of soluble salts resulting from the weathering of the parent soil material. Under certain conditions the soluble salts accumulate at the surface, while under other conditions the greatest accumulation of soluble salts is found in a soil layer at some distance below the surface and varying with the depth to which the light rainfall of the region penetrates the soil or the depth to the water table Extensive studies of alkali soils have been made in America, Egypt, Hungary and other countries where arid or semi-arid conditions have resulted in the accumulation in the soil of harmful quantities of soluble salts. The salts that most frequently predominate are the carbonates, chlorides and sulphates of sodium, magnesium and calcium, or a mixture of two or more of these salts, but other forms may be encountered Under the broad definition of alkali soil the reaction is not necessarily alkaline, but under certain conditions the predominating salt may be neutral, as in the vicinity of Great Salt Lake, Utah, where sodium chloride is present in abundance.

Alkali is commonly designated as white alkali or as black alkali, depending upon the appearance of the incrustations caused by excessive accumulations at the surface of the soil Usually when large quantities of sodium chloride or sodium sulphate accumulate at the surface their presence is marked by white incrustations, hence the term white alkali. Since sodium carbonate, when present in large quantities attacks the vegetable matter of the soil, causing a dark brown stain, it is frequently called black alkali This classification is not entirely satisfactory since a much less harmful salt, such as sodium chloride, may likewise impart a dark stain to the soil surface. Since the salts of which the alkali is composed are readily soluble in water, it is evident that, while they will remain inactive in a dry soil, they will dissolve when water is added and will move with the moisture Farmers living in arid regions are familiar with the fact that parts of their fields heavily encrusted with alkali show no such crusts after heavy rains or after the application of irrigation water. The salts dissolve in the water and move down into the soil but again make their appearance at the surface as the water rises and evaporates leaving the salts behind. Many farmers in a new irrigation district have found to their dismay that after a few years of irrigation practice, alkali has appeared at unexpected places. If sufficient water is added not only to dissolve and start a downward movement of the salts, but also to leach them away into the country drainage, no harmful accumulation will occur. In many irrigated areas the greater part of the alkali accumulations in cultivated fields is the result of seepage, by which the soluble salts are moved from higher to the lower areas where there is a tendency for the drainage water to collect. Such accumulations can be prevented if precautions are taken to provide suitable drainage at the time the irrigation project is undertaken. Extensive studies of methods for the reclamation of alkali soils in different areas have been made and it has been demonstrated that where adequate drainage is provided and irrigation water of good quality is available, reclamation can be accomplished.

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ALKALOIDS. For reasons given below, it is not possible to give a precise definition of this term, although to the chemist there is no ambiguity in its use. Man had from very early times drugs, but his knowledge of the alkaloids themselves began little more than a century ago. In 1803 Derosne observed that a syrupy extract of opium (*q v*), when diluted with water, deposited crystalline matter, which he separated and purified and so prepared the first alkaloid, probably impure narcotine (*q.v*). He attempted to improve the yield by adding alkali to the diluted opium syrup and obtained a different substance, which undoubtedly contained the alkaloid morphine (*q.v*). About the same time Séguin made similar observations and also had morphine in his hands. But the crowning achievement of first isolating a typical alkaloid in a pure state and describing its properties in unmistakable terms was reserved for Sertürner, who in 1816 was able to announce that he had found a new organic, alkaline, salt-forming base, apparently related to ammonia, of which he had prepared a number of salts and whose physiological action he had been able to demonstrate. Meanwhile, in 1810, B A Gomes, by treating an alcoholic extract of cinchona bark (*q v*) with alkali, obtained a precipitate, which he purified by crystallization from alcohol and called "cinchonino" Houtou-Labillardière observed its basic properties and brought it to the notice of his friends Pelletier and Caventou, who, guided by Sertürner's description of morphine as an "organic alkali," were able to show in 1820 that "cinchonino" was a mixture of two substances, which they named quinine and cinchonine. Between 1817 and 1840 practically all the more important alkaloids were isolated, including emetine, veratrine, strychnine, piperine, caffeine, quinine, berberine, coniine, atropine, codeine, thebaine, (*qq v*), cinchonine (*see* CINCHONA), hyoscyamine (*see* HYOSCYAMINE), curarine, quinidine, aconitine and colchicine

Definition.—The two points Serturner stressed in his description of morphine—its basic, salt-forming, ammonia-like character and its physiological action—would be enough upon which to frame a definition of the term alkaloid, were it not for the fact that since then substances such as methylamine and amino-acids (*q v*), such as asparagine and betaine, have been found in plants A growing knowledge of the intimate structure of some typical alkaloids, led at one time to confining the term to naturally-occurring derivatives of pyridine (*q v.*), which is a structural feature of the majority of known alkaloids; further knowledge, however, made it clear that pyridine formed no part of the structure of some alkaloids and this narrow definition had to be abandoned With our present knowledge, alkaloids may be defined as relatively complex, basic substances, occurring naturally and exhibiting physiological action. The simple substances already referred to, such as methylamine, asparagine and betaine, together with those formerly known as "animal alkaloids," have been grouped together by Barger as "simple natural bases," though it is difficult to draw the dividing line.

General and Special Interest of Alkaloids.—Everyone is familiar with the physiological action of alkaloids, *e g.*, quinine is

naturally associated with malaria, morphine (*q.v.*) with the relief of pain, cocaine (*q.v.*) with minor surgical operations and atropine (*q.v.*) with the skilled work of the oculist. The chemist on the other hand looks upon alkaloids as fascinating problems for the exercise of his technique and imagination. He has devoted much attention to devising methods for their detection, isolation and purification; and he has displayed considerable ingenuity in splitting them into recognizable fragments, and so acquiring such a knowledge of their intimate structure as will provide a basis for producing them at will in the laboratory. He has begun to take an interest also in the reason for the occurrence of these things in plants and the methods by which they are produced in nature; and one of his aims is to place the pharmacology (*q.v.*) of alkaloids on a sound chemical basis; so that he may know, for example, the nature of the chemical action which takes place when a neutral salt of cocaine is applied to a nerve-ending and local anaesthesia ensues, and is able to explain the remarkable specific toxicity of quinine and emetine to the protozoa which cause malaria and amoebic dysentery, respectively, in man.

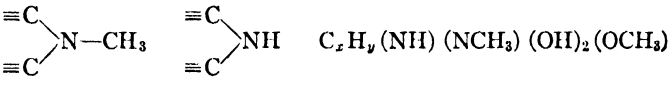
Over 800 alkaloids are known but of these only about 24 are in common use, chiefly in medicine, though some of them find other outlets, *e.g.*, strychnine as a vermin killer, quinine and pilocarpine as cosmetics, while certain of the cinchona alkaloids are used for rendering woollen textiles moth-proof. They are comparatively restricted in their distribution among plants, occurring chiefly in the Rubiaceae, Papaveraceae, Fumariaceae, Solanaceae, Leguminosae and Apocynaceae, and to a less extent in the Rosaceae, Graminaceae, Labiatae and Compositae. Where alkaloids do occur they are to be found in all parts of the plants, but especially in the barks and fruit-rinds of perennial species, the leaves and seeds of annual plants and the roots of biennials. They tend to accumulate in those parts of a plant which are thrown off at the end of the growing season, and this is one of the principal arguments for the view that alkaloids are of no use to plants, but are mere waste products of metabolism.

Detection and Preparation of Alkaloids.—The processes by which alkaloids are obtained from plants depend upon the complete extraction of the dry ground material (bark, roots, leaves or seeds) with a suitable solvent, usually alcohol or slightly acidified water. The solvent is then distilled off *in vacuo* and the resulting extract diluted with water, made distinctly acid, if necessary, and left to stand to deposit impurities. It is next made alkaline, preferably with sodium carbonate or ammonia, when the bulk of the alkaloid is usually precipitated and can be filtered off. If the alkaloid is soluble in water, other devices involving the use of immiscible solvents (*i.e*, liquids which, when shaken with watery fluids, will remove soluble substances therefrom and then form a separate layer) and sometimes special precipitants or absorbents have to be adopted. These processes almost invariably yield a mixture of alkaloids, since the latter rarely occur singly in plants. The separation of these mixtures into their components can generally be achieved (*a*) by treating the mixture of bases with various solvents in turn, and (*b*) by converting the partially separated components into salts by exact neutralization with acids and fractional crystallization of the salts. These processes have to be repeated until there are no longer changes in the physical and chemical properties of the fractions. Each kind of alkaloidal plant requires different treatment and long experience has enabled the processes to be greatly simplified for most of the alkaloids which are produced on a large scale for use in medicine, though on the other hand the standard of purity required in these is constantly rising. The balance between quality and expense of production is settled periodically by the standards set up for medicinal alkaloids and their salts in the various national pharmacopoeias (*q v.*). The criteria of purity for alkaloids are the same as those for any other organic chemical, viz., determination of physical constants such as melting point, boiling point, optical rotation and the chemical composition as determined by ultimate analysis (*see* CHEMISTRY: *Analytical*). These, the methods of the research laboratory, are those which the works chemist and the analyst must always have in mind as the ultimate court of appeal in evolving their short routes to control of quality in alkaloids.

The analytical work of the toxicologist in connection with alkaloids is important. The methods by which poisonous alkaloids are extracted from viscera and stomach contents do not differ in principle from those for the extraction of alkaloids from plant material, but in these cases the problem is greatly complicated by the risks of loss by decomposition of the small quantities of alkaloid to be recovered. The usual methods of purification and conversion into identifiable derivatives cannot be applied to these minute quantities; so use has to be made of crystalline form, colour tests which most of the alkaloids give with certain reagents, or in a few cases special pharmacological tests, methods which are perfectly satisfactory in the hands of experts.

Determination of the Intimate Structure of Alkaloids.—A few of the alkaloids are liquid and volatile and contain only three elements—carbon, hydrogen and nitrogen; but most of them contain oxygen in addition, and are colourless, crystalline solids. Most alkaloids are optically active (*see* STEREOCHEMISTRY) and in a few cases the salts show an optical activity opposite in kind to that of the base. Regarding the alkaloids as extensively substituted ammonias, those containing two atoms of nitrogen should be capable of forming salts containing two molecules of monobasic acids, and this is so with some alkaloids such as quinine, $C_{20}H_{24}O_2N_2$ (*q.v.*), but quite frequently, as in the case of strychnine (*q.v.*), also containing two atoms of nitrogen, the alkaloid combines with only one molecule of a monobasic acid, so that its hydrochloride is represented by the formula $C_{21}H_{22}O_2N_2$, HCl, and this difference in the basicity of the two nitrogen atoms must be taken into account in assigning constitutional formulae (*see* CHEMISTRY: *Organic*) to such alkaloids.

In most cases the nitrogen atoms are tertiary, that is, each is united to three different carbon atoms, one of which in such cases is generally in a methyl group, so that the state of such nitrogen atoms can be graphically represented by (*a*).



(*a*) (*b*) (*c*)

Such a group is called a methylimino-group, and a method of estimating these in alkaloids has been devised. Sometimes a secondary nitrogen group is present, *e.g.*, ammonia, NH_3, in which only two of the hydrogen atoms have been replaced by carbon linkages (*b*). The hydrogen of a secondary nitrogen group can in most cases be replaced in an alkaloid by a methyl group, and the secondary nitrogen (*b*) is thereby converted into a methylimino-group (*a*) which can be estimated.

By similar means it is possible to discover how the oxygen atoms in an alkaloid are built into the molecule. Most frequently they are present as hydroxyl (·OH) groups or derivatives of such groups, such as methoxy (·OCH_3), acetoxy (O·$COCH_3$) or benzoxy (O·CO·C_6H_5). Occasionally a carboxyl group (·COOH) is present, either as such or linked up with the nitrogen to form a betaïne (*q.v.*) or with its hydrogen atom replaced by methyl forming a methyl ester. There are now well-established methods of ascertaining the presence or absence of all these various types of groups, and after a preliminary investigation of a new alkaloid in this fashion the chemist arrives at a point at which he can write the empirical formula of the alkaloid in some such extended form as (*c*), that is, he has still to ascertain how the alkaloidal nucleus, consisting of x carbon atoms and y hydrogen atoms is built up, and how the groups shown in brackets are built into it. This further information is generally obtained by breaking up the alkaloid chemically into small fragments, examining each of the pieces in the same way as the parent alkaloid was examined, and going on with this process until a recognizable fragment, which may be any one of the thousands of known organic compounds, is found. With that first clue to guide him, and within the limits rigidly prescribed by all he knows as to the composition and reactions of the alkaloid, the chemist can then proceed to visualize a constitutional formula. This breaking-down process is generally accomplished by carefully regulated oxidation of the alkaloid, with such agents as potassium permanganate, chromic acid or

nitric acid, substances which burn off a few carbon atoms at a time leaving products which generally become simpler in character; or a more complicated process called "exhaustive methylation" may be used, in which the nitrogen atom of a carbon-nitrogen ring is loaded with substituents until it breaks from its cyclic carbon attachments leaving fragments either recognizable or convertible into recognizable substances.

The Opium Alkaloids.—Opium (*q.v.*) contains at least 25 alkaloids of which morphine (*q.v.*) is by far the most important, followed by codeine (morphine methyl ether), thebaine, narcotine, papaverine, and protopine (*qq.v.*). Much progress has been made in the determination of the intimate structure of the alkaloids of opium and they can all be regarded in a broad sense as derivatives of isoquinoline. Thus the five minor alkaloids, papaverine, laudanosine, codamine, laudanine and laudanidine, form a group of substituted *l*-benzylisoquinolines; narcotine and narceine (*q.v.*) are *l*-meconylisoquinolines, and as the meconyl residue $\cdot CH \cdot C_6H_2(OMe)_2 \cdot CO \cdot O$ itself can be regarded as derived from benzyl, $C_6H_5 \cdot CH_2$; all seven alkaloids are derivatives of *l*-benzylisoquinoline.

The next group of opium alkaloids, morphine, codeine and thebaine are more condensed and more complex in structure. The simplest member of the group to which they belong is glaucine, found in the yellow-horned poppy, *Glaucium luteum,* but not in the opium poppy. Glaucine has been synthesized from laudanosine by a simple reaction, which gives rise to a phenanthrene (*q.v.*) complex by internal condensation within the benzylisoquinoline structure and so this whole group of alkaloids is conveniently spoken of as the phenanthrene group. Synthesis of the simpler members of this group is in progress, but their representatives in opium, the three alkaloids just mentioned, constitute an interesting variation on the typical structure of the phenanthrene group and for them possible formulae—of which those of Pschorr (1905), Knorr and Horlein (1906), and Gulland and Robinson (1923) may be mentioned—are still being discussed.

A third group is represented in opium by two members, protopine and cryptopine. The former is almost the typical alkaloid of the poppy order (Papaveraceae) since it has been found in most species of this order, the alkaloids of which have been systematically examined. This group can be regarded as developed from berberine (*q.v.*), though curiously enough no alkaloids of the berberine type have been found in any member of the poppy order. Their intimate structure has been determined by W. H. Perkin, in whose laboratory both protopine and cryptopine have been synthesized (1926).

(*See* also EPHEDRINE, HYDRASTINE, LAEVO-HYOSCINE, NICOTINE, PHYSOSTIGMINE, PILOCARPINE, PURINE, SPARTEINE; CHEMISTRY: *Organic, Heterocyclic.*)

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ALKANET, a plant, *Alkanna* or *Anchusa tinctoria,* of the family Boraginaceae, also known as orchanet, dyer's bugloss, Spanish bugloss or bugloss of Languedoc, which is grown in the south of France and on the shores of the Levant. Its root yields a fine red colouring matter which has been used to tint tinctures, oils, wines, varnishes, etc.

AL-KASR AL KEBIR: *see* KASR AL, AL KEBIR.

ALKMAAR, town in the province of North Holland, Holland, 24½m. by rail north-north-west of Amsterdam, communicating with Haarlem and Amsterdam, and on the North Holland canal. Pop. (1927) 27,304. The name Alkmaar ("all sea") first occurs in the 10th century and recalls the original situation of a fishing village in the midst of marshes and lakes. The first charter was dated 1254; charters (1436 and 1437) of Philip the Good of Burgundy established an oligarchy on grounds of previous mismanagement; much damage was done in wars between Hollanders and Frisians, and the Gelderlanders and Frisians captured the town in 1517. In 1573 it successfully sustained a siege by the Spaniards. It acquired an important trade after reclamation of the surrounding swamps from 1685 onwards. In 1799 it gave its name to a convention by which the Russo-British army evacuated Holland. It is a typical North Holland town, with tree-lined canals and brightly coloured 17th century houses. The city walls have been replaced by boulevards and there is a park with a monument commemorating the siege by the Spaniards in 1573. The Groote Kerk (1470–1498) has the tomb of Floris V., count of Holland (d. 1296). In the town hall (1507) are the library and a small museum with two pictures by Caesar van Everdingen, who, with his brother Allart van Everdingen (*q.v.*), was a native of the town. The weigh-house (1582) has a quaint gable and tower. Alkmaar has a flourishing butter and cheese trade, and is a centre of cheese export. It is also a considerable market town. Tramways connect Alkmaar with Egmond and the summer resort of Bergen, sheltered by woods and dunes.

ALLACCI, LEONE (LEO ALLATIUS) (1586–1669), Greek scholar and theologian, and a voluminous writer, was born in the island of Chios. His early years were passed in Calabria and at Rome, where he finally settled as teacher of Greek at the Greek college, at the same time devoting himself to the study of classics and theology. Allacci was sent to superintend the removal to Rome of the 196 cases of mss. from Heidelberg presented by the elector Maximilian of Bavaria to Pope Gregory XV. This collection (*bibliotheca Palatina*) was incorporated with the Vatican library. On the death of Gregory, Allacci became librarian to Cardinal Berberini, and subsequently (1661) librarian of the Vatican, which post he held till his death.

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ALLÂH, the Arabic name used by Muslims of all nationalities for the one true God, compounded of *al,* the definite article, and *ilāh,* a god. The same word is found in Hebrew and Aramaic as well as in ancient Arabic (Sabaean).

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ALLAHABAD, a city of British India, the capital of the United Provinces of Agra and Oudh, giving its name to a district and a division. The city (pop. 157,220 in 1921) is situated at the confluence of the Ganges and the Jumna rivers, 564m. from Calcutta by rail. Its most conspicuous feature is the fort, at the junction of the rivers. It contains one of Asoka's pillars, also the remains of a splendid palace, erected by the Emperor Akbar, and once a favourite residence of his; also an important arsenal. Outside the fort the places of most historic interest are the tomb and gardens of Khasru, the son of the Emperor Jehangir, and the Jama Masjid or Great Mosque. Allahabad (Illahabad) was the name given to the city when Akbar built the fort. To the Hindus it is still known by its ancient name of Prag or Prayag ("place of sacrifice"), and is a noted resort of Hindu pilgrimage. A bathing festival, known as the Magh-mela, is held at the confluence of the rivers during the Hindu month of Magh. It is attended by as many as 250,000 persons in ordinary years and every twelfth year it becomes the Kumbh-Mela, when as many as a million devotees will crowd to it from all parts of India. Allahabad was taken by the British in 1765 from the wazir of Oudh, restored to him in 1771, and by him finally ceded together with the district to the British in 1801, in commutation of the subsidy which the wazir had agreed to pay for British protection. During the Mutiny of 1857 (*see* INDIAN MUTINY) Allahabad became the scene of one of the most serious outbreaks and massacres which occurred in the North-Western Provinces. The fort was held by a little garrison of Europeans and loyal Sikhs, until it was relieved by Gen. Neill on June 11 of that year.

The modern buildings of Allahabad include Government House, the High Court, the University, the Mayo memorial and town hall, the Muir central college, the Thornhill and Mayne memorial library and museum, the Naini central jail and the Anglican and Roman Catholic cathedrals. Both rivers are crossed by fine rail-

way bridges; and the place is an important railway centre. The military cantonments contain accommodation for all three arms and are the headquarters of a brigade. At Allahabad is published the *Pioneer,* perhaps the best known English paper in India It is the home of the parent university of the provinces, from which most of the others have branched off; and it is a centre of numerous educational and missionary institutions.

The district of Allahabad has an area of 2,858 sq.m. In shape it is an irregular oblong, and it is very difficult to define its boundaries, as at one extremity it wanders into Oudh, while on the south the villages of the State of Rewa and those of this district are intermingled. The Jumna and the Ganges enclose within their angle a fertile tract well irrigated with tanks and wells The East Indian railway and the Grand Trunk road afford the principal means of land communication. In 1921 the population was 1,404,445.

The present division of Allahabad has an area of 10,242 sq m. The population in 1921 was 4,795,666 It comprises the five districts of Farrukhabad, Etawah, Cawnpore, Fatehpur and Allahabad.

ALLAMANDA, named after J. N. S. Allamand (1713–87), of Leyden, a genus of shrubby, evergreen climbers, belonging to the family Apocynaceae, and a native of tropical America.

ALLAN, DAVID (1744–1796), Scottish historical painter, was born at Alloa. On leaving Foulis's academy of painting at Glasgow (1762) Lord Cathcart and Erskine of Mar furnished him with the means of proceeding to Rome (1764), where he remained for a number of years. Returning from Rome in 1777, he lived for a time in London. In 1780 he removed to Edinburgh, where he was appointed director and master of the Academy of Arts. There he painted and etched in aquatint a variety of works, those by which he is best known—as the "Scotch Wedding," the "Highland Dance," the "Repentance Stool," and his "Illustrations of the Gentle Shepherd"—all being remarkable for their comic humour. Allan died at Edinburgh on Aug 6, 1796.

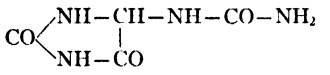
ALLAN, SIR HUGH (1810–1882), Canadian financier, was born on Sept. 29, 1810, at Saltcoats, Ayrshire, Scotland. He emigrated to Canada in 1826, and in 1831 entered the employ of the chief shipbuilding and grain-shipping firm of Montreal, of which he became a junior partner in 1835. In 1853 he organized the Allan line of steamships, plying between Montreal, Liverpool and Glasgow; till his death he was closely associated with the commercial growth and prosperity of Canada, and in 1871 was knighted in recognition of his services. In 1872–73 he obtained from the Canadian Government a charter for building the Canadian Pacific railway, but the disclosures made with reference to his contributions to the funds of the Conservative Party led to the Pacific scandal (*see* CANADA, *History*), and that company was soon afterwards dissolved. He died in Edinburgh on Dec. 9 1882.

See J. C. Dent, *Canadian Portrait Gallery* (1881).

ALLAN, SIR WILLIAM (1782–1850), Scottish historical painter, was born in Edinburgh, and studied at the school of design in his native city. Allan spent some years in Russia between 1805 and 1814 and travelled extensively in Southern Russia, bringing back a portfolio of vivid sketches which provided material for much of his later work. In 1814 he returned to Edinburgh and in the two following years exhibited at the Royal Academy "The Circassian Captives" and "Bashkirs conducting Convicts to Siberia." In the next 20 years he established his fame by the illustration of Scottish history in a series of works which included "Archbishop Sharpe on Magus Moor"; "John Knox admonishing Mary Queen of Scots" (1823), engraved by Burnet; "Mary Queen of Scots signing her Abdication" (1824); and "Regent Murray shot by Hamilton of Bothwellhaugh." The last subject procured his election as A.R.A. (1825). In 1834 he visited Spain and Morocco, and in 1841 went again to St. Petersburg, when he undertook, at the request of the tsar, his "Peter the Great teaching his Subjects the Art of Shipbuilding", exhibited in London in 1845, and bought for the Winter Palace of St. Petersburg. Allan received many honours, including that of knighthood in 1842. He died on Feb. 22, 1850.

ALLAN-DESPRÉAUX, LOUISE ROSALIE (1810–1856), French actress, was "discovered" by Talma in Brussels as a child, when she played Joas. She played children's and then *ingénue* parts at the Théâtre Français, and in 1831 began to play at the Gymnase. During her six years at the Gymnase she made a great name. Madame Allan (she married an actor in the Gymnase company) then went to St. Petersburg, and there discovered *Un Caprice* by Alfred de Musset, made a success of it, and on her return to Paris chose it for her reappearance at the Théâtre Français. This was the beginning of Alfred de Musset's success as a dramatist. Madame Allan held her own as an actress even when she appeared by the side of Rachel. She died at the height of her success in 1856.

ALLANTOIN is found in the allantoic liquid of the cow, and in the urine of sucking calves. It forms glancing prisms of neutral reaction slightly soluble in water It can be obtained by the oxidation of uric acid by means of lead dioxide, manganese dioxide, ozone or potassium permanganate, and has been synthesized by E. Grimaux by heating one part of glyoxylic acid with two parts of urea (*q.v.*) for ten hours at 100° C. It is the diurcide of glyoxylic acid, with the formula



ALLARGANDO (Ital.), a musical term indicating a slackening of the speed and a general increase of weight and breadth in the style of performance

ALLBUTT, SIR THOMAS CLIFFORD (1836–1925), British physician, was born at Dewsbury, Yorkshire, July 20 1836. Educated at St. Peter's school, York, and Caius college, Cambridge, he studied medicine at St. George's hospital, London, and afterwards in Paris, subsequently practising in London and Leeds He carried out much valuable work on the pathology of the nervous system, and made important investigations of tetanus and hydrophobia, devoting, in addition, considerable time to ophthalmoscopy and inventing the short clinical thermometer.

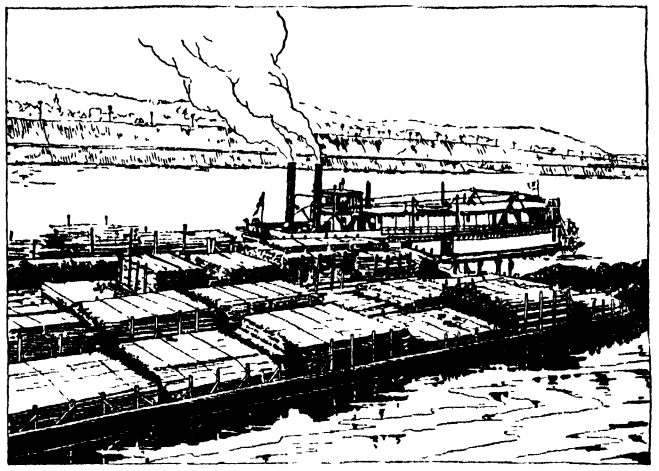
He was consulting physician to many institutions and from 1889 to 1892 was a commissioner in lunacy. In 1892 he became regius professor of physic at Cambridge, in 1907 was created K.C.B. and in 1920 a privy councillor. He died at Cambridge, Feb. 22, 1925

BIBLIOGRAPHY.—Allbutt's published works include *The Use of the Ophthalmoscope in Medicine* (1871); *On Scrofulous Neck* (1885); *Diseases of the Heart* (Lane Lectures, 1896); *Historical Relations of Medicine and Surgery* (1905); *Greek Medicine in Rome* (Fitzpatrick lectures, 1909–10), *Diseases of the Arteries and Angina Pectoris* (1915); *Science in the School* (1917) and *Notes on the Composition of Scientific Papers* (3rd ed., 1923). He also edited *A System of Medicine* and *A System of Gynaecology* (1896, 1899, 1907).

ALLEGHENY MOUNTAINS or **THE ALLEGHENIES,** a name formerly applied to all the Appalachian mountains (*q.v.*), and now, sometimes, to all that system lying west and south of the Hudson river, being steep and narrow-crested in Pennsylvania (1,500–1,800ft.), in Maryland, Virginia and West Virginia rising to above 4,000ft. and with broader crests It is also used to include the ridges (the Allegheny ridges) parallel to the Blue ridge; the north-western part of this region is called the Allegheny Front, and is characterized by a bold south-eastward facing escarpment and a gentle north-westward slope. The Allegheny plateau is the north-westernmost division of the Appalachian system; it is an eroded mass of sedimentary rock sloping north-westward to the Lake plains in the region of the Great Lakes and reaching south-west from the Catskill (*q.v.*) region of New York State to the Cumberland plateau region in Tennessee. The Alleghenies, which once formed a barrier to western communication, have long since been crossed by numerous railways and highways which follow the lower elevations or the "water gaps" of the eastward-flowing streams.

ALLEGHENY RIVER, a river of Pennsylvania and New York and the principal tributary of the Ohio river, whose source is the confluence of the Allegheny and the Monongahela at Pittsburgh. The Allegheny rises in the high, hilly plateau region of

Potter County, Pa., at an elevation of about 2,250ft. above sea-level. From its source it flows in a general north-westerly direction about 80m., crossing into New York, to a point 11m. N. of the State line. Here it turns abruptly south-west and continues in this direction for 120m to the central part of Venango county, Pennsylvania. It then turns to the south-east and again south-west to its confluence with the Monongahela at Pittsburgh. Its total length is about 310m. and its drainage basin 11,400 sq. miles. The topographical character of its drainage basin ranges



PART OF A TOW ON THE ALLEGHENY RIVER OF 9 BARGES OF STEEL PRODUCTS FROM PITTSBURGH AND 2 BARGES OF COAL FOR THE FUEL OF THE STERN-WHEEL STEAMER DURING THE TRIP

from the steep hills and broken country of the eastern slope to the comparatively level marshy western slope. The chief tributaries of the Allegheny are Conewango creek (which flows from the lake region of Chautauqua county, N.Y.), French creek, and Clarion and Kiskiminetas rivers. The Allegheny once served as an important highway for keel-boat navigation and later for transporting the petroleum and coal produced along its banks, but this was only before the beginning of railway competition. The canalized portion of the river, extending from Pittsburgh to Natrona (24m) and seven feet in depth, has an annual traffic valued at about $12,000,000.

ALLEGIANCE, the duty which a subject or citizen owes to the State or to the sovereign of the State to which he belongs. It is often used by English legal commentators in a larger sense, divided by them into natural and local, the latter applying to the deference which even a foreigner must pay to the institutions of the country in which he happens to live; but it is in its proper sense, in which it indicates national character and the subjection due to that character, that the word is important. In that sense it represents the feudal *liege homage,* which could be due only to one lord, while simple homage might be due to every lord under whom the subject held land. The English doctrine asserted that allegiance was indelible: *Nemo potest exuere patriam.*

It was said to be a debt and duty to the sovereign co-extensive with the life of the subject. As Blackstone wrote: "It is a principle of universal law that the natural-born subject of one Power cannot by any act of his own (no, not by swearing allegiance to another) put off or discharge his natural allegiance to the former; for this natural allegiance was intrinsic . . . and cannot be diverted without the concurrent act of that Prince to whom it was first due." This doctrine was one of the causes of the war of 1812 with the United States, which had already rejected it. Eventually, after much controversy with Great Britain, Congress in 1868 ordained that "The right of expatriation is a natural and inherent right of all people, indispensable to the enjoyment of the rights of life, liberty and the pursuit of happiness," and one of the "fundamental principles of the Government." In the same year a Royal Commission was set up by the British cabinet to enquire into the subject, resulting in the Naturalization Act 1870, whereby for the first time British subjects, whether natural-born or naturalized, were enabled, apart from an Act of Parliament or cession of British territory, to renounce their nationality and allegiance. This right of expatriation was substantially re-enacted by the British Nationality and Status of Aliens Act 1914–22. By s. 13 "a British subject, who when in a foreign State and not under any disability, by obtaining a certificate of naturalization or by any other voluntary and formal act becomes naturalized therein, shall thenceforth be deemed to have ceased to be a British subject" And by s. 14 a natural-born British subject who has become a subject of a foreign State may, if of full age and not under disability, make a declaration of alienage. But it was held in *Lynch's Case* (1903), 1. K.B. 444, that a British subject could not become naturalized in an enemy's country during time of war. Taking an oath of allegiance to the enemy State was an act of treason. It would appear, however, from the decision in *Pedlar v. Johnson* (1920), 2 *I.R.* 450, that a British subject may become naturalized in a neutral State and engage in acts of hostility against his State of origin without sacrificing his rights as a friendly alien. Before a certificate of naturalization can become operative, the applicant must take the following oath of allegiance: "I, *A. B.*, swear by Almighty God that I will be faithful and bear true allegiance to His Majesty, King George the Fifth, His Heirs and Successors, according to law." Emigration to an uncivilized country leaves British nationality unaffected: indeed the right claimed by all States to follow with their authority their subjects so emigrating is one of the usual and recognized means of colonial expansion. (*See* OATH, NATIONALITY, and NATURALIZATION.)

See Salmond, "Citizenship and Allegiance" in the *Law Quart Rev*, vols. 17 and 18; and J. A. Foote, *Private Inter. Law*, 5th ed. (1925).

(J. W.; H. H. L. B.)

ALLEGORY, a figurative representation conveying a meaning other than and in addition to the literal. It is generally treated as a figure of rhetoric, but the medium of representation is not necessarily language. An allegory may be addressed to the eye, and is often embodied in painting, sculpture or some form of mimetic art. The etymological meaning of the word is wider than that which it bears in actual use. An allegory is distinguished from a *metaphor* by being longer sustained and more fully carried out in its details, and from an *analogy* by the fact that the one appeals to the imagination and the other to the reason. The fable or parable is a short allegory with one definite moral The allegory has been a favourite form in the literature of nearly every nation. The Hebrew scriptures present frequent instances of it, one of the most beautiful being the comparison of the history of Israel to the growth of a vine in the 80th psalm In classical literature one of the best-known allegories is the story of the belly and the members in the speech of Menenius Agrippa (Livy ii 32, Plutarch's *Life of Coriolanus*, and Shakespeare's play derived therefrom); and several occur in Ovid's *Metamorphoses*. Perhaps the most elaborate and the most successful specimens of allegory are to be found in the works of English authors. Spenser's *Faerie Queene,* Swift's *Tale of a Tub,* Addison's *Vision of Mirza,* and, above all, Bunyan's *Pilgrim's Progress,* are examples which it would be difficult to match in elaboration, beauty and fitness, from the literature of any other nation.

ALLEGRI, GREGORIO (1582–1652), Italian priest and composer, was born at Rome and studied music under G Maria Nanini, the friend of Palestrina He was a member of the Sistine chapel choir from 1629 until his death on Feb 18, 1652. His most famous composition is the *Miserere,* performed once a year in Holy Week at the Sistine chapel, the score of which was jealously guarded for a century. But in 1769 Mozart, then a boy of 13, heard it and wrote it down from memory—a wonderful feat—and Dr. Burney afterwards (1771) obtained a copy and published it. Two volumes of concertos (published 1618–19), and two volumes of motets (published 1620–21) are available, but much of his work remains in manuscript.

ALLEGRO, an Italian word meaning literally "cheerful," which, however, as used in music has come by a natural process to mean a quick or lively rate of speed, coming between *andante* and *presto.* It is also used of a separate piece of music, or of a movement in a sonata, symphony, etc. The diminutive form *allegretto* signifies a speed somewhat less fast.

ALLEINE, JOSEPH (1634–1668), English Nonconformist divine, was born at Devizes, Wiltshire, and educated at Oxford, where he became a fellow and tutor of Corpus Christi. He was curate to George Newton, vicar of St. Mary Magdalene, Taunton, from 1655 to 1662, when both he and his vicar were ejected for nonconformity. He was several times imprisoned for preaching during the remaining six years of his life, which were spent in wandering from one place of temporary safety to another. He died on Nov. 17, 1668. Alleine was one of the best loved of the Puritan preachers, and a considerable scholar. His *Alarm to the Unconverted* (1672) had an enormous circulation.

See *Life*, edited by Baxter; *Joseph Alleine: his Companions and Times*, by Charles Stanford (1861); Wood's *Athenae*, iii. 819.

ALLEINE, RICHARD (1611–1681), English Puritan divine, was born at Ditcheat, Somerset, where his father was rector. He was a younger brother of William Alleine, the saintly vicar of Blandford. Richard was educated at St. Alban's hall, Oxford, and New Inn, and in 1641 became rector of Batcomb (Somerset). He was one of the 2,000 ministers ejected in 1662. The Five Mile Act drove him to Frome Selwood, and in that neighbourhood he preached until his death on Dec. 22, 1681. His most famous work is *Vindiciae Pietatis* (which first appeared in 1660).

See Calamy, *s.v.*; Palmer's *Nonconf. Mem.* iii. 167–168; C. Stanford's *Joseph Alleine; Researches at Batcomb and Frome Selwood;* Wood's *Athenae* (Bliss), iv. 13.

ALLELOMORPH, the name applied to each of a pair of characters in Mendelian inheritance. (*See* HEREDITY, MENDELISM.)

ALLEMANDE, a name for two kinds of dance, one a German national dance, in 2–4 time, the other somewhat resembling a waltz (from Fr. for German). In music, it signifies a certain kind of movement in a suite, usually following the prelude and preceding the courante (*q.v.*), with which it is contrasted in rhythm; but this has no connection with the dance. The name, however, is also applied to pieces of music based on the dance movement, examples of which are found in Beethoven's German dances for the orchestra. (*See* DANCE.)

ALLEN, ETHAN (1739–1789), American soldier, was born at Litchfield, Conn., on Jan 10, 1739. He removed, probably in 1769, to the "New Hampshire grants," where he took up lands, and eventually became a leader of those who refused to recognize the jurisdiction of New York, and contended for the organization of the "grants" into a separate province About 1771 he was placed at the head of the "Green Mountain boys," an irregular force organized for resistance to the "Yorkers." On May 10, 1775, soon after the outbreak of the Revolutionary War, in command of a force, which he had assisted some members of the Connecticut assembly to raise for the purpose, he captured Ticonderoga from its British garrison, calling upon its commanding officer—according to the unverified account of Allen himself—to surrender "in the name of the great Jehovah and the Continental Congress." Seth Warner being elected colonel of the "Green Mountain boys" in July 1775, Allen, piqued, joined General Philip Schuyler, and later with a small command, but without rank, accompanied General Richard Montgomery's expedition against Canada. On Sept. 25, 1775 near Montreal he was captured by the British, and remained a prisoner until exchanged on May 6, 1778. Upon his release he was brevetted colonel by the Continental Congress. He then, as brigadier general of the militia of Vermont, resumed his opposition to New York, and from 1779 to 1783, acting with his brother, Ira Allen, and several others, carried on negotiations, indirectly, with Governor Frederick Haldimand of Canada, who hoped to win the Vermonters over to the British cause. He seems to have assured Haldimand's agent that "I shall do everything in my power to make this state a British province." In March 1781, he wrote to Congress, with characteristic bluster, "I am as resolutely determined to defend the independence of Vermont as Congress that of the United States, and rather than fail will retire with the hardy Green Mountain boys into the desolate caverns of the mountains and wage war with human nature at large." He removed to Burlington, Vt., in 1787, and died there February 11, 1789. He was, says Tyler, "a blustering frontier hero—an able-minded ignoramus of rough and ready humour, of boundless self-confidence, and of a shrewdness in thought and action, equal to almost any emergency." Allen wrote a *Narrative of Colonel Ethan Allen's Captivity* (1779), the most celebrated book in the "prison literature" of the American revolution; *A Vindication of the Inhabitants of Vermont to the Government of New York and their Right to form an Independent State* (1779); and *Reason, the Only Oracle of Man* (1784).

Ethan's youngest brother, IRA ALLEN (1751–1814), born on April 21, 1751 at Cornwall, Conn., also removed to the New Hampshire grants, where he became one of the most influential political leaders. In 1775 he took part in the capture of Ticonderoga and the invasion of Canada. He was a member of the convention which met at Winchester, Vt., and in January 1777 declared the independence of the New Hampshire grants; served (1776–1786) as a member of the Vermont council of safety; conducted negotiations, on behalf of Vermont, for a truce with the British and for an exchange of prisoners, in 1781; served for eight terms in the general assembly, and was State treasurer from 1778 to 1786 and surveyor general from 1778 to 1787. In 1789, by a gift of £4,000, he made possible the establishment of the University of Vermont, of which institution, chartered in 1791 and built at Burlington in deference to his wishes, he was thus virtually the founder. In 1795, on behalf of the State, he purchased from the French government arms for the Vermont militia, of which he was then the ranking major general, but he was captured by a British cruiser west of Ireland on his return journey, was charged with attempting to furnish insurrectionary Irish with arms, and after prolonged litigation in the British courts, the case not being finally decided until 1804, returned to Vermont in 1801. During his absence he had been dispossessed of his large holdings of land through the operation of tax laws, and to escape imprisonment for debt, he removed to Philadelphia, where on Jan. 4, 1814 he died. He published a dull and biassed, but useful *Natural and Political History of Vermont* (1798), reissued (1870) in vol. i. of the *Collections* of the Vermont Historical Society.

There is no adequate biography of Ethan Allen, but Henry Hall's *Ethan Allen* (New York, 1892) may be consulted. The best literary estimate may be found in M. C. Tyler's *Literary History of the American Revolution* (1897). For a brief recent sketch *see* John Spargo, *Ethan Allen at Ticonderoga* (Rutland, Vt., 1926).

ALLEN, FREDERICK MADISON (1879–), American physician, was born in Des Moines, Ia., on March 16, 1879. He graduated at the University of California in 1902, studied medicine for three years in the University of Chicago, and in 1907 graduated in medicine at the University of California. He made researches on diabetes at the Harvard medical school in 1909–12 and at the Rockefeller institute for medical research in 1913–18. In 1920 he was made director of the Physiatric institute, Morristown, N.J., where he continued investigation and treatment of diabetes and related disorders. In 1922 he became the editor of the *Journal of Metabolic Research*.

His published writings include *Studies Concerning Glycosuria and Diabetes* (1913), *Total Dietary Restriction in the Treatment of Diabetes*, with E. Stillman and R. Fitz (1919), and *Treatment of Kidney Diseases and High Blood Pressure* (1925).

ALLEN, GEORGE (1832–1907), English engraver and publisher, was born at Newark-on-Trent on March 26, 1832, and died at Orpington, Kent, on Sept. 5, 1907. He was apprenticed to a Clerkenwell builder, and became a skilled joiner. He came into contact with Ruskin at Ruskin's drawing class at the Working Men's college, and was closely associated with him as general assistant engraver and publisher for 50 years. He studied mezzotint under Lupton, under J. H. Le Keux, and produced the plates for Ruskin's later books. In 1862 Allen went to Mornex, Savoy, where Ruskin then thought of settling, and there he made a considerable collection of minerals. He began his publishing business in 1871, in his cottage at Keston, and afterwards in the garden of his house at Orpington, as the publisher of Ruskin's works. Twenty years later he removed to London, and began business as general publisher. He was engaged on the library edition of Ruskin's works (1903–11) at the time of his death.

ALLEN, GLOVER MERRILL (1879–), American naturalist, was born in Walpole, N.H., on Feb. 8, 1879. He was educated at Harvard university at which he graduated in 1901, received the degree of Ph.D. in 1904 and continued further study in 1906–07. In 1901 he was appointed librarian of the Boston Society of Natural History. In 1907 he began the critical study of mammals in the Museum of Comparative Zoology, Harvard university, and in 1924 was made lecturer in zoology. As naturalist he was a member of several scientific expeditions, notably to the Bahama islands in 1904, to British East Africa in 1909, to Grenada, British West Indies, in 1910, and to the Sudan in 1912. He published, with R. H. Howe Jr., *The Birds of Massachusetts* (1925) and *Birds and Their Attitudes* (1925). His writings include also numerous scientific papers, mainly on birds and mammals.

ALLEN, GRANT (CHARLES GRANT BLAIRFINDIE) (1848–1899), English author, son of a clergyman of Irish descent, was born at Kingston (Ont.), Canada, on Feb. 24, 1848. He was educated partly in America and France, and in England at King Edward's school, Birmingham, and afterwards at Merton college, Oxford. He was for a few years a schoolmaster in Jamaica, but then made his home in England. He died in his house at Hindhead, Surrey, on Oct. 24, 1899. Grant Allen was a voluminous author. His scientific books (such as *Physiological Aesthetics*, 1877; *The Evolutionist at Large*, 1881; *The Evolution of the Idea of God*, 1897) contain much original matter, popularly expressed. He first attracted attention as a novelist with a sensational story, *The Devil's Die* (1888), though this was by no means his first attempt at fiction; and *The Woman who Did* (1895), which had a temporary *succès de scandale* on account of its treatment of the sex problem, inspired many imitations.

ALLEN, SIR HUGH PERCY (1869–), director of the Royal College of Music and professor of music at Oxford university, was born at Reading, Dec. 23, 1869, and received his first appointment as organist of St. Saviour's, Reading, at the age of 11. After holding many similar appointments he became closely associated with the music of both Cambridge and Oxford, in the one case as organ scholar of Christ's College and in the other as organist of New College. In the latter capacity he displayed characteristic energy and enthusiasm in developing the musical life of the university. Concurrently he became known to the London musical public as conductor of the Bach choir, and when on the death of Sir Hubert Parry (q.v.) in 1918 he was chosen to succeed him at the Royal College of Music the wisdom of the appointment (subsequently abundantly justified) was generally recognized. He succeeded Sir Walter Parratt as professor of music at Oxford in the same year and was knighted in 1920.

ALLEN, SIR JAMES (1855–), New Zealand statesman, was born in South Australia on Feb. 10, 1855, his parents settling in New Zealand a year later. He was educated in England at Clifton and St. John's College, Cambridge, and afterwards studied at the Royal School of Mines, in London. Returning to New Zealand, he was, in 1887, elected a member of the house of representatives. He was minister of finance, defence and education from 1912–15, and, in 1915, when a separate ministry of defence was formed, he took charge of it, retaining the post until 1920. It was largely due to his efforts that, in 1914, the New Zealand force was one of the most effective of the British Dominion armies. In the absence of Mr. Massey in England during and after the World War, he acted as prime minister for two years. He was made a K.C.B. in 1917 and was high commissioner for New Zealand in London from 1920 to 1926. His long, practical experience as a Dominion administrator and his sympathetic understanding of the needs of the empire rendered his presence in London especially valuable both to the Dominion and the empire. He is the author of *New Zealand and Federation: The Financial Aspect* (1890), a pamphlet issued by *The Press*, Christchurch, and *New Zealand's Possessions in the South Seas* (1903).

ALLEN, JAMES LANE (1849–1925), American author, was born Dec. 21, 1849, on a small plantation near Lexington, Ky., where he passed most of his early life. He acquired a scholarly background for his creative work through his study at Transylvania university (then called Kentucky university), his professorship of Latin and English at Bethany college, West Virginia, his teaching of languages in preparatory schools and his own wide reading and early essays in criticism. The landscape and gentle breeding of Kentucky inspired his first ripe and polished series of tales, *Flute and Violin* (1891). These are the dominant notes also in his sketches, *The Blue-Grass Region of Kentucky* (1892), and his early novels, *A Kentucky Cardinal* (1894) and its sequel, *Aftermath* (1895), and *The Choir Invisible* (1897). *A Summer in Arcady* (1896) marks a transition to a second phase in which he is preoccupied with problems, largely of sex, as in *The Mettle of the Pasture* (1903), *The Bride of the Mistletoe* (1909) and *The Doctor's Christmas Eve* (1910), although *The Reign of Law* (1900) concerned itself with a youth whose old-fashioned faith was shattered by his new-found science. His latest novels are more varied. His early poems, beautiful and serious as they were, have never been published in book form. He died in New York, Feb. 18, 1925.

ALLEN, JOEL ASAPH (1838–1921), American zoologist, was born in Springfield, Mass., on July 10, 1838. He attended Wilbraham academy and then studied zoology under Louis Agassiz in the Lawrence scientific school, Harvard university. From 1865 to 1869 and again in 1873 he was a member of scientific expeditions to Florida, the Rocky mountains and Brazil. In connection with these expeditions he collected much zoological material on which he made extensive investigations, the results of which were published chiefly in the *Proceedings of the Boston Society of Natural History*. His *Mammals and Winter Birds of Eastern Florida* (1871) won for him the Humboldt scholarship of the Lawrence scientific school, and placed him in the front rank of American naturalists. In 1871–73 he was lecturer and in 1873–85 assistant in ornithology in the Museum of Comparative Zoology, Harvard. From 1885 until his death he was curator of mammalogy and ornithology in the American Museum of Natural History, New York city. During this period he published a large number of papers on birds and mammals and for more than 30 years gave editorial supervision to all the zoological publications of the museum, about 60 volumes. He took a leading part in organizing the American Ornithologists' Union, edited three issues of its *Check List of North American Birds*, and from 1884 to 1912 edited its official journal *The Auk*, to which he contributed more than 600 papers. His *Autobiographical Notes* (1916) contains a bibliography of his scientific writings, including some 1,400 titles. He died at Cornwall-on-Hudson, Aug. 29, 1921.

Among his more important works, other than those before mentioned, are *The American Bisons Living and Extinct* (1876); with Eliott Coues, *Monographs on North American Rodentia* (1877); *History of North American Pinnipeds* (1880); *Mammals of Patagonia* (1905); *The Influence of Physical Conditions on the Genesis of Species* (1905); and *Ontogenic and Other Variations in Musk-Oxen* (1913).

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ALLEN, JOHN (1476–1534), English divine, after studying at both Oxford and Cambridge, was sent by Archbishop Warham on an ecclesiastical mission to Rome. He was one of Wolsey's agents in the suppression of the minor monasteries in 1524–25, and in 1528 became archbishop of Dublin. For four years he was chancellor of Ireland. In 1531 he was fined under the statutes of provisors and praemunire, and in 1534 was murdered by Lord Thomas Fitzgerald's followers.

ALLEN, RICHARD (1760–1831), American negro clergyman, was born of slave parents in Philadelphia, Pa., in 1760. Soon after his birth his parents were sold into slavery in Delaware. At 17 years of age he joined the Methodist Episcopal Church and when 22 years old was licensed to preach. Four years later (1786) he purchased his freedom for $2,000, Continental money, and returned to Philadelphia. Here he joined St. George's M.E.

Church in which he was permitted to preach to coloured people at 5 o'clock meetings. Dissatisfied with the restrictions placed upon those who attended these meetings, he decided to withdraw. He personally purchased a lot at the corner of 6th and Lombard streets, and moved upon it an old blacksmith shop which he refurbished as a house of worship. Here he organized in 1787 the first church for coloured people in the United States His followers who congregated here were called Allenites. Despite opposition and a series of obstructive lawsuits, a charter was secured from the General Assembly of Pennsylvania. A new church building was erected and opened in 1794. It was dedicated by Bishop Francis Asbury (*q.v.*) and called Bethel. In 1799 Allen was regularly ordained in the ministry of the Methodist Episcopal Church, the first coloured minister so ordained. In 1816, upon the organization of the African Methodist Episcopal Church, Allen was elected bishop. He died in Philadelphia on March 26, 1831.

See *Centennial Encyclopaedia of the African Methodist Church* (Philadelphia, 1916).

ALLEN or **ALLEYN, THOMAS** (1542–1632), English mathematician, was born at Uttoxeter, Staffordshire, Dec. 21, 1542, and died Sept. 30, 1632. He was educated at Oxford, and found patrons in Henry Percy, 8th earl of Northumberland and Robert Dudley, earl of Leicester. He was on intimate terms with Sir Robert Cotton, William Camden, and their antiquarian associates. His great skill in mathematics and astrology earned him the credit of being a magician; and the author of *Leicester's Commonwealth* accused him of employing the art of "figuring" to further the earl of Leicester's unlawful designs, and of endeavouring by the black art to bring about a match between his patron and Queen Elizabeth. Much of Allen's collection of old manuscripts was presented to the Bodleian library by Sir Kenelm Digby

ALLEN, VIOLA (1869–), American actress, was born in Huntsville, Ala., on Oct. 27, 1869. She was a daughter of C. Leslie Allen, an actor of ability, and was educated in Boston, Toronto, and New York city. At the age of 13 she made her début in the title-rôle of *Esmeralda* at Madison Square theatre, New York. Later she appeared in leading classical, Shakespearian and comedy rôles with Lawrence Barrett, Tommaso Salvini, Joseph Jefferson, and other noted actors She created and played leading parts in *Sowing the Wind, The Masqueraders,* and *Under the Red Robe.* In 1898 she appeared with marked success as Gloria Quayle in *The Christian,* by Hall Caine, and in 1902 as Roma in Hall Caine's *The Eternal City.* Beginning in 1903 in a series of Shakespearian productions, she played Viola in *Twelfth Night,* in 1904–05 she appeared as Hermione and Perdita in *A Winter's Tale,* and in 1906–07 she played in a repertoire which included, besides the foregoing, *Cymbeline* and *As You Like It.* During the ensuing ten years she was seen mainly in modern comedy parts, but in 1915 she returned to Shakespearian drama, playing Lady Macbeth in company with J. K. Hackett, and in 1916 she appeared as Mistress Ford in *The Merry Wives of Windsor.* In 1906 she was married to Peter Duryea.

ALLEN, WILLIAM (1532–94), English cardinal, was born at Rossall, Lancs, and died in Rome Oct. 16, 1594. He was educated at Oriel College, Oxford, and became principal of St. Mary Hall. Although he was deprived for refusing the oath of supremacy at Elizabeth's accession, he remained in the University until 1561. He then went to Louvain, but soon returned to England and lived in hiding until 1565. After two years spent in lecturing at the Benedictine college in Malines, he went to Rome and began working on his scheme for the establishment of a Catholic college where English students could be trained in theology. With the help of friends, notably of the Benedictines of neighbouring monasteries, he founded (Sept. 29, 1568), with papal approval and under the patronage of the king of Spain, the English seminary at Douai. He himself became regius professor there. The seminary at Rome, established in the old English hospice there, was also founded by his advice. In 1578 the Flemish insurgents against Spanish rule expelled the English students from Douai, and Allen moved his seminary to Reims, where the translation of the Bible known as the Douai version was begun under his direction.

In 1577 he began to correspond with Robert Parsons, the Jesuit, one of the directors of the many plots against Elizabeth. Under the advice of Parsons the seminary at Rome was handed over to the Society of Jesus to train men for the Jesuit mission to England. Allen left Reims in 1585 for Rome, where he spent the rest of his life. Although he was in reality only the leader of a group of émigrés, Allen was regarded on the Continent, quite wrongly, as the authorized representative of the English Catholics. In this assumed capacity he wrote to Philip II. of Spain after the execution of Mary, Queen of Scots, urging him to invade England and to punish Elizabeth, "that woman hated by God and man."

After much negotiation, he was made cardinal by Sixtus V. Aug. 7, 1587. One of his first acts was to issue, under his own name, two violent works for the purpose of inciting the Catholics of England to rise against Elizabeth. "The Declaration of the Sentence of Sixtus V." a broadside, and a book, *An Admonition to the nobility and people of England* (Antwerp 1588). On the failure of the Armada, Philip nominated him to the archbishopric of Malines, but the canonical appointment was never made. Gregory XIV. made him librarian at the Vatican; and he served on the commission for the revision of the Vulgate. He took part in four conclaves, but never had any real influence after the failure of the Armada. Before his death he found reasons to change his mind concerning the wisdom of the Jesuit politics in Rome and England.

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ALLEN, WILLIAM (1803–1879), American lawyer and politician, was born in Edenton, N C, in 1803. When 16 years old he removed to Chillicothe, O, attended the Chillicothe academy, studied law, and at the age of 21 was admitted to the bar. He rapidly attained prominence as a lawyer and in 1833 was elected to Congress as a Democrat, the youngest member, when seated, of the national House. In 1836, following his energetic support of Van Buren's presidential campaign, he was elected to the U.S. Senate, in which he served two terms, 1837–49. In the Senate, in which he was a forceful figure, he received the nicknames "Earthquake Allen," "Petticoat Allen" and the "Ohio Gong," and is said to have originated the famous slogan used so effectively in the presidential campaign of 1844, "Fifty-four forty, or fight!" Following the defeat in 1848 of Lewis Cass, the Democratic candidate for president, whom he most ardently supported, and the expiration soon after of his own term in the Senate, Allen withdrew from active participation in politics until 1873, when he was elected governor of Ohio. While governor, he became a prominent advocate of an irredeemable currency, and in 1875, on the Greenback issue, he was defeated for re-election by Rutherford B. Hayes (*q v*). Allen died in Chillicothe, O, on June 11, 1879.

See Reginald Charles McGrane, *William Allen* (Columbus, O., 1925).

ALLEN, ZACHARIAH (1795–1882), American scientist, inventor and manufacturer, was born in Providence, R I, on Sept. 15, 1795, the son of a wealthy merchant. He graduated at Brown university in 1813, was admitted to the bar in 1815, and in 1822 became engaged in manufacturing enterprises. By the use of his wealth and through his inventions he substantially aided the development of various industries in Rhode Island. In 1821 he constructed the first hot-air furnace for the heating of dwelling-houses. For the purpose of studying advanced mechanical methods he visited in 1825 England, France and the Netherlands. In 1833 he secured the patent for the automatic cut-off valve for steam-engines, his most widely known invention. He made an improved fire-engine, devised a storage reservoir for water-power and was the first to make a calculation of the motive power of Niagara Falls, which he published in *Silliman's Journal* in 1844. Among his published writings are: *The Science of Mechanics* (1829);

Philosophy of the Mechanics of Nature (1851); *The Rhode Island System of Treatment of the Indians, and of Establishing Civil and Religious Liberty* (1876); and *Solar Light and Heat, the Source and Supply* (1879). He died in his native city on March 17, 1882.

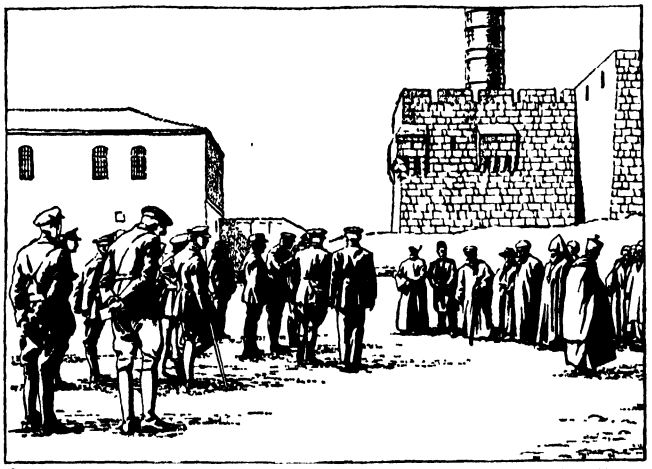
See Amos Perry, *Memorial of Zachariah Allen, 1795–1882* (Cambridge, Mass., 1883).

ALLEN, BOG OF, a group of morasses in Kildare, King's County, Queen's County, and Westmeath, Ireland. Clane bog, the eastern extremity, is within 17m. of Dublin, and the morasses extend westward almost to the Shannon. Their total area is about 238,500 acres. The tract of country to which the name is given is intersected by strips of dry cultivated land. The rivers Brosna, Barrow, and Boyne rise in the morasses, and the Grand and Royal canals cross them. The bog has a general elevation of 250ft above sea level, and the average thickness of the peat beds is 25ft. It rests on clay and marl.

ALLENBY, EDMUND HENRY HYNMAN, 1ST VISCOUNT (1861–), British field-marshal, was born April 23, 1861, and joined the Inniskilling Dragoons in 1882. He saw active service early in the Bechuanaland expedition of 1884–85 and in Zululand 1888, and later passed through the Staff College During the South African war (1899–1902) he took part in the cavalry operations leading to the relief of Kimberley, in the battle of Paardeberg, and in the advance to Pretoria. His command of the 5th Lancers from 1902–05 spread his reputation throughout the Army. After commanding a cavalry brigade, he became inspector of cavalry in 1910 and in 1914 went out to France in command of the cavalry division

The work of his troops, mounted, during the retreat from Mons and advance to the Aisne, and, dismounted, in holding the line south of Ypres during the critical weeks of October, won high praise in Sir John French's despatches. When a second cavalry division arrived, Allenby was given command of the Cavalry Corps then formed, and in Oct. 1915 he succeeded Sir Charles Monro as commander of the III. Army Throughout 1916 his Army front was relatively quiet, but in the spring of 1917 it played a foremost rôle in the battle of Arras.

In June Allenby left France to succeed Sir Archibald Murray in charge of the forces in Egypt and Palestine. His first three months on the borders of Palestine, the season being still unsuitable for operations, were devoted to intensive preparations for an autumn offensive, reorganizing the command, greatly developing the communications, and moving his own General Headquarters from Cairo to the front at Rafa. Complete secrecy and many ruses misled the Turks as to the main point of attack. The strong defences of Gaza were bombarded from Oct. 26 onwards, and serious attacks followed on Nov. 1 to fix the enemy's attention and compel him to draw in his reserves.



GENERAL ALLENBY, COMMANDER OF THE BRITISH FORCES IN PALESTINE, WITH HIS STAFF AND ACCOMPANIED BY ITALIAN AND FRENCH OFFICERS, RECEIVED BY THE INHABITANTS IMMEDIATELY AFTER THE FALL OF JERUSALEM

Meanwhile, as a necessary preliminary to the real blow, the outlying bastion of Beersheba, 35 m. E. of Gaza, was gained by a convergent manoeuvre on Oct. 31, a prelude to the decisive attack on Nov. 6 which broke through the enemy's weakened centre and into the plain of Philistia This compelled a general retreat of the Turks, and the pursuit was pressed so relentlessly that by Nov. 14 the port of Jaffa had been seized, the Turkish armies driven apart in two divergent masses, and Allenby was able to wheel his forces to the right for an advance inland on Jerusalem. The British troops kept too closely on the heels of the Turks for the latter to block the narrow mountain passes, and, despite a stout Turkish resistance almost at the gates of Jerusalem the objective was gained with the surrender of the city on Dec. 9. By the time the winter rains set in the position of the British had been improved and their hold on Jaffa and Jerusalem had been made thoroughly secure

The further advance initiated in the spring was interrupted by the crisis on the western front, which forced the dispatch to France of most of Allenby's British troops The depletion was made up by reinforcements from India and Mesopotamia, and the summer of 1918 was devoted to reorganization and the training of these new units Finally, in mid-September, the carefully planned and prepared offensive was launched. Feinting towards the east bank of the Jordan, to distract the enemy's attention, Allenby secretly concentrated, on the Mediterranean flank, the mass of the infantry and behind them the cavalry In this way he changed a two-to-one superiority on the general front into a four-to-one superiority at the decisive point of attack On the night Sept. 18–19 the forces in the hilly centre had attacked to fix the enemy's attention, and at dawn on the 19th the western mass struck; the result was to roll the Turks back north-east, like a door on its hinges.

Through the open doorway the cavalry passed, riding straight up the coastal corridor for 30 m. before swinging east to cut the Turkish communications and close all exits of retreat. Completely trapped, the main Turkish armies were rounded up, while the British cavalry exploited the victory of Megiddo by a swift and sustained pursuit which gained first Damascus and finally Aleppo. The capitulation of Turkey rang down the curtain on this brief and dazzling campaign Making all allowances for the British superiority in strength, it must rank as one of the masterpieces of military history, as perfect in execution as in design. For his services the victor was promoted field-marshal and raised to the peerage as Viscount Allenby of Megiddo and Felixstowe, receiving also a grant of £50,000

Though his campaign had been waged beyond the borders of Egypt, Allenby had been throughout responsible for the protection and internal order of the Nile delta, where the military situation and the changed status of Egypt had led to considerable unrest. In 1919 he was appointed British High Commissioner in Egypt, and held the post until 1925, through the long sequence of political trouble and disturbances arising out of the agitation for independence. In such conditions criticism of the administration was inevitable, but it is a testimony to Allenby's impartiality and sympathy that it was rather of the velvet glove than of the iron hand. If the ultimate verdict rests with history, it can at least be recognized now that the prestige of his name was a unique asset, and indeed made him the only possible choice for the post at such a critical period *See* PALESTINE, OPERATIONS IN.

(B. H. L. H.)

ALLENSTEIN, a town in East Prussia, Germany, on the river Alle, 100m. N.E. of Thorn by rail. Pop (1925) 38,065. The town possesses a mediaeval castle, and has courts, with superior courts at Königsberg. The town makes machines, cement, furniture, gloves and umbrellas It trades in grain, leather and cattle.

ALLENSTEIN-MARIENWERDER, a region composed of districts of the former Prussian provinces of East and West Prussia.

Articles 94–98 of the Treaty of Versailles (*q.v.*) provided that the East Prussian Circles (Kreise) of Allenstein, Ortelesburg, Osterode, Sensburg, Johannisburg, Lotzen, Lyck and Neidenburg, in so far as they had not already been ceded to Poland, and further the West Prussian Circles of Marienwerder (east of the

Vistula), Stuhm, Rosenburg and the section of the Circle Marienburg situated east of the Nogat, should declare by a plebiscite whether they desired to belong to Germany or Poland. Until the plebiscite should take place the administration of these Circles was taken over by inter-Allied commissions for East and West Prussia respectively, supported by Allied garrisons.

The plebiscite held on July 11, 1920, was preceded by much agitation and band warfare. In the East Prussian region 98% of the population voted for Germany, in the West Prussian 92%. Both districts were assigned to Germany on the basis of the vote; but, in accordance with the terms of the Treaty of Versailles, a zone 50m. broad and some 30m. long on the east bank of the Vistula near Marienwerder and four villages with the harbour of Kurzebrack on the same river were assigned to Poland in order to secure for the Polish state, at this point, the sovereignty over the course of the Vistula accorded to it by the treaty. The inhabitants of the adjacent East Prussian territory are at all times to have access for themselves and their boats to the Vistula. Three frontier communes in the south-west of East Prussia were also assigned to Poland. On Aug. 16 both the inter-Allied commissions left the plebiscitary areas.

ALLENTIACAN, a small independent linguistic stock of South American Indians, so called from the Allentiacs or Huarpes (Guarpes) who were its most important tribe. The Allentiacs lived in western Argentina, in the vicinity of the lagoon of Huanacache on the borders of the provinces of San Luis and Mendoza. They were a fierce tribe of low culture, and have, with most of their neighbours, been extinct since the latter part of the 18th century.

See D. S. Aguiar, *Los Huarpes* (B. Aires, 1900–04); E. Boman, *Antiquités de la Région Andine de la République Argentine*, etc. (Paris, 1908).

ALLENTOWN, a city of Pennsylvania, U.S.A., on the Lehigh river, 56 m. N.N.W. of Philadelphia; the county seat of Lehigh county. It is on the William Penn highway, and is served by the Reading system, the Central Railroad of New Jersey and the Lehigh Valley Railroad, and the Lehigh and New England (for freight only). The area of the city is 9·75 sq. miles. Its population increased from 35,416 in 1900 to 73,502 in 1920, of whom 8,612 were foreign-born (4,219 Slavs); and was estimated locally at 100,000 in 1927.

The city is situated on high ground sloping gently towards the river and commanding diversified views of the surrounding country. Its main streets are crowded with traffic. There were 258 factories in 1927, and the aggregate value of their output was $145,000,000, which was over eight times as much as the value of the manufactured products in 1905. The silk industry, introduced in 1881, developed into the dominating interest, until in 1905 Allentown ranked sixth in the manufacture of silk and silk goods in the U.S.A. Silk is still its leading industry, but there are also extensive iron furnaces, rolling mills, forges and foundries; planing mills and furniture factories; and factories making shoes, cigars, linen thread, barbed wire, cement, firebrick, auto-trucks and mining machinery.

Allentown is the seat of Muhlenberg college for men and Cedar Crest college for women. The former in 1926–27 had an enrolment of 455 in the college; 362 in the summer school, to which women are admitted; 869 in the extension schools, also co-educational; and 200 in the preparatory school affiliated with it.

Allentown was settled in 1751. In 1762 it was laid out as a town by James Allen, the son of a chief justice of the province, after whose family the city is named. In 1811 it was incorporated as a borough, and the name was changed to Northampton; in 1812 it was made the county seat; in 1838 the original name was resumed; and in 1867 it was incorporated as a city. The Lehigh county Historical Society occupies Trout Hall, a home built by William Allen, who settled here in 1702. During the Revolution the Liberty Bell was brought to Allentown from Philadelphia for safe-keeping and for a time was placed in the basement of one of the churches.

Trexler Park, 10 m. N. of the city, is a game preserve containing large herds of buffalo, elk and deer.

ALLEPPEY, a seaport of south India, in the State of Travancore, 33m. south of Cochin, on a strip of coast between the sea and one of those backwaters that here form the chief means of inland communication. Pop. (1921) 32,074. There is a lighthouse 85ft. high. Though the third town in the State in point of population, Alleppey is the first in commercial and industrial importance. It commands a fine harbour, affording safe anchorage for the greater part of the year. It was opened to foreign trade towards the latter end of the 18th century. The exports include pepper, cardamoms, copra, coir, ginger and coco-nuts. There are several oil-mills.

ALLERGY, a hypersensitivity which causes various diseases such as serum sickness, asthma, hay fever and hives. When a foreign protein, say horse serum, is injected into a laboratory animal of another species, it is harmless. But it renders the animal hypersensitive to further injections of the same serum after a period of incubation. When the second injection is given the animal will have a severe reaction which may result in its death. This sensitivity is remarkably specific, and the animal will react only to the type of foreign protein originally given. One hypothesis is that the tissues form antibodies to counteract the original foreign protein and when the second injection is made the antibodies and foreign protein react so violently that destruction of tissue takes place. This has never been experimentally proved.

ALLERTON, ISAAC (1583?–1659), one of the American Pilgrims, was born probably in England about 1583. The first record concerning him is as a merchant in Leyden, Holland. He was a member of the English Separatist Church there and was made a freeman of the city in 1614. On the first voyage of the "Mayflower" in 1620 he came to Plymouth, Mass., and was the fifth to sign the historic "Mayflower Compact" (*see* MAYFLOWER). One of the most enterprising members of the colony, he took a prominent part in the conduct of its early affairs. As the colony's first assistant or agent he made several voyages to England and also carried on negotiations with the Indian chief Massasoit. A disagreement in 1631 led to his separation from the colony. He went first to Marblehead, Mass., and later, about 1635, to New Amsterdam, now New York, where in 1643 he was made a member of the council. His latter years were spent at New Haven, Conn., where he died in 1659. His daughter Mary, whose death occurred in 1699, was the last survivor of the original "Mayflower" company.

See William Bradford, *History of the Plymouth Plantation* (Boston, 1856, 1898); Annie A. Haxton, *Signers of the "Mayflower Compact"* (1896–99); Edward Beaman Patten, *Isaac Allerton, First Assistant of Plymouth Colony* (1908), and George E. Bowman, *The "Mayflower Compact" and Its Signers* (Boston, 1920).

ALLESTREE or **ALLESTRY, RICHARD** (1619–1681), royalist divine and provost of Eton College, son of Robert Allestree, and a descendant of an ancient Derbyshire family, was born at Uppington in Shropshire. He took an active part in the Civil War, and during the Commonwealth frequently carried despatches between Prince Charles and the English royalists. He was imprisoned for a brief period after one of these missions. At the Restoration he became canon of Christ Church, D.D. and city lecturer at Oxford, in 1663 chaplain to the king and regius professor of divinity, and in 1665 provost of Eton College. He introduced order into the disorganized finances of the college and procured the confirmation of Laud's decree, which reserved five of the Eton fellowships for members of King's College. His additions to the college buildings were less successful; for the "Upper School," constructed by him at his own expense, was falling into ruin almost in his lifetime, and was replaced by the present structure in 1689. Allestree died Jan. 28, 1681, and was buried in the chapel at Eton College, where there is a Latin inscription to his memory.

His writings include many controversial tracts. A share in the composition, if not the sole authorship, of the books published under the name of the author of the *Whole Duty of Man*, has been attributed to Allestree (Nichols's *Anecdotes*, ii. 603), and the tendency of modern criticism is to regard him as the author. His lectures, with which he was dissatisfied, were not published. Alles-

tree was a man of extensive learning, of moderate views and a fine preacher. He was generous and charitable, of "a solid and masculine kindness," and of a temper hot, but completely under control.

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ALLEYN, EDWARD (1566–1626), English actor and founder of Dulwich college, was born in London Sept. 1, 1566, the son of an innkeeper. In 1586 his name was on the list of the earl of Worcester's players, and he was eventually rated by common consent as the foremost actor of his time. Ben Jonson bestowed unstinted praise on Alleyn's acting (*Epigrams*, No. 89). Nash expresses in prose, in *Pierce Penniless*, his admiration of him, while Heywood calls him "inimitable," "the best of actors," "Proteus for shapes and Roscius for a tongue." Alleyn inherited house property in Bishopsgate from his father. His marriage, on Oct 22, 1592, with Joan Woodward, stepdaughter of Philip Henslowe, brought him eventually more wealth. He became part owner in Henslowe's ventures and, in the end, sole proprietor of several play-houses and other profitable pleasure resorts. Among these were the Rose theatre at Bankside, the Paris garden and the Fortune theatre in St. Luke's—the latter occupied by the earl of Nottingham's company, of which Alleyn was the head. He filled, too, in conjunction with Henslowe, the post of "master of the king's games of bears, bulls, and dogs." On some occasions he directed the sport in person, and Stow, in his *Chronicles*, gives an account of how Alleyn baited a lion before James I. at the Tower.

Alleyn's connection with Dulwich began in 1605, when he bought the manor of Dulwich from Sir Francis Calton. The landed property, of which the entire estate had not passed into Alleyn's hands earlier than 1614, stretched from the crest of that range of Surrey hills on whose summit now stands the Crystal Palace, to the crest of the parallel ridge, three miles nearer London, known in its several portions as Herne hill, Denmark hill and Champion hill. He began the task of building and endowing in his own lifetime the College of God's Gift at Dulwich. All was completed in 1617 except the charter or deed of incorporation for setting his lands in mortmain. Tedious delays occurred in the Star Chamber, but the College of God's Gift at Dulwich was founded and endowed under letters patent of James I dated June 21, 1619. The building had been already begun in 1613 (*see* DULWICH). Alleyn was never a member of his own foundation, but he continued to the close of his life to guide and control its affairs under powers reserved to himself in the letters patent. His diary shows that he took a large part in the life of the college.

Alleyn's first wife died in 1623. The same year he married Constance, daughter of John Donne, the poet and dean of St. Paul's. Alleyn died in Nov. 1626, and was buried in the chapel of the college which he had founded.

ALL FOOLS' DAY: *see* APRIL-FOOLS'-DAY.

ALL FOURS, a card game (also termed HIGH LOW JACK, OLD SLEDGE, and SEVEN UP) for two, three, or four players (in partnership). A complete pack of cards is used. All players cut for deal, the one cutting the highest card being the dealer. Ace is highest and deuce lowest The dealer shuffles and his right-hand opponent cuts. The cards are dealt in rotation, three at a time, beginning at the dealer's left. Six cards are dealt to each player, and the next card is turned up as trump. The deal passes to the left. If an exposed card or a wrong number of cards be given a player there must be a new deal. If the dealer turns a *Jack* as trump he scores one point. The player at the dealer's left *stands* and makes first lead, *i.e.*, *begs*. The dealer either gives the *beggar* one point, requiring him to lead, or *refuses*. If he refuses the trump turned is discarded face up and three added cards are given each player. If the next card differs in suit from the first one turned it becomes trump; otherwise the card turned is discarded and three more cards are dealt to each player. The process is repeated until another suit appears or the pack is exhausted, in which case all cards are collected, shuffled, cut and redealt by the same player. The winner of one trick leads for the next one. Each player must either follow suit, trump or forfeit a point to his opponents. The highest card of the suit led or the highest trump played wins the trick. One point is scored by the one to whom is dealt the highest trump out; one point is scored by the one to whom is dealt the lowest trump out. The player of a trump may enquire if it is *high* or *low*. *Jack* (*Knave*) scores one point for the one winning the trick containing the Jack of trumps. *Cards* count one point for the player scoring most, with each 10 counting 10, each Ace 4, each King 3, each Queen 2 and each Jack 1. The claimant of cards turns each card of his tricks face up and counts aloud. A tie for *cards* goes to the non-dealer; as between non-dealers a tie does not score. Should two players be able to score game, precedence is given, first to the holder of *high*, next to *low*, third to *Jack*, last to *cards*. Game is 7 or 10 points, as agreed.

(E. V. S.)

ALLGEMEINE-ELEKTRIZITÄTS-GESELLSCHAFT, commonly known as the A E.G. Prior to 1923, this was the largest electrical manufacturing concern in Germany and one of the most important industrial undertakings in the world. Since that year, however, the rapid expansion of the Siemens-Schuckert, Siemens-und-Halske group has served to relegate it to second place. The total share capital invested in the company, ordinary and preferred, was, in 1926, 156,000,000 marks, debentures and loan capital 61,760,000 marks, and reserves 16,120,000 marks, so that the total operating capital of the company was 233,880,000 marks. Its output in 1925 was given as in excess of 400,000,000 marks, and it employs about 80,000 workers.

The A E G. was founded by Emil Rathenau in 1883 as the Deutsche *Edison Gesellschaft für Angewandte Elektrizität* and its function at that time was merely to exploit Edison patents. Since then, working always in close association with American firms, it has been able to expand very rapidly, and its range of production covers practically all equipment used in the generation, production and consumption of electricity, while it has embarked on the manufacture of steam locomotives, steam turbines, marine engines and internal combustion engines generally. From an output of 200,000 h p. of electrical machinery recorded in 1899, it has reached the annual quota of almost 3,000,000 h p , while, in steam turbines alone, its effective output has risen to 800,000 h.p.

Much of this expansion has been due to the financial and administrative policy of the concern. It has applied a great part of the profits realized in production to the acquisition of controlling interests in a number of manufacturing firms both at home and abroad These firms specialize in the production of batteries and accumulators, cables, meters and instruments, lamps and telegraphic and telephonic apparatus, and, in this way, are subsidiary to the main firm A further development has lain in the creation of power finance corporations to finance the production, transmission and distribution of electricity in Germany and in other important markets. The electricity supply companies financed in this way constitute important customers for the products of the concern, and allow the A E G to compete effectively for the supply of equipment to firms outside the range of control.

A recent survey has shown that the A E.G. has interests in 14 manufacturing firms, four power finance corporations and 33 electricity supply companies, while it has close technical connections with the General Electric Company of America. Both these concerns work together in the development of the European market outside of the great industrial countries. The A.E.G. has also important interests among coal-mining, iron and steel, shipbuilding, chemical and engineering firms, especially in Germany, and has thus secured an outlet for its products. (H. Q.)

ALLIA (mod. Fosso BETTINA), a small tributary of the Tiber on the left (east) bank, about 11m. N. of Rome. It gave its name to the terrible defeat of the Romans by the Gauls on July 18, 390 B C. Despite objections, Livy's account, placing the battle on the left bank of the Tiber, must probably be accepted.

ALLIANCE, a city of north-western Nebraska, U.S.A., on the Burlington route; the county seat of Box Butte county. The population was 4,591 in 1920 (90% native white), and was estimated locally at 6,000 in 1928. It has railroad shops, a cereal mill and several other industries.

ALLIANCE, a city of Stark county, O., U.S.A., on the Mahoning river, 55m. S E. of Cleveland, about 1,080ft. above sea-level. It is served by the Pennsylvania and the New York Central railway systems. The population was 21,603 in 1920, of whom 3,026 were foreign-born whites; and was estimated at 24,979 in 1925. The city has important manufactures, including heavy machinery, steel, automatic equipment, household appliances, office equipment, boilers and pottery. One drop-forging plant employs 2,000 men. The output of the 42 establishments within the city in 1925 was valued at $24,302,777.

On an eminence in the south-western part of the city, two miles from the business and industrial districts is Mount Union college, a co-educational college of the Methodist Episcopal Church, which in 1926–27 had an enrolment of 769. It began as a "select school" of six pupils in 1846, and in 1858 was chartered as a college. In 1911 Scio college (1857) was merged with it. Alliance was settled and laid out in 1838; incorporated as a village in 1854, and as a city in 1888. Until 1851 it was called Freedom.

ALLIANCE, in international law, a league between independent States, defined by treaty, for the purpose of combined action, defensive or offensive, or both. Alliances have usually been directed to specific objects carefully defined in the treaties. Thus the Triple Alliance of 1688 between Great Britain, Sweden, and the Netherlands, and the Grand Alliance of 1689 between the emperor, Holland, England, Spain and Saxony, were both directed against the power of Louis XIV. The Quadruple or Grand Alliance of 1814, defined in the treaty of Chaumont, between Great Britain, Austria, Russia and Prussia, had for its object the overthrow of Napoleon and his dynasty, and the confining of France within her traditional boundaries. The Triple Alliance of 1882 between Germany, Austria and Italy was ostensibly directed to the preservation of European peace against any possible aggressive action of France or Russia; and this led, some 10 years later, to the Dual Alliance between Russia and France, for mutual support in case of any hostile action of the other powers. Occasionally, however, attempts have been made to give alliances a more general character. Thus the "Holy Alliance" (*q.v.*) of Sept. 26, 1815, was an attempt, inspired by the religious idealism of the emperor Alexander I. of Russia, to find in the "sacred precepts of the Gospel" a common basis for a general league of the European governments, its object being, primarily, the preservation of peace. So, too, by Article VI. of the Quadruple Treaty signed at Paris on Nov. 20, 1815 (which renewed that of Chaumont and was again renewed, in 1818, at Aix-la-Chapelle) the scope of the Grand Alliance was extended to objects of common interest not specifically defined in the treaties.

It was this article of the treaty of Nov. 20, 1815, rather than the "Holy Alliance," that formed the basis of the serious effort made by the great powers, between 1815 and 1822, to govern Europe in concert, which will be found outlined in the article on the history of Europe. In general it proved that an alliance, to be effective, must be clearly defined as to its objects, and that in the long run the treaty in which these objects are defined must—(to quote Bismarck's somewhat cynical dictum)—"be reinforced by the interests" of the parties concerned. Yet the "moral alliance" of Europe, as Count Nesselrode called it, though it failed to secure the permanent harmony of the powers, was an effective instrument for peace during the years immediately following the downfall of Napoleon; and it set the precedent for those periodical meetings of the representatives of the powers, for the discussion and settlement of questions of international importance, which have contributed much to the preservation of the general peace. (*See* EUROPE: *History.*)

In the World War the United States were "Associates," not "Allies," signifying the want of a common agreement on the objects to be attained by the war. (W. A. P.)

ALLIARIA OFFICINALIS: *see* GARLIC MUSTARD.

ALLIBONE, SAMUEL AUSTIN (1816–1889), American author and bibliographer, was born in Philadelphia (Pa.), April 17, 1816, of French Huguenot and Quaker ancestry. He was privately educated and for many years was engaged in mercantile business in his native city. He, however, acquired a very unusual knowledge of English and American literature, and is remembered as the compiler of the well-known *Critical Dictionary of English Literature and British and American Authors* (1854–71), and of various anthologies and indexes. From 1867 to 1873, and again in 1877–79, Allibone was book editor and corresponding secretary of the American Sunday School Union; and from 1879 to 1888 he was librarian of the Lenox library, New York city. He died at Lucerne, Switzerland, Sept. 2, 1889.

See the "Memoir" by S. D. M'Connell, an address delivered before the Historical Society of Philadelphia (1890).

ALLIED MARITIME TRANSPORT COUNCIL. This Council (which will be referred to below as the A M T C) was the organ through which, in the latter months of the World War, the Allied Powers decided how the merchant shipping at their disposal should be allotted among their different supply services. Throughout 1918 shipping was, in each of the Allied countries, the limiting factor in the whole of the civilian effort by which the military struggle was supported and conditioned. The authorities responsible for securing the food of their respective populations and for meeting the needs of the armies in munitions and other supplies found at this period that the primary factor in all their calculations was the amount of shipping space which they could obtain for their imported supplies or raw materials. Thus in 1918 the policy governing, in main principle, the allocation of merchant shipping determined in a very large measure the character and direction of the whole effort of the several Allied countries. It involved decisions of such intricate, far-reaching and decisive consequence that they could not be properly taken by a pure shipping authority nor indeed by any body of ministers except with the aid of a system which could give them at once access to the advice of the many authorities concerned and the means to judge between their competing claims.

We thus find that the A M.T.C., the body of Allied ministers by whom the ultimate decisions were to be taken, was a part only, but the pivotal part, of a vast system partly national and partly international, through which the competing demands were sifted and adjusted and reduced to questions of principle, few in number but far-reaching in effect, for decision by the Council itself. This system was the counterpart in the civilian sphere of the unity of military command which was achieved at about the same time, and it was among the decisive factors in the issue of the struggle. It was different, not only in its enormous range, but in the principles of its organization, from anything previously known in administration; and it has had a profound effect on the methods and machinery by which world problems have been handled since the war. For all these reasons it deserves more attention than it has yet received both from the historian and the student of political and economic science.

The different parts of the system which were linked together by the A M.T C. had a separate existence, fulfilling in most cases some functions unconnected with shipping; and they are described in various other articles (*see* list at end of article). But as the A M.T.C. was the pivotal part, it is here that we may conveniently give a brief sketch of the whole structure. Without such a general view no account of the A.M.T.C. would be intelligible, for it was essentially an instrument for linking together, for a special purpose, other authorities whose range of action extended beyond its own sphere, and except with them and through them it had no separate existence or means of action. The A.M.T.C. linked together a number of international (Allied) authorities dealing with the control of different commodities; and each of these was formed by linking together the national authorities dealing with the same commodities in the different Allied countries. The whole system was built up on the basis of national departmental control and administration, which it united and in no way replaced. We must therefore sketch, in the briefest practicable outline, the way in which the State control system grew up,

first nationally and then internationally; and for this purpose we can properly write mainly from the point of view of Great Britain, which was the principal centre of the whole Allied supply organization.

The British System of State Control.—Under the economic system in operation before the war, as now in most countries, supply is adjusted to demand by a method which is not only elastic and responsive but also automatic. Increased demand for an article pushes the price up; increased prices make it pay to produce more; they also pare off from the demand the poorer or less eager consumer. The essential characteristic of this system is that, over the whole range of human activity, needs and the means to satisfy them are adjusted without any human brain requiring to survey the system as a whole; without any attempt being made to measure competing demands in terms of either human need or public interest except so far as they are reflected in economic demand.

But for the conditions of war needs and shortage this system, independent of deliberate direction and control, proved blind and wasteful. It produced too little, it produced the wrong things, and it distributed them to the wrong people.

The State in war can order in large quantities; it can therefore dispense with many middlemen. And in war the necessities of all must have priority over the luxuries of a few. Under conditions of national shortage the criterion of effective economic demand does not secure this; with only bread enough to go round it will cause alternate surfeit and starvation. For these reasons, from the early days of the war, we find State control extending over spheres previously occupied by unfettered private enterprise. The new system was not introduced full-fledged on any general principles. On the contrary it was applied piecemeal, and often with obvious reluctance, under the compelling force of a breakdown or obvious defect of the peace system. Usually the earliest motive was to save the Treasury the expense of inflated competitive prices for war materials; then came the desire to mitigate the public indignation at similar prices for their own purchases; and lastly there was the necessity of distributing equitably what had become a bare sufficiency of the necessities of life.

90% of British Imports Under Control.—First sugar, then some two years later wheat and flour, were bought by the State In time all the prime articles of food, both fresh and frozen meat, all cereals, oils and fats and subsidiary foodstuffs, were brought within the extending sphere of State control. And the control developed in intensity as well as range, passing from purchase to distribution, and in some cases to a detailed rationing of the individual consumer. Ultimately these activities were grouped under a central Ministry of Food. Meantime a similar process was developing in an equally wide sphere. First the manufacture of munitions and then not only all the raw materials needed for munitions, the metals and the chemicals required for explosives (coin ores, copper, zinc and spelter, lead, tin, aluminium, oils, nitrates, coal tar, etc.), but also, by a necessary consequence, all the manufactures of the country which were dependent on them, were brought within the single authority of the Ministry of Munitions. By the end of 1917 the national system of control was practically complete for both metals and food, and the two great ministries ultimately brought under their direct authority 70% of the national imports. Many of the remaining raw materials (wool, flax, jutes, hides and leather, and the connected industries) were being dealt with simultaneously, on similar principles, by the War Office. Finally, the Board of Trade, more slowly, less completely, and by more commercial methods, exercised its authority over the remaining imports (timber, cotton, paper and pulp, etc.). Ultimately 90% of the imports of Great Britain and something like that proportion of the principal productive activities of the country, were directed by the Government in the public interest. One by one the necessities of life, and of war, were brought under control, their purchase centralized, their transport allotted, their prices fixed, their consumption rationed.

It was the necessity of organizing a priority between different services and requirements needing the same raw materials of which the full supplies available were insufficient that, to a large extent, compelled the grouping within a few great ministries which has just been described. The same necessity was constantly improving the mechanism of consultation and authority within each of these great departments which determined the proportions of the available resources to be allotted to different services and different industries. This was sufficient until a serious shortage began to be felt in the three great requirements common to them all—men, finance for the purchase of foreign supplies, and shipping to import them. This needed new machinery to decide not only within each of the ministries but between them. The system devised to allot men and to ration finance need not be described here. The central requirement, which at the most difficult period was the most serious of all, was shipping; it was upon this need that the international system under the A M T.C. was ultimately based.

Before describing this international development it is therefore necessary to add a note on the British control of shipping; for it was this control which the submarine made the centre of the whole system. So long as the shipping authorities were able to do their proper and normal work, that of providing the tonnage the supply services wanted, they were the servants of the supply departments. Just in proportion as submarine losses and increased requirements made it impossible for the shipping authorities to supply all the ships they were asked for, they necessarily tended to become the masters. For the allotment of the ships rested with them and that allotment set the limit to the programme of the supply department. This position only developed gradually. The British shipping department at first requisitioned only the ships needed for army and navy supplies and transport, leaving the rest for free or only partially controlled chartering But the area extended as the stringency increased, and as a natural counterpart to the increasing control of supplies and materials by the other departments. With this extension the responsibility attaching to the allocation made by the shipping department constantly increased, till it became obviously too great to be exercised except in effective collaboration with the supply departments concerned. The successive methods by which this collaboration was attempted are described in another article (WAR CONTROL OF SHIPPING). Only the later developments can be noted here.

Tonnage Priority Committee.—The process by which the control of commodities was both extending and becoming grouped in a few great departments has already been described In all these supply departments, specialized experts from the business world were incorporated in the official machine Day by day they were testing the requirements of each industry by the criterion, not of changing market prices (which were ended by control) but of intrinsic importance in the general scheme of national policy. The Ministry of Shipping therefore, in allocating its ships, no longer had to deal with innumerable demands from hundreds of private industries, nor even directly with a score of government controls, but only with a few great ministries. In the penultimate state of this process, from Feb. 1917 till towards the end of that year, the task of balancing competing demands for shipping was facilitated by a new committee (viz , the TONNAGE PRIORITY COMMITTEE presided over by Sir Leo Chiozza Money, the under-secretary in the Ministry of Shipping) consisting of executive officials from each of the main supply departments. Finally, in the last year of the war, after the intensive submarine campaign had made the allocation of tonnage the crucial factor in all supply arrangements, the decisions involved exceeded the authority of the officials who composed the greater part of that committee, and it was succeeded by a standing committee of cabinet ministers, presided over by Lord Milner, in which both the great supply departments and the Ministry of Shipping were represented Here at last was a mechanism—a central committee of supreme authority, having behind it centralized and co-ordinated commodity controls—by which the nation's requirements as a whole could be surveyed, adjusted and directed. The problem of national organization was solved; and with it was secured the foundation of the wider international organization which was to follow.

The International System.—For the real problem was international as well as national, and the need for common action increased with the stress. France and Italy were buying supplies in the same neutral markets and they needed transport from the same interchangeable pool of tonnage under British and Allied control.

To understand the significance of the system which gradually grew up to meet this need it is necessary to recall the normal method by which arrangements were made between countries before the war broke out. If the French Ministry of Commerce needed to arrange something with the British Board of Trade, *e.g.*, about shipping, it transmitted its request through the British embassy in Paris, or the French embassy in London, to the British Foreign Office, who in turn sent it on to the Board of Trade. The reply would come by the same channel, so that the communication between two specialized departments would have passed four times through the hands and pens of non-specialists—or, to be exact, of those who were specialized not in shipping but in the foreign relations of the two countries. This system was based on the principle that in such discussions the primary fact was not that shipping was the subject, but that two countries were negotiating. A shipping concession on the one hand might be set off against a concession of quite another kind, perhaps political. This could only be done by those dealing with the general foreign policy of their countries.

This procedure was obviously unsuitable in war. The intricacy of the arrangements necessitated direct contact between specialized ministers and officials; the common interests of the Allies outweighed their divergencies. Gradually a system was developed of which it was the fundamental principle that a French official wanting British ships was primarily a person wanting ships from someone who could supply them and not primarily a Frenchman negotiating with an Englishman.

Commission Internationale de Ravitaillement.—This result, which will be described later, was reached through many intermediate stages. The first modest beginning was in the establishment in 1914 of a body known as the *Commission Internationale de Ravitaillement,* whose principal object was to prevent the confusion and waste caused by hundreds of Allied agents in England placing orders with private manufacturers in competition both with each other and the British War Office. This body included representatives of the Allied purchasing departments and served a useful purpose in restraining prices, distributing orders with some regard to urgency, and to some extent in pooling knowledge and experience. Essentially, however, it was not an Allied organization but a British organization to help Allied purchases. At the same time it marked a progress towards the final development. At first the British representative in the C.I.R. would collect Allied demands and then himself deal with the officials of the British departments concerned. Then he would bring the Allied supply specialist with him. Then he ceased to come himself. "Direct contact" between specialists was established in individual cases; but it still needed to be developed and organized into a system.

Shipping assistance from Great Britain to the Allies was in the first years rather improvised than organized. Appeals for help were dealt with as far as possible on their merits by the British shipping authority, a method not unjustified at first when shipping was among the least of the Allied problems. But it was obviously inadequate when the shipping situation became so serious that the allocation of tonnage was of the most vital importance to the whole of the supply arrangements. A British authority was ill-equipped to measure British against French or Italian needs.

Wheat Executive.—A further development which began, on the supply side, with the establishment in 1916 of an effective Allied committee, the "Wheat Executive," led the way to the final solution. The British Royal Commission on Wheat Supplies had found itself faced with the evils of competitive purchase in the same markets by France and Italy; and the Wheat Executive, consisting of the cereal specialists of the three countries, was formed primarily to arrange combined purchase. In this it was very successful, but it soon had other advantages. The cereal specialists in this committee settled among themselves the proportion of the total supplies each country should have. Henceforth the Ministry of Shipping could deal with cereal demands in the mass. It no longer had to weigh France's claim for wheat tonnage against Italy's, but only the competing claim of cereals as a whole against other commodities. A little later similar committees of specialists from the Allied countries were formed for some of the "munitions" commodities; and these were gradually increased and finally grouped under an Allied munitions council of ministers.

A new impulse to developing organization on an Allied basis was given when the United States entered the war in 1917 by the formation of a council to advise as to the allocation of American Credits (*see* INTER-ALLY COUNCIL ON WAR PURCHASE). Had finance been more limited than ships the council might have proved the centre of the whole system; but as transport could be found only for the most vital supplies, and it was certain that for these finance would be forthcoming, the real struggle was to squeeze supply demands within the limits of the available shipping, not within those of the available finance. This meant that the shipping organization was the centre of the system; and that it was under the pressure of shipping shortage that the highly developed national and the more partially developed Allied organs were linked into one comprehensive international system The final impetus to this development was given by the transport crisis of 1917.

Transport Crisis of 1917.—By the autumn of 1917 the pressure on shipping was greater than it had ever been; 17,000,000 tons dead-weight of the world's shipping had been lost, and less than half had been replaced. More shipping had been lost in the first ten months of this year than in the previous 30 months of the war. American building had not yet seriously begun. The prospect of her vital contribution to the armed forces meant further demands on transport. And, apart from this, the demands were constantly increasing. All the distant expeditions, except to the Dardanelles, were fully maintained, and both troops and supplies were being sent to Salonica, Mesopotamia, Palestine and East Africa. Drafts were still required from Canada, South Africa, Australia and New Zealand. The scale of the war in France grew constantly, and the development in the character of warfare involved a larger expenditure of munitions The navies were at their maximum strength. And serious food troubles throughout the winter and spring were anticipated in Great Britain, France and Italy alike.

The strain on the shipping authorities, while there was still no comprehensive inter-Allied organization fitted to determine priority between the different supplies, was in these conditions an intolerable one. At any moment the allocation of a batch of ships to food might mean a shortage of vital munitions, an allocation to munitions might entail starvation.

But by this time the national organization in the several countries, which was the indispensable condition of the inter-Allied system, was at its full development, and in wheat and munitions partial international arrangements were already working. In Great Britain the Ministry of Shipping had full and effective control over every voyage and every cargo, and the whole system supply was centralized under the Milner Committee. A standing committee under M. Clémentel, Minister of Commerce, played a similar rôle in France. Italy's problem resolved itself practically into coal and cereals, and she had both of these as well as her shipping under complete control. Except, however, for consultation between munitions experts and the more fully developed Allied action of the Wheat Executive, these national supply systems were working with little knowledge of each other's needs. As regards most commodities there was still no means of judging fairly whether the standards of sacrifice and restriction were approximately equal or not.

The Allied Maritime Transport Council Established.—Those who realized the desperate position of shipping were convinced that it was now essential to develop and complete the system by extending Allied committees like the Wheat Executive over the whole range of supplies, and linking them up by depend-

ence for their transport upon a supreme Allied Shipping Council. On their proposal the necessary decisions were taken at the important Allied Conference which met in Paris in Nov. and Dec. 1917; and the A.M.T.C., consisting of two ministers of the three principal European Allies and two delegates from the United States of America was constituted and furnished with an executive organization.

What was the nature of this new council and of the Allied supply organization which now developed rapidly round it? It was not a supreme authority acting with a delegated power enabling it to override the governments which created it. No body of men could have been entrusted with such power, and those who at this time proposed either the appointment of a council with supreme executive power or a single economic dictator, were misled by the military analogy or ignorant of the realities of the supply situation. A single decision of such an authority, a reduction in sugar or in wheat imports for example, would affect every civilian household in the countries concerned. No cabinet could divest itself of responsibility for such decisions. The Paris Conference rightly, therefore, at the end of 1917, rejected the proposal of an "International Board with complete executive power over a common pool of tonnage."

Its Constitution.—On the other hand, if the A.M.T C. was not in principle executive, it was in practice much more than advisory. If the first was impracticable, the second would have been useless. How could the need for urgent and desperate decisions be met by a body which, when it had itself decided, could only make recommendations to four governments and wait for their assent?

The solution of this particular dilemma was found in appointing as members of the council the ministers who in their own countries had the right to decide, and in forming the executive organization of the officials who in their own countries actually directed, or could effectively influence, the execution. This principle practically destroyed distinction between the executive and the advisory. In principle the council was advisory. But, if the British Shipping Controller agreed as a member of it to a decision involving orders to British shipping, he gave effect to it as a minister in his own department; and the same thing followed if the French Minister of Commerce agreed as a member to a decision involving a change in French supplies.

Had this principle been confined to the ministerial councils it would have represented some advance, but a quite insufficient one. Departmental conferences of ministers had often taken place before. To develop these into councils with a regular constitution and periodical meetings would have been useful, but not decisive. Ministers meet for a day or two and return. On matters of such intricate and detailed daily administration as are involved by arranging supplies in war, no such occasional meetings can resolve the difficulties of diverging national interest. The novelty of the new system consisted in the extension of this new principle, so far as was materially possible, to a series of committees of officials covering the whole range of shipping and supplies and responsible to the A.M.T.C. and two similarly formed Munitions and Food Councils.

Immediately under the A M.T.C. was the first of these bodies, the Allied Maritime Transport Executive, of which, on the principle described above, the British member, who was the chairman, was the Director of Ship Requisitioning in the Ministry of Shipping, the French member, the influential *chef du cabinet* of the French Minister of Commerce, the Italian, an official of great influence in the Italian supply departments, while the American was one of the American members of the council. The headquarters were in London, and the staff was grouped in four national divisions under the direction respectively of the four members of the executive. The Council of ministers itself met only three times before the end of the war. But the Executive of officials met frequently, and in the long intervals between the council meetings was the instrument through which Allied co-ordination in the direction of shipping was secured

Ultimately the whole range of imported commodities was covered by the following committees:—

Under the (Allied) Food Council:

1. Cereals (the wheat executive).
2. Oils and Seeds.
3. Sugar.
4. Meats and fats.

Under the (Allied) Munitions Council

5 Nitrates.
6. Aircraft.
7 Chemicals.
8 Explosives.
9 Non-Ferrous Metals.
10 Mechanical Transport
11. Steel

And (without being grouped under a similar ministerial council):

12. Wool.
13. Cotton.
14. Flax, Hemp and Jute.
15. Hides and Leather.
16. Tobacco.
17. Paper and Pulp.
18. Timber
19. Petroleum
20 Coal and Coke

It had been intended to group these last nine committees under a Raw Materials Council, but this council had not been formed when the Armistice made further organization of this kind unnecessary.

These committees secured combined Allied plans on all questions within their respective spheres on which combined action was necessary. It was only so far as their programmes needed shipping that they needed the approval of the A M.T C. But as the allocation of shipping was the crucial factor in all the main supply arrangements, the A.M T.C. and its executive acquired the dominant position.

Working of the Machine.—As an example of the working of this system let us look at the duties of the most important of the Allied supply committees, the Wheat Executive, say in the spring of 1918. The committee is working, within a general programme agreed for the cereal year 1917–18. It has arranged through common agents for the provision of supplies in the United States, Canada, the Argentine and elsewhere. In contact with the shipping authorities, shipping has been sent to the loading ports. The ships are provisionally allotted for discharge in Great Britain, France and Italy; but the stocks, port facilities, etc., in each of these countries are watched daily, and the ships directed where desirable by orders sent to the ports of loading or even on arrival on the eastern side of the Atlantic.

Meantime, the Wheat Executive is negotiating with the Transport Executive as to the new programme for 1917–18. The latter, conscious of the competing claims for munitions, etc. is urging reduction. The Wheat Executive makes efforts at reduction and tries to distribute this reduction among the three countries. The margin of difference between the two executives is diminished, but not removed. An attempt is made by negotiations with the other food committees, and under the general authority of the Food Council, to balance the respective claims of cereals and other foodstuffs. The final food programme put forward by the Food Council is still in excess of what is likely to be obtained, but the difference is reduced to manageable dimensions. And the final issue is presented to the A M T.C., when it is practically simplified, to a decision between the competing claims of Allied food as a whole and Allied munitions.

The concluding stages of this process are best illustrated by the decisions taken at the A M.T.C. meeting in Sept 1918. The council, at that meeting, reviewed the whole of the prospective shipping position for 1918–19. They had before them estimates carrying the authority of the shipping experts of all the countries concerned to the effect that, after allowing for ships allotted to military expeditions and the fleets, the total imports could not exceed:

72,500,000 tons	for coal raw materials food munitions	for Great Britain France Italy

They decided, on the advice of the Transport Executive, that 25,200,000 tons must be allowed for coal, and 7,500,000 tons for raw materials, leaving 39,800,000 tons for food and munitions;

TABLE SHOWING THE ORGANIZATION OF INTER-ALLIED CONTROLS

1 Commodity.	2 Inter-Allied Body.	3 Method of Purchase.	4 Purchasing Body or Bodies.	5 Represented in United States by	6 Represented in certain other countries as follows:
1. Wheat.	Wheat Executive.	Single buyer.	Royal Commission on Wheat Supplies (British).	Wheat Export Company of America	Canada: Wheat exporters. India: Controlled firms. Argentine: Controlled firms. Brazil: Controlled firms. Russia: French Commission.
2. Sugar.	Inter-Allied Sugar Programme Committee.	Single buyer in London and from International Sugar Committee in U.S.A.	Royal Commission on Sugar Supplies (British).	Representatives of Royal Commission on the International Sugar Committee.	In addition to purchases made as in column 3, the produce of some small British colonies was secured through the British Colonial Office.
3. Meats, fats, and other foodstuffs	Inter-Allied Meats and Fats Executive.	Purchasing Organization in each procuring country aimed at.	Various.	Allied Provisions Export Committee.	British Colonies and also Argentine by the British Government.
4. Oil and oil-seeds.	Oil and Oil-seeds Executive.	Purchasing through A.P.E.C. or the govts concerned (*see* cols. 4, 6).	The Executive.	A.P.E.C	British and French Colonies by the respective governments. Brazil by agents of Wheat Commission.
5. Copper.	Copper Sub-committee, allocating powers only	By the governments requiring supplies.	*See* column 3.	Purchase in U.S.A. by govts from producers at controlled price, in account with allocation by Copper Committee	Purchases in Spain by British Government.
6. Tin	Tin Executive.	Supplies for France and Italy through British Ministry of Munitions.	Tin Executive.		The Executive generally represented in the producing countries by controlled firms
7. Nitrate of Soda.	Nitrates Executives.	Agents on Commission	Director of Purchases under the Executive	..	Special agreement with the Government of Chile.
8. Rubber.	Allied Rubber Committee.	Generally by governments concerned.	Bulk of trade in hands of City merchants.	.	
9. Wool, hair and products of wool and hair.	Wool Programme Committee (Advisory).	Australian and N.Z. clip bought by British Government, otherwise trade channels.	.	..	France partially controlled prices and quantities through Inter-departmental Wool Committee.
10. Cotton.	Cotton Programme Committee.	Usual trade channels except for Egyptian crop.	..	..	Egyptian crop bought by British and Egyptian Governments.
11. Jute, hemp and flax:–	Jute, Hemp and Flax Programme Committee.	Purchase by British Government from leading jute firms	..	..	..
(*a*) Jute.					
(*b*) Hemp.	Jute, Hemp and Flax Programme Committee.	British Government purchase for European Allies.	..	..	Controlled firms in Manila.
(*c*) Flax.	Jute, Hemp and Flax Programme Committee.	Local Allied representatives at Archangel.	..	..	Informal Inter-Allied buying arrangements at Archangel
12. Hides and leather.	Hides and Leather Programme Committee (an Executive under consideration).	British Government purchase in India through Buying Committee of British firms in Calcutta	Great Britain and United States control the market (chiefly India and Argentina).	..	..
13. Timber.	Timber Programme Committee and Commission Internationale d'Achats de Bois.	Purchase centralized in Italy, France, Gt. Britain, C.I.A.B. control purchasing policy.	C.I.A.B.	Purchase in United States through War Missions.	..
14. Coal.	Coal Programme Committee.	British Government controls the mines and works them through existing channels on basis of profits over period of pre-war years.		.	France —Office National des Charbons, buying in United Kingdom through existing channels on a fixed basis. Italy.—All purchases made on Italian Government account.
15. Paper.	Paper and Paper-making Materials Programme Committee.	Central purchase of woodpulp in each country.	Centralized purchase through British Controller for European Allies suggested.	..	Italy.—Italian Paper Commission. France —Office National de la Presse.
16. Petroleum.	Inter-Allied Petroleum Conference (Advisory).	By central purchase in United States of America at fixed price. Usual trade channels in other countries, subject to allocation by Conference.	..	United States Fuel Administration.	..
17. Tobacco.	Tobacco and Matches Programme Committee.	No purchasing arrangements between the Allies, price control being purely national through medium of the state monopolies in France and Italy, and the Tobacco and Matches Control Board in Great Britain.			..

against demands of 49,000,000 (27,000,000 for food and 22,000,000 for munitions). Finally, after difficult negotiations, they allowed 22,000,000 for food and 17,800,000 for munitions. The conclusion of the Armistice a few weeks later robbed these decisions of the practical importance they would otherwise have possessed. But they illustrate the way in which the whole Allied system was, by the end of the war linked together and dominated by the supreme shipping authority.

The system was, however, not fully and equally working when brought to an end by the Armistice. It was tested and working fully for food and beginning to work for munitions; but was still in its preparatory stages for miscellaneous raw materials for civilian use.

Summary of Achievements.—Imperfect as it was, however, and having to build up its elaborate organization and carry on its work simultaneously, its achievements were very striking. Though the shipping available for European supplies was some 2,000,000 tons less, the import services of France and Italy were, in 1918, for the first time put on a substantially satisfactory and substantially equal basis. Food stocks were raised to a much safer level. The Belgian relief requirements, previously in a desperate condition, were adequately met and the American trooping needs substantially assisted. These results were obtained partly through shipping economies effected by the pooling of tonnage and partly by supply economies effected by the common examination of needs and resources by the programme committees.

The fundamental principle is the *direct* contact of specialized ministers and officials of different countries effected through a regular organization whose members are grouped according to special experience and authority, not according to nationality. The national administrations now touched each other, not at one point (the Foreign Offices), but at scores (the officials engaged in the different controls) and the contact was no longer occasional but continuous. Any divergence of national interest was settled within its own sphere, and independently of differences elsewhere. Agreement once reached within each specialist committee, the further issue was not between nation and nation but between supply and supply. The Allied munitions demands were pressed as a whole with the support of the representatives of all countries against the claims of Allied food demands supported by all theirs. Thus was co-operation between the Allies at last shifted from a diplomatic to an administrative basis.

Influence of War System on Later International Organization.—The machinery so erected, and the principles of administration so developed, have left a deep impress upon subsequent organization. In the Armistice period, after some delay due to the desire of the American Government to terminate all war organizations at once, a Supreme Economic Council based on the principles described above and with a personnel very largely the same carried on the Armistice tasks of removing the blockade, bringing the German ships into use, re-allotting ships for the repatriation of troops and prisoners, for the import of raw materials required for reconstructions, arranging relief for the starving countries of Europe, and re-establishing railway transport and communications.

More important and more permanent is the influence of the same experience upon the administrative organization of the League of Nations. In spite of the obvious differences of the tasks, the student of political science will find many resemblances to the A.M.T. organization in the composition and method of working of the technical committees for finance, economics, transit, mandates, etc.—by which the Assembly and Council of the League are advised. The members of such committees regard themselves primarily as specialists in their particular subject-matter. At the same time, as they are in fact of differing nationality and know the tendencies of opinion and interest in their different countries, they afford just the kind of bridge between national opposing views which was provided by the programme committees. It was perhaps useful that all three of the European members of the A.M.T. executive joined the secretariat of the League and had a part in building up the new machinery. But essentially that machinery was constructed as it was because it is among the fundamental principles of the League itself, first that the common interests of nations are no less important than their differences, and secondly that these common differences must be resolved by agreement and not by the overriding decision of a superior authority.

With some difference of emphasis, these were the principles which determined the Allied system; with some difference of application, the international system follows the same principles. With this system the real instrument of the League's action is not merely its permanent staff but the national organizations, public and private, which are linked together through its specialist committees and commissions. Its real executive is located not in one city but in sections, in all the main capitals of the world. Its central staff is the "coupling" which unites this intricate mechanism and enables it to achieve an international task. Geneva is not a centre of controlling power but an instrument to co-ordinate activity which is world-wide in its influence and means of action. It is an instrument, not for governing the world, but for assisting the world to govern itself in agreement and in co-operation. It permeates and transforms the policy of the world as the Allied organization permeated and transformed, without an overriding authority, the policy of the Allies. (*See* also SHIPPING, MINISTRY OF; FOOD, MINISTRY OF, MUNITIONS, MINISTRY OF; SHIPPING, *Control Committee, War Control;* COMMISSION INTERNATIONALE DE RAVITAILLEMENT; MEAT COMMISSION, ETC.)

BIBLIOGRAPHY.—Most of the documents concerned with the inter-Allied control of shipping and commodities were secret, and remained unpublished. A selection of the more important papers is printed in J. A. Salter, *Allied Shipping Control* (1921), in the British series "Economic and Social History of the World War" (Carnegie Endowment for International Peace). This book covers control of commodities as well as shipping, and the national and international system. The full bibliography is very voluminous. The following English books may perhaps be specially mentioned as giving a good picture of the general principles and actual working of the control system —J. L. Garvin, *Economic Foundations of Peace* (1919); Sir L. Chiozza Money, *Triumph of Nationalisation* (1920), written from the point of view indicated in title but includes much first-hand information not otherwise available; H. D. Henderson, *The Cotton Control Board* (1922); E. M. H. Lloyd, *Experiments in State Control at the War Office and Ministry of Food* (1924); F. H. Coller, *State Trading Adventure* (1925). (A. SA.)

ALLIER, a department of France on the northern border of the *Massif Central,* formed in 1790 from the old province of Bourbonnais. Area 2,849sq m. Pop. (1926) 370,562, a considerable decrease since 1906. It is bounded on the north by Nièvre, east by Saône-et-Loire, south-east by Loire, south by Puy-de-Dôme, south-west by Creuse, and north-west by Cher. The department is a well watered plateau, mostly 600–1,500ft. above sea-level, with heights reaching 4,239ft in the south, in the Bois-Noirs, and forests in the northern zone. The Allier crosses the centre from south to north, the Loire forms most of the eastern boundary, and the Cher runs parallel to the Allier across the west. The heights of the Forez in the south-east and beyond get one metre of rain or more per annum and the mean winter temperature (reduced to sea level) is 39°, implying severe conditions on the heights. In the lower lands the rainfall is 600–800mm. per annum. The basin of the Allier east of its tributary the Sioule, within the department, is largely a northward continuation of the fertile Limagne of the Allier valley in Puy-de-Dôme, and is called the Limagne Bourbonnaise. It grows cereals, potatoes, and fruits, including some vines. Sheep and cattle rearing is active in the department and goats and pigs are numerous, while there are also several forests.

Carboniferous rocks outcrop along north-east to south-west lines west of the Allier, with coal seams worked for the iron and other industries at Montluçon, Commentry, Murat, etc. There are also lime and building stone quarries, so that the mineral wealth is considerable. The mineral waters of the region are widely famed, Vichy (*q.v.*), in the arrondissement de la Palisse, being the best known spa in France.

Allier is served chiefly by the Orléans and P.L.M. railways and the lateral Loire canal; the Berry canal and the canal from Roanne to Digoin touch the department. Moulins (the capital), Montluçon and Lapalisse are towns which give their names to

the usual three arrondissements of the modern system. There are 29 cantons and 321 communes. The department is also the diocese of Moulins under the archbishop of Bourges. It is in the region of the XIII. army corps and in the *académie* or educational province of Clermont Ferrand. Its court of appeal is at Riom.

Apart from Moulins (*q v.*), it may be mentioned that the department has interesting mediaeval buildings at Souvigny (Cluniac priory 11th–15th century), St. Menoux, Ebreuil, Gannat, Veauce and Ygrande (Romanesque churches), Huriel (fine 11th century church, also castle), St. Pourçain sur Sioule (11th–18th century church). The castle at Bourbon l'Archambault (13th–15th century) was the house of the Bourbon dukes.

ALLIER (anc. *Elaver*), river of central France flowing into the Loire. Rising in the department of Lozère, its upper course is mostly through deep gorges following structural lines of weakness between the mountains of the Margeride and those of the Velay. It then traverses the basins of Langeac and Brioude, receives torrents from the mountains of Dore and Dôme, and flows through a wide but shallow channel in the fertile wheat-growing plains north of Clermont Ferrand, being joined by the Sioule above Moulins, the chief town on its banks. It reaches the Loire, 4m. W. of Nevers, after a course of 269m. (154 navigable). Its basin has an area of 6,755 square miles.

ALLIFAE (mod. *Alife*), a town of the Samnites, 15m. N.W. of Telesia, and 17m. E.N.E of Teanum. The site of the Samnite city, which in the 4th century B.C. had a coinage of its own, is not known; the Roman town lay in the valley of the Vulturnus, and its walls (4th century A D.) enclose a circuit of 1½m.; they have four gates at the ends of the *cardo* and *decumanus* (the main streets) by which it is still divided. Outside are preserved remains of large baths (*Thermae Herculis*) and a theatre.

ALLIGATOR, an animal so closely allied to the crocodile that the old naturalists classed them together as forming one genus. In popular speech the two are often confused (*see* CROCODILE). It differs from the true crocodile principally in having the head broader and shorter, and the snout more obtuse; in having the fourth, enlarged tooth of the under jaw received, not into an external notch, but into a pit formed for it within the upper one; in wanting a jagged fringe which appears on the hind legs and feet of the crocodile; and in having the toes of the hind feet webbed not more than half way to the tips. Two species, *A. mississippiensis* in the southern states of North America up to 12ft. in length, and the small *A. sinensis* in the Yang-tse-kiang, are still living. In Central and South America alligators are represented by five species of the genus *Caiman,* which differs from *Alligator* by the absence of a bony septum between the nostrils, and by the fact that the overlapping bony scales of the ventral armour are each composed of two bones. *C. niger* of the Amazon grows to a length of 20ft.

ALLIGATOR PEAR: *see* AVOCADO-PEAR.

ALLINGHAM, WILLIAM (1824–1889), Irish poet and man of letters, was born at Ballyshannon, Donegal, Mar. 19, 1824, and died at Hampstead, London, Nov. 18, 1889. He held various posts in the customs until 1870, when he became sub-editor of *Fraser's Magazine,* where he succeeded Froude as editor in 1874. He was a friend of D. G. Rossetti, and the 2nd edition of *Day and Night Songs* (1855) had two illustrations by Rossetti and Millais. Allingham is best remembered for many charming lyrics, some of which, like "Up the airy mountain," still find a place in anthologies.

His chief works are *Poems* (1850); *Laurence Bloomfield in Ireland* (1864); *Irish Songs and Poems* (1887); *Flower Pieces and other Poems* (1888), with two designs by D. G. Rossetti. *William Allingham: a Diary* (1907), ed. Mrs. Allingham (Helen Paterson, b. 1848) and D. Radford, contains many interesting reminiscences of Tennyson, Carlyle and other famous contemporaries. Mrs. Allingham also published a volume of letters addressed to her husband She died in 1926 and was herself an artist of some distinction.

ALLISON, WILLIAM BOYD (1829–1908), American legislator, was born at Perry, O., on March 2, 1829. Educated at Allegheny and Western Reserve colleges, he studied law, and practised in Ohio until 1857. In that year he settled in Dubuque, Ia., where he took a prominent part in Republican politics; and in 1860 he was a delegate to the national convention at Chicago which nominated Abraham Lincoln for the presidency. In 1861 he was appointed a member of the staff of Governor Samuel J. Kirkwood (1813–1894), and was of great service in the work of equipping and organizing the Iowa volunteers. From 1863 until 1871 he served with distinction in the House of Representatives; in 1873 he was elected to the United States Senate, and was re-elected for five consecutive terms. He became one of the highest authorities on questions connected with finance, and from 1877 he was a member of the Senate committee on finance. In 1881–93, and again from 1895, he was chairman of the committee on appropriations, in which position he had great influence. He declined offers of the secretaryship of the treasury made to him by Presidents Garfield and Harrison. He was a prominent candidate for the presidential nomination in the Republican national conventions of 1888 and 1896. In 1892 he was chairman of the American delegation to the International Monetary Conference at Brussels. He died at Dubuque, on Aug. 4, 1908.

ALLITERATION, the commencing of two or more words, in close juxtaposition, with the same sound. As Milton defined rhyme to be "the jingling sound of like endings," so alliteration is the jingle of like beginnings. All language has a tendency to jingle in both ways, even in prose. Thus in prose we speak of "near and dear," "high and dry," "health and wealth." But the initial form of jingle is much more common—"safe and sound," "thick and thin," "weal or woe," "fair or foul," "spick and span," "fish, flesh or fowl," "kith and kin." The poets of nearly all times and tongues have not been slow to seize upon the emphasis which could thus be produced.

Although mainly Germanic in its character, alliteration was known to the Latins, especially in early times, and Cicero blames Ennius for writing: "O Tite tute, Tati, tibi tanta, tyranne, tulisti." We read in Chaucer:—

> But of the fyr and flaumbe funeral
> In which my body brennen shal to glede.

In Shakespeare:—

> Full fathom five thy father lies.

In Coleridge.—

> The fair breeze blew, the white foam flew,
> The furrow followed free;
> We were the first that ever burst
> Into that silent sea.

As thus far considered, alliteration is a device wholly dependent on the poet's fancy. He may use it or not, or use it much or little, at his pleasure. But there is an extensive range of Teutonic poetry whose metrical laws are entirely based on alliteration. This, for example, is the principle on which Icelandic verse is founded; and we have a yet nearer interest in it, because it furnishes the key to Anglo-Saxon and a large portion of early English verse. Here is a passage from the famous epic *Beowulf,* alliteratively rendered by Mr. C. K. Scott-Moncrieff:—

> Oft Shield of the Sheaf from scathing hordes
> From many meinies their mead-stoves tore,
> Affrighted them the Earl since erst he was
> Found unwealthy; then friendship he awaited,
> Waned under the welkin, in worship throve,
> Until each one of those outdwelling
> Over the whale-road, must hearken to him,
> Gold must give him; that was a good king.

The rhymeless lines divide into halves, and each half has normally two strong accents, irrespective of the number of syllables, all, or some, of the accented syllables being alliterated—three in each line being the usual number. Double alliteration is occasionally found. The influence of French poetry, with its definite syllabic system, worked against the continuance of this ancient recitative, and the alliterative line gradually ceased to be the vehicle of serious verse in England. But there were two great revivals, one in the 14th century, when such poems as *Pearl* (*q.v.*),

Syr Gawayne and the Grene Knight, and the *Morte Arthure* were written; the other, also in the 14th century, but quite independent, when the great poem known as *Piers Plowman* was written.

Piers Plowman, consciously archaic, suggests the Anglo-Saxon manner:—

> Then gan I to meten a merveilouse swevene,
> That I was in a wilderness, wist I never where;
> As I beheld into the east, an hiegh to the sonne,
> I seigh a tour on a toft, trielich ymaked;
> A depe dale benethe, a dongeon there-inne,
> With depe dyches and derke and dredful of sight

But though alliteration lingered on as a form of emphasis in popular songs, it ceased to be a regular way of English verse. Chaucer makes his Parson refer contemptuously to alliteration; but as he sneers at rhyme as well, perhaps we should not take him too seriously:—

> But, trusteth wel, I am a southren man,
> I can not geste "rum, ram, ruf" by lettre,
> Ney, God woot, rym holde I but litel bettre.

For a study of alliterative verse *see* J. Schipper, *History of English Versification* (1910).

ALLIUM (Lat. for "garlic"), a genus of plants, of the family Liliaceae, with about 325 species (eight of which occur in Britain), found in central and south Europe, north Africa, the dry country of west and central Asia, and North and Central America. The plants are bulbous herbs, with flat or rounded radical leaves and a central naked or leafy stem, bearing a head or umbel of small flowers, with a spreading or bell-shaped white, pink, red, yellow or blue perianth. Several species afford useful foods such as onion (*Allium Cepa*), leek (*A. Porrum*), shallot or eschallot (*A. ascalonicum*), garlic (*A. ursinum*) and chives (*A. Schoenoprasum*).

In North America there are about 70 native species, most numerous in the Rocky Mountain region and in California where the majority are found. Among some 10 species occurring in the Eastern United States and Canada are the meadow garlic (*A. canadensis*), formerly used for food by the Indians; the wild leek (*A. tricoceum*), found in rich woods; the wild chives or rush-garlic (*A. sibiricum*), found from Maine to Alaska; the nodding wild onion (*A. cernuum*), with inverted clusters of handsome flowers; and the prairie wild onion (*A. stellatum*), of rocky banks in the interior. The field garlic (*A. vineale*) of Europe, widely naturalized in meadows and pastures, is a troublesome weed tainting the flavour of butter.

ALLMAN, GEORGE JAMES (1812–1898), British biologist, was born in Cork, Ireland, and died at Parkstone, Dorset, Nov. 24, 1898. His most important work was upon the gymnoblastic hydrozoa, on which he published in 1871–72, through the Ray Society, an exhaustive monograph, based largely on his own researches and illustrated with drawings of remarkable excellence from his own hand.

ALLMERS, HERMANN (1821–1902), German writer, was born on Feb. 11, 1821, at Rechtenfleth, near Bremen. In 1858 he wrote *Marschenbuch,* in which northern lands and peoples are described. In 1860 appeared his *Dichtungen,* and nine years later his *Römische Schlendertage,* both manifesting his love of landscape imagery. The drama, *Elektra* (1872), and his somewhat stiff lyric and ballad poetry are among other writings in his *Sämtliche Werke,* 6 vols. (1891).

ALLOA, municipal and police burgh and seaport, Clackmannanshire, Scotland. It is on the north bank of the Forth, 32m. from Edinburgh by the L.N.E.R. via the Forth Bridge, and 28m. from Leith by steamer. Pop. (1921) 12,421. The L.M.S.R. enters the town from the south-west by a steel bridge across the river, and also owns a ferry to South Alloa, on the opposite shore, in Stirlingshire. Between Alloa and Stirling the stream forms the famous sinuous "links," giving a 12-mile river-course as against 6½m. by road.

Alloa makes yarn, the famous Alloa ale, spirits and yeast (Carsebridge), glass, pottery, electrical appliances, brass, iron and ships. Coal is exported and oil imported. The docks are accessible only at high water. Among the principal buildings are the fine Gothic parish church, the town hall, including the free public library, and the museum of the Natural Science and Archaeological Society. Alloa Park, the seat of the earl of Mar and Kellie, is in the immediate vicinity, and in its grounds stand the ruins of Alloa Tower (1315), once the residence of the powerful family of Erskine, descendants of the earl of Mar.

ALLOBROGES (ăl-lŏb'rŏ-gās), a Celtic tribe in the north of Gallia Narbonensis, inhabiting the low ground called the "island" between the Rhodanus, the Isara, and the Graian Alps, corresponding to the modern Dauphiné and Savoy. If the name is rightly interpreted as meaning "aliens," they would seem to have driven out the original inhabitants. Their chief towns were Vienna (Vienne), Genava (Geneva) and Cularo (later Gratianopolis, whence Grenoble). The Allobroges first occur in history as taking part with Hannibal in the invasion of Italy. After the subjugation of the Salluvii (Salyes) by the Romans in 123 B.C., the Allobroges were attacked and finally defeated (121 B.C.) at the junction of the Rhodanus and Isara by Q. Fabius Maximus (afterwards Allobrogicus). But they still remained hostile to Rome, as is shown by the conduct of their ambassadors in the Catilinarian conspiracy (63 B.C ; *see* CATILINE).

BIBLIOGRAPHY.—*See* A. Desjardins, *Géographie historique de la Gaule romaine* ii. (1876–1893); Mommsen, *Hist. of Rome* (Eng. trans.) bk. iii. ch. 4, iv. ch. 5; T. R. Holmes, *Caesar's Conquest of Gaul* (1899); G. Long in Smith's *Dict. of Greek and Roman Geography;* M. Ihm in Pauly-Wissowa's *Realencyklopädie,* i. 2 (1894).

ALLOCATUR, a law term, meaning a certificate given by a taxing master, at the termination of an action, for the allowance of costs.

ALLOCUTION, a name given to the formal addresses made by the pope to the College of Cardinals and through them to the church (Lat. *allocutio,* an address). Allocutions are usually called forth by ecclesiastical or political circumstances, and aim at safeguarding papal principles and claims. They are published by being affixed to the door of St. Peter's church.

ALLODIUM, that portion of land allotted to an individual by the chief, as representing the community, in the early Anglo-Saxon settlement of Britain. It usually consisted of the homestead, and was regarded as the property of the family. It was free from rent and services. Later, *allodium* is the regular Latin translation of bocland (*q.v.*).

ALLOMERISM, the quality of bodies by virtue of which they can change their elements and proportions while preserving their form.

ALLON, HENRY (1818–1892), English Congregational minister, was born on Oct. 13 1818, at Welton, Yorkshire. In 1844 he became co-pastor with Thomas Lewis of Union chapel, Islington. In 1852, on the death of Lewis, Allon became sole pastor, and this position he held with increasing influence till his death in 1892. Under his ministry the social aspects of church life were developed, and Union chapel became the first of what have since come to be known as institutional churches. Allon published in 1852 the original edition of his well-known *Congregational Psalmist.* For many years his collection of hymns, chants and anthems was used in hundreds of churches throughout England. Allon edited the *British Quarterly Review* from 1877 onwards, and was twice chairman of the Congregational Union.

ALLONGE, a slip of paper affixed to a negotiable instrument, as a bill of exchange, for the purpose of receiving additional endorsements for which there may not be sufficient space on the bill itself. An endorsement written on the allonge is deemed to be written on the bill itself.

ALLOPHANE, a hydrous aluminium silicate, said to be $Al_2SiO_5 \cdot 5H_2O$: it only occurs as an amorphous incrustation in thin layers on the walls of fissures and cavities in rocks, and is sometimes stained blue by copper, though usually white, yellow, or brownish. The hardness is 3 and the density 1·9.

ALLORI, CRISTOFANO (1577–1621), Italian portrait painter of the Florentine school, was the son of ALESSANDRO ALLORI (1535–1607), and was brought up and trained in art by his uncle, Angelo Bronzino (*q.v.*). Cristofano, who was born at Florence, received his first lessons in painting from his father, but becoming dissatisfied with the hard anatomical drawing and

cold colouring of the latter he entered the studio of Gregorio Pagani (1558–1605), who was one of the leaders of that later Florentine school which endeavoured to unite the rich colouring of the Venetians with the correct drawing of Michelangelo's disciples. Allori became one of the foremost of that school. His technical skill is proved by the fact that several copies he made after Correggio have been taken to be duplicates by Correggio himself. The finest of all his works is his "Judith and Holofernes," in the Pitti Palace. The model for the Judith was his mistress, the beautiful Mazzafirra, who is also represented in his Magdalene; and the head of Holofernes is generally supposed to represent his own.

ALL OR NONE, a condition set by a bidder for an issue of securities meaning that at the price he offers he wants the entire issue and cannot be held to his offer unless the issue in its entirety is awarded to him. Sellers of securities use the same term to indicate that prospective buyers must bid for, and stand ready to take, the entire issue and cannot demand a portion of it at the price offered.

ALL-OR-NONE LAW in physiology relates response to stimulus in excitable tissues. It was first established for the contraction of heart muscle by H. P. Bowditch in 1871. Describing the relation of response to stimulus, he stated, "An induction shock produces a contraction or fails to do so according to its strength; if it does so at all, it produces the greatest contraction that can be produced by any strength of stimulus in the condition of the muscle at the time." It was believed that this law was peculiar to the heart and that the other highly specialized and rapidly responding tissues—skeletal muscle and nerve—responded in a different way, the intensity of response being graded according to the intensity of the stimulus. This impression arose because nerves and muscles are composed of hundreds or thousands of individual fibres, and since some of these do not respond to a weak stimulus the total response of the organ is apparently subject to such gradation. It has now been established, largely through the work of Gotch, Lucas, Pratt, Adrian, Kato and others, that the individual fibres of both skeletal muscle and nerve respond to stimulation according to the all-or-none principle. This does not mean that the size of response is immutable. Functional capacity varies with the condition of the tissue The response to a stimulus applied during recovery from a previous response is subnormal. The energy liberated by a muscle fibre when stimulated depends, among other things, on the mechanical conditions obtaining while the response is being evoked. But the size of response is independent of the strength of stimulus, provided this be adequate. These facts show that the functional response is essentially alike in these specialized tissues—heart, skeletal muscle and nerve; its precise nature is not known, but it resembles an explosive reaction in that it depletes for a time the available store of energy on which it depends. (A. Fo.)

ALLOSAURUS, a large carnivorous Dinosaur from North America. It was bipedal in locomotion, with very small front feet. (*See* DINOSAURIA; REPTILES.)

ALLOTMENT. In England, the term denotes a portion of land assigned on partition or under an inclosure award (*see* COMMONS); also a division of land into small portions for cultivation by a labourer or artisan at a small rent (*see* ALLOTMENTS and SMALL HOLDINGS). In company law, "allotment" is the appropriation to an applicant by a resolution of the directors of a certain number of shares in response to an application. The document sent to such an applicant, which announces the number of shares assigned and concludes the contract, is called a *letter of allotment* or *allotment certificate.* (*See* COMPANY.)

Allotment note is a writing by a seaman authorizing his employers to make an allotment of part of his wages, while he is on a voyage, in favour either of a "near" relative or of a savings bank. In the United States, the term allotment was used during the World War to denote that portion of the pay of a member of the Army, Navy or Marine Corps which was sent by direction of such person in the service to dependant relatives. In those cases, the Government paid an additional sum to such dependants as were nominated.

ALLOTMENTS. An allotment, in England and Wales, as defined by the Allotments acts 1922 and 1925, is any parcel of land above ¼ac., but not exceeding five ac. in extent, which is cultivated as a farm or garden, or partly as a farm and partly as a garden. In other words, it is a small agricultural holding, subject to the same terms relating to notice to quit and compensation. Such allotments are almost exclusively confined to rural districts and are to be found principally in the Fen District and where the soil is suitable for market gardening In Scotland and Ireland the proportion of allotments is relatively small (due mainly to backward legislation), but they are now governed by laws framed very largely on the English model

The word "allotment," as popularly used, means something entirely different, and really refers to an "allotment-garden." This is defined by the act of 1922 as "an allotment not exceeding 40 poles in extent, which is wholly, or mainly, cultivated by the occupier for the production of vegetables and fruit crops for consumption by himself or his family." The overwhelming number of allotments are of this kind, and in this article the term "allotments" must be taken generally in this sense.

The Small Holdings and Allotments act, 1908, was followed by a great increase in the number of allotments. On Dec. 31, 1909, there were 58,648 allotments covering an area of 17,529ac, increased on Dec 31, 1914, to 130,526 allotments and 33,523 acres. During that period, land-renting associations were formed in all parts of the country with the object of procuring and managing land for their members

Allotments for the War.—The World War changed the whole aspect of the problem. The provision of allotments had been, hitherto, largely a rural question, but the food shortage which developed as the war went on transferred the problem from the countryside to the towns and cities. Home food production on a larger scale became an imperative necessity. To ensure this, emergency legislation under the Defence of the Realm regulations was passed in 1916–17 (since withdrawn), the effect of which was to give local authorities powers for the compulsory acquisition of land for allotments. The powers granted were at first confined to the appropriation of vacant land, *i e*, undeveloped building sites, but were afterwards extended so that practically any land could be acquired. Hitherto, the statutory right to an allotment was confined to the "labouring population," but this limitation was withdrawn The result was that by Dec 31 1920, there were 1,330,000 allotments, embracing 185,000 acres. Even then there remained 44,736 unsatisfied applicants.

When the temporary allotments which had been used were taken for purposes of greater public utility, a widespread demand for alternative land on a more permanent tenure was made. This desire may be traced in a series of acts of parliament: The Land Settlement (Facilities) act, 1919; the Agriculture act, 1920; the Allotments act, 1922; the Agricultural Rates act, 1923; and the Allotments act, 1925 This legislation entitled the allotment holder, under normal circumstances, to a six months' minimum notice to quit; compensation for crops and manures when less notice was received; concessions in local rates and representation on the statutory allotments committees of local authorities. The 1925 act enabled associations to borrow from the Public Works Loan Commissioners up to two-thirds of the value of land purchased, repayment being spread over a maximum period of 35 years. Local authorities providing allotments were also empowered, if necessary, to incur a loss not exceeding a 1d. rate when action was taken under the Allotments acts. They might also obtain allotments in advance of the demand, and were compelled to consider what provision should be made for them in all schemes of town planning.

The great problem which confronts the allotment movement is insecurity of tenure. Allotment associations are helping to solve it themselves by the purchase of land where practicable, but this is impossible in congested areas where land is scarce and very expensive. Large allotment areas still exist where the tenancies may be determined by short notices to quit. An increasing number of temporary allotments have been surrendered for building purposes.

Number of Allotments.—The Ministry of Agriculture gave the figures at the end of 1923 as 1,190,000 allotments and, at the end of 1924, 1,170,000, a decrease of about 1·5%. There were 15,000 registered applicants waiting for allotments at the end of 1924. A further decrease of 64,000 was reported for 1925, and, in 1926, 27,000 more were lost, but the area was increased by 1,000 acres in that year. The Minister of Agriculture stated in the House of Commons about the middle of 1927 that the rapid decline had been almost arrested.

Allotments produce 700,000 tons of foodstuffs each year, worth, approximately, £7,000,000, and this produce not only increases the national wealth but makes a valuable contribution to the family budgets of over 1,000,000 families. From a small allotment-garden of 10 rods (just over 300 sq yd.) it is estimated that £10 worth of vegetables is obtained during the season, when the allotment is well-cultivated and planned for rotational crops.

BIBLIOGRAPHY—*Annual Report of Proceedings under the Small Holdings and Allotment Acts, 1920* (1921), *1923* (1924), *1924* (1925); *Report of the Departmental Committee on Allotments, 1921* (1922); *Memorandum setting out the Provisions of the Allotments Act, 1922* (1922); *Memorandum Indicating Amendments in the Allotments Act, 1922, Made by the Allotments Act, 1925* (1925); *Annual Report Allotments Organisation Society and Small Holders Ltd.* (1926).

(G. W. G.)

ALLOTMENTS ORGANIZATION SOCIETY. The Allotments Organization Society and Small Holders Ltd. may be termed the residuary legatee of the late Agricultural Organization Society, and is continuing the co-operative organization of small cultivators in England and Wales, a task first undertaken by the latter body many years ago. Its principal functions are the registration of allotment and small holding associations under the Industrial and Provident Societies acts and the giving of expert advice on the leasing and purchase of land and co-operative trading. Prospective associations are supplied with model rules and when these are used the chief registrar of friendly societies reduces his fee from £10 to £3. The society acts as a central bureau of information and supplies facts and figures on the various phases of the movement of which it is the mouthpiece. It is recognized by the Ministry of Agriculture and the president, chairman and secretary have each a seat on the Ministry of Agriculture's allotments advisory committee. The society was founded in 1924, and in 1927 had affiliated 300 associations with a membership of 65,000. The society's work, so far as the small holder is concerned, consists principally of advice and guidance in the co-operative purchase and distribution of agricultural requirements, the co-operative marketing of produce and the joint ownership of implements. The chief office is at 40 Broadway, London, S.W.

ALLOTROPY was the term applied by Berzelius (1841) to the existence of a substance in two or more distinct forms. The modern tendency is to restrict the application of the term to *crystalline* forms of elements which usually have different physical but similar chemical properties, and to use the word "polymorphism" to describe the same property in compounds.

The first instance of polymorphism was noted by Mitscherlich, who in 1812 found that disodium hydrogen phosphate, Na_2HPO_4, $12H_2O$, existed in two crystalline forms; this was followed in 1823 by the discovery of the rhombic and monoclinic forms of sulphur (*see* below). These modifications of sulphur are now said to be "allotropes" or "allotropic" forms. Among inorganic compounds which exhibit allotropy, in the older and broader sense, mention may be made of mercuric iodide; when this is precipitated by the cautious addition of a solution of potassium iodide to one of mercuric chloride, it may often be seen in a yellow form which changes almost instantly to the more stable red modification. Many organic compounds exhibit dimorphism, that is, there are two crystalline forms of the same chemical individual; for example, when para-bromoacetanilide first crystallizes from solution it does so in needles which are so felted together that they enclose the whole of the liquid and form an apparently solid mass; on standing in contact with the mother-liquor, however, they gradually change to small compact crystals, leaving the liquid quite clear. Both these cases are examples of W. Ostwald's generalization that the less stable form is produced first.

Before the various instances of allotropy are discussed in detail, some general aspects of the phenomenon must be considered. Three types of allotropy are recognized: (1) enantiotropic; (2) monotropic; and (3) dynamic.

(1) If each of two varieties involved passes reversibly into the other, at a definite temperature and pressure, and therefore exists only within a certain range of conditions, the allotropy is said to be enantiotropic. Thus, tin exists in the familiar white modification and also in a "grey" form. Above 20°C. the former is the stable modification, but below that temperature it *tends* to pass into the latter, since this is the stable form at lower temperatures. Conversely, if grey tin is gradually warmed from 0°C. it will tend to become converted into its white allotrope at 20°, which is therefore said to be the transition temperature

(2) Monotropic allotropy occurs where the change can only be made to take place in one direction. Thus, antimony can be obtained in an "explosive" variety, which will readily pass into the ordinary stable form with the evolution of much heat, for instance, by warmth, friction or shock; but the latter form cannot be reconverted by any change of temperature or pressure into the unstable modification. This type is irreversible (*cf.* type 1).

(3) In dynamic allotropy, two forms may co-exist in a definite proportion which varies with the temperature and pressure. Alex. Smits (1903) studied the first known case of this, namely, that of sulphur. This type of allotropy has the same characteristics as dynamic isomerism (*q.v.*) or tautomerism, but it relates to elements instead of to compounds.

Since 1911 the whole question of allotropy has been studied in a new light, chiefly owing to the work of A. Smits. According to this author, the underlying cause is to be found in polymerisation, *i.e.*, that different types of molecule contain different numbers of atoms; moreover, not only is a fused element an equilibrium mixture of two or more types of molecule, but also the solid forms separating from the molten liquid are solid solutions of the different types of molecule. Further, this "inner equilibrium" may be established either so rapidly as to make the two molecular species simulate the behaviour of a single type or so slowly that the mixture behaves as if two different individuals are present.

Another general aspect of allotropy must be considered, for any two allotropic forms of an element have different energy contents (except at their transition point); the less stable, having the higher content, will evolve heat on changing into the more stable (as in the case of antimony, above); also it has a higher vapour pressure and is more soluble in any given solvent (*see* PHOSPHORUS). Moreover, this energy difference can be made to appear in an electrical form instead of a thermal form, and an e m f. can be developed between the two: if electrodes of grey and white tin are immersed in a conducting solution of a tin salt, according as the temperature is above or below 20° the grey or the white will be unstable and tend to go into solution and be deposited in the other (stable) form—at 20° (the transition temperature) there is no interconversion and no e m f. is developed.

Further, the conditions of temperature and pressure tend to influence the interconversion of allotropes according to H. Le Chatelier's principle of "mobile equilibrium," that is, the substance tends to assume that form which makes it adapt itself to the external circumstances. Thus increase of pressure favours the production of the denser form, and increase of temperature favours a change which takes place with absorption of heat, and vice versa.

Usually, the introduction of a *trace* of the form which is stable under the prevailing conditions will bring about the conversion of a supercooled liquid or metastable solid to the stable form.

Cohen has shown that most metals and alloys are in a metastable state when first formed, and as this may change slowly into a more stable state, the physical properties are somewhat variable. Aluminium, bismuth, cadmium, copper, lead, zinc, and even sodium show evidence of such changes Mercury shows no change. For the more interesting cases of allotropy *see* CARBON; OXYGEN; PHOSPHORUS; SULPHUR; IRON; ARSENIC; SELENIUM; TIN; ANTIMONY; TELLURIUM; BORON and ICE.

The methods which have been used in determining transition points are the following: (a) *Dilatometric method:* The solid is sealed in a bulb attached to a capillary tube; the bulb is then filled with an indifferent liquid, which just reaches to the bottom of the capillary, the whole resembling a large thermometer. When the apparatus is immersed in a bath which is slowly heated the regular rise of the liquid in the capillary undergoes a sudden alteration, corresponding with a change in the solid, at the transition temperature, and then resumes its regular rise after a degree or so. (b) *Solubility measurements:* If the solubility in a given solvent is measured at a number of temperatures, the regular alteration is found to undergo a sudden change at the transition point. (c) *Thermometric method:* This method depends on the principles described in the case of iron. (d) *Optical methods:* These depend on the change of colour, crystalline form, etc. (e) *Electrical methods:* This may be illustrated by reference to the case of white and grey tin, for it is obvious that, in view of the electrical behaviour of two such electrodes (already described above), the current will undergo a reversal of sign at the transition point.

BIBLIOGRAPHY.—A. Smits, *The Theory of Allotropy* (trans. by J. S. Thomas, 1922; very abstruse); A. Findlay, *The Phase Rule* (1923; brief and elementary). (A. D. M.)

ALLOUEZ, CLAUDE JEAN (1622–1689), French Jesuit missionary to the Indians of North America, was born in St. Didier, France, on June 6, 1622. At the age of 17 he entered the Jesuit novitiate at Toulouse and, upon completion of student life at Rodez in 1656, he was appointed preacher. In 1658 he went to Canada and devoted the remainder of his life to work among the Indians. He was one of the early French Jesuits who visited the Great Lakes region. At first he served at Three Rivers and other settlements on the St. Lawrence river. In 1665 he began work among the Ottawas of Lake Superior, building in that year the first mission established among the Indians of Wisconsin. Later he founded missions among the Illinois Indians. About 1675 he settled in the Indian village of Kaskaskia and developed the mission started there by Marquette (*q.v.*). In 1679, on the approach of La Salle (*q.v.*), who was unfriendly to the Jesuits, Allouez withdrew from Kaskaskia. Thereafter he laboured chiefly among the Miamis of the St. Joseph river in south-eastern Michigan. He died in one of the Ottawa missions near the site of the present town of Niles, Mich., on Aug. 27, 1689.

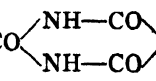
See J. D. G. Shea, *Discovery and Exploration of the Mississippi Valley* (1853); *The Jesuit Relations and Allied Documents*, ed. Reuben Gold Thwaites (Cleveland, O., 1894–1901); Joseph Stephen La Boule, "Allouez, The Apostle of the Ottawas," *Parkman Club Publications*, No. 17 (1897); "Allouez, and His Relations with La Salle," *Hist. Soc. Wis., Proc.*, p. 168–182 (1899); Charles Wesley Mann, *Manners and Customs of the Western Indians* (1906).

ALLOWANCE, the action of allowing, or the thing allowed; particularly, a certain limited apportionment of money or food and diet (*see* DIETARY). Commercially "allowance" means the deduction made from gross weight of goods to make up for weight of box or package, waste, breakages, etc. (*See* TARE AND TRET.)

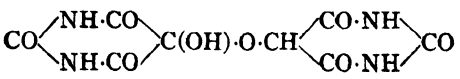
ALLOWAY, hamlet and ecclesiastical parish (pop. 797), in Ayrshire, 2¼ m. south of Ayr, Scotland. It is famed as the birthplace of Burns the poet and as the scene of his "Tam o' Shanter."

ALLOXAN or **MESOXALYL UREA,** crystallizes from water in colourless rhombic prisms containing four molecules of water of crystallization. It possesses a very acid reaction; it colours the skin purple-red, and with ferrous sulphate it develops an indigo-blue coloration. It is an oxidation product of uric acid, being obtained from it by the action of cold nitric acid,

$$C_5H_4N_4O_3 + H_2O + O = C_4H_2N_2O_4 + CO(NH_2)_2;$$

it has the structural formula  . Zinc and hydrochloric acid in the cold convert it into alloxantin (*q.v.*), hydroxylamine to nitroso-barbituric acid, $C_4H_2N_2O_3{:}NOH$, baryta water to alloxanic acid, $C_4H_4N_2O_5$; hot dilute nitric acid oxidizes it to parabanic acid (*q.v.*), hot potassium hydroxide solution hydrolyses it to urea and mesoxalic acid (*q.v.*), and zinc and hot hydrochloric acid convert it into dialuric acid, $C_4H_4N_2O_4$. Alloxan combines with thiourea in alcoholic solution in the presence of sulphur dioxide to form pseudothiouric acid. Methyl and dimethylalloxans are also known, the former being obtained on oxidation of methyl uric acid, and the latter on oxidation of caffeine. (*See* PURINES.)

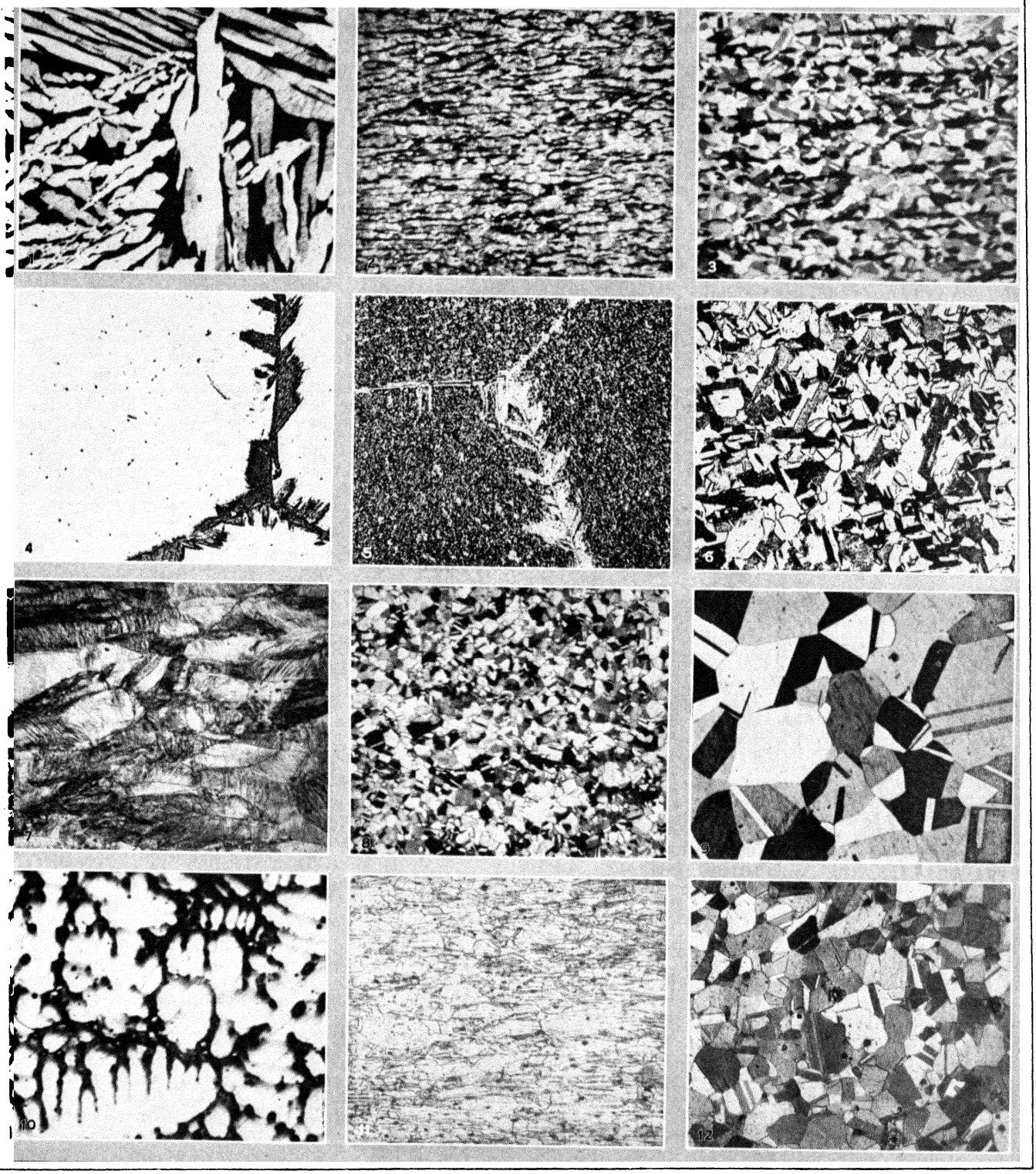
ALLOXANTIN, a product obtained by the combination of alloxan and dialuric acid. It forms small hard prisms which become red on exposure to air containing ammonia, owing to the formation of murexide (ammonium purpurate), $C_8H_4(NH_4)N_5O_6$. The formation of murexide is used as a test for the presence of uric acid, which on evaporation with dilute nitric acid gives alloxantin, when by the addition of ammonia to the residue the purple red colour of murexide becomes apparent. Alloxantin, $C_8H_4N_4O_7{\cdot}3H_2O$, may also be obtained by the action of sulphuretted hydrogen on alloxan, and it probably possesses the constitution



one of the three molecules of water being possibly constitutional. The tetra-methyl derivative, amalic acid, $C_8(CH_3)_4N_4O_7$, has been prepared by oxidizing caffeine (*see* PURINES) with chlorine water, and forms colourless crystals which are only slightly soluble in hot water.

ALLOYS, a term applied in its broadest sense to any metallic substance which is not a chemical element. If this definition is taken literally all of the metals of commerce could be regarded as alloys, since even the purest ones contain some foreign substance. It is the practice, however, to classify the metallic materials of commerce into two main groups—pure or commercially pure metals and alloys. The commercial metals are often graded with respect to the nature and amount of "impurity" present, thus giving some justification for differentiating between a "commercially pure" metal and an alloy. It is interesting to note a use of the term alloy applying to "impurities" in connection with gold. For several thousands of years gold was the most valuable metal known and any other metal mixed with it decreased the value for a given weight. The art of alloying cheaper metals with gold was practiced so fraudulently that "alloy" became associated with "impurity" or an addition which detracted from the value. This usage is standard in general English literature It is not intended to convey the idea that the art of alloying was used formerly only to degrade or debase, but such practices became common knowledge, whereas the constructive practices did not. The great efforts in the 19th century toward modifying the properties of one metal by the addition of others served not only to popularize the benefits of alloying, but also contributed generously to the great industrial advances of the last few generations.

A definition of alloy is given by the American Society for Testing Materials, 1927, as follows: "A substance having metallic properties, consisting of two or more metallic elements or of metallic and non-metallic elements, which are miscible with each other when molten, and have not separated into distinct layers when solid." Although this definition suggests what should obtain in the molten condition—and most alloys are prepared by melting—they may be made in other ways. One of the oldest alloys is steel, composed essentially of iron and carbon. The old method of adding carbon was by heating solid iron in charcoal or in the reducing portions of wood fires, similar in principle to the present methods of adding carbon to solid iron or steel by carburization. Also alloys may be formed by mixing metal powders and heating to a temperature below the melting point, and they may be formed directly by electro-deposition. The art of preparing alloys is very old. In ancient times a number of alloys were produced by direct and simultaneous reduction of two or more metals from the ores. All of the material in a metallic substance need not be part of the alloy. For example, puddled iron or wrought iron contains some non-metallic material called slag. Wrought iron is not regarded as an alloy of iron and slag but as a relatively pure iron because the metallic constituent is relatively pure. The slag is regarded as an "inclusion." On the other hand,



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PHOTOMICROGRAPHS OF ALLOYS AND METALS

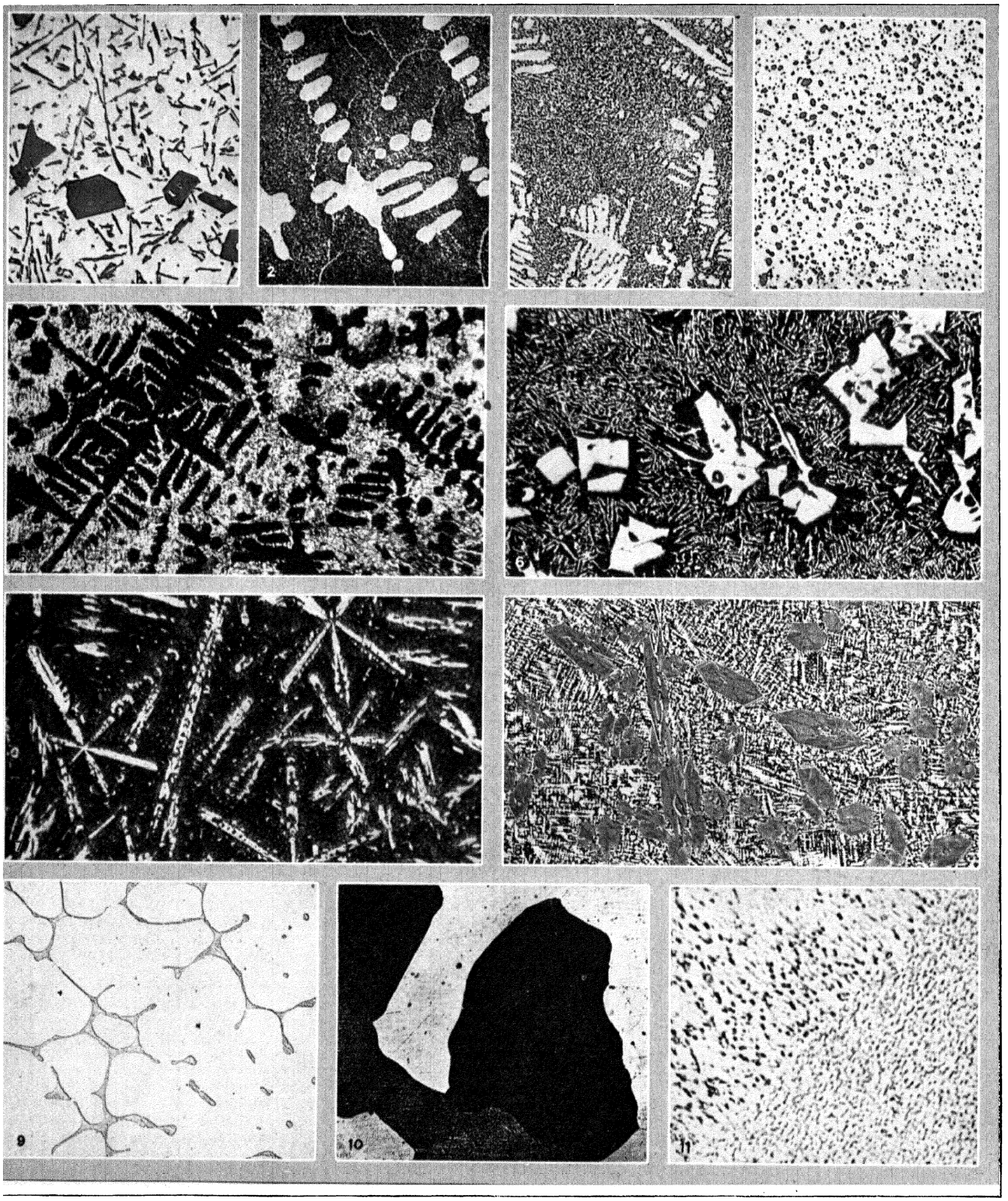
Figs. 1, 2, 3.—Brass, Muntz metal (60% copper, 40% zinc). 1, as cast, Brinell hardness number B.H.N. 68; 2, hot rolled, B.H.N. 77; 3, cold drawn, B.H.N. 107, magnified 75 diameters; 75x

Figs. 4, 5, 6.—Rolled Muntz metal quenched from 825° C. and reheated. 4, reheated 2 hrs. at 150° C., B.H.N. 100; 5, reheated 2 hrs. at 300° C. B.H.N. 143; 6, reheated 2 hrs. at 470° C., B.H.N. 59; 100x

Figs. 7, 8, 9.—Brass, 70% copper, 30% zinc. 7, cold rolled, B.H.N. 150; 8, cold rolled and annealed at 425° C., B.H.N. 70; 9, cold rolled and annealed at 700° C., B.H.N. 49; 75x

Figs. 10, 11, 12.—Monel metal (67% nickel, 28% copper, 5% other elements), 10, as cast, B.H.N. 105; 11, cold rolled, B.H.N. 200; 12, hot rolled, B.H.N. 144; 100x

ALLOYS



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PHOTOMICROGRAPHS OF ALLOYS AND METALS

Figs. 1, 2, 3, 4.—Aluminium alloy containing 13% silicon. 1, sand cast, tensile strength (T.S.) 19,000 lb. per sq. in. (psi), elongation (El.) 1%. 2, "modified" with 0.05% sodium before sand casting, T.S. 27,000 psi. El. 12%. 3, Chill cast, T.S. 34,000 psi, 5.8% El. 4, chill cast and heated 40 hrs. at 565° C and quenched, T.S. 28,000 psi; El. 16%; 100x

Figs. 5, 6, 7.—Lead alloy containing 10% antimony; lead-rich solid solution dendrites in eutectic; 90x. 6, lead alloy containing 18% antimony; antimony crystals in eutectic; 90x. 7, Babbitt, tin 91%, copper 4.5%, antimony 4.5%; 50x

Figs. 8, 9, 10.—Stellite cutting tool, 45% cobalt, 30% chromium, 15% tungsten, balance carbon, manganese, silicon and iron; 100x. 9 and 10, aluminium alloy containing 5.5% copper. 9, as sand cast, T.S. 20,500 psi. 10, same after prolonged heating at 544° C, followed by quenching, T.S. 37,000 psi; 100x

Fig. 11.—Aluminium alloy containing 4.05% copper, quenched from 540° C and heated two weeks at 200° C; 1,500x

non-metallic particles of cuprous oxide in copper may technically be regarded as part of the alloy because molten copper dissolves several per cent of this oxide.

Gradually the metallurgical art has advanced until nearly all of the metallic elements can be produced in a more or less pure state. Tens of thousands of combinations of 50 or more of the metallic elements with one another and with non-metallic elements have been prepared in recent times in the search for useful mixtures. It is estimated that more than 5,000 alloy compositions are in current use. This number does not include small variations such as may be expected in attempts to produce the same composition. In some respects the most common of the alloys are those used in coinage and jewellery. The so-called copper coins are really "bronze" alloys containing usually 95% copper, 4% tin and 1% zinc. Silver coins in Great Britain until 1920 were made of "sterling" silver containing 92·5% silver and 7·5% copper. All U.S. silver coins contain 90% silver and 10% copper; the five-cent piece contains 75% copper and 25% nickel. British gold coins contain 91·67% gold and 8·33% copper, whereas U.S. gold coins contain 90% gold and 10% other metals, mostly copper. Platinum, gold and silver used in the manufacture of jewellery are nearly always alloyed with other metals to modify colour, improve strength, hardness and wearing qualities or to effect economy. The purity of gold jewellery is indicated by the "karat," 24-karat being pure gold. Eighteen-karat gold containing 75% gold and 25% silver is green, 75% gold, 12·5% silver and 12·5% copper is yellow, and 75% gold and 25% copper is red White gold can be made by the addition of nickel. These precious metal alloys comprising many specific compositions also have other important uses. For example, platinum alloys are used in thermo-couples and electric contacts of magnetos, gold alloys in dentistry and silver alloys for table ware.

Ferrous Alloys.—Alloys are classified industrially into the two main divisions, ferrous (iron base alloys) and non-ferrous. Many ferrous alloys are termed steel. (*See* IRON AND STEEL; STEELS, ALLOY; TOOL STEELS; STAINLESS STEELS.) Steels are by far the most important industrial alloys. They not only differ markedly in composition, but also the properties of many steels can be profoundly changed by heat treatment or mechanical working. A piece of carbon steel containing 1% carbon quenched in water from 775° C is hard and may be used for a cutting tool. It will readily machine a piece of the same steel which has been "annealed" by holding at 700° C followed by slow cooling. One steel may be magnetized by an electric circuit and become a permanent magnet. Another (iron-silicon alloy) is used in transformers partly because of its high magnetic permeability and its low magnetic hysteresis. An iron alloy containing 13% manganese and 1% carbon (Hadfield's manganese steel) is soft and non-magnetic after quenching from a high temperature, and relatively hard and magnetic when slowly cooled. Invar is an alloy containing about 64% iron and 36% nickel which does not expand when heated 200° C above room temperature Rustless, heat-resisting and stainless qualities are imparted to iron by adding chromium, with or without nickel, silicon or aluminium, and varying the carbon content and heat treatment. Iron alloys may be made to retain high hardness at a dull red heat by suitable additions of tungsten, or molybdenum, with or without carbon, chromium or vanadium, each composition requiring a special heat treatment to develop "red" hardness. Certain of these alloys are termed "high speed" steels.

Steels are made in the form of castings, and all kinds of wrought shapes such as forgings, bars, rods, plates, sheets, structural shapes, tubing and wire. Cast irons not used in the wrought form are also included in the ferrous alloys. These are classified in three main groups: grey, white and malleable cast iron. Grey iron is essentially an iron alloy containing 2 to 4·5% carbon and sufficient silicon to cause the major part of the carbon to separate as graphite on solidification and cooling. White iron contains so little silicon or is solidified and cooled so rapidly that the carbon does not separate as graphite. It is hard and has a white fracture, whereas grey iron is relatively soft and machinable and has a grey fracture. Malleable iron is obtained by annealing white iron in such a manner as to eliminate the carbon or more commonly to cause its separation into small and more or less spherical particles of graphite resulting in relative softness and absence of brittleness.

Non-ferrous Alloys.—Non-ferrous alloys are further classified industrially in terms of the most important metal present. Brass, for example, is termed a copper base alloy because copper is present in greater proportion than zinc. Other industrial copper base alloys are tin-bronze, silicon-bronze, aluminium-bronze, nickel-silver, copper-nickel-silicon, phosphor-bronze and cupro-nickel. (*See* COPPER, OUTPUT AND MANUFACTURE: *Alloys of Copper.*) Zinc base alloys are used extensively in pressure die castings. A popular alloy contains about 92 to 93% zinc, 4·5% aluminium and 3% copper, with or without a little magnesium. (*see* ZINC.) Lead base alloys are also used extensively in pressure die castings for bearings, acid-resisting parts, storage battery grids, etc. Plumbers' solder (*q.v.*) is an alloy containing about 67% lead and 33% tin. Type metal (*q.v.*) is also a lead base alloy containing up to 20% antimony, with or without other elements. (*See* LEAD, *Lead Alloys.*) Aluminium and magnesium base alloys are known as the "light alloys" because of their low specific gravity. (*See* ALUMINIUM, *Industrial Alloys.*) A number of nickel base alloys have found important industrial applications. (*See* MONEL METAL) Among other important nickel alloys are those used as high temperature heating units in electric furnaces, thermo-couples, etc., known as nichrome, chromel, alumel, etc. These alloys all contain from 60 to 94% nickel, the other alloying elements being chromium, iron or manganese. Of particular industrial as well as scientific interest is an alloy containing 79% nickel and 21% iron, known as permaloy. This alloy when properly prepared has a low magnetic hysteresis and a very high magnetic permeability in weak fields. Its properties have made possible great advances in trans-oceanic communication by wire. (*See* TELEPHONE.) Tin base alloys are used for many purposes, but the principal use is in bearings. Britannia metals and babbitts are tin alloys containing antimony and copper with or without zinc, lead or bismuth. (*See* Plate II , fig 7) Ordinary pewter is a tin base alloy containing 8 to 15% lead. Stellite, a cobalt-chromium-tungsten alloy containing a small amount of carbon, is so hard that it is used as a cutting tool. It is not only hard at ordinary temperatures but possesses useful "red" hardness. (*See* Plate II , fig. 8.)

CONSTITUENTS OF ALLOYS

With so many alloys, each having its special properties and internal structure, and with countless possible combinations, the need for scientific as well as industrial classification is apparent. The study of the constitution and crystalline structure of alloys by means of the microscope (*q v*), X-ray spectrometer, thermal analysis, chemical analysis and various physical tests, has resulted in a classification of the constituents with reference to the manner of aggregation of the atoms Three types of constituent are found: (1) Pure or substantially pure metals; (2) solid solutions; (3) chemical compounds.

Nature of Pure Metals.—A pure metal constituent is composed substantially of one kind of atom. The atoms of different metallic elements vary somewhat in effective size but they are on the order of a hundred-millionth of an inch in diameter X-ray wave lengths are the same order of magnitude as the diameter of an atom and hence the arrangement of atoms in a crystal can be determined by diffraction of X-rays of known wave length. Although solid metals are opaque they are crystalline. The crystalline structure is described by the type and dimensions of a space lattice. A space lattice consists of a series of points in space such that every point is situated similarly to every other point. Space may be imagined as divided into cells by three sets of parallel planes, the intersections of these planes constituting the points of the space lattice. The angles which these planes make with one another and the distances apart determine the type and constants of the crystal Most pure metals crystallize in the cubic and hexagonal systems. (*See* CRYSTALLOGRAPHY.) The microscope is a coarser grained tool than the X-ray spectrometer

and can only resolve particles comprising about 1,000,000,000 atoms and more. It reveals the presence of grains and grain boundaries in metals as shown in a number of the accompanying micrographs shown in Plates I. and II. Each grain in a pure metal is the same kind of a crystal but differs in orientation of the crystal axes from its neighbours. Grains may also differ markedly in size and shape.

Before making micrographs of a sample of alloy, a surface is highly polished and usually "etched" by slight chemical attack. In Plate I., figs. 1 and 10, and in Plate II., figs. 5 and 8 the different colours represent different constituents. In Plate I, figs. 9 and 12 and in Plate II., fig. 10, only one constituent is present, the different colours being due to different orientation of the grains.

Nature of Solid Solutions.—Metallic solid solutions are also crystalline. Adopting the terminology of aqueous solutions, metallic solid solutions consist of "solvent" and "solute." If, for example, a small amount of copper is alloyed with nickel, the crystalline identity of copper is lost and the nature of the nickel is changed. Copper atoms are supposed to substitute for some of the nickel atoms in the space lattice. Nickel is the solvent and copper is the solute. It so happens that nickel and copper crystallize with the same type of space lattice, and that each is soluble in the other in the solid state to an unlimited extent. Therefore in the alloy containing 50 atomic per cent of each metal no attempt is made to differentiate between solvent and solute. In other alloys of these metals the element present in the higher atomic per cent is the solvent. Although these metals crystallize with the same type of space lattice, a side of the unit cube in copper is 3·60 by 10^{-8} and in nickel 3·54 by 10^{-8} centimetres. The dimensions of the unit cube of the solid solution bear an approximately linear relationship to the atomic concentration, that is, the unit cube of an alloy containing 50 atomic per cent each of copper and nickel is about 3·57 by 10^{-8} centimetres.

Nickel and chromium form a complete series of solid solutions but the pure metals crystallize with different types of space lattice. The solvent metal in any such solid solution alloy is the one whose type of space lattice persists. Within a certain range of composition it appears that either type of space lattice may be stable at ordinary temperatures. Nickel is the only solvent up to about 65% chromium, whereas chromium persists as the sole solvent up to only about 5% nickel. Many pairs of metals do not form solid solutions throughout the whole composition range. In the aluminium-magnesium alloys, for example, even the systems of crystallization are different, the former being cubic and the latter hexagonal. Solid aluminium dissolves only a limited amount of magnesium and vice versa. The aluminium-rich solid solutions have the same type of space lattice as aluminium, and the magnesium-rich solutions the same as magnesium These are referred to as cases of "limited solid solubility." Not only is the solid solubility limited but the limit changes with change in temperature, usually increasing with increase in temperature, but sometimes the reverse. If a solute is present in an amount less than the solubility limit, the solution is "under-saturated," and if equal to the solubility limit it is "saturated." A solid solution saturated or nearly so at a relatively high temperature may be cooled so quickly that a "super-saturated" solid solution obtains either temporarily or more or less permanently at some lower temperatures.

An alloy composed of two elements is termed binary, one of three elements ternary, and one of four elements quaternary. Solid solution alloys may be binary or they may contain a large number of elements Although atom substitution seems to be the rule in solid solutions, it appears that carbon atoms dissolved in solid iron occupy spaces between iron atoms.

Nature of Compounds.—Certain combinations of metals produce materials with space lattices different from that of either of the constituent elements. These materials are called, in general, compounds. Compounds have definite proportions of the elements, such as $FeAl_3$, Fe_3C, $CuAl_2$, Mg_2Si, etc. Usually inter-metallic compounds possess lower crystalline symmetry than the elements from which they are formed. The constituent atoms of a compound crystal are supposed to be so fixed in their positions that different kinds of atoms are not readily interchangeable in position. It is not supposed that an oxygen atom, for example, in Cu_2O would be interchangeable with a copper atom in the Cu_2O space lattice. On the other hand, a metallic compound may be the solvent of a solid solution. Mn_3C seems to be soluble in solid Fe_3C. If so, the material would be a solid solution of manganese carbide in iron carbide. Even in this case, it is suggested that the manganese substitutes only for the iron in the space lattice, the carbon atoms being interchangeable only with one another.

PROPERTIES OF ALLOYS

Properties of Pure Metals.—The properties of an alloy depend on the properties, the proportions and arrangement of the constituents. Pure metals differ greatly in specific properties, such as hardness, melting point, electrical conductivity, ductility, density, etc. Many of these properties are transmitted to alloys of which a pure metal is one constituent, and the effect can be approximately calculated by applying the rule of mixtures. One of the outstanding characteristics of metals is their ability to be plastically deformed without rupture. This plastic deformation is possible because a portion of a crystal of a metal will slip on one or more of the crystallographic planes without rupture. In general, slip takes place the more easily the purer the given metal, and the larger the grains Slip takes place at a much lower unit load than that which would be required to separate one plane of atoms from the other simultaneously. The total attractive forces on one of these planes would be the sum of the attractive forces of all of the atoms participating, a value termed "absolute cohesion," which is large as compared with the force required to produce slip. An automobile, weighing two tons, standing on a smooth but level pavement exerts a pressure on the pavement equal to its weight. A force of 150 lb. applied horizontally, however, may start the car in motion. This latter force would be comparable to that required to produce slippage in a metal crystal, whereas the weight of the automobile would be compared with the absolute cohesion. That the absolute cohesion is markedly greater than the unit force required to produce slip in a plastic metal crystal is clearly demonstrated by the fact that the same atoms can be differently arranged, as by reduction in grain size or by cold working, so as to greatly increase not only the force required to produce slip but also that required to produce rupture. A single crystal of iron, for example, may have a tensile strength of only 11 tons per square inch. Iron of the same purity composed of small grains may have a tensile strength of 20 tons per square inch. Another piece of iron of the same purity drawn cold through a number of dies may have a tensile strength of 40 tons per square inch. In general, the strength and hardness of a given pure metal increase with decrease in grain size, with decrease in temperature, and with increase in degree of cold work. There are some exceptions to the rule in connection with temperature change, notably in iron which undergoes an allotropic transformation at about 900° C and has a higher tensile strength in the gamma condition slightly above 900° C than in the alpha condition slightly below this temperature. Also, commercial iron and most of the ordinary steels have higher tensile strength at about 200° C than at room temperature. Because the softness of a metal is dependent on ease of slip on the crystallographic planes, any condition which interferes with the ease or freedom of this slip movement is a hardening factor. The factors favouring high plasticity are generally those which favour softness, namely large grain size, freedom from cold work and high temperature.

Properties of Solid Solutions.—The properties of very dilute solid solutions are usually quite similar to the properties of the commercially pure solvent metals themselves. The departure from similarity takes place gradually as the amount of solute increases, and obtains to a different degree for equal amounts of different solutes. Pure metals freeze or melt at a constant temperature, whereas most solid solution alloys freeze or melt throughout a range of temperature. Solid solution alloys are harder and

in general less plastic than the solvent metal. The electrical conductivity is less than that of the solvent metal. In fact, this property changes to a much greater extent than would be indicated by the law of mixtures. The hardness also disobeys the law of mixtures. For example, tin is much softer than copper, but a solid solution of tin in copper is considerably harder than the copper itself. The temperature coefficient of electrical resistivity of solid solution alloys is usually lower and sometimes markedly lower than in the pure metals. Certain solid solution alloys possess a zero or even slightly negative temperature coefficient. Also, the thermo-electric force of a solid solution is often markedly different from that of the solvent metal.

Properties of Compounds.—Compounds, and particularly inter-metallic compounds, are characterized by relatively high hardness and low plasticity. Metallic compounds are very important constituents in alloys from the standpoint of increasing hardness, decreasing grain growth and particularly for the purpose of maintaining strength of alloys at high temperatures. Each compound has its specific properties, some having high melting point, some low, some with high hardness, some with low hardness, a few with considerable plasticity, but many with practically no useful plasticity.

Proportions and Arrangements of Constituents.—Certain properties of alloys, such as density and resistance to penetration by X-rays, may be determined by the proportions and specific properties of the various constituents. Many of the properties, however, depend to a greater or less extent on the *arrangement* as well as the proportions. In an alloy containing more than one type of constituent, the most important thing to be considered is which constituent possesses continuity. This is particularly important if the different constituents vary considerably in hardness and plasticity.

The importance of the degree of refinement of the separate constituents has been demonstrated forcibly in recent years. In many alloys the proportions of the constituents may be changed by heat treatment, and at the same time the manner of aggregation may be changed. Using the copper–Ni_2Si system as an example, the alloy containing 6% Ni_2Si will consist largely of solid solution of nickel and silicon in copper after quenching from 900° C. The Brinell hardness is about 70. By heating to 525° C a short time a considerable portion of the nickel and silicon precipitate in submicroscopic particles of Ni_2Si, increasing the hardness to above 200. During this heating period the hardness rises for a certain length of time, reaches a maximum and eventually may decrease somewhat to approximately a constant value These changes in hardness are associated with change in amount and size of the hard particles of Ni_2Si. There appears to be an average size of precipitated particle which produces maximum hardening effect for a given quantity of the constituent. In this condition, referred to as "critical dispersion" for maximum hardness, the particles are too small to be resolved with a microscope.

The above is an example of what has become a common practice in commercial selection and heat treatment of a number of alloy types. The high temperature step in the heat treatment is referred to as the *solution treatment,* and the low temperature step as *precipitation treatment.* Many alloys have been found to exhibit changes in properties and structure when subjected to this type of heat treatment. The alloy compositions must be carefully selected with reference to solubility limits of solid solutions, change of solubility with change in temperature, and the temperature and time of the heat treatment must be varied to suit the particular alloy. Some alloys, for example, duralumin and lead-antimony alloys, need not be given an "artificial" precipitation heat treatment because the precipitation takes place spontaneously at room temperature. Other alloys must be heated above room temperature in order to cause precipitation. These changes in particle size and in the amount of solute in a solid solution are possible in alloys only because of diffusion in the solid state. Diffusion is supposed to occur by migration of solute atoms in the grain boundaries and in the space lattice of the solvent. Rapid diffusion is favoured by high temperature and at certain relatively low temperatures, different for different alloys, diffusion may, for practical purposes, be considered not to take place. Also diffusion is more rapid along grain boundaries than through the crystalline grains themselves.

CONSTITUTION DIAGRAMS

The number, composition and proportions of the constituents in equilibrium at any given temperature, and changes due to change in temperature may be represented graphically in a constitution diagram. Such diagrams present only equilibrium conditions and are not concerned with the arrangement of the constituents. A binary alloy diagram may be represented on a two dimensional chart, as in fig. 1, but ternary alloy systems require three dimensions for suitable graphic representation. Complete graphic representation of the constitution becomes difficult if not hopeless in alloys containing four or more components. Plane charts, however, within restricted composition limits, particularly

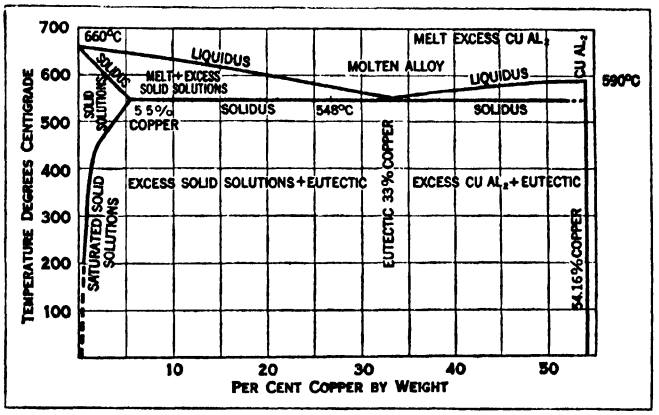

FIG 1—CONSTITUTION DIAGRAM SHOWING NUMBER, COMPOSITION AND PROPORTION OF THE CONSTITUENTS IN EQUILIBRIUM AT ANY GIVEN TEMPERATURE, AND CHANGES DUE TO CHANGES IN TEMPERATURE

when only two of the components are allowed to vary at one time, are exceedingly useful even with complex alloys In alloy systems each physically distinct and homogeneous part is called a "phase," and the chemical elements or compounds which participate in the equilibria are called "components."

In fig. 1, the liquid alloy is one phase, the solid aluminium or aluminium-rich solid solution another, and the solid compound $CuAl_2$ another Aluminium and $CuAl_2$ are the components In the whole system other compounds are formed and the elements, aluminium and copper, may be regarded as the components. The *liquidus* is the line or curve representing the beginning of solidification, and the *solidus* represents the end of solidification on cooling. In some alloy systems the liquidus passes through a minimum temperature, coinciding with the solidus at a certain composition. If the solidified alloy having such a minimum freezing point shows the presence of at least two phases under the microscope it is called a *eutectic* alloy. Eutectics may be binary, ternary, etc., in accordance with the number of phases present. Eutectic alloys freeze and melt at a constant temperature rather than through a temperature range, and the eutectic composition does not, except by coincidence, represent simple whole number proportions of the elements.

The properties and structures of alloys may be profoundly changed by mechanical working and by heat treatment Certain of these changes in structures are indicated in the accompanying micrographs and the corresponding changes in properties are indicated in the titles.

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(Z. J.)

ALLOY STEELS: *see* STEEL (ALLOYS).

ALLPORT, SIR JAMES JOSEPH (1811–1892), English railway manager, was, for 20 years onwards from 1853, the general manager of the Midland railway. He is remembered as the pioneer of cheap and comfortable railway travelling. He was the first to appreciate the importance of the third-class passenger as a source of revenue, and in 1872 he inaugurated the policy, subsequently followed by all the important railways of Great Britain, of carrying passengers in well-fitted third-class carriages at the rate of a penny a mile. He was also the first to introduce the Pullman car on British railways. Allport was knighted in 1884. He died in London on April 25, 1892.

ALLPORT, SAMUEL (1816–97), English petrologist, was born in Birmingham Jan. 23, 1816, and died at Cheltenham July 7, 1897. He was a pioneer in microscopic petrology. The basalts of south Staffordshire, the diorites of Warwickshire, the phonolite of the Wolf Rock (to which he first directed attention), the pitchstones of Arran and the altered igneous rocks near the Land's End were investigated and described by him during the years 1869–79 in the *Quarterly Journal of the Geological Society* and in the *Geological Magazine*.

ALL RISKS INSURANCE: *see* INSURANCE, MISCELLANEOUS.

ALL SAINTS BAY or **BAHIA DE TODOS OS SANTOS,** a land-locked bay and natural harbour on the eastern coast of Brazil about 738m. (1,187km.) north-east of Rio de Janeiro. The bay is about 20m. wide and 23m. long with an entrance from the Atlantic about 2m. broad. The channel leading through this entrance is rather circuitous and varies with the seasons of the year. Detached breakwaters, one 1,300yd. long and another about 1,000yd. long, cause the water of the bay to be less disturbed by the winds. The controlling depth of the channel varies from 26 to 33 feet. On entering All Saints bay from the Atlantic, one is impressed with the beauty of the bay and the hills rising from the water's edge. On the western side of the peninsula separating the bay from the Atlantic, in 13° S. and 38° 30′ W., is Bahia or São Salvador (pop. 350,000), an important seaport and capital of the State of Bahia.

ALL SAINTS, FESTIVAL OF (ALL HALLOWS, HALLOWMASS), a feast of the Church celebrated on Nov. 1 in honour of all saints, known or unknown, as a festival of the first rank, with vigil and octave. The first trace of a general commemoration of martyrs is in Antioch on the Sunday after Pentecost; Chrysostom (d. 407) also refers to the custom. At Rome the feast of St. Mary ad Martyres was instituted on May 13, 609 or 610, when Boniface IV. dedicated the Pantheon to the Blessed Virgin and all martyrs. Gregory III. (731–741) dedicated an oratory in St. Peter's to all saints, and fixed the anniversary for Nov. 1. This observance was extended by Gregory IV. (827–844) to the whole Church; the octave was added by Sixtus IV. (1471–84). At the Reformation the festival was retained in the calendars of the Church of England and many of the Lutheran Churches; in the latter, however, it has fallen into complete disuse.

ALL SOULS' DAY, the day (Nov. 2 or, if that be a Sunday or festival of the first class, Nov. 3) set apart in the Roman Catholic Church for commemoration of the faithful departed; a custom based on the doctrine that souls which at death are not yet sufficiently purified to be fit for the Beatific Vision may be helped by the prayers of the faithful here on earth. The practice of devoting certain days to intercession for particular groups of the dead is of great antiquity; but the institution of this feast of general intercession is due to Odilo, abbot of Cluny (d. 1048), who ordered its observance in the Cluniac monasteries. It spread thence among other congregations, and became practically universal before the end of the 13th century. It was abolished in the Church of England at the Reformation, but has been revived in "Anglo-Catholic" churches. Among continental Protestants its tradition has been more tenaciously maintained, especially in Saxony, where, though its ecclesiastical sanction has long since lapsed, its memory survives strongly in popular custom. As in France people of all ranks and creeds decorate the graves of their dead on the *jour des morts*, so in Germany the people stream to the graveyards once a year with offerings of flowers.

Certain popular beliefs connected with All Souls' Day are of pagan origin and immemorial antiquity. In many Catholic countries the dead are believed by the peasantry to revisit their homes on All Souls' night and partake of the food of the living. In Tirol cakes are left for them on the table. In Brittany the people flock into the cemeteries at nightfall to kneel bare-headed at the graves of their loved ones, and to pour libations of milk or holy water on the tombstones, and at bedtime supper is left on the table for the dead.

ALLSPICE, the dried unripe berry of the pimento or allspice tree (*Eugenia pimenta* or *Pimenta officinalis*) of the myrtle family. The tree, which attains a height of 40ft., is native to Central America and to the West Indies where it is also cultivated. This highly aromatic spice, widely used in cookery and in medicine, is supposed to combine the flavour of cinnamon, nutmeg and cloves, whence its name. The name is applied also to other aromatic shrubs, especially to the Carolina allspice (*Calycanthus floridus*), a handsome flowering shrub, native to the south-eastern United States and often cultivated in England; to the Japanese allspice (*Chimonanthus fragans* or *Meratia praecox*), native to Eastern Asia and planted for ornament in England and the United States; and to the wild allspice or spicebush (*Benzoin aestivale*), a lauraceous shrub of eastern North America, with aromatic berries, reputed to have been used as a substitute for spice.

ALLSTON, JOSEPH (*c.* 1779–1816), American planter and governor of South Carolina, was born probably in All Saints' parish, S.C., about 1779. He was educated at Princeton but left in his senior year without graduating and studied law in the office of Edward Rutledge. He was elected a member of the lower house of the South Carolina legislature in 1802, and continued to serve until 1812, being speaker from 1805 to 1809. In 1812 he was elected governor and his administration, 1813–15, was noted for its energetic support of the War of 1812. In 1801 Allston married Theodosia Burr (*q.v.*), brilliant daughter of Aaron Burr (*q.v.*). Through this marriage Allston was drawn into a minor connection with the so-called "Burr Conspiracy," and the fact seriously hampered his later political career. It was but natural that he should have aided Burr during the trial to establish his innocence, and it has been established that he was the author of the pamphlet *Agrestis* which then appeared. Allston's only child died in 1812 and in 1813 Theodosia was lost at sea. Allston, himself of frail health, survived these tragedies but a few years, dying on Sept. 10, 1816.

ALLSTON, ROBERT FRANCIS WITHERS (1801–1864), American planter and governor of South Carolina, was born in All Saints' parish, S.C., on April 21, 1801. He was educated at the West Point academy and upon his graduation in 1821 he was appointed a lieutenant in the Coast Survey. He aided in the surveys of Plymouth and Provincetown harbours in Massachusetts and the entrance to Mobile bay. In 1822 he resigned his commission in order to manage the plantation of his widowed mother. He was elected in 1823 to the office of surveyor general of South Carolina which he held for two terms. In 1828 he was elected to the lower house of the legislature. He was re-elected in 1830, and in 1832 he was elected to the State senate, to which he was regularly returned for 24 years. He served from 1847 to 1856 as that body's presiding officer. During the nullification episode he was made colonel of militia. He was a supporter of the States' rights doctrine but believed, nevertheless, that closer co-operation must be instituted between the Southern States. He was elected governor for the term 1856–58, and did much during his administration for the development of agriculture and the backward public school system.

Because of his energy and his scientific knowledge of agriculture Allston rose to a high position among Southern planters. His

was one of the last great rice plantations in the low lands, and he did much in an engineering way in the draining and reclaiming of swamp country. He published two treatises, *A Memoir of the Introduction and Planting of Rice in South Carolina* (1843), and *An Essay on Sea Coast Crops* (1854), both of which were authoritative works and of great influence among the planters of the time. He died on April 7, 1864.

His daughter, Mrs. E. W. A. Pringle, gives an intimate account of him in *Chronicles of Chicora Wood* (1922).

ALLSTON, WASHINGTON (1779–1843), American historical painter and poet, was born Nov. 5, 1779, at Waccamaw (S. C.), where his father was a planter. He graduated at Harvard in 1800, and for a short time pursued his artistic studies at Charleston with Edward Greene Malbone (1777–1807), the miniature painter, and Charles Fraser (1782–1860). With the former, in 1801, he went to London, and entered the Royal Academy as a student of Benjamin West, with whom he formed a lifelong friendship. In 1804 he went to Paris, and, after a few months' residence there, to Rome, where he spent the greater part of the next four years. During this period he became intimate with Coleridge and Thorwaldsen. From 1809 to 1811 he resided in his native country, and from 1811 to 1817 he painted in England. After visiting Paris a second time, he returned to the United States, and practised his profession at Boston (1818–30), and afterwards at Cambridge (Mass.), where he died July 9, 1843. He was elected an associate of the Royal Academy in 1819. In colour and the management of light and shade Allston closely imitated the Venetian school, and he has hence been styled the "American Titian." Many of his pictures have biblical subjects, and Allston himself had a profoundly religious nature. His first considerable painting, "The Dead Man Revived," executed shortly after his second visit to England, and now at the Pennsylvania Academy of Fine Arts in Philadelphia, gained a prize of 200 guineas. In England he also painted his "St. Peter Liberated by the Angel," the remarkable canvas, "Uriel in the Sun," "Jacob's Dream" (at Petworth) and "Elijah in the Wilderness" To the period of his residence in America belong "The Prophet Jeremiah" (at Yale), "Saul and the Witch of Endor," "Miriam," "Beatrice," "Rosalie," "Spalatro's Vision of the Bloody Hand," and the vast but unfinished "Belshazzar's Feast" (in the Boston Athenaeum), at which he was working at the time of his death. As a writer, Allston shows great facility of expression and imaginative power. Coleridge (a portrait of whom by Allston is in the National Portrait Gallery) said of him that he was surpassed by no man of his age in artistic and poetic genius. His literary works are—*The Sylphs of the Seasons and other Poems* (1813), where he displays true sympathy with nature and deep knowledge of the human heart; *Monaldi* (1841), a tragical romance, the scene of which is laid in Italy; and *Lectures on Art,* edited by his brother-in-law, R. H. Dana the novelist (1850).

See J. B. Flagg's *Life and Letters of Washington Allston* (1892).

"ALL THE TALENTS," MINISTRY OF, the name given to the coalition government which came into office after the death of Pitt (Jan. 23, 1806). Lord Grenville was at the head of the ministry, which included Fox and Lord Sidmouth. Fox died on Sept. 13; and after a disastrous year in which Napoleon reached the summit of his power, Grenville resigned (March 18, 1807) rather than agree to George III.'s unconstitutional demand that the ministers should undertake never again to approach him on the subject of concessions to Roman Catholics. It was due to the Ministry of all the Talents that the bill for the abolition of the slave trade was passed on March 25, 1807.

ALLUVION, a word taken from Roman law, in which it was one of the examples of *accessio,* that is, acquisition of property without any act being done by the acquirer. It signifies the gradual accretion (*q.v.*) of land or formation of an island by imperceptible degrees. If the accretion or formation be by a torrent or flood, the property in the severed portion or new island continues with the original owner until the trees, if any, swept away with the island take root in the ground. Alluvion never attached at all in the case of *agri limitati; i.e.,* lands belonging to the State and leased or sold in plots. Dig. xli. 1, 7, is the main authority. English law is in general agreement (except as to *agri limitati*) with Roman, as appears from the judgment in *Foster* v. *Wright,* 1878, 4 C.P.D 438. The Scottish law, as laid down by the House of Lords in *Earl of Zetland* v. *Glover Incorporation,* 1872, L.R. 2 H L., Sc., 70, is in accordance with the English. (*See* WATER RIGHTS.)

ALLUVIUM, the material deposited by rivers (*see* the general article GEOLOGY). It is usually most extensively developed in the lower part of the course of a river, forming flood-plains and deltas, but may be deposited at any point where the velocity of a river is checked; for example, where it runs into a lake. Alluvium in the true sense consists mostly of silt, sand, and gravel, without much true clay; it often contains a good deal of organic matter and therefore yields very fertile soils. Some of the great alluvial deposits of the world are: the flood-plain of the Mississippi, the deltas of the Nile, of the Ganges and Brahmaputra, and of the Hwang Ho in China. Owing to elevation of the land and consequent deepening of the river channel, patches of alluvium are often left forming terraces on the sides of valleys On such terraces much of London is built. In some regions alluvial deposits contain gold, platinum or gem-stones, and the greater part of the world's supply of tin ore comes from similar sources

(R. H RA)

ALLYL ALCOHOL, a colourless mobile liquid of pungent smell, boiling at 97°C. Its chemical formula is C_3H_5OH or $CH_2{:}CH{\cdot}CH_2OH$ It is an unsaturated primary alcohol occurring in very small quantities in wood spirit. It may be prepared by heating glycerin with oxalic acid and a little ammonium chloride to 260° C. In this reaction glycerol monoformin is produced as an intermediate product, but is decomposed as the temperature rises:—

$$C_3H_5(OH)_3 + H_2C_2O_4 = C_3H_5(OH)_2{\cdot}O{\cdot}CHO + CO_2 + H_2O$$
$$C_3H_5(OH)_2{\cdot}O{\cdot}CHO = C_3H_5OH + CO_2 + H_2O$$

Being unsaturated allyl alcohol combines readily with the halogens. Oxidation by strong oxidizing agents converts it successively into its aldehyde, acrolein, and into acrylic acid. By gentle oxidation with potassium permanganate, it may be converted into glycerin (*see* CHEMISTRY: *Organic*).

ALMA, a city of Gratiot county, Mich., U.S.A., on the Pine river, 37m. W. of Saginaw, almost exactly in the geographical centre of the lower peninsula. It is served by the Ann Arbor and the Pere Marquette railways. The population increased between 1910 and 1920 from 2,757 to 7,542. It has good water-power. Its factories make automobile steering wheels, motor-trucks, beet sugar, cement blocks, and pickles. It is the shipping point for a fertile farming and grazing district, and is the seat of Alma college and the State Masonic home. The city was incorporated in 1905, and adopted a commission-manager form of government in 1919.

ALMA, a river of Russia, in the south-west of the Crimea, entering the Black Sea 17m. N. of Sevastopol. It gives its name to a famous victory gained over the Russians, on Sept. 20, 1854, by the allied armies in the Crimean War (*q v*). The south bank of the river is bordered by a long ridge, which becomes steeper as it approaches the sea, and upon this the Russians, under Prince Menshikov, were drawn up, to bar the Sevastopol road to the allies, who under General Lord Raglan and Marshal St Arnaud approached from the north over an open plain. The Russian commander massed his troops in heavy columns after the fashion of 1813, and drew in his left wing so that it should as far as possible be out of range of the allied men-of-war, which were sailing down the coast in line with their land forces The allied generals decided that the French (right wing) and the Turks should attack Menshikov's left, while the British, further inland, were to assault the front of the Russian position. The forces engaged are stated by Hamley (*War in the Crimea*) as, French and Turks, 35,000 infantry, with 68 guns; British, 23,000 infantry, 1,000 cavalry and 60 guns; Russians 33,000 infantry, 3,800 cavalry and 120 guns; by the Austrian writer Berndt (*Zahl im Kriege*) the allied forces are reckoned at 57,000 men with 108 guns, and the

Russians at 33,600 men with 96 guns. The French advance met at first with little opposition, and several divisions scaled the cliffs of the lower Alma without difficulty. Menshikov relied apparently on being able to detach his reserves to cope with them, but the assailants moved with a rapidity which he had not counted upon, and the Russians only came into action piecemeal in this quarter. Opposite the British, who as usual deployed at a distance and then advanced in long continuous lines, the Russians were posted on the crest of a long glacis-like slope, which offered but little dead ground to an assailant. The village of Burliuk, and the vineyards, which bordered the river, were quickly cleared by the British skirmishers, and the line of battle behind them crossed though with some difficulty. On emerging from the cover afforded by the river-bed the British divisions, now crowded together, but still preserving their general line, came under a terrible fire from heavy guns and musketry. The enemy's artillery was three hundred yards away, yet the British pressed on in spite of their losses, and as some of the Light Division troops reached the "Great Battery" the Russians hurried their guns away to safety. In the meantime, on both sides of this battery, the assailants had come to close quarters with the Russian columns, which were aided by their field guns. A brave counter-attack was made by the Russian Vladimir regiment, 3,000 strong, against the troops which had stormed the great battery, and for want of support the British were driven out again. But they soon rallied, and now the second line had crossed and formed for attack. The Guards brigade attacked the Vladimir regiment, and on the left the Highland brigade and the cavalry moved forward also. Some of the field artillery, which had now crossed the Alma, fired steadily into the closed masses of the Russian reserve, and the Vladimir regiment lost half of its numbers under the volleys of the Guards. The French were now severely pressing the Russian left, and one-third of Menshikov's forces was drawn into the fight in that quarter. The success of the frontal assault had dispirited the remainder of the defenders, and Menshikov drew off his forces southwards. He had lost 5,700 men (Berndt and Hamley). The British had about 2,000 killed and wounded; the French stated their losses at 1,340 men.

ALMA ATA (formerly *Vyernyi*). (1) A town which is the capital of the Dzhetysyisk province of the Autonomous Kazak (Kirghiz) S.S.R. Pop. (1926) 45,379. It was founded as a fortified settlement by the Russians in 1855, but is now important commercially, and may become more so if the projected railway links with the Trans-Siberian and Orenburg-Tashkent railways are built. (2) A district round the town, area 72,052sq.km. Pop. (1926) 370,806, on the northern slopes of the beautiful Khungai Ala Tau mountains, watered by streams which run through the fertile loess area below to Lake Balkash. The climate and soil are favourable to vine and fruit cultivation.

ALMACANTAR (also written ALMUCANTAR), an astronomical term for a small circle of the sphere parallel to the horizon; when two stars are in the same almacantar they have the same altitude. The term is also given (1880) to instruments of a pattern invented by S. C. Chandler to determine the latitude or the time by observing the times of transit of stars across a fixed almacantar.

ALMACK'S, formerly the name of a famous London club and assembly rooms. The founder is usually said to have been one Macall, or McCaul, of which name Almack is an anagram. In 1764 he founded a gentlemen's club in Pall Mall, where the present Marlborough Club stands. It was famous for its high play. In 1778 it was taken over by one Brooks, and established as Brooks's Club in St. James's Street, where it still exists. In 1765 Almack built a suite of assembly rooms in King Street, St. James's. At his death in 1781 they were left to his niece Mrs. Willis, and as "Willis's Rooms" lasted till 1890, when they became a restaurant; but as "Almack's" they ceased in 1863. A 20th century club has since adopted the old name.

ALMADÉN or **ALMADEN DEL AZOGUE,** a town in Spain, province of Ciudad Real. Pop (1920) 9,829. Almadén (Ar. almaden, the mine) has been for centuries the principal centre for the famous ores of mercury, impregnating the quartzite of certain ridges between the Sierras of Chillón (N.) and Cordoneros (Alcudia) (S.). The *Sisapo* of the Romans lay in the same neighbourhood. Almadén and Adria (Southern Austria) were the chief sources of mercury till New Almadén (California) was opened up (1853–57). They were long worked by convicts owing to the unhealthy atmosphere and exemption from military service is granted to miners who have worked at Almadén for two years.

See *Minas de Almadén* (Madrid, 1926), guide-book, XIVth. Int. Congr. of Geol., with diagram showing entire production of the mines since the 15th century.

ALMAGEST, the famous treatise on astronomy by Ptolemy in the 2nd century A.D. Besides the exposition of the Ptolemaic theory of the heavens, it contains an important catalogue of the places of 1,080 stars. (*See* PTOLEMY.)

ALMAGRO, DIEGO DE (*c.* 1470–1538), Spanish *conquistador;* a foundling, born in Spain about 1470. In 1526, he contracted with Francisco Pizarro (*q.v.*) an equal partnership in the conquest of Peru. Pizarro immediately assumed the precedence; Almagro was delegated to provide reinforcements and supplies. He arrived in Peru in 1532, was present at the death of Atahuallpa (*q.v.*), assisted in the capture of Cuzco (Nov., 1533) and in 1534 was sent to stop Pedro de Alvarado's march upon Quito, from the coast. Receiving, in 1535, a royal grant of 200 leagues, south of Cuzco, he undertook the terrible march into Chile, but finding no gold, returned and seized Cuzco. In the battle of Abancay (1537), he destroyed Pizarro's army, but allowing himself to be drawn into a truce, was completely routed by Hernando Pizarro at Las Salinas (April 1538) and captured Convicted by his captor of treason against the crown, in July, 1538, he was garrotted in his prison, and beheaded in the public square of Cuzco

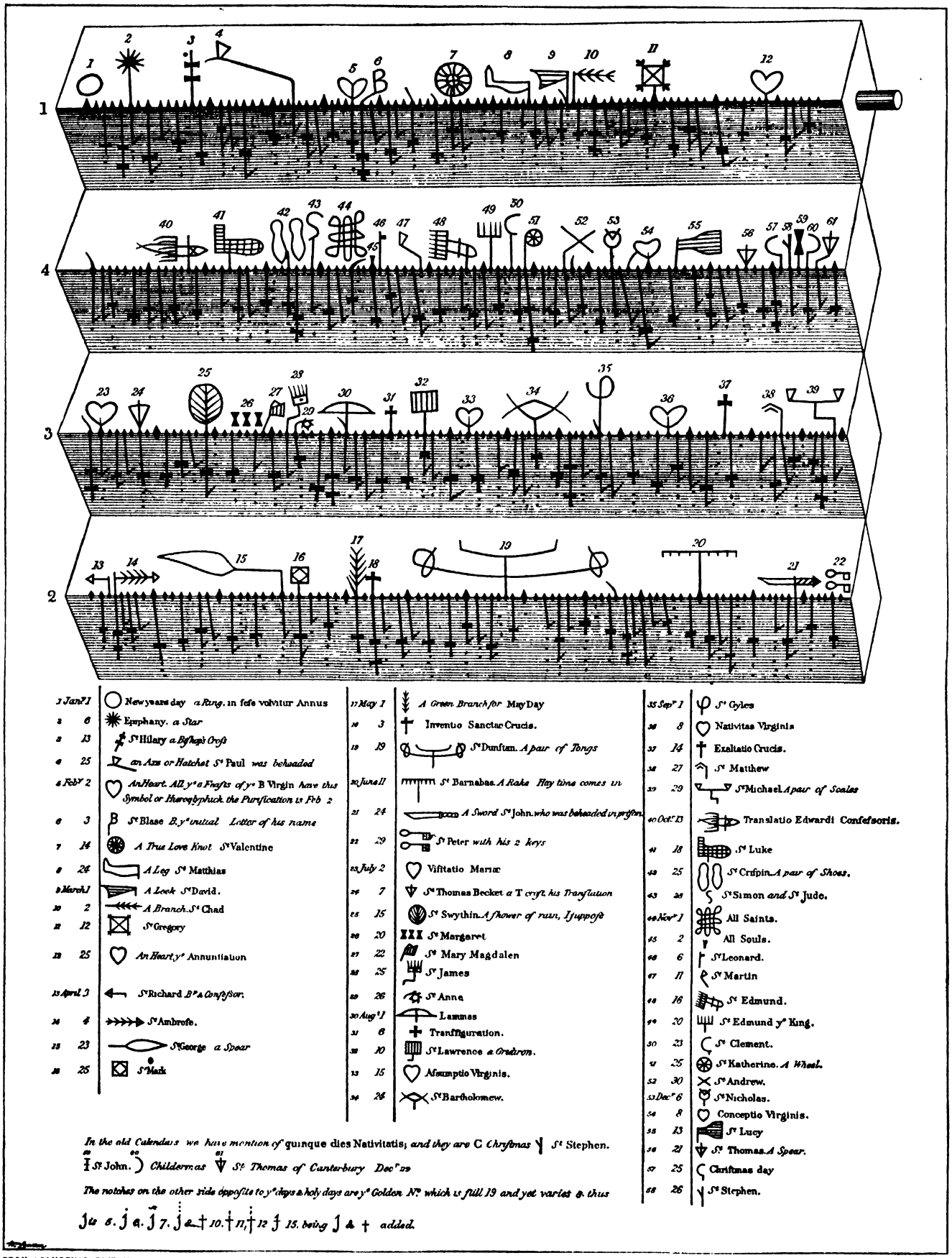
ALMA MATER, a name, signifying "bounteous mother," given by the Romans to certain goddesses, especially to Ceres and Cybele, and now applied to universities and schools regarded as the "foster mothers" of those who have attended them.

ALMANAC, a book or table containing a calendar of the days, weeks, and months of the year, a register of ecclesiastical festivals and saints' days, and a record of various astronomical phenomena, etc.

The attention given to astronomy by Eastern nations probably led to the early construction of such tables as are comprised in our almanacs; of these we know little or nothing. The *fasti* (*q.v.*) of the Romans are far better known and were similar to modern almanacs. Almanacs of a rude kind, known as *clogg almanacs,* consisting of square blocks of hard wood, about 8in. in length, with notches along the four angles corresponding to the days of the year, were in use in some parts of England as late as the end of the 17th century.

Early almanacs had commonly the name of "prognostications" in addition, and what they professed to show may be gathered from titles like the following, which is quoted by J. O. Halliwell: "Pronostycacyon of Mayster John Thybault, medycyner and astronomer of the Emperyall Majestie, of the year of our Lorde God MCCCCCXXXIJ., comprehending the iiij. partes of this yere, and of the influence of the mone, of peas and warre, and of the sykenesses of this yere, with the constellacions of them that be under the vij. planettes, and the revolucions of kynges and princes, and of the eclipses and comets" Most English almanacs were published by the Stationers' Company, the most famous of them being the *Vox Stellarum* of Francis Moore (1657–1715?), the first number of which was completed in July 1700, and contained predictions for 1701. Its publication has been continued under the title of *Old Moore's Almanac.*

The exclusive right to sell "almanacs and prognostications" in England, enjoyed in the time of Elizabeth by two members of the Company of Stationers, was extended by James I. to the two universities and the Stationers' Company jointly; but the universities commuted their privilege for an annuity from the company. This monopoly was challenged by Thomas Carnan, a bookseller, who published an almanac for three successive years, after having been thrice imprisoned on that account by the company. The case came, in 1775, before the court of common pleas,



FROM "CAMDEN'S BRITANNIA" (GOUGH'S EDITION, 1806)

A CLOGG ALMANAC OF WOOD, THE ORIGINAL CALENDAR OF THE NORWEGIANS AND DANES

Each of the four edges contained the calendar for three months. The number of days in them were expressed by notches, and every seventh day by a large sized notch. Over against many of the notches were placed on the left hand, marks or symbols denoting the golden number of cycle of the mean. The festivals are marked with symbols of the several saints

and was decided in Carnan's favour. The company, however, virtually retained its monopoly for many years, but this power has altogether ceased, although a considerable proportion of the almanacs published in England still issue from the hall of the Stationers' Company.

On Jan. 1, 1828, the Society for the Diffusion of Useful Knowledge issued the *British Almanac* for that year. Its success, with its valuable supplement, the *Companion to the Almanac,* led to a great improvement in this class of publications. The Stationers' Company issued the *Englishman's Almanac,* a work of a similar kind. Since 1870, the *British Almanac* and *Companion* have been the principal almanacs published by the Stationers' Company. *Whitaker's Almanac,* commenced in 1868 by Joseph Whitaker (1820–1895), is perhaps the best known of modern almanacs.

In Scotland, almanacs containing much astrological matter appeared to have been published at about the beginning of the 16th century; and about a century later those published at Aberdeen enjoyed considerable reputation. In 1683, *Edinburgh's True Almanack, or a New Prognostication,* appeared, a publication which improved with years and was issued after 1837 as *Oliver and Boyd's New Edinburgh Almanac,* a standard book of reference for Scottish affairs. *Thom's Irish Almanac* (since 1843) deals mainly with Ireland.

The earliest almanac published in the United States is probably to be ascribed to Bradford's press in Philadelphia for the year 1687. *Poor Richard's Almanac,* commenced in 1732 by Benjamin Franklin under the pseudonym of "Richard Saunders," and continued by him for 25 years, gained a high reputation for its wise and witty sayings. *The American Almanac and Repository of Useful Knowledge* was published at Boston from 1828 to 1861. *The Old Farmer's Almanac* enjoys considerable popularity and has been published for many years.

In France prophetic almanacs circulated very freely among the poorer and rural classes, although an *Ordonnance* of Charles IX. required the seal of a diocesan bishop on all almanacs. In 1579 Henry III. prohibited the publication of predictions relating to political events, a prohibition renewed by Louis XIII. Of such almanacs, the most famous was the *Almanach Liégeois,* first published in 1625 at Liége by Matthieu Laensbergh. The most important French almanac is the *Almanach Royal,* afterwards *Impérial,* and now *National,* first published in 1679.

A number of publications, issued in Germany, from the middle of the 18th to the middle of the 19th century, under such titles as *Musenalmanach,* modelled on the *Almanach des Muses,* a contemporary almanac published at Paris, contain some of the best works of some of the most celebrated German poets. The *Almanach de Gotha,* which has existed since 1763, published since 1871 both in French and German, gives a particular account of all the royal and princely families of Europe, and ample details concerning the administration and the statistics of the different states of the world.

For the *Nautical Almanac* and similar publications *see* EPHEMERIS.

ALMANSA (ALMANZA), a town in Spain, province of Albacete, at the foot of a castle-topped crag, above a fertile plain, which is the principal "gate" to the interior of Spain on the Mediterranean side. Pop. (1920) 12,589 Almansa is, in consequence, an important railway junction, and was the scene of a decisive defeat of the British and their peninsular allies by the French under the Duke of Berwick (1707). (*See* SPANISH SUCCESSION, WAR OF THE.)

AL-MANṢŪR (Arab. "victorious"), a surname (laqab) assumed by a large number of Mohammedan princes. The best known are: (1) ABŪ JA'FAR IBN MOHAMMED, second caliph of the Abbasid house born A.D. 712, who reigned A.D. 754–775 and founded Baghdad in 764 (*see* CALIPHATE; § C, § 2); (2) ABU TĀHIR ISMA'IL IBN AL-QĀ'M, the third Fatimite caliph of Africa (946–953) (*See* FATIMITES); (3) ABŪ YŪSUF YA 'QUB IBN YUSUF, often described as Jacob Almanzor, of the Moorish dynasty of the Almohades, conqueror of Alfonso III. in the battle of Alarcos (1195); (4) IBN ABĪ. 'ĀMIR MOHAMMED, commonly called Almanzor by European writers, of an ancient but not illustrious Arab family, which had its seat at Torrox near Algeciras. The last-named was born A.D. 939, and began life as a lawyer at Cordova. In 967 he obtained a place at the court of Hakam II., the Andalusian caliph, and rapidly rose to distinction, enjoying the powerful support of Subḥ, the favourite of the caliph, and mother of his heir Hishām. In 978, two years after the death of Hakam he became chief minister, but at first Manṣūr had to share the power with his father-in-law Ghālib, the best general of Andalusia, and with Ṣubḥ. At last a rupture took place between the two ministers. Ghālib professed himself the champion of the caliph and called in the aid of the Christians of Leon, but Manṣūr, anticipating the struggle, had long before remodelled the army and secured its support. Ghālib fell in battle (981); a victorious campaign chastised the Leonese, and on his return to Cordova the victor became practically sovereign of Andalusia. The caliph was a mere prisoner of state, and Manṣūr ultimately assumed the title of king (996). He reconquered territory from Christians, and restored the Muslim power in Spain. In Africa his armies were for a time hard pressed by the revolt of Zīrī, viceroy of Mauretania, but before his death this enemy had also fallen. Manṣūr died at Medinaceli on Aug. 10, 1002, and was succeeded by his son Mozaffar.

ALMANZOR: *see* AL-MANṢŪR.

ALMA-TADEMA, SIR LAURENCE, or **LAURENS** (1836–1912), British artist, was born Jan. 8 1836, at Dronrijp, a Frisian village near Leeuwarden, the son of Pieter Tadema, a notary, who died when the boy was four years old. In 1852 he entered the Antwerp academy under Gustav Wappers, and subsequently that of Henri (afterwards Baron) Leys, whom he assisted in 1859 in painting the frescoes in the hall of the Hôtel de Ville at Antwerp.

In the exhibition of Alma-Tadema's collected works at the Grosvenor Gallery in London in the winter of 1882–83 were two pictures which may be said to mark the beginning and end of his first period. These were a portrait of himself, dated 1852, and "A Bargain," painted in 1860. His first great success was a picture of "The Education of the Children of Clovis" (1861), which was exhibited at Antwerp. In the following year he received his first gold medal at Amsterdam.

In the '60s and '70s he produced two series of pictures, the subjects of which are drawn from Merovingian and Egyptian history. These had a considerable popular vogue because each of them told a "story." But Alma-Tadema's most characteristic work was done in his scenes from Greek and Roman life. Among the best known of his earlier pictures of scenes from classical times are "Tarquinius Superbus" (1867), "Phidias and the Elgin Marbles" (1868), and "The Pyrrhic Dance" and "The Wine Shop" (1869). "The Pyrrhic Dance," though one of the simplest of his compositions, is one of the best. "The Wine Shop" is one of his many pictures of historical *genre,* but marked with a humour more robust than usual.

In 1863 Alma-Tadema married a French lady, and lived at Brussels till 1869, when she died, leaving him two daughters, Laurence and Anna, both of whom afterwards made reputations—Laurence in literature, Anna in art. In 1869 he sent from Brussels to the Royal Academy two pictures, "Un Amateur romain" and "Une Danse pyrrhique," which were followed by three pictures, including "Un Jongleur," in 1870, when he came to London. In 1871 he married Miss Laura Epps, who also won a high reputation as an artist.

After his return to England he continued to exhibit important pictures each year, generally on subjects drawn from the classics. Apart from these large canvases he painted some small pictures of exquisite finish, like the "Gold-fish" of 1900. These, as well as all his works, are remarkable for the way in which flowers, textures and hard reflecting substances, like metals, pottery, and especially marble, are painted. His work shows much of the fine execution and brilliant colour of the old Dutch masters.

Alma-Tadema became a naturalized British subject in 1873, and was knighted on the occasion of Queen Victoria's 80th birthday, 1899. He was made an associate of the Royal Academy in 1876 and a Royal Academician in 1879. In addition he received honours in many of the capitals of Europe. He died on June 25 1912; a posthumous exhibition of his work was held in London in 1913.

See Georg Ebers, "Lorenz Alma-Tadema," *Westermann's Monatshefte,* Nov. and Dec. 1885, since republished in volume form; Helen Zimmern, "L. Alma-Tadema, his Life and Work," *Art Annual,* 1886; C. Monkhouse, *British Contemporary Artists* (London, 1899).

ALME or **ALMAI** (from *ālim,* "wise," "learned"), the name of a class of singing girls in Egypt who are present at festivals and entertainments and act as hired mourners at funerals. They are to be distinguished from the *ghawazee,* or dancing girls, who perform in the public streets, and are of a lower order.

ALMEIDA, DOM FRANCISCO DE (*c.* 1450–1510), the first viceroy of Portuguese India, was born in Lisbon about the middle of the 15th century. In March 1505, having received from Emmanuel I. the appointment of viceroy of the newly conquered territory in India, he set sail from Lisbon in command of a large and powerful fleet, and arrived in July at Quiloa (Kilwa), which yielded to him almost without a struggle. Mombasa was taken and destroyed, and its large treasures went to strengthen the resources of Almeida. At the island of Angediva, near Goa, and Cannanore, he built forts, and adopted measures to secure the Portuguese supremacy. Upon his arrival in India, he took up his residence in Cochin, where a Portuguese fort had been built by Alphonso d'Albuquerque in 1503.

The most important events of Almeida's brief but vigorous administration were the conclusion of a commercial treaty with Malacca, and the discoveries made by his son Lorenzo, who acted as his lieutenant. Lorenzo was probably the first Portuguese who visited Ceylon, where he established a settlement, and Fernando Soarez, a captain commanding a squadron of his fleet, appears to have been the first European to sight Madagascar. In 1508 he was killed at Dabul in a naval engagement with the Egyptians, who at this time endeavoured to dispute Portuguese supremacy in the Indian Ocean. His father was preparing to avenge his death when Albuquerque (q v.) arrived in Cochin, and presented a commission empowering him to supersede Almeida in the government. He refused to recognize Albuquerque's commission, and cast him into prison.

The punishment he inflicted on the Arabs and their Egyptian allies was speedy and terrible. Sailing along the coast, he pillaged and burned various ports, including Goa and Dabul, and finally, encountering the enemy's combined fleet off Diu in Feb. 1509, he completely destroyed it. Returning immediately to Cochin, he held out for a few months against the claims of Albuquerque, but in Nov. 1509 he was compelled to yield.

On Dec. 1 he set sail for Europe with an escort of three vessels. On the voyage the fleet called at Table bay, then known as Saldanha bay, to procure water, and here Almeida was killed (March 1, 1510) in an attack upon the Hottentot natives, during which he showed great personal courage. In this fight, which took place on the site of Cape Town, 65 Portuguese perished, including 12 captains. Almeida's body was recovered on the following day and buried on the spot where he fell.

See Franz Hümmerich, *Die erste deutsche Handelsfahrt nach Indien, 1505–06,* Historische Bibliothek, Bd. 49 (1922).

ALMEIDA, a town of north-eastern Portugal, in the district of Guarda; situated in hilly country near the River Côa, a tributary of the Douro, and long an important frontier fortress. Pop. (1920) 1,599. During the Peninsular War (*q v.*) much fighting occurred between the Côa and the Spanish fortress of Ciudad Rodrigo, 25m E.S.E. Almeida was taken by the French in 1810, and its recapture, by allied British and Portuguese forces, was only effected after a relieving force under Marshal Masséna had been defeated at Fuentes de Oñoro, 13m. S.S.E., on May 5, 1811.

ALMELO, town in the province of Overysel, Holland, 12m. by rail N.W. of Hengelo, at the junction of the Overysel and Almelo canals. Pop. (1927) 28,743. The lordship of Almelo belonged to the lords of Heeckeren, who acquired the barony of Rechteren by marriage in 1350, and the countship of Limpourg in 1711. A branch of the family still holds the seat. The town has shared in the extraordinary development of the Twente district and possesses many cotton and other textile factories. This industrial development received a great impetus (1914–18) through the advantages of neutrality enjoyed by Holland.

ALMENDRALEJO, a town in Spain, province of Badajoz, 27 m. E.S.E. of Badajoz. Pop. (1920) 15,448. The town has an important annual sheep fair, handles much farm produce and makes brandy. Local Roman antiquities are preserved in a museum in the palace of the Marqués de Monsalad. The development of the Merida-Seville Railway (1875–1905) increased the trade in grain, fruit and wine of the Guadiana valley and the Tierra de Barros highland.

ALMERÍA, maritime province in southern Spain, formed in 1833, from the parts of the ancient kingdom of Granada. Pop. (1920) 358,149; area, 3,391sq.m. This most easterly part of Upper Andalusia (*see* ANDALUSIA), is crossed by sierras in which terminate successive zones of the Andalusian, or Baetic, Cordillera. The Sierra de Gádos and Sierra Alhamilla form part of, or continue, the Alpujarra system (*see* ALPUJARRAS); the Sierra de los Filabres continues the Nevada core of the Cordillera, while the enveloping crystalline of the Málaga zone is represented in the Sierra de las Estancias. The intervening valleys of the rivers Adra, Andaraz-Almería, and Almanzora provide the only fertile land. The annual rainfall is below 200mm. in the east of the province, and the supply of water for irrigation is most irregular. For these reasons Almería has always been notable for the number of absentees, who may be described as temporary drought-refugees. Despite the high birth-rate, the population (105·6 per sq m.) has actually fallen since 1900. Minerals and grapes, with oranges and esparto to a lesser extent, are the only significant exports. Only 40% of the area is cultivated; there are no large systems of irrigation; but some fruit-growing districts produce well, especially white Almería grapes of which 2,000,000 barrels are exported annually. The demand for packing material has a considerable effect on the cork trade of Andalusia, Estremadura and Catalonia. The livestock of the province was tragically diminished by a series of dry years before 1920, but is now recovering, sheep (330,000 in 1924) taking the lead. Almería is rich in minerals, especially iron and lead; gold, silver, salt, barium sulphate, white lead, sulphur and zinc are also obtained. Fine marble is quarried in the Sierra Nevada. Roads are poor, but railways serve the mining areas. The principal seaports are Almería, the capital, pop. (1920) 50,194, Adra (8,565), and Garrucha (4,416), which, with Berja (10,224), Cuevas de Vera (20,403), Huércal-Overa (15,982) and Níjar (10,809), are described in separate articles. Education is backward, 66 % of the population being illiterate (1920), and the standard of comfort low. In the districts of Cuevas de Vera, Sorbas and Berja there are numerous groups of caves used as habitations.

ALMERÍA, capital of the province of that name, was the ancient Urci (or Portus Magnus), one of the chief harbours of Spain under the Romans after 19 B C. Under the Muslims it was a great arsenal (al meriya—the watch-tower and harbour). After the fall of the Umaiyads it became the head of a small independent state and then (1288–1489) a petty kingdom dependent on Granada. The dismantled Castillo de San Cristóbal with four Moorish towers overlooks the city which stands at the mouth of a rich alluvial valley enclosed by hills. It is an episcopal see with a Gothic cathedral (1524), and the terminus of a railway from Madrid. Pop. (1920) 50,194. The harbour, sheltered and adapted for vessels of large draught, is equipped with oil-fuel depôts and all modern facilities. About 1,400 ships (c.1,000,000 tons) per annum bring fuel and timber and take away iron, lead, esparto, and fruit, especially white grapes.

See D. F. Margall, *Almería* (Barcelona, 1886).

ALMERY: *see* AMBRY.

ALMODÓVAR DEL CAMPO or **ALMODOVAR,** a town of Spain, province of Ciudad Real, north of the Sierra de Alcudia. Pop. (1920) 12,635. Almodóvar was a Muslim fortress in the middle ages (Ar. *al-mudawwar,* round). It owes its modern prosperity to the valuable Puertollano coal-field, 3 m. to the south by a branch of the Madrid-Badajoz-Lisbon railway. At Horcajo (1½ m.) and elsewhere in the vicinity are mines of argentiferous lead. South of the Sierra lies the Alcudia valley, crown-owned pasture for immense sheep flocks.

ALMOGÁVARES (from the Arab. *Al-Mugavari*, a scout), the name of a class of Spanish soldiers who came originally from the Pyrenees, and were in later times recruited mainly in Navarre, Aragon and Catalonia. They were frontiersmen and professional foot-soldiers who wore no armour, dressed in skins, were shod with brogues (*abarcas*), and carried the same arms as the Roman legionaries—two heavy javelins (Spanish *azagaya*, the Roman pilum), a short stabbing sword and a shield. When Peter III. of Aragon made war on Charles of Anjou after the Sicilian Vespers —March 30, 1282—for the possession of Naples and Sicily, the Almogávares formed the most effective element of his army. When the Peace of Calatabellota in 1302 ended the war in southern Italy, the Almogávares followed Roger di Flor (Roger Blum) the unfrocked Templar, who entered the service of the emperor of the East, Andronicus, as *condottieri* to fight against the Turks. When Roger di Flor was assassinated by his Greek employer in 1305, they turned on the emperor, held Gallipoli and ravaged the neighbourhood of Constantinople. In 1310 they marched against the duke of Athens, of the French house of Brienne. Walter of Brienne was defeated and slain by them with all his knights at the battle of Cephissus, or Orchomenus, in Boeotia in March. The foundation of the Aragonese duchy of Athens was the culmination of the achievements of the Almogávares. In the 16th century the name died out. It was, however, revived for a short time as a party nickname in the civil wars of the reign of Ferdinand VII.

See Ramon de Muntaner's *Chronicle* (Eng. trans. Lady Goodenough, 1920); G. Schlumberger, *Expédition des "Almugávares" ou routiers catalans en orient, de l'an 1302 à l'an 1311* (1902).

ALMOHADES (properly *Muwāḥḥadis, i.e.*, "Unitarians"), a Mohammedan religious power which founded the fifth Moorish dynasty in the 12th century, and conquered all northern Africa as far as Egypt, together with Muslim Spain. It originated with Mohammed ibn Tūmart, a member of the Maṣmūda, a Berber tribe of the Atlas. Ibn Tūmart was the son of a lamplighter in a mosque and had been noted for his piety from his youth; he was small, ugly and misshapen and lived the life of a devotee-beggar. He represented a revolt against the anthropomorphism of commonplace Mohammedan orthodoxy, but he was a rigid predestinarian and a strict observer of the law. After his return from Mecca and Baghdad to Morocco at the age of 28, he began preaching and agitating, heading riotous attacks on wine-shops and on other manifestations of laxity. He even went so far as to assault the sister of the Murābti (Almoravide) amir 'Ali III, in the streets of Fez, because she was going about unveiled after the manner of Berber women. 'Ali, who was very deferential to any exhibition of piety, allowed him to escape unpunished

Ibn Tūmart, who had been driven from several other towns for exhibitions of reforming zeal, now took refuge among his own people, the Masmūda, in the Atlas It is highly probable that his influence would not have outlived him, if he had not found a lieutenant in 'Abd-el-Mūmin el Kūmi, another Berber, from Algeria, who was undoubtedly a soldier and statesman of a high order. When Ibn Tūmart died in 1128, 'Abd-el-Mūmin not only rooted out the Murābṭis, but extended his power over all northern Africa as far as Egypt, becoming amir of Morocco in 1149 He died in 1163, and in 1170 the Muwāḥḥadis transferred their capital to Seville, a step followed by the founding of the great mosque, now superseded by the cathedral, the tower of which they erected in 1184 to mark the accession of Ya'kūb el Manṣūr. From the time of Yūsef II., however, their amirs crossed the straits only to lead a *jehad* against the Christians and to return to their capital, Marrākesh.

The Muwāḥḥadi princes had a longer and a more distinguished career than the Murābṭis or "Almoravides" (*q.v.*). Yūsef II. or "Abu Ya'ḳub" (1163–84), and Ya'ḳub I. or "El Manṣūr" (1184–99), the successors of Abd-el-Mūmin, were both able men. They were fanatical, and their tyranny drove numbers of their Jewish and Christian subjects to take refuge in the growing Christian States of Portugal, Castile and Aragon. But in the end they became less fanatical than the Murābṭis, and Ya'kūb el Manṣūr was a highly accomplished man, who wrote a good Arabic style and protected the philosopher Averroes. His title of El Manṣūr, "The Victorious," was earned by the defeat he inflicted on Alphonso VIII. of Castile at Alarcos in 1195. In 1212 Mohammed III., "En-Nāṣir" (1199–1214), the successor of El Manṣūr, was utterly defeated by the allied five Christian princes of Spain, Navarre and Portugal, at Las Navas de Tolosa in the Sierra Morena.

The amirs of the Muwāḥḥadi Dynasty were as follows: 'Abd-el-Mūmin (1145); Yūsef II., "Abu Ya'ḳūb" (1163); Ya'ḳūb I., "Abu Yūsef el Manṣūr" (1184); Mohammed III., "En-Nāṣir" (1199); Yūsef III, "Abu Ya'ḳub el Mustanṣir" (1214); 'Abd-el-Wāhid, "El Makhlūwi" (1223); 'Abd-Allah II., "Abu Mohammed" (1224); Yaḥya V., "El Mu'tāṣim" (1226); Idrīs III., "El Māmūn" (1229); Rashīd I., "'Abd-el-Wāhid II." (1232); 'Ali IV., "Es-Sa'id el Mu tadīd" (1242); Omar I., "El Mortaḍa" (1248); Idrīs IV, "El Wāthik" (1266–69). (B. M.; D. H.)

ALMON, JOHN (1737–1805), English political pamphleteer and publisher, was born at Liverpool on Dec. 17, 1737, and died on Dec. 12, 1805 He came to London in 1758 at a time when the Whig opposition, hampered and harassed by the Government to an extent that threatened the total suppression of independent opinion, needed a channel of publicity, which they found in Almon. He was already known by *The Conduct of a late Noble Commander* (Lord George Sackville); *Examined* (1759); a *Review of his late Majesty's Reign* (1760); *A Review of Mr. Pitt's Administration* (1761); and a number of letters on political subjects. The review of Pitt's administration secured for Almon the friendship of Earl Temple, to whom it was dedicated. In 1763 he opened a bookseller's shop in Piccadilly, chiefly for the publication and sale of political pamphlets. In 1765 the attorney-general moved to have him tried for the publication of the pamphlet entitled *Juries and Libels*, but the prosecution failed, and in 1770, for merely selling a copy of the *London Museum* containing Junius's celebrated "Letter to the King," he was sentenced by Lord Mansfield to pay a fine of ten marks and give security for his good behaviour. It was this trial that called forth the letter to Lord Mansfield, one of the bitterest of the Junius series. In 1774 Almon commenced the publication of his *Parliamentary Register*, a monthly report of the debates in Parliament, and he also issued an abstract of the debates from 1742, when Richard Chandler's *Reports* ceased, to 1774. He became proprietor in 1784 of the *General Advertiser*, in the management of which he lost his fortune and was declared insolvent. To these calamities was added an imprisonment for libel. Almon had to leave the country, but after some years in France he returned and resumed business, publishing among other works an edition of Junius. His last publication was an edition of Wilkes's correspondence, with a memoir (1805).

ALMOND. The almond is the fruit of *Prunus Amygdalus* a plant belonging to the tribe Pruneae of the family Rosaceae. It used to be placed in a separate genus *Amygdalus*, the distinction lying in the fruit, the soft pulp attached to the stone in the plum being replaced by a leathery separable coat in the almond. The tree appears to be a native of western Asia, Barbary and Morocco; but it has been extensively distributed over the warm-temperate region of the Old World. It ripens its fruit in the south of England. It is a tree of moderate size; the leaves are lanceolate, and serrated at the edges; and it flowers early in spring. The fruit is a drupe, having a downy outer coat, called the epicarp, which encloses the reticulated hard stony shell or endocarp. The seed is the kernel which is contained within these coverings. The shell-almonds of trade consist of the endocarps enclosing the seeds. The tree grows in Syria and Palestine; and is referred to in the Bible under the name of *Shaked*, meaning "hasten." The word Luz, which occurs in Genesis xxx. 37, and which has been translated hazel, is supposed to be another name for the almond. In Palestine the tree flowers in January, and this hastening of the period of flowering seems to be alluded to in Jeremiah i. 11, 12, where the Lord asks the prophet, "What seest thou?" and he replies, "The rod of an almond-tree"; and the Lord says, "Thou hast well seen, for I will hasten my word to perform it." The application of *Shaked* or hasten to the almond is similar to the use of the name "May" for the hawthorn, which usually flowers in that month in Britain. The rod of Aaron, mentioned in Numbers xvii, was taken

from an almond-tree; and the Jews still carry rods of almond-blossom to the synagogues on great festival days. The fruit of the almond supplied a model for certain kinds of ornamental carved work (Exodus xxv. 33, 34; xxxvii. 19, 20).

There are two forms of the plant, the one (with pink flowers) producing sweet, the other (with white flowers) bitter almonds. The kernel of the former contains a fixed oil and emulsin. It is used internally in medicine, and must not be adulterated with the bitter almond.

The bitter almond is rather broader and shorter than the sweet almond and has a bitter taste. It contains about 50% of the fixed oil which also occurs in sweet almonds. It also contains a ferment *emulsin* which, in the presence of water, acts on a soluble glucoside, *amygdalin,* yielding glucose, prussic acid and the essential oil of bitter almonds or benzaldehyde (*q.v.*), which is not used in medicine. Bitter almonds may yield from 6 to 8% of prussic acid.

Cultivation of sweet almonds has been established in climatically suitable districts in the United States, chiefly on the Pacific coast. According to the census of 1920, the total commercial crop exceeded 15,850,000 lb , of which 99% was produced in California.

Recipes.—Below are given certain commonly needed almond recipes.—

Almond Cake.—A standard recipe for this is: Beat 6 oz. of warmed castor sugar into four eggs until the mixture is the thickness of cream. Add 3 oz. melted butter, mix in ½ oz. pounded almonds (bitter), 1 lb. sifted flour, and essence of lemon to taste. Place the mixture in a greased mould and bake 1½–2 hours in a steady oven Beware of burning.

Almond Paste.—A standard recipe for this is: Bring to the boil 6 oz of loaf sugar with a teaspoonful of lemon juice; skim and boil to 237° F. Pour the syrup on to 4 oz ground almonds, mix in the white of half an egg and use as required The traditional cook's method of ascertaining when the sugar has reached the proper temperature is called small balls, because the sugar, when a portion is removed by the forefinger into cold water, can be rolled into a small ball.

Almonds, Salted.—To salt blanched almonds, fry them till brown in olive oil, drain and roll or toss them in a mixture of celery salt (⅞ths) and cayenne pepper (⅛th).

ALMOND OIL, the fixed oil termed in the British Pharmacopoeia *Oleum amygdalae,* is obtained from the ground blanched kernels of the fruit of the almond, either by expression or by extraction with a volatile solvent; the latter process is used in the case of damaged seeds where the residual meal is valueless. The commercial oil is prepared from the kernels of the bitter almond (*Prunus amygdalus,* var. *amara*), or from a mixture of these and the seeds of the sweet variety. Yield from sweet almonds ranges from 44%–55%; the bitter variety averages 35%–45% of oil.

The expressed oil is pale yellow in colour and possesses a bland, nutty flavour; the extracted oil is darker and has a harsh taste. Almond oil is used in pharmacy as a vehicle for drugs, and is employed in the preparation of cosmetics. Its scarcity leads to extensive sophistication, the usual adulterants being apricot, plum and peach kernel oils, which closely resemble almond oil.

Oleum amygdalae amarae (*essentiale*), "ethereal bitter almond oil," is produced by trituration of the oil-free meal of bitter almonds with water. The natural ferment *emulsin* acting on the glucoside *amygdalin* also present in the seed produces a mixture of glucose, benzaldehyde and prussic acid. The distilled product contains up to 5% prussic acid, which is removed by treatment with lime and iron sulphate when the essence is required for flavouring purposes.

BIBLIOGRAPHY.—*See* Lewkowitsch, *Oils, Fats, and Waxes* (1921); *British Pharmacopoeia; U.S. Pharmacopoeia.* (E. L.; G. H. W.)

ALMONER, an officer charged with the distribution of alms, primarily for a religious house or bishop (from Lat. *eleemosynarius,* through M. Lat. *almonarius* and Fr. *almosnier*). Almoners attached to the French court appear early, but the title of grand almoner of France first appears in 1486. The office, which acquired great importance through its control of preferments, was revived by Napoleon I. and again by Napoleon III., but was abolished in 1870. In England the offices of hereditary grand almoner (a sinecure held by the marquess of Exeter), and lord high almoner still exist. The latter, usually a bishop or other prelate, distributes the royal alms of silver pennies on Maundy Thursday (*q v.*).

ALMONRY, the name for the place where alms were distributed to the poor in churches or other ecclesiastical buildings. At Bishopstone church (Wilts.), it is a sort of covered porch attached to the south transept, but not communicating with the interior of the church At Worcester cathedral the alms are said to have been distributed on stone tables, on each side, within the great porch. In large monastic establishments, as at Westminster, it seems to have been a separate building of some importance, either joining the gatehouse or near it.

ALMORA, a town and district of British India, the chief town and administrative headquarters of the Kumaon division of the United Provinces, situated on a mountain ridge of the Himalayas 5,494ft. above the sea. Pop (1921), 8,359 The town has a college called after Sir Henry Ramsay, several schools and a large cantonment. The climate is supposed to be particularly kindly to sufferers from lung trouble. The town was captured in 1790 by the Gurkhas, who constructed a fort on the eastern extremity of the ridge. Another citadel, Ft. Moira, is situated at the other end of the ridge. Almora is also celebrated as the scene of the British victory which terminated the war with Nepal in 1815.

The district of Almora was constituted in 1891, together with Naini Tal, by a redistribution of the two former districts of Kumaon and the Tarai It lies among the mountains of Kumaon between the upper waters of the Ganges and the Gogra, here called the Kali. Area, 5,389sq m ; pop. (1921), 530,338. Tea is grown in the district, which includes the military sanatorium of Ranikhet

ALMORAVIDES (properly *Murābtis, ie,* "religious ascetics"), a Berber horde from the Sahara which, in the 11th century, founded the fourth dynasty in Morocco The most powerful of the invading tribes was the Lamtūna ("veiled men") from the upper Niger, whose best-known representatives now are the Tuareg

They had been converted to Mohammedanism in the early times of the Arab conquest, but their knowledge of Islam did not go much beyond the formula of the creed—"there is no god but God, and Mohammed is the apostle of God,"—and they were ignorant of the law Their first military leader, Yaḥya ibn Omar, gave them a good military organization. Their main force was infantry, armed with javelins in the front ranks and pikes behind, formed into a phalanx and supported by camelmen and horsemen on the flanks From the year 1053 the Murābtis began to impose their orthodox and puritanical religion on the Berber tribes of the desert, and on the pagan negroes Yahya was killed in battle in 1056, but Abd-Allah, whose influence as a religious teacher was paramount, named his brother Abu Bakr as chief. In 1061 Abu Bakr made a division of the power he had established, handing over the more settled parts to his cousin Yūsef ibn Tashfīn, as viceroy, resigning to him also his favourite wife Zaināb, who had the reputation of a sorceress.

Ibn Tashfīn, who was largely guided by Zaïnāb, had in the meantime brought what is now known as Morocco to complete subjection, and in 1062 had founded the city of Marrākesh ("Morocco City"). He is distinguished as Yūsef I. In 1080 he conquered the kingdom of Tlemçen and founded the present city of that name, his rule extending as far east as Oran In 1086 he was invited by the Mohammedan princes in Spain to defend them against Alphonso VI., king of Castile and Leon In that year Yūsef passed the straits to Algeciras, and on Oct. 23 inflicted a severe defeat on the Christians at Sacralias, or in Arabic, Zallāka, near Badajoz. He was debarred from following up his victory by trouble in Africa which he had to settle in person. When he returned to Spain in 1090 it was avowedly for the purpose of deposing the Mohammedan princes and annexing their states. By 1094 he had removed them all, and though he regained little from the Christians except Valencia, he reunited the Mohammedan power and gave a check to the reconquest of the country by the

Christians. After friendly correspondence with the caliph at Baghdad, whom he acknowledged as Amīr el Mūminīn, "Prince of the Faithful," Yūsef in 1097 assumed the title of "Prince of the Resigned"—Amīr el Muslimīn. He died in 1106, when he was reputed to have reached the age of 100.

The Murābti power was at its height at Yūsef's death, and the Moorish empire then included all north-west Africa as far as Algiers, and all Spain south of the Tagus, with the east coast as far as the mouth of the Ebro, and the Balearic islands. Three years afterwards, under Yūsef's son and successor, 'Ali III. of Morocco, Madrid, Lisbon and Oporto were added, and Spain was again invaded in 1119 and 1121, but the tide had turned, and the conquest of the city of Marrākesh by the Muwāḥhadis in 1147 marked the fall of the dynasty, though fragments of the Murābṭis continued to struggle in the Balearic islands, and finally in Tunisia.

The amirs of the Murābti dynasty were as follows.—Yūsef I., bin Tashfīn (1061); 'Ali III. (1106); Tashfīn I. (1143); Ibrāhim II. (1145); Isḥāk (1146).

See the anonymous *Raōḍ el Karṭās* (Fez, 1326), translated by Baymier as *Roudh el-Kartas* (Paris, 1860); Ibn Khaldūn, *Kitāb el 'Aibr . . . fi Aīyām el Maghrib, etc.* (*c* 1405), partly translated by de Slane as *Histoire des Berbers*, vol. ii. (Algiers, 1852–56); Makkāri, *History of the Mahommedan Dynasties in Spain*, translated by Gayangos (London, 1840); R. Dozy, *Histoire des Mussulmans d'Espagne*, vol. iv. (Leyden, 1861); B. Meakin, *The Moorish Empire* (1899). (B. M., D. H)

ALMQVIST, KARL JONAS LUDWIG (1793–1866), Swedish writer, was born at Stockholm in 1793. He became a student at Uppsala, where his father was professor of theology, in 1808, and took his degree in 1815. In 1823 he threw up the position he held in the capital to lead a colony of friends to the wilds of Wermland. The experiment was a failure, and in 1828 he returned to Stockholm as a teacher in the new elementary school there, of which he became rector in 1829.

The publication of his great series of novels, *The Book of the Thorn-Rose* (1832–35), made him famous, and few writers have equalled Almqvist in productiveness and versatility. Poems, romances, lectures and treatises on many subjects form the most prominent of his countless contributions to modern Swedish literature; and, so excellent was his style, that in this respect he has been considered the first of Swedish writers. His life was as varied as his work. Unstable in all his doings, he passed from one lucrative post to another, at last subsisting entirely on the proceeds of literary labour. More and more vehemently he espoused the cause of socialism in his brilliant novels and pamphlets; friends were beginning to leave him, when suddenly all minor criticism was silenced by the astounding news that Almqvist, convicted of forgery and charged with murder, had fled from Sweden (1851).

For many years no more was heard of him; but it is now known that he went over to America and settled in St. Louis. During a journey through Texas he was robbed of all his manuscripts, among which are believed to have been several unprinted novels. He is said to have appealed in person to President Lincoln, but the robbers could not be traced. In 1865 he returned to Europe, and his strange existence came to a close at Bremen on Sept. 26, 1866. It is by his romances that his literary fame will mainly be supported; but his singular history will always point him out as a remarkable figure, even when his works are no longer read. He was another Eugene Aram, but of greater genius, and so far more successful that he escaped the judicial penalty of his crime.

See his *Samlade Skrifter* (ed. F. Böök, Stockholm, 1920–23).

ALMS, the giving of relief, and the relief given, whether in goods or money, to the poor, particularly applied to the charity bestowed under a sense of religious obligation. Like "riches" the word is often wrongly treated as a plural. (*See* CHARITY.)

ALMSHOUSE, a building for the residence of poor or aged people. In England the term is generally used of those built and endowed by private charity and frequently better treatment is given to the inmates than in the publicly supported workhouses. In America the term is synonymous with "poorhouse" (workhouse). An interesting mediaeval example is the Hospital of St. Cross, near Winchester, founded 1136.

ALMUCE, a hooded cape of fur, or fur lined, worn as a choir vestment by certain dignitaries of the Western Church (late Lat. *almucia, almucium, armucia,* etc.). It was originally a head covering only, and the German word *Mütze,* "cap," is derived from it. The name of another vestment akin to the almuce —the *mozzetta*—has been by some traced to the word *mutzen,* to dock, cut off, through the Ital. *mozzare* and *mozzo* (but *see* below).

In numerous documents from the 12th to the 15th century the *almucium* is mentioned, occasionally as identical with the hood, but more often as a sort of cap distinct from it; *e.g.,* in the decrees of the council of Sens (1485)—*non caputia, sed almucia vel bireta tenentes in capite.* In the late 13th century two types of *almucium* were distinguished: (1) a cap coming down just over the ears; (2) a hood-like cap falling over the back and shoulders. This latter was reserved for the more important canons, and was worn over surplice or rochet in choir The introduction of the biretta (*q.v.*) in the 15th century tended to replace the use of the almuce as a head covering, and the hood now became smaller, while the cape was enlarged till, in some cases, it fell below the elbows. Almuces were occasionally made of silk or wool, but from the 13th century onward usually of fur, the hem being sometimes fringed with tails. Hence they were known in England as "grey amices" (from the ordinary colour of fur), to distinguish them from the liturgical amice (*q.v.*). By the 16th century the almuce had become definitely established as the distinctive choir vestment of canons; but it had ceased to have any practical use, and was often only carried over the left arm as a symbol of office. It has now been almost entirely superseded by the mozzetta, but is still worn in certain cathedrals. The "grey amice" of the canons of St. Paul's in London was put down in 1549, the academic hood being substituted.

See du Cange, *Glossarium, s.* "Almucia"; Joseph Braun, *Die liturgische Gewandung,* p. 355, etc. (Freiburg im Breisgau, 1907); also the bibliography to the article VESTMENTS.

ALNAGE or **AULNAGE,** the official supervision of the shape and quality of manufactured woollen cloth, the derivation being from Fr. *aune,* ell. It was first ordered in the reign of Richard I. that "woollen cloths, wherever they are made, shall be of the same width, to wit, of two ells within the lists, and of the same goodness in the middle and sides." This ordinance is usually known as the Assize of Measures or the Assize of Cloth. Article 35 of Magna Charta re-enacted the Assize of Cloth, and in the reign of Edward I. an official called an "alnager" was appointed to enforce it. His duty was to measure each piece of cloth, and to affix a stamp to show that it was of the necessary size and quality. As, however, the diversity of the wool and the importation of cloths of various sizes from abroad made it impossible to maintain any specific standard of width, the rules as to size were repealed in 1353.

The increased growth of the woollen trade and the introduction of new and lighter drapery in the reign of Queen Elizabeth compelled a revision of the old standards. A statute was passed in 1665 creating the office of alnager of the new drapery and defining the sizes to which cloth should be woven. The objects of the statute were to prevent people being deceived by buying spurious woollen cloth and to provide against fraud and imposition. Alnage duties and the office of alnager were abolished in 1699.

See W. J. Ashley, *Economic History;* and W. Cunningham, *Growth of English Industry and Commerce.*

ALNWICK, urban district and county-town of Northumberland, England, 309 m. N. by W. from London, on a branch of the L N E.R.; Pop. of urban district (1921) 6,988. It is beautifully situated on the small river Aln, in a hilly district near the sea. Dominating the town from above the south bank of the river stands the castle, held by the Percys since 1309, and long before this an important border stronghold. A gateway of *c.* 1350 and a fine Norman arch of the middle of the 12th century are among noteworthy ancient portions. The castle has been extensively renovated and has largely lost its historic character. The town evidently grew up round the castle, and tradition states that it received its borough charter from King John,

but it is first definitely mentioned as a borough in a charter given by William de Vescy in the reign of Henry II. According to an inquiry of 1291 a market and fair were held in Alnwick from time immemorial. Edward I., in addition, granted the bishop of Durham a market on Saturday, and a fair on March 17 and six following days. By charters of Henry VI. the burgesses received licence to enclose their town with a wall, to have a free port at Alnmouth, a market on Wednesday as well as Saturday, and two new fairs. Tanning and weaving were formerly the principal industries carried on in Alnwick, and in 1646 there were 22 tanneries there.

Remains of the town wall are visible, and one of the four gates, the Bondgate, stands, dating from the early part of the 15th century. The church of St. Michael has Norman remains, but is principally Perpendicular. Within the confines of the park are ruins of two abbeys. Alnwick Abbey was a Premonstratensian foundation of 1147; only a gateway tower stands. Three miles from the town are more extensive remains of Hulne Abbey (1240), an early Carmelite monastery. The long narrow church remains unroofed; there are also a gateway tower, and portions of the chapter-house and cloisters. The Norman chapel of the hospital of St. Leonard, and Alnwick Abbey, were founded by Eustace FitzJohn. Howick mansion, built in the 18th century, has a fine situation near the coast to the north-east Not far away are the ruins of Dunstanborough Castle; it dates from the 14th century, though the site was probably occupied as a stronghold from earlier times.

The chief industries are brewing, tobacco, and fishing-tackle making. Alnwick is under an urban district council, but is a borough by prescription, and its freemen form a body corporate without authority over the affairs of the town.

ALOE, a genus of plants belonging to the family Liliaceae, with about 180 species growing in the dry parts of Africa, especially Cape Colony, and in the mountains of tropical Africa. Members of the closely allied genera *Gasteria* and *Haworthia,* with a similar mode of growth, are also cultivated and popularly known as aloes. The plants are apparently stemless, bearing a rosette of large, thick, fleshy leaves, or have a shorter or longer (sometimes branched) stem, along which, or towards the end of which and its branches, the generally fleshy leaves are borne. They are much cultivated as ornamental plants, especially in public buildings and gardens, for their stiff, rugged habit The leaves are generally lance-shaped with a sharp apex and a spiny margin; but vary in colour from grey to bright green, and are sometimes striped or mottled The rather small tubular yellow or red flowers are borne on simple or branched leafless stems, and are generally densely clustered. The juice of the leaves of certain species yields aloes. In some cases, as in *Aloe venenosa,* the juice is poisonous. The American aloe, *Agave americana* (*see* AGAVE), belongs to a different family, viz., Amaryllidaceae.

Aloes is a medicinal substance used as a purgative and produced from various species of aloe, such as *A. vera, vulgaris, socotrina, chinensis,* and *Perryi.* Several kinds of aloes are distinguished in commerce—Barbadoes, Socotrine, hepatic, Indian, and Cape aloes. The first two are those commonly used for medicinal purposes. Aloes is the expressed juice of the leaves of the plant. When the leaves are cut the juice flows out, and is collected and evaporated. From the juice active principles termed *aloins* are extracted by water.

The *lign-aloes* is quite different from the medicinal aloes. The word is used in the Bible (Numb. xxiv. 6), but as the trees usually supposed to be meant by this word are not native in Syria, it has been suggested that the LXX. reading in which the word does not occur is to be preferred. Lign-aloe is a corruption of the Lat. *lignum-aloe,* a wood, not a resin. Dioscorides refers to it as *agallochon,* a wood brought from Arabia or India, which was odoriferous but with an astringent and bitter taste. This may be *Aquilaria Agallocha,* a native of East India and China, which supplies the so-called eagle-wood or aloes-wood, which contains much resin and oil.

ALOIDAE (ăl″o-ī′dē), or **ALOADAE;** *i.e.,* Otus and Ephialtes, in ancient Greek legend, the twin sons of Aloeus or Poseidon, celebrated for their extraordinary stature and strength. According to Homer (*Od*, xi 305), they made war upon the Olympian gods and endeavoured to pile Pelion upon Ossa in order to storm heaven itself, but Apollo destroyed them before they reached manhood. In the *Iliad* (v. 365) Ares is imprisoned by them, but delivered by Hermes. They sought Artemis and Hera in marriage, whereupon Artemis appeared between them in the shape of a stag, which they endeavoured to kill, but slew each other. The Aloidae (Gr. *alōē*=threshing-floor) represent the spirits of the fertile earth and agriculture

ALOMPRA, ALOUNG P'HOURA (1711–60), founder of the last Burmese dynasty, was chief of the village of Mōtshobo; near Ava. Burma was at that time under the rule of Pegu. Alompra raised a small force of men, seized Ava in 1753, and gradually ousted the Peguans and made himself master of the country. For the wars which followed, in which Alompra invaded and subdued Pegu, *see* BURMA. He was undertaking the subjugation of Siam when he was taken ill, and died on May 15 1760 Alompra had undoubted military genius and a measure of political sagacity, and he sought to improve the administration of justice His cruelty and deceitfulness were faults common to the oriental potentates of his time.

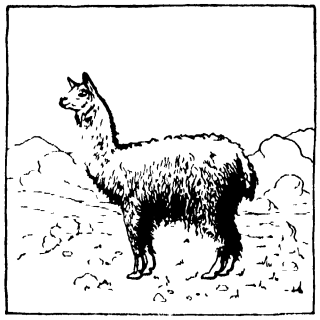
ÁLORA, a town of Málaga, southern Spain. Pop. (1920) 11,458. Álora, an ancient and picturesque town (Rom. *Iluro*) stands at the foot of the *Hacho,* one of a series of table-lands along the line of the structural depression followed by the river Guadalhorce. The fertile *vega* irrigated from this river, and renowned for oranges, lemons and other fruits, is the uppermost part of the semi-circular *Hoya de Málaga,* which descends from the defile *El Chorro* to the coast near Málaga There are hot sulphur springs in the town. Brandy distilling is, after agriculture, the chief local industry.

ALOST (Flem. *Aalst*), Belgium, province of East Flanders, on the left bank of the Dender; the ancient capital of "Imperial Flanders." Pop. (1925) 36,541. In the feudal period when Flanders was a fief of the king of France, there was a small strip extending from Alost to the isles of Zeeland, called Imperial Flanders, the count of which was the vassal of the Holy Roman emperor The *hôtel de ville* has a fine 15th century belfry, damaged by fire in 1879. In the church of St Martin, dating from 1498 but unfinished, is a fine Rubens, "St. Roch," said to have been painted in eight days At Alost, Thierry Maartens (*c.* 1474) set up one of the first printing presses in Europe. The town is famous to-day for its hop gardens and linen-bleaching industry.

ALOYSIA: *see* VERBENA.

ALP, a term applied to the summer pastures of the Alps situated just below the snow-line, freed from snow each spring. Such mountain pastures are of great antiquity, being mentioned as early as the 8th century, and are found in all parts of the Alpine chain. In German Switzerland, particularly, the alps are the centre round which the pastoral life of the inhabitants turns. The *Alpgemeinden,* as the Swiss Alpine communes are called, are composed of the persons who have a right to send cattle up to the alps in summer, this right being attached either to certain plots of ground in the valley or certain houses in the village, or to certain persons. In any case the owners of an alp fix the greatest number of cows which it can support during the summer without being permanently damaged. A plot of ground which can support a single cow (or two heifers, three calves or sheep, four pigs or eight goats) is called a *Kuhstoss.* On each alp there are several sets of huts at different levels for the cow-herds and cheese-makers, the cattle being generally left in the open. These sets of huts, properly called *châlets* or *Sennhütten*—though the former term is also applied to houses in the village below—are used in turn between the end of June and the end of September. The cheese and butter are stored in huts and carried down to the village at the end of the season. Hay is never mown on the true alps save in spots which are not easily accessible to cattle, but it is made on the *Voralpen,* the lowest pastures, situated between the homesteads and the true alps; these *Voralpen* are individual (not communal) property and are grazed, to some extent, during the late spring and early autumn.

ALPACA, one of the two domesticated breeds of S. American camel-like artiodactyls, derived from the wild guanaco (*q.v.*). Alpacas are kept in flocks on the level heights of the Andes in Chile, Peru and Bolivia, at an elevation of 14,000 to 16,000 ft. above the sea. In appearance the animal resembles a sheep, except for the long head and neck, carried erect. It is kept mainly for the sake of its wool, though the flesh is quite palatable. The alpaca is sheared yearly, the fleece consisting of thick woolly hair, about 8 in. of which is removed from the total length of 2 feet. In colour it is mainly black or dark brown, but lighter hues occur. The fibre is elastic, silky, lustrous and strong, and was used by the Peruvian Indians centuries before its introduction into Europe. It was due to the sagacity of Sir Titus Salt (*q.v.*) that the manufacture of alpaca cloth was successfully started in 1836 At the present day, however, most of the alpaca cloth of commerce is made from mohair and other types of fibre. (*See* also Wool.) Scientifically, the alpaca is *Lama huanaco* var. *paca.* (*See* Guanaco; Llama; Vicuña.)



BY COURTESY OF N Y ZOOLOGICAL SOCIETY

THE ALPACA, A DOMESTICATED ANIMAL BRED BY NATIVES OF THE ANDES FOR ITS VALUABLE WOOL

The four species of indigenous South American fibre bearing animals are the llama, the alpaca, the guanaco and the vicuña. These are all of the camel class, without humps but having the "water stomach." The llama, of which there are 700,000, and the alpaca, of which there are 1,500,000, are domesticated; the guanaco and the vicuña run wild. Of the four the alpaca and the vicuña are the most valuable fibre-bearing animals: the alpaca on account of the lustre and quantity, the vicuña on account of the softness, fineness and quality of its fibre. The usual length of alpaca staples appears to be about 12in., this being a three years' growth; but the length may be little more than about half this, *i.e.*, a one to two years' growth, shearing being in part dependent upon the demand for and price of the fibre. The fleeces are sorted for colour and quality by skilled native women. The colour of the greater proportion of alpaca imported into the British Isles is black and brown, but there is also a fair proportion of white, grey and fawn. It is customary to mix these colours together, thus producing a curious ginger-coloured yarn, which upon being dyed black in the piece takes a fuller and deeper shade than can be obtained by piece-dyeing a solid white wool In physical structure alpaca is akin to both hair and wool, having scales and some fibres medullated. It is probably a mixture of an outer and under fibre-coat. It is very glossy, and its softness and fineness enable the spinner to produce satisfactory yarns with comparative ease.

Alpaca Industry.—Alpaca is a name given to two distinct things. It is primarily a term applied to the fibre obtained from the alpaca. It is, however, more broadly applied to a style of fabric originally made from the alpaca fibre but now frequently made from allied types of fibres, viz., mohair, Iceland or even from lustrous English wool. In the trade, distinctions are made between alpacas and the several styles of mohairs and lustres, but so far as the general purchaser is concerned little or no distinction is made.

The Romance of Alpaca.—The history of the manufacture of this fibre into cloth is one of the romances of commerce. Undoubtedly the Indians of Peru employed it in the manufacture of many styles of fabrics for centuries before its introduction into Europe as a commercial product. The first European importations would naturally be into Spain. Spain, however, transferred the fibre to Germany and France. Apparently alpaca yarn was spun in England for the first time about the year 1808. It does not appear to have made any headway, however, and alpaca was condemned as an unworkable material. In 1830 Benjamin Outram, of Greetland, near Halifax, appears to have attempted again the spinning of this fibre, and for the second time alpaca was condemned. These two attempts to use alpaca were failures owing to the style of fabric into which the yarn was woven—a species of camlet. It was not until the introduction of cotton warps into the Bradford trade about 1836 that the true qualities of alpaca could be developed in the fabric. Where the cotton warp and mohair or alpaca weft plain-cloth (usually termed "Orleans") came from is not known, but it was this simple yet ingenious structure which enabled Titus Salt (*q.v.*), then a young Bradford manufacturer, to utilize alpaca successfully. Bradford is still the great spinning and manufacturing centre for alpacas, large quantities of yarns and cloths being exported annually to the Continent, to the United States, to South America and elsewhere, although the quantities naturally vary in accordance with the fashions in vogue. The typical "alpaca-fabric" was originally a very characteristic "dress-fabric" but to-day the fibre is chiefly used for linings.

Owing to the success in the manufacture of the various styles of alpaca cloths attained by Sir Titus Salt and other Bradford manufacturers, a great demand for alpaca arose, and this could not be met by the native product, for there never seems to have been any appreciable increase in the number of alpacas available. Unsuccessful attempts have been made to acclimatize the alpaca in England, on the European continent and in Australia, and even to cross certain English breeds of sheep with the alpaca. There is, however, a cross between the alpaca and the llama, termed the "paco-vicuña," (whether a true hybrid is not yet known) producing a material placed upon the Liverpool market under the name "Huarizo." Crosses between the alpaca and vicuña produce a fibre practically equal to the vicuña fibre in softness and fineness, and it is hoped that further attempts will be made to develop this cross. It is often suggested that the wild huanaco crosses with the alpaca; but this is still doubtful, although such supposed crosses are exhibited at shows in Peru The preparing, combing, spinning, weaving and finishing of alpacas and mohairs are dealt with under Wool. (A. F. B.)

The following statistics, taken from the Bradford Chamber of Commerce *Statistics of the Woollen and Worsted Trades of the United Kingdom,* give an idea of the extent of the trade in yarns and fabrics of the alpaca type; unfortunately statistics for alpaca alone are not published.

Alpaca, Vicuña and Llama Wool imported into the British Isles

Year.	Peru.		Chile.*	
	lb.	£	lb.	£
1870 .	3,324,454	388,969	563,782	65,996
1890 .	3,114,336	190,703	564,606	30,694
1900 .	4,236,566	205,839	1,148,694	51,116
1910 . .	5,429,408	299,353	429,270	24,481
1913 .	5,432,400	288,951	338,900	19,477
1920 .	3,564,600	456,496	271,900	33,019
1925	4,817,900	343,610	552,300	38,977
1926 .	4,673,900	266,477	423,700	21,755

*Grown in Peru or Bolivia, but shipped from Valparaiso.

Exports of Mohair and Alpaca (including Cashmere) Yarns for 1926

	lb.	£
Germany	3,241,900	663,065
Belgium	101,100	21,221
France	636,600	162,016
Other Countries	2,356,000	524,081

Exports of Alpaca, Vicuña and Llama from the British Isles

1923 . . .	£ 97,056	1925 . .	£152,752
1924 . . .	151,183	1926 . .	138,024

ALP ARSLAN, or **AXAN, MOHAMMED BEN DA'UD** (1029–72), the second sultan of the dynasty of Seljuk, in Persia, and great-grandson of Seljuk, the founder of the dynasty, was born in the year A.D. 1029 (421 of the Hegira). He assumed the name of Mohammed when he embraced the Muslim faith; and on account of his military prowess he obtained the surname *Alp Arslan,* which signifies "a valiant lion." He succeeded his father Da'ud as ruler of Khorassan in 1059, and his uncle Togrul Bey as sultan of Oran in 1063, and thus became sole monarch of Persia from the river Oxus to the Tigris. In consolidating his empire he was assisted by Nizām ul-Mulk, his

vizier. Peace and security being established in his dominions, he convoked an assembly of the States and declared his son Malik Shah his heir and successor.

With the hope of acquiring immense booty in the rich church of St. Basil in Caesarea, the capital of Cappadocia, he placed himself at the head of the Turkish cavalry, crossed the Euphrates and entered and plundered that city. He then subdued Armenia and Georgia, in 1064. In 1068 Alp Arslan invaded the Roman Empire. The emperor, Romanus Diogenes, assuming the command in person, met the invaders in Cilicia. In three arduous campaigns, the first two conducted by the emperor himself, the third by Manuel Comnenus, the Turks were defeated in detail and finally (1070) driven across the Euphrates. In 1071 Romanus again took the field and advanced with 100,000 men, including a contingent of the Turkish tribe of the Uzes and of the French and Normans, under Ursel of Baliol, into Armenia.

At Manzikert, on the Murad Tchai, north of Lake Van, he was met by Alp Arslan; and the sultan having proposed terms of peace, which were scornfully rejected by the emperor, a battle took place (1071) in which the Greeks, after severe losses, were totally routed, a result due mainly to the rapid tactics of the Turkish cavalry. Romanus was taken prisoner and conducted into the presence of Alp Arslan, who treated him with generosity, and terms of peace having been agreed to, dismissed him, loaded with presents and respectfully attended by a military guard. Alp Arslan now prepared to march to the conquest of Turkistan, the original seat of his ancestors. With a powerful army he advanced to the banks of the Araxes (Oxus). Before he could pass the river with safety it was necessary to subdue certain fortresses, one of which was for several days vigorously defended by the governor, Yussuf Kothual, a Kharizmian. He was, however, obliged to surrender and was carried a prisoner before the sultan, who condemned him to a cruel death. Yussuf, in desperation, drew his dagger and stabbed the sultan, who died within a few hours (Dec. 15, 1072).

See Gibbon, *Decline and Fall of the Roman Empire*, ed. by J. B. Bury (1898), vi. pp. 235 *et seq.*, and authorities there cited.

ALPENA, a city of Michigan, U S A, on Thunder bay, a small arm of Lake Huron, at the mouth of Thunder Bay river, the county seat of Alpena county. It is served by the Detroit and Mackinac and the Boyne City, Gaylord and Alpena railways, and by steamboats to Detroit and other ports. The population in 1920 was 11,101, of whom 2,506 were foreign-born whites The city is built on sandy ground on both sides of the river and has a good harbour, with a controlling depth of 16 feet. The navigation season is from April 3 to Dec. 20.

In 1925 the commerce of the port, chiefly in coal, cement, stone, and lumber amounted to 1,424,810 tons, valued at $6,521,313; and the output of the 28 factories, producing chiefly lumber, shingles, wood pulp, veneer, excelsior, brick, cement, leather and flour was valued at $8,696,299. The city has extensive fisheries, and is a summer and hunting resort. It occupies the site of an Indian burying-ground. A trading post was established here in 1835, a permanent settlement in 1858, and the city was chartered in 1871. It has a commission manager form of government.

ALPENHORN, ALPHORN, a musical instrument, consisting of a natural wooden horn of conical bore, having a cup-shaped mouthpiece, used by mountaineers in Switzerland and elsewhere. The well-known *Ranz des Vaches* is the traditional melody of the alpenhorn immortalized by Beethoven in the finale of the *Pastoral Symphony* where the music is generally rendered by a *cor anglais* (*q.v.*). Rossini also introduced the melody in his opera *William Tell.*

ALPES MARITIMES, department of south-east France, formed in 1860 out of the county of Nice, to which were added the districts of Grasse (formerly in the department of the Var) and of Mentone (purchased from the prince of Monaco). Pop. (1906) 334,007; (1926) 435,253. It is bounded north-east by Italy, south by the Mediterranean sea, and west by the departments of Var and Basses Alpes. Area, 1,444sq.m. It is composed mainly of the valleys of the Var and its affluents, the Tinée and the Vésubie. Most of the department is mountainous, Mont Tinibras at the head of the Tinée valley reaching nearly 10,000ft. The Italian frontier here is peculiar. The centre of the Roja valley is French; the upper and lower parts are Italian because they formed part of the county of Ventimiglia; the central section, part of the county of Nice, alone became French in 1860. It is thus impossible to have an Italian railway from Cuneo by the Col de Tenda and down the Roja valley direct to Ventimiglia. From near Isola in the upper Tinée valley southwards the political frontier is not the main Alpine watershed; the reason (it is said) is that in 1860 all the higher valleys of the Maritime Alps (on both sides of the watershed) were expressly excepted from the treaty of cession, in order that Victor Emmanuel II. might retain his right of chamois hunting in these parts. The department is divided into two arrondissements (Nice and Grasse), 28 cantons and 156 communes. It forms the bishopric of Nice (the first bishop certainly known is mentioned at the end of the 4th century), which till 1792 was in the ecclesiastical province of Embrun, then (1802) in that of Aix en Provence, next in that of Genoa (1814) and finally (1860) in that of Aix again. Its chief town is Nice. The broad-gauge railways in the department cover 56m., including the line along the coast, while there are also 82m. of narrow-gauge railways. The chief industries are the distilling of perfumes and manufacture of olive oil, of pottery and of tiles, besides a great commerce in cut flowers. To foreigners the department is best known for its winter resorts, Nice, Cannes, Mentone, Antibes and Beaulieu, while other important towns are Grasse and Puget Théniers.

ALPHA and **OMEGA** (A and Ω), the first and last letters of the Greek alphabet (Rev. i. 8, xxi. 6, xxii. 13). The Speaker never claims to combine in Himself all and every power. So in Rabbinic writers the word Emeth (Truth, אמת), which is composed of the first, middle and last letters of the Hebrew alphabet, is the seal of God.

ALPHABET. The name alphabet is derived from the names of the first two letters of the Greek alphabet, *alpha* and *beta,* and denotes a set of characters, or, as we call them, letters, each of which represents a given sound or sounds. This representation is necessarily rough and of quite a general character. This is easily seen in the case of the first letter of the English alphabet, for example, which represents different sounds in the words *father, man* and *take.* But even in cases where a letter is regarded as representing a single sound, it does so roughly, taking no account of differences of intonation, tone or pitch, nor of stress, nor of slight variations of pronunciation which vary not only between one individual speaker and another, but also from time to time in the case of an individual in accordance with the position of a given sound in a word, of a word in a phrase, or with the nature of the phrase to which he is giving utterance. In this connection writing stands in much the same relationship to speech as speech does to thought. If language is not a sufficiently delicate instrument to express the nuances of human thought, writing is a less delicate instrument still, and any attempt to multiply signs and characters to keep pace with the subtle variations of the human voice would only impair their usefulness.

An alphabet is a highly-developed, artificial form of writing. The connection between sound and character is conventional and not essential. This is not the case with all forms. Pictographs (*see* PICTOGRAPHY), ideographs (*q.v.*), and hieroglyphs (*q v*) are forms of writing the characters of which bear an essential relationship to what they are intended to represent. Such methods constitute generally speaking an earlier stage in the development of writing than syllabaries and alphabets, which have passed into the conventionalized stage. An earlier stage still may be found in the various devices employed to assist memory, such as the notched stick, notched in the presence of the messenger to whom the significance of each notch is verbally emphasized, a method not far removed from the tying of a knot in the handkerchief (*see* KNOTS). Again there are the Peruvian Quipus (*q.v.*), notched sticks from which strings are suspended of varying colour and length, knotted in various places, each variation having its own significance; or the North American Indian custom of adorning deerskin belts with wampum beads (*see* WAMPUM), whose colour

TABLE I.

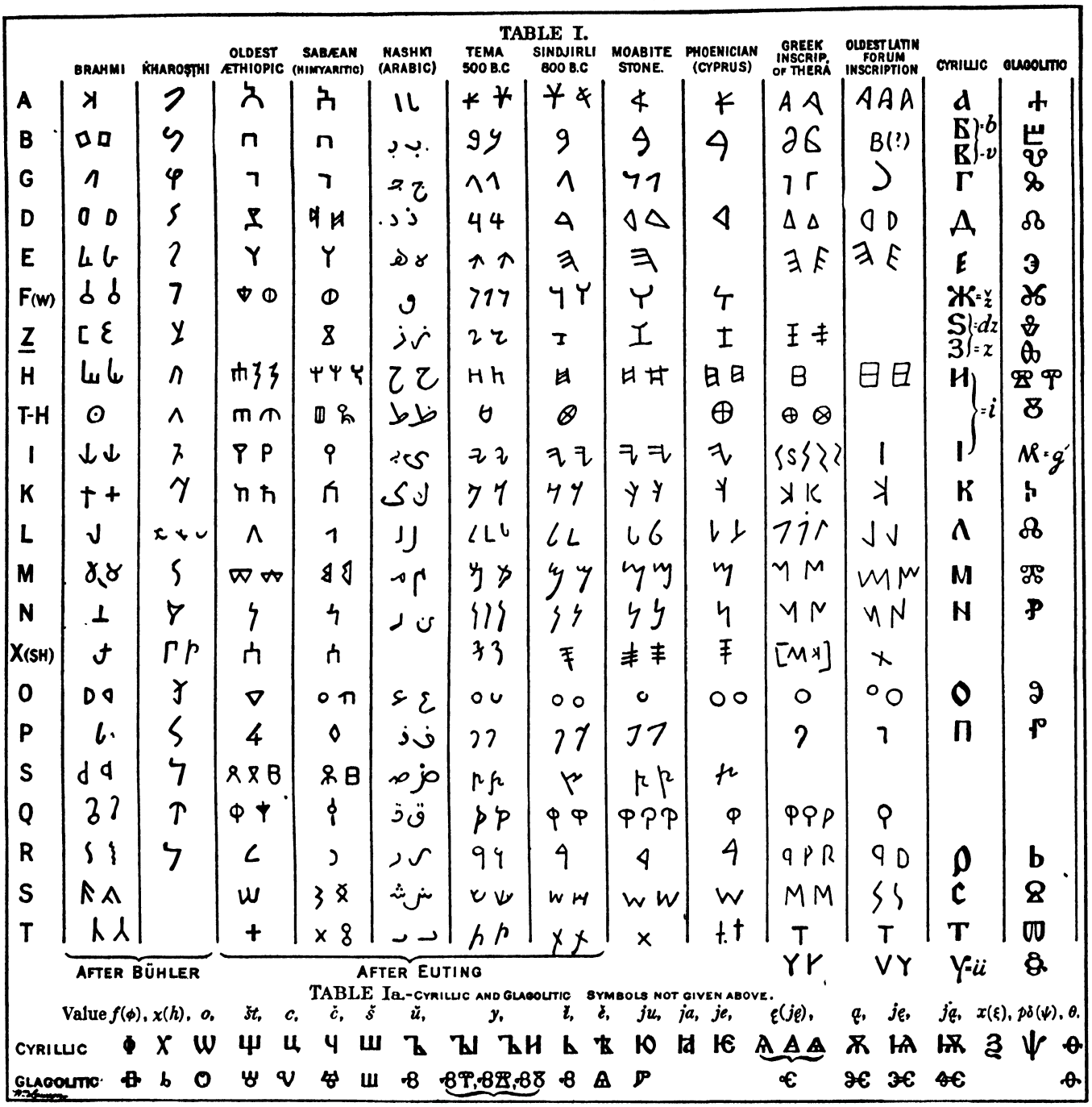


TABLE Ia.—CYRILLIC AND GLAGOLITIC SYMBOLS NOT GIVEN ABOVE.

CHART ILLUSTRATING THE PRESUMED DEVELOPMENT OF THE MODERN EUROPEAN ALPHABET FROM THE BRAHMI LETTERS OF INDIA

and position were employed to described historical events such as battles, or even the terms of treaties, with remarkable accuracy to those who knew the secret of their elucidation. There are thus three distinct stages in the growth of writing, though they need not necessarily be thought of as hard and fast chronological stages.

Picture-writing or the use of the ideograph is the intermediate of the three stages. An ideograph (*q v.*) is a drawing representing not a sound, nor even a word, but an idea Thus the drawing of a man with protruding ribs represents famine; or an eye with tears dropping from it, sorrow. Till recently such methods of communication were in use among certain tribes of North American Indians. They appear to have been so among many races in various regions.

In this connection should be mentioned the writing known as Nsibidi or Nchibiddi in use among a secret society or club among the Ekoi people of southern Nigeria. The writing is purely ideographic, but the symbols are conventional, fixed in form and meaning. The script is jealously guarded by the members of the secret society. Its origin is unknown; but certain resemblances have been detected to the Egyptian hieroglyphic system, one of the most remarkable being that the Nsibidi picture-symbol for *house* is rectangular in shape, whereas all dwellings among the people who use it to-day are, and have been for centuries, round. Moreover the Ekoi people are semi-Bantu in descent, and there is reason to suppose that the Bantu peoples migrated from the lower Nile regions (For an account of this writing see *In the Shadow of the Bush* by P. Amaury Talbot, Appendix G. p. 447 ff.)

Six different peoples in various parts of the world developed a system of writing usually known as transitional, that is to say, they continued the use of the ideograph, but added symbols of a purely phonetic value, and made use of the two side by side. These peoples were the Sumerians and Babylonians, whose cuneiform was a script of this nature, the Egyptians, the Hittites, the Chinese in the Far East, and in America the Mayas and Aztecs.

The method by which this change took place was, generally speaking, that the picture-symbol representing any given object, an eye, for example, came to represent the same sound under all circumstances, as if for instance the drawing of an eye came to stand not only for the meaning *eye,* but also for the pronoun *I,* which has the same phonetic value. This could be the case not only when the sound constituted a whole word, but when it occurred as a single syllable within a word. Even in purely pictographical writing something of the sort occasionally took place. The Mexican name *itz-coatl* meaning literally *snake-knife* and represented by the drawing of a snake surrounded by knives, occasionally occurs as *itz-co-atl* with a different picture, *co* meaning a pot Though this process is of a different nature, it serves as an illustration of the tendency to connect the drawing not only with the object it essentially represented but also with any homonym of that object. This being so, it became the custom to draw or write the picture with greater haste and carelessness, time being more important than accuracy, so soon as the symbol came to represent not an object but a sound. A badly-drawn eye, for example, will serve perfectly well for a sound that covers both words *eye* and *I.* There is no longer need for the drawing to be recognizable as an *eye* when it is no longer required to represent the object to the sight, but only a sound which itself carries meaning to the ear. Thus picture-writing degenerated, the process being a distinct gain in ease of communication. It was in this way that the Egyptian hieratic and demotic scripts came into existence, although so strong was the habit of writing hieroglyphs that for many centuries both were employed side by side, even literally so in the same piece of writing, the hieroglyph sometimes actually following the phonetic symbol in order, as it were, that the meaning might be doubly assured.

The Chinese ideographic system exhibits peculiarities which depend upon the language that it was formed to represent So soon as the symbols attained a phonetic value, serious difficulty arose from the fact that a single monosyllabic word might have many distinct meanings, distinguished in speech only by intonation which it was, for a time, impossible to represent in writing. The difficulty was felt in the spoken language also, and one homonym was distinguished from another by the addition of a second word which made the meaning clear, a kind of compound being thus formed. In the course of time the original pictographs have deteriorated, but they are capable of analysis into their original constituent parts without undue difficulty (*see* CHINESE LANGUAGE).

The Japanese, when they came into contact with Chinese civilization in the 5th century A.D., adopted the Chinese phonographic script and endeavoured to adapt it to their language Finding, however, that their chief sounds could be comprehended in a syllabary of 47 characters they developed these from Chinese characters. For literary or learned purposes the Chinese phonograms are still in use among them, so that in spite of the utter difference of language the Japanese and Chinese can communicate by means of writing, although each symbol has a totally different phonetic value to the speakers of either language. The neighbouring countries of China, Japan and Korea exhibit three separate modes of writing, ideographic, syllabic and alphabetical, the Koreans having invented an alphabet based on Sanskrit forms.

The syllabary and alphabet are examples of the most highly-developed stage of writing, the conventional stage, when there is no essential connection between sound and symbol. To some peoples the development of a syllabary seemed to come more easily than that of an alphabet. A syllabary existed in Cyprus in ancient times. In the case of a language that for reasons of phonetic decay or otherwise has multiplied consonants in a single syllable the syllabary is a cumbersome mode of writing. The word *strength,* for example, would have to be written *as-at-ar-eng-ath,* or *sa-ta-re-nga-tha* and this is obviously a representation of the sounds composing the word that is far from adequate. It will also be readily seen that a much greater number of symbols is required for a syllabary than is the case with the far more convenient alphabet.

The alphabet then is the form of writing that to those peoples who have developed, borrowed or adopted it has been found the most convenient and adaptable. Its use is acquired in childhood with ease, which is far from being the case with the Chinese phonograms, for instance. It may also be passed from one language to another without difficulty. The history of our own alphabet, which has survived as an alphabet with, all things considered, surprisingly little change for nearly 3,000 years and is still vigorous, untouched by the introduction of printing or of the typing machine, demonstrates its suitability to the needs of the many languages it has served

TABLE II.

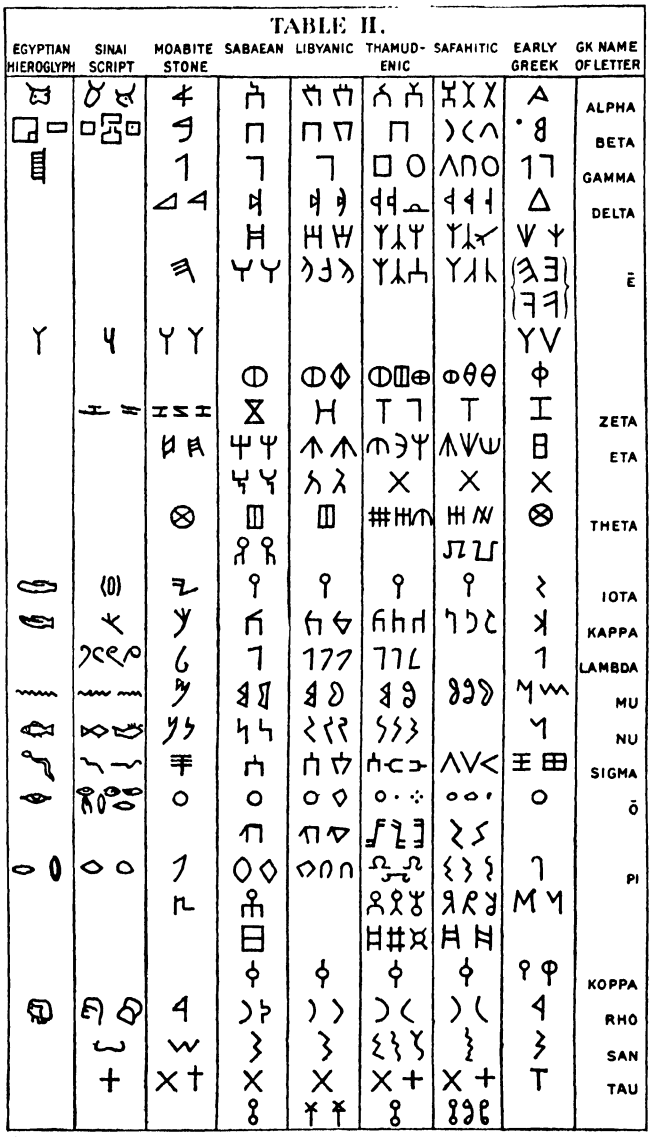


CHART SHOWING THE EVOLUTION OF THE ALPHABETIC SYMBOLS FROM HIEROGLYPHIC SIGNS TO EARLY GREEK LETTERS

The story of our alphabet from the time that we first find it employed in the earliest known Greek inscriptions is not hard to trace It is its history in its pre-Greek days that is still wrapped in doubt. The Greek names for its letters, *alpha, beta, gamma, delta,* etc , demonstrate its Semitic origin, for though the names may not in every case have a Semitic etymology, they correspond closely with the Semitic names (*cf.* the Hebrew *aleph, beth, gimel, daleth*). Two questions have hitherto remained unanswered How did the Greeks obtain it from the Semites? And what was its pre-Semite history? In recent years decided advances have been made towards a solution of either question.

Until rather more than ten years ago the earliest known examples of the Semitic alphabet were what is known as the Moabite Stone, an inscription of Mesha king of Moab dating from the 9th century B.C , and a votive inscription to Baal-Lebanon discovered in Cyprus. Various theories have been current as to

the origin of the Semitic alphabet, the earliest being the view of Lenormant, published by De Rougé in 1874, that Egypt was its starting-place. Others attempted to connect it with Babylonian cuneiform, with the Cyprian syllabary, or with the Minoan writing of Crete. The latter is the view of Sir Arthur Evans who, in his great work *Scripta Minoa*, develops the theory that the alphabet was taken from Crete to Palestine by the Philistines and from

TABLE III.

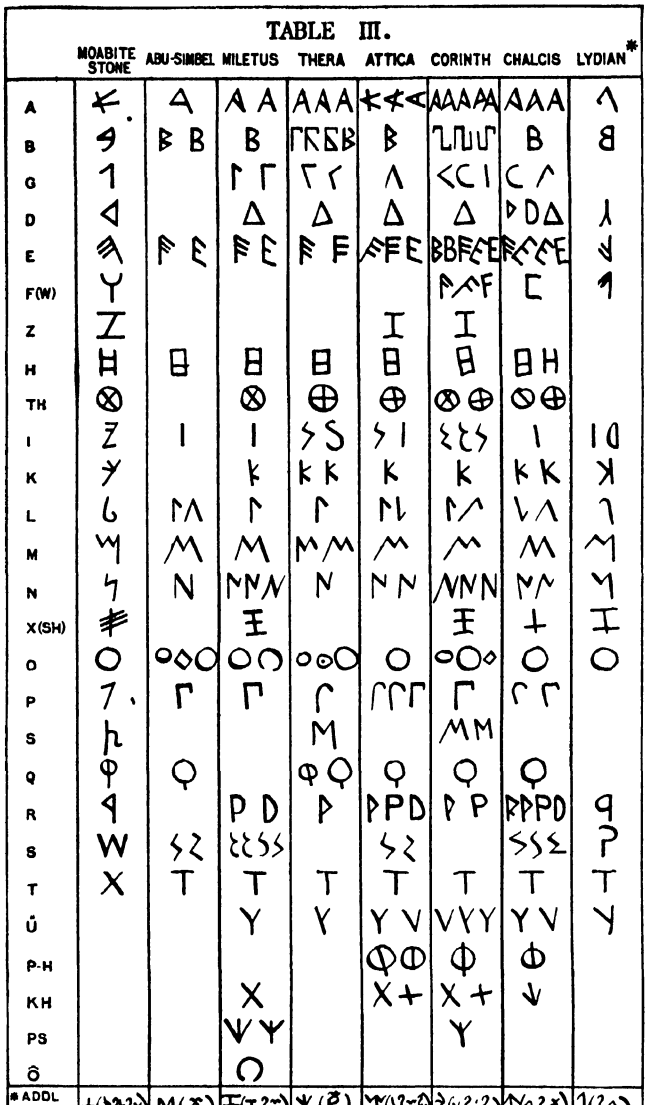


CHART SHOWING ILLUSTRATIONS OF DIFFERENT GREEK FORMS OF ALPHABETIC LETTERS AS DEVELOPED FROM THE MOABITE STONE SYMBOLS

them borrowed by the Phoenicians The Egyptian view was revived in 1916 in a paper published in the *Journal of Egyptian Archaeology*, vol. iii. (1916) p 1 ff., by Dr. Alan Gardiner. This paper deals with certain inscriptions discovered in 1906 by Sir W. Flinders Petrie in the Sinaitic peninsula, in which Dr. Gardiner sees a stage of writing intermediate between Egyptian hieroglyphic and the Semitic alphabet. The script appears to be fully alphabetic, and the date of the inscriptions is not later than 1500 B C. These inscriptions have also been dealt with by Hans Bauer (*Zur Entziferung der neuentdeckten Sinaischrift*, Halle, 1918), who is inclined to see in the script a prototype of the Semitic alphabets, independent of Egypt.

For a solution of the question the evidence of the four south Semitic alphabets must be considered. These are known as Sabaean, Lihyanic, Thamudenic and Safahitic. Inscriptions in these south Semitic alphabets were discovered in considerable numbers during the course of the 19th century. Those in the Sabaean alphabet come from the district of Yemen in south Arabia, the Lihyanic from El-Ola in the north of the Hejaz. The Safahitic inscriptions come from rocks in the district of Safah near Damascus. Most of the south Semitic inscriptions read from right to left but a few are written *βουστροφηδόν*, as the Greeks said, that is to say, from right to left and left to right in alternate lines. There are 29 letters in the Sabaean alphabet. The date of the earliest Sabaean inscriptions appears to be about the 6th century B C., and most of those who have noticed them are agreed that this alphabet descends not from that of the Moabite Stone but from an older source common to both. Dr. Alan Gardiner sees this source in the alphabet of the Sinai inscriptions. Two or three of the signs, notably that for *beth* ⊏ in Sabaean, for *phe* ◊ in Sabaean, and for *thau* ┼ in Thamudenic and Safahitic resemble symbols of the Sinai script. But it would be difficult to derive most of the signs from any found there. Further, Dr. Gardiner's identification of the Sinai symbols does not rest upon a completely sure basis in the absence of a certain interpretation of the inscriptions. Dr. Gardiner sees the most important line of evidence in the names of the letters. Of the 22 letters of the Semitic alphabet 17 have Semitic names, which are the names of ordinary objects. Five are unintelligible. It is obvious that the simplest interpretation of the fact of these names is that the letters were once picture-symbols representing the object whose name the alphabetical symbol has retained. In 15 cases symbols appear on the Sinai inscriptions which evidently represent objects to which these names belong. It is therefore no far-fetched conclusion to regard these symbols as prototypes of the alphabetical symbols which continued to bear the names of the objects they represent. There is also no doubt of the close connection of the symbols of the Sinai script with certain Egyptian hieroglyphics, and it is scarcely probable that identical picture symbols would have developed independently in Egypt and so near to its borders as to be in use in the Sinai peninsula. The close intercourse between Egypt and regions lying beyond Sinai render complete independence of script unlikely. On the other hand, of 32 separate characters apparently employed in the Sinai inscriptions, 17 are unintelligible, not being found to correspond sufficiently closely either with Egyptian hieroglyphic characters on the one hand nor letters of the Semitic alphabets on the other. The accompanying table, taken from that drawn up by Dr. Alan Gardiner to illustrate his article shows the relationship between the Egyptian hieroglyphs, the Sinai script, the alphabet of the Moabite Stone, the south Semitic alphabets, and that of early Greece. While Dr Gardiner's interpretation of this script cannot be said to have proved that Egypt was the original home of the Semitic alphabets, it has directed attention to Egypt as deserving serious consideration as a claimant to this honour.

A different view of the origin of both the Phoenician and Greek alphabets is offered by Prof. Sir W. Flinders Petrie who in 1912 published his book *The Formation of the Alphabet*. In this he argues that both these alphabets together with those of Asia Minor, the south Semitic, Cyprian and certain Egyptian scripts developed from a series of conventional marks or signs employed for commercial purposes throughout the Mediterranean area from earliest times. "In Egypt, especially," he says, "the monumental evidence shows two entirely different sources of conventional marks. In late times the picture writing passed through many stages, until it became the complex grouping of slightly varying strokes in the demotic writing. But far before all this there had existed, from the beginning of the prehistoric ages, a totally different system of linear signs, full of variety and distinction. This early system was certainly in its decadence long before any hieroglyphs were used in Egypt. Similarly in Crete a system of linear signs precedes the pictographic records." But Professor Petrie is alone, or practically so, in supposing that the early marks to which he refers had any significance, and his theory of the development of various local alphabets from such marks has not found general acceptance. Too many links are missing in the chain of proof. The fact that identical alphabetical symbols occur in widely distant regions of the Mediterranean area, which he stresses, is capable of other explanations.

The most important fact ignored by any theory that would derive the Greek and Phoenician alphabets independently from a

source older than either is that the names of the letters, as far as they have a known etymology or meaning, are Semitic. Hebrew *aleph, beth, gimel, daleth,* etc., correspond unmistakably with Greek *alpha, beta, gamma, delta.* The Semitic names are words in the Semitic languages. The Greek names are meaningless in Greek. It has indeed been argued that the Greek names were the original ones, meaningless, and taken in the first instance simply from the sounds represented by the letters; that the Phoenicians took over the alphabet together with the names from the Greeks and adapted the names by the process known as folk-etymology. But the Sinai inscriptions, discussed above, may be said to have rendered this theory untenable. If they do not represent a link between the hieroglyphic system of Egypt and the Phoenician alphabet, they represent a prototype of the latter, appearing at a date and at a place that render any theory of borrowing from Greek sources highly improbable. It is reasonably certain that the Greeks derived their alphabet from Semitic sources, taking over the names with the letters. The names are not identical. The Greek names end with a vowel—*alpha* for *aleph, beta* for *beth,* etc. The vocalization has been explained merely as being more in agreement with Greek morphology, but this is not a very definite or satisfactory explanation Isaac Taylor had already pointed out in the *History of the Alphabet* (1883) vol. ii. p. 27 that the Greek forms are taken from *Aramaic,* Aramaic showing an emphatic form of the root which ends in a vowel and drops the vowel in the preceding syllable. He postulated two separate borrowings of the alphabet by Greeks, the earlier being the Chalcidic alphabet borrowed with the Babylonian system of weights and coinage from Aramaic peoples in the south-eastern extremity of Asia Minor, possibly through Lydia; the second the borrowing by the Ionians directly from Phoenician traders. The Aramaic names came with the first borrowing and were carried on and applied by the later borrowers. These two forms of the alphabet, Chalcidic and Ionic, generally known as western and eastern, represent two different borrowings, but we may probably rule out the theory of any direct borrowing from Phoenician sources. The tradition that this was so comes from Herodotus, who refers only to Boeotia, and it is probable that the name *Phoenices* was a vague term for eastern foreigners. The Achaeans were a naval power settled in the eastern Aegaean in the 15th century B.C. There is therefore no difficulty in concluding that they borrowed the alphabet from peoples with whom they were in close contact in western and southern Asia Minor at a considerably earlier date than has hitherto been supposed; nor that, independent as Greek States were, there were separate borrowings and separate adaptations.

The chief adaptations made by the Greeks were the allocation of certain of the 22 Semitic letters to vowel-sounds, and the addition of certain letters. The oldest extant Greek inscriptions are those found in 1896 in the island of Thera, which date from the 8th, possibly even the 9th, century B.C., the inscriptions from Abu Simbel in Upper Egypt, dating from the 7th century, a Corinthian and an Athenian inscription of the 6th century. In Thera the oldest inscriptions are written from right to left, others are *βουστροφηδόν,* others still later read from left to right. In the Lydian alphabet, known to us by inscriptions found at Sardis in the beginning of the present century, these symbols also represent vowels. Most Greek States developed local variations either in the forms of certain letters, or in the representation of sounds not represented by any of the 22 letters taken over. The two main divisions, eastern and western, however, remain till the 4th century B.C., when in the main uniformity of alphabet was attained throughout Greece. The early inscriptions from Thera show a remarkably close resemblance to the forms of the Semitic alphabet as represented on the Moabite Stone or the Baal-Lebanon inscription from Cyprus. The alphabet of Abu-Simbel is of the Ionic type.

The two main divisions, eastern and western, again sub-divide into two, the cities of Asia Minor and the adjacent islands with their colonies using forms showing in some cases slight differences from those in use in the Cyclades and Attica. Again the alphabets of Megara, Corinth, Sicyon, Phlius and western Argolis with their colonies differ from the west which includes Euboea, Boeotia, Phocis, Locris, Thessaly and the rest of the Peloponnese. Throughout all Greek alphabets the Semitic letters *aleph, he* and *ayin,* which represented breathings, were adapted to represent vowels. *Alpha* (*aleph*) was consistent throughout. The letter corresponding to Semitic *he* (later *epsilon*) represented both the short and long vowel *e* in those cases where *eta* represented the rough breathing. Generally speaking *eta* represented the vowel-sound in the eastern alphabet, the breathing in the western. Thus in the west the symbol Ⅎ or E is used for the two sounds represented in Attic by ε and η; in the east it more usually represents the short vowel alone. In addition to this, however, it is occasionally used throughout to represent the long close ē (the long ē represented by *eta* was open), which in Attic is written as if it were a diphthong, ει. The Corinthian alphabet is peculiar in using (up to the 6th century and later in outlying regions) the sign ⋑ or B to represent *c,* the long close vowel being written B⋋. Sicyon uses a symbol with the form ⋛. Semitic *cheth,* Greek *eta,* was

TABLE IV.

CHALCIDIC	ETRUSCAN	UMBRIAN	OSCAN	FALISCAN	LATIN
A	A	A	N	Я	A
B	B	B	B		B
C	C		>	Ↄ	C
D	D	ϙ	Я	D	D
E	E	E	E		E
	F				F
	I		I		
H	H		H	H	H
⊗	⊗				
I	I	I	I	I	I
K	K	K	K		K
L	L	L	L	L	L
M	M	M	M	M	M
N	N	N	N	N	N
O	O			O	O
Γ	P	1	Π	Γ	P
		M			
Q	Q				Q
P	P	Q	Q	Я	R
S	S	ƨ	ƨ	ƨ	S
T	T	T	T	T	T
V	V	V	V	V	V
	X			X	X
Φ	Φ				
	Y				

CHART SHOWING VARIOUS ROMAN FORMS OF THE ALPHABET

used, as we have seen, in the east generally speaking as a vowel, in the west as the rough breathing. In the Theran inscriptions, it occurs in both capacities. The semi-vowel i̯ (resembling the sound of English initial *y*) had disappeared from the Greek language in prehistoric times, degenerating into a rough breathing, so that Semitic *yod* was adapted in Greek to represent the vowel ι (iota). *Koppa* (Ϙ) had disappeared in the eastern alphabets by the 5th century B.C., its place being usurped by *kappa* (K),

but it lingered in the west and was introduced into the Italic alphabets, as we shall see.

The origin of the *digamma* (F, representing the *w* sound) is obscure. *Vau*, the sixth letter of the Semitic alphabet, was taken by the Greeks for use as a vowel, exactly as they had taken *yod*, and placed at the end of the alphabet following *tau*. But whereas the consonantal *j*-sound did not exist in Greek, the consonantal

TABLE V.

SABAEAN	BRAHMI	KHAROSTHI	ARAMAIC	NASHKI	HEBREW	PALMYRA	MOD EUROPEAN
							A
							B
							C
							D
							D
							E
							F(W)
							Z
							H
							TH
							I
							K
							L
							M
							N
							X(SH)
							O
							P
							S
							S
							Q
							R
							S
							T
							T

COMPARISON OF THE INDIAN AND SEMITIC FORMS OF THE ALPHABET

u-sound (akin to *w*) survived till classical times in certain dialects and needed a symbol to represent it. Thus the *digamma* took the place of *vau* in the order of the alphabet, but opinions differ as to whence it derived its form. Some hold that it was differentiated from the preceding letter by the omission of one of the horizontal strokes, others that it descends from *vau* (Y). The latter view is rendered less difficult by the fact that N occurs as a form of the digamma from Oaxos in Crete. In the absence of further evidence it is impossible to reach any definite conclusion.

The treatment of the sibilants of the Semitic alphabet by the Greeks is complicated. *Zain* was taken over as *zeta*, though its pronunciation in early times is not certain and may have varied throughout the dialects between *dž*, *dz*, *ž* and *z*. The 15th letter of the Semitic alphabet was *Samech* the name of which through its Aramaic form *simcha* became in Greek by metathesis *sigma*. The name, however, was transposed to the 21st letter, which in Semitic was *san*. The letter itself was retained in the eastern or Ionic alphabet with the value *ks* (ξ). In Thera, however, in early times it has the value of *ss*, *x* or *ks*, being expressed by KM. The usual manner of expressing this combination in the Aegaean islands was XS. The letter X, which often appears in the west as +, may be a direct descendant of ⋕ (*samech*), and quite independent of X or +, the 26th letter of the Greek alphabet, the origin of which is unknown. The sibilant *s* was expressed by two separate symbols, M and S or Σ, the one descended from Semitic *ssade*, the other from Semitic *san*. Both do not appear in the same alphabet. M appears in Crete, Thera and Melos, in Phocis in the 6th century, elsewhere only in the Peloponnese and its colonies. In two 5th century inscriptions from Teos and Halicarnassus a form T appears with the value *σσ*. The unvoiced velar aspirate was expressed by a form X or +, which became the 26th letter of the alphabet in practically all alphabets except in the western group. The same form was used in the west for the *x*-sound, and here it was probably a descendant of Semitic *samech* ⋕. In the west where X was used for the *x*-sound and not for the unvoiced velar aspirate (*kh*, X), the latter was expressed by a symbol Ψ. In Boeotia we actually find Ψ used in combination with S to represent the *x*-sound, a fact that suggests that there was some consciousness that it was used in the west as a substitute for eastern X. Ψ is used singly to express the *x*-sound in Thera and Melos. In the east, where X expressed the *kh*-sound, Ψ was used (sometimes with the form Ψ) to express the combination *ps*, a use in which it was later standardized by the spread of the Ionic alphabet.

Other symbols not derived from Semitic were (i) Φ (*phi*) used to express the unvoiced labial aspirate (*ph*) and (ii) Ω the last letter of the Greek alphabet, probably differentiated from O. In the west this symbol appears very seldom. In the east it represents the long open *o*. In the Cyclades curiously enough it frequently expresses the close vowel, whether long or short (*o* or *ou*) while O represents the open sound

The origin of the symbols Φ and Ψ is unknown. In the case of X or + it is probable that we should differentiate X derived from ⋕ and standing for *x* from X standing for *kh*. The origin of the latter is however obscure. It is possible that these signs were adapted in Asia Minor from the Cypriote syllabary.

Various local alphabets were in use in Asia Minor that were parallel to the Greek The Lydian alphabet for instance is known to us from inscriptions dating from the 4th century B.C. A few of these were discovered in the last century, 36 were found by an American expedition in Sardis between the years 1910 and 1913, the rest by J. Keil and von Premerstein in various parts of ancient Lydia between 1906 and 1912. The alphabet consisted of 26 symbols. The parallelism with the Greek and Semitic alphabets is clear, but there are additional symbols the sound of some of which is uncertain in the absence of a completely certain interpretation of the language of the inscriptions. The most interesting fact about this alphabet is the identity of the symbol for *f* 8 with the Etruscan symbol for the same sound.

The western Greek or Chalcidian alphabet was brought to Italian soil by the Greek colonies of Magna Graecia, and until recently it was confidently held that the Latin alphabet, the parent of our own, was derived from this Chalcidic alphabet by contact with the Greek colonies of southern Italy. Too little was made of the influence of Etruria because too little was known of that country and its people. Six Italic alphabets have come down to us. These are the Latin, Faliscan, Etruscan, Umbrian, Oscan and Messapian. The Messapian is purely Greek in origin and was used by a people who were isolated in Calabria and spoke an Illyrian dialect. The Umbrian and Oscan alphabets are derived from the Etruscan. The district in which the Umbrian alphabet was used was east of the Apennines. The Oscan was in Campania. Thus the Latin and Faliscan alphabets were bounded on all three sides by the Etruscan and alphabets derived from it. In these circumstances, Etruscan must have exercised a strong influence upon the Latin alphabet, following the impact of Etruscan civilization upon Roman in other directions.

The Etruscan alphabet is known to us from certain tomb inscriptions, from part of an Etruscan book that was used as the

wrapping of a mummy, and from three alphabets or abcdaria found at Marsiliana di Albegna (near Siena), at Formello (near the site of the ancient Veii), and at Cerveteri, the ancient Caere. It has **F** (digamma) as *f*, and retains forms corresponding to all three Phoenician sibilants, *samech*, *san* and *ssade*. It has **X** representing *ks*, **Φ** for *ph* and **Ψ** as *ch*. On one tomb inscription of the 8th century B C. **8**, is found representing *f*, identical with the same character used for the same sound in the Lydian alphabet (*see* above). The view now usually held as to the origin of the Etruscan alphabet is that it was brought by its users to Italy when they migrated thither from Asia Minor probably in the 9th century B.C., and that they had received it while still in Asia Minor from Greek sources at a period prior to the division of the Greek alphabet into eastern and western Unfortunately we do not know the Etruscan names for the letters of the alphabet. There is nothing impossible, nor even improbable, in the view of the derivation of the Etruscan alphabet from Greek sources in Asia Minor at an early date, since the Achaeans were of considerable importance in the eastern Aegaean as early as the 15th century B.C. It may be taken as reasonably certain that the Etruscans did acquire their alphabet in Asia Minor. One important point of contact with the Lydian alphabet has been already noticed, but although there was a close mutual relationship between the Greek and other alphabets in Asia Minor in the first half of the first millennium B C, the evidence does not yet indicate with precision who were borrowers and who lenders

The oldest extant records of the Latin alphabet are firstly the inscription known as the *Dvenos Inscription* (it reads **DVENOS MED FECED**) found in 1880 in Rome upon an earthenware vessel with three separate branches, dating from the former half of the 4th century B C. In the second place is the Praeneste fibula, dating from the 6th or 5th century, the inscription upon which runs from right to left. It reads **MANIOS MED FHEFHAKED NUMASIOI**, and is remarkable as illustrating the device of combining the letters **F** (digamma) and **H** (aspirate) to represent the sound of *f* which was common in Latin, but did not occur in Greek. In the Dvenos Inscription **F** alone is used, a development that may be due to Etruscan influence; for the Romans had the *w*-sound in their language, but instead of using **F** to represent it, they rather clumsily allowed **V** to represent both this and the vowel-sound *u*. The third instance of early Latin is an inscription upon a column, written *βουστροφηδόν* found in the Roman forum and dating probably from the 5th century In it **K** is in ordinary use as a consonant, and the word **RECEI** occurs where **C** has still the force of *g*.

The third letter of the alphabet **C**, which represented in Greek the voiced velar stop (the sound of *g*), came in Latin to represent the unvoiced stop. The reason for this is obscure, but Etruscan influence cannot have been absent, for the voiced stops were unrepresented in the Etruscan language. Latin did not lose the voiced stop but adapted a symbol **G** from **C** to represent it, which it placed in the position of **I** (*zeta*) for which it had no use. **C** thus took the place of **K**, which fell out of ordinary use, remaining only as the initial of well-known or official words. **C** also remained with the force of *g* in the initials of proper names **F** (*digamma*) was used at first in combination with **H** to represent the *f*-sound. Later the **H** was dropped, again probably under Etruscan influence. When after the conquest of Greece Greek words began to be borrowed by the Latin language, the symbols **Y** and **Z** were adapted from Greek for use in such words and placed at the end of the alphabet. There were no sounds in Latin to correspond to the three aspirates. **⊙** (*theta*) was retained to represent the numeral 100, and became modified to **C** and identified with the initial letter of the number. **Φ** (*phi*) written **(|)** was used to represent 1,000 and became identified with **M**, the initial letter of *mille*. **Ψ** (*chi*) became **⊥**, then **L**, and was used for 50.

The Latin alphabet of 23 letters (including **Y** and **Z** became extended during the course of the middle ages to our own of 26 by the division of **I** into *i* and *j* and the tripartite division of **V** into *u*, *v* and *w*. *J* developed in the 15th century as an initial (more ornate) form of *i*, and as the consonantal sound occurred more usually at the beginning of words and the vocalic in the middle, *j* became specialized to represent the consonant, *i* the vowel. The history of *u* and *v* is precisely similar except that it took place five centuries earlier. W arose, as its name implies, out of a combination *uu* or *vv*, which about the 11th century came to represent in old English the *w*-sound which had previously been represented by a rune.

It only remains to consider briefly certain alphabets which derived from the same source as our own. The alphabets of India are offshoots of the stem. All derive from two sources, *Kharoṣṭhi* and *Brāhmī*. Though attempts have been made to show that the Brāhmī alphabet was developed in India itself without connection with outside sources, this contention cannot be maintained. It has a manifest kinship with the Semitic alphabets. Its origin is obscure, but there seems little doubt that it derives from the south Semitic group of alphabets through contact with Sabataean

TABLE VI.

Mod European	Latin	Runes	Greek	Cyrillic	Glagolithic
A	A		A	A	
B	B	ᛒ	B	B(v) B(b)	
C	C	ᚲᚳᚴᚵ	⟨Λ	Г	
D	D	ᛞᚦᚧᚩ(th)	DΔ	Д	
E	E	ᛖᚧᚨᛖ	E	Е	
F	F	ᚠᚡᚢᚠ	Ϙ F	Ф	
G	G	ᚸ ᚷ			
H	H	ᚺᚻᚼᚽ	H	H(i)	
I	I	ᛁ	I	I(i)	
J					
K	K	ᛕ	K	К	
L	L	ᛚ	Λ	Л	
M	M	ᛗ	M	М	
N	N	ᚾᚿᛏᚿ	N	Н	
O	O	ᛟᚭᚮ	○ ◇	О	
P	P	ᚹᛘ(ᛈ)	Γ	П	
Q	Q		Q		
R	R	ᚱ ᚲ	P	Р	
S	S	ᛊ	Σ	С	
T	T	ᛏ	T	Т	
U	V	ᚢᚤ	V		
V					
W		ᚹ ᚻ			
X	X	X (ᛉ)	X	Х (h)	
Y	Y	ᛘᛋᛦᛇ		У (u)	
Z	Z	ᛊᛇ(ih,eo)	I	Ж(z)S(dz)З(n)	
N.G.		ᛜ ᛝ (ng)	Ξ +		

Value	o št c č š ŭ	y	ľ ě ju ja je	ę(ję)	ǫ ję jǫ x ps θ
Cyrillic	Ш Ч Ц Ч Ш Ъ	Ы Ъ	Ь Ѣ Ю Ꙗ Е	Ѧ Ѧ	Ѫ Ѭ Ѯ Ѱ Ѳ
Glagolitic	ⰾ ⰹ ⰲ ⰿ ⰻ ⰸ ⰵ ⰶ ⰴ ⰻ ⰸ ⰰ ⰴ ⰼ	ⰹ ⰰ	ⰻ ⰵ	ⰵ ⰱ	ⰱ ⰻ ⰽ ⰻ ⰸ ⰲ ⰹ ⰾ

COMPARISON OF THE LATIN, GREEK, AND SLAVONIC ALPHABETS WITH THE RUNES

traders. The Brāhmī alphabet is the parent of all modern Indian alphabets. Kharoṣṭhi is an adaptation to the needs of the Indian languages of the Aramaic alphabet, which was in use in northwest India in the days of Persian rule. Inscriptions in it first appear in the 3rd century B.C None have been found of a date subsequent to the 5th century A.D By the 3rd century A D it had spread to Chinese Turkestan. It was superseded in all districts by Brāhmī.

The alphabets in use in Persia, at least from the time of the

Arsacid dynasty onwards, are based upon the Aramaic. Cuneiform was the writing of the Achaemenid empire, but after the Greek conquest Aramaic was introduced and became general. The Pahlavi is the alphabet of the Sassanid kings. The Arsacid and Sassanian alphabets are found together in the liturgical inscription of Hadji-abad, as well as in the Paikuli inscription dating from about 300 B.C. Ernst Herzfeld dates the commencement of Pahlavi in the time of Darius the Great (vd. *Paikuli* p. 73).

Modern Arabic writing has developed from a form of Aramaic used in the land of the Nabataeans, an Arabian people. The oldest record of it now extant is a stēlē from Tema, in north-west Arabia, dating from the 5th century B C. or perhaps earlier. Later inscriptions, known as Nabataean, belong to the period between 9 B C. and A D. 75. The *graffiti* on the rocks of Mount Sinai carry the record of the development of this alphabet down to the 3rd century A D. In the early Mohammedan period two types of Arabic writing existed, known as the Cufic and the *nashki*. The former was discontinued except for formal purposes, where cursive writing could not be employed. The *nashki* is the parent of modern Arabic writing, in which many characters have become so similar owing to the degeneration of the cursive script that it is necessary to distinguish them by diacritical points. The Christians of northern Syria employed a form of Arabic alphabet, known as Estrangelo, and this was taken by Nestorian missionaries into central Asia, becoming the ancestor of a great number of alphabets which spread as far east as Manchuria.

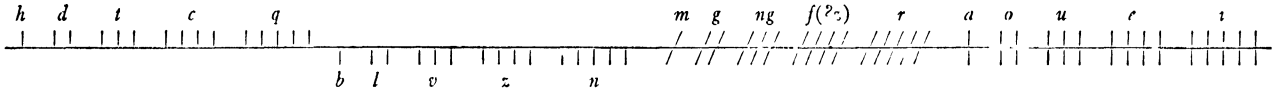
The earliest records of Aramaic go back to about 800 B.C. and were found at Sindjirli in northern Syria. The alphabet at this time differs little from that of the Moabite Stone. Aramaic became by far the most important and widespread of the north Semitic alphabets. It was used in Assyria as a cursive script side by side with cuneiform. It is marked by two distinct tendencies: (i.) the opening of the heads of the letters, *beth* (9) becoming Y, *daleth* (Δ) 4 and *resh* (4) 4. O became U, then V; (ii.) angles became rounded and ligatures developed. These tendencies were completed during the Persian period, and they are emphasized in the Aramaic writing on papyrus employed in Egypt between 500 and 200 B C Other developments of Aramaic are modern square Hebrew and the alphabet of Palmyra.

A group of alphabets arose in Asia Minor during the first half of the first millennium B C. deriving from a common source, probably an early stage of Aramaic. The Greek alphabet in its two varieties was one of these. The Carian alphabet was another, as also the Lycian. These both seem parallel to Greek, not offshoots of it. The Phrygian on the other hand seems to be derived from the Greek, and from the western variety.

The Armenian alphabet owes its origin to Bishop Mesrob late in the 4th century A D. Both an Iranian and a Greek origin have been claimed for it, Isaac Taylor contending for the former, Gardthausen and Hübschmann for the latter. The country had been divided between Persia and the Byzantine empire. The larger share fell to the Persians who discouraged the study of Greek, and an Armenian Christian literature thus arose. It is likely that the origin is Greek, a few Persian characteristics that appear being due to the influence of the dominating power.

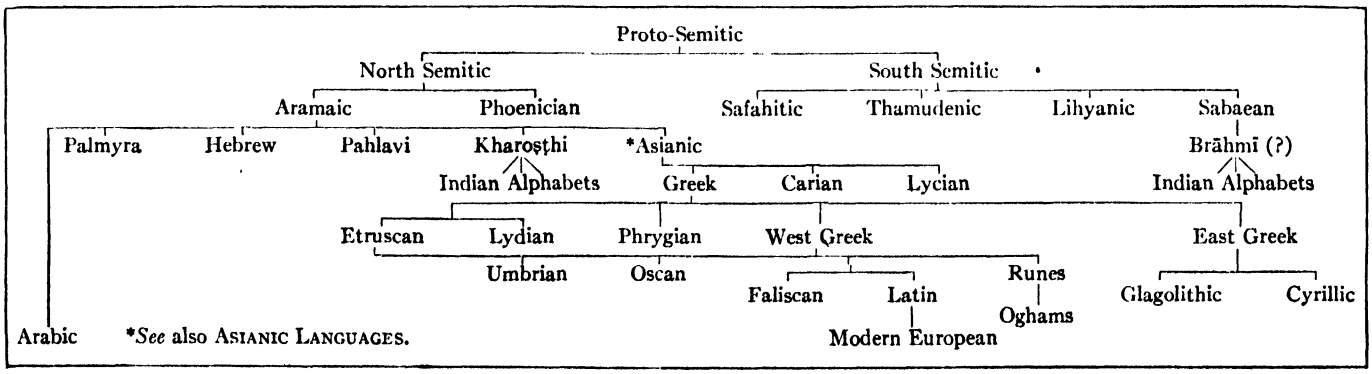
In all Teutonic countries are found inscriptions in the alphabet known as Runic. The affinities of this alphabet with the Greek are apparent, but there has been dispute as to whether it is derived directly from Greek or through an Italic alphabet. The strongest argument in favour of a Latin derivation is the fact that the value of the letter ᚠ is *f*, not *w*. L. F. A. Wimmer in his book *Die Runenschrift* (1887) contended strongly for a Latin origin. He believed that the Runes developed from the Latin alphabet at the end of the 2nd century A D. This can scarcely be the case however, for the Romans had been in contact with the Germanic tribes for some time before this date, and the alphabet, if borrowed from them, would thus have been borrowed sooner. Again many Runic inscriptions are written from right to left or *βουστροφηδόν* and this would have been impossible had the alphabet been borrowed from one uniformly written from left to right. Others have concluded with more probability that the Runes are derived directly from a western Greek alphabet resembling that which appears on the Formello abcdaria. It is possible that knowledge of such an alphabet reached northern Europe from Italy through the medium of Etruscan traders. This might account for the value of ᚠ; Isaac Taylor's view was that the alphabet was derived from a Greek colony on the Black Sea about 600 B C. Of the two views this is perhaps the more probable. It may even be that the alphabet was derived in the region of the Black Sea not directly from a Greek, but from an Asianic source, closely parallel with the Greek developments, as we have already seen the Etruscan alphabet probably to have had its origin. There is some, but not conclusive, evidence that the alphabet was borrowed previous to the Teutonic sound-shift.

An outcome of the Runic alphabet was the cryptographic Ogham writing employed by Celtic peoples in Britain and Ireland (*see* OGHAM LANGUAGE). In this the several letters of the alphabet were represented by strokes differing in number (from one to five) and in position on either side, or on both sides, of a straight horizontal line



The date of these inscriptions in Wales is the 5th and 6th centuries A D.

Finally must be mentioned the two Slavonic alphabets, Cyrillic and Glagolithic, both according to tradition the invention of Cyril, the missionary to the Slavs, in the 9th century A D. Each is taken from the Greek alphabet of that period, Glagolithic from the cursive writing, Cyrillic from uncial, when the value of B had become the spirant *v*, that of H *i*, of Φ *f* and of X the sound of Scotch *ch*. Several additional symbols were invented to express those sounds of the Slavonic language which could not be comprised within the compass of the Greek alphabet. Glagolithic survived in Croatia till the 17th century. Cyrillic has for long been the alphabet in which the Slavonic languages are normally expressed.



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ALPHA PARTICLES, also called α-rays, the positively charged particles that are ejected by certain radioactive substances. (*See* RADIOACTIVITY.) They are helium atoms (*see* ATOM) which have lost one or two electrons (*see* ELECTRON) and are identical with the ionized helium which is produced by an electric discharge through this gas. (*See* POSITIVE RAYS; and ELECTRICITY, CONDUCTION OF: *in Gases.*)

'AL-PHASI, ISAAC (1013–1103), Jewish rabbi and codifier, known as *Riph,* was born near Fez, and died at Lucena. He settled in Spain. His fame rests on his Talmudical Digest, which omitted all homiletical passages and also passages relating to religious duties practicable only in Palestine. He occupies an important place in the development of the Spanish method of studying the Talmud. As opposed to the French rabbis, the Spanish sought to simplify the Talmud, and to free it from casuistical detail. His Digest was the forerunner of the great Codes of Maimonides and of Joseph Oaro.

ALPHEGE (AELFHEAH) ST. (954–1012), archbishop of Canterbury. He was a monk at Deerhurst, and then became an anchorite at Bath. His piety and austerities led to his election as abbot. In 984 he was appointed through Dunstan's influence to the bishopric of Winchester, and in 1006 he succeeded Aelfric as archbishop of Canterbury. At the sack of Canterbury by the Danes in 1011 Aelfheah was captured and kept in prison for seven months. Refusing to pay a ransom he was barbarously murdered at Greenwich on April 19 1012. He was buried in St. Paul's, whence his body was removed by Canute to Canterbury with all the ceremony of a great act of State in 1023.

Lives of St. Alphege in prose (which survives) and in verse were written by command of Lanfranc by the Canterbury monk Osbern (d. *c.* 1090).

ALPHEUS ('Αλφειός; mod *Ruphia*), the chief river of Peloponnesus The Alpheus proper rises near Asea in central Arcadia, but its passage thither by subterranean channels from the Tegean plain, and its union with the Eurotas, are probably mythical (W. Loring, *Journ. Hell. Studies,* xv. p. 67). The shallow and rapid stream occupies but a small part of its broad, stony bed. Leaving the plain of Megalopolis by a rugged gorge, it receives above Olympia two large tributaries, Erymanthus and Ladon, from the north-east and empties itself into the Ionian sea. Strictly, Ruphia is the modern name for the Ladon, but the name has been given to the whole river. Pliny states that it was navigable for six Roman miles from its mouth. Alpheus was recognized as the typical river-god in the Peloponnesus, as was Achelous (*q v*) in northern Greece. His waters were said to pass beneath the sea and rise again in the fountain Arethusa at Syracuse.

ALPHONSE I. (1103–1148), count of Toulouse, son of Count Raymond IV. by his third wife, Elvira of Castile, was born in the castle of Mont-Pèlerin, Tripoli. He was surnamed Jourdain on account of his having been baptized in the river Jordan. In his tenth year he succeeded to the countship of Toulouse and the marquisate of Provence, but Toulouse was taken from him by William IX., count of Poitiers, in 1114. He recovered a part in 1119, but continued to fight for his possessions until about 1123. He next fought for the sovereignty of Provence against Raymond Berenger I, and by a peace reached in Sept. 1125 Jourdain became absolute master of the regions lying between the Pyrenees and the Alps, Auvergne and the sea.

His ascendancy was an unmixed good to the country, for during a period of 14 years art and industry flourished Louis VII., for some reason which has not appeared, besieged Toulouse in 1141, but without result. Jourdain was twice excommunicated, but in 1140 he took the cross at the meeting of Vézélay called by Louis VII, and in Aug. 1147 embarked for the East, reaching Acre in 1148. He was poisoned at Caesarea, either the wife of Louis or the mother of the king of Jerusalem having suggested the draught.

See the documentary *Histoire générale de Languedoc* by De Vie and Vaissette, vol. iii. (Toulouse, 1872).

ALPHONSE (1220–1271), Count of Toulouse and Poitiers, the son of Louis VIII, king of France, and brother of St. Louis, was born on Nov. 11 1220. He joined the county of Toulouse to his appanage of Poitou and Auvergne, on the death, in Sept. 1240, of Raymond VII, whose daughter Jeanne he had married in 1237. He took the cross with his brother, St. Louis, in 1248 and in 1270. In 1252, on the death of his mother, Blanche of Castile, he was joint regent with Charles of Anjou until the return of Louis IX., and took a great part in the negotiations which led to the treaties of Abbeville and of Paris (1258–59). His main work was on his own estates. There he repaired the evils of the Albigensian war and made a first attempt at administrative centralization, thus preparing the way for union with the crown The charter known as "Alphonsine," granted to the town of Riom, became the code of public law for Auvergne. He died without heirs on his return from the 8th crusade, in Italy, probably at Savona, on Aug. 21 1271.

See B. Ledain, *Histoire d'Alphonse, frère de S. Louis et du comté de Poitou sous son administration* (1241–71) (Poitou, 1869); E. Boutaric, *Saint Louis et Alphonse de Poitiers* (Paris, 1870); A Molinier, *Étude sur l'administration de S. Louis et d'Alphonse de Poitiers* (Toulouse, 1880); and also his edition of the *Correspondance administrative d'Alphonse de Poitiers* in the *Collection de documents inédits pour servir à l'histoire de France* (Paris, 1894 and 1895).

ALPHONSINE TABLES, astronomical tables produced at Toledo in 1252 by 50 astronomers under the patronage of Alphonso (Alfonso) X. of Castile.

ALPHONSO, the common English spelling of Affonso, Alonso and Alfonso, which are respectively the Galician, the Leonese, and the Castilian forms of Ildefonso (Ildefonsus), the name of a saint and archbishop of Toledo in the 7th century. The name has been borne by a number of Portuguese and Spanish kings.

ALPHONSO I. (1104–1134), King of Aragon, is sometimes counted the seventh in the line of the kings of Leon and Castile. A passionate fighting-man (he fought 29 battles against Christian or Moor), he was married to Urraca, widow of Raymond of Burgundy, a very dissolute and passionate woman. The marriage had been arranged by Alphonso VI., in 1106, to unite the two chief Christian states against the Almoravides, and to supply them with a capable military leader. But Urraca was tenacious of her right as proprietary queen, and had not learnt chastity in the polygamous household of her father. Husband and wife quarrelled with the brutality of the age, and came to open war. Alphonso had the support of one section of the nobles who found their account in the confusion. Being a much better soldier than any of his opponents he gained victories at Sepúlveda and Fuente de la Culebra, but his only trustworthy supporters were his Aragonese, who were not numerous enough to keep down Castile and Leon. The marriage of Alphonso and Urraca was declared null by the pope, as they were third cousins. The king quarrelled with the Church, and particularly with the Cistercians, almost as violently as with his wife. As he beat her, so he drove Archbishop Bernard into exile and expelled the monks of Sahagun. He was finally compelled to give way in Castile and Leon to his stepson, Alphonso, son of Urraca and her first husband. The intervention of Pope Calixtus II. brought about an arrangement between the old man and the young. Alphonso the Battler won his great successes in the middle Ebro, where he expelled the Moors from Saragossa; in the great raid of 1125, when he carried away a large part of the subject-Christians from Granada; and in the south-west of France, where he had rights as king of Navarre. Three years before his death he made a will leaving his kingdom to the Templars, the Hospitallers, and the Knights of the Sepulchre; this his subjects refused to carry out. He was a fierce soldier and nothing else; his piety was wholly militant; but, though he died in 1134 after losing to the Moors at Braga, he has a great place in the reconquest.

ALPHONSO II., King of Aragon (1162–1196) was the son of Raymond Berenger, count of Barcelona, and of Petronilla, niece of Alphonso the Battler, and daughter of Ramiro, surnamed the Monk. He succeeded to the county of Barcelona in 1162 on the death of his father, at the age of 11, and in 1164 his mother renounced her rights in Aragon in his favour. Though christened Ramon (Raymond), the favourite name of his line, he reigned as Alphonso out of a wish to please his Aragonese subjects, to whom the memory of the Battler was dear. As king of Aragon he took a share in the work of the reconquest, by helping his cousin, Alphonso VIII. of Castile, to conquer Cuenca, and to suppress one Pero Ruiz de Azagra, who was endeavouring to carve out a kingdom for himself in the debatable land between Christian and Mohammedan. But his double position as ruler, both north and south, of the eastern Pyrenees, distracted his policy. In character and interests he was rather Provençal than Spanish, no enemy of the Albigensian heretics, a favourer of the troubadours and himself a poet in the southern French dialect.

ALPHONSO III. of Aragon (1285–1291), the insignificant son of the notable Peter III., succeeded to the Spanish and Provençal possessions of his father, but his short reign did not give him time even to marry. His inability to resist the demands of his nobles and his recognition of their right to rebel in the articles called the Union helped to make anarchy permanent in Aragon.

ALPHONSO IV. of Aragon (1327–1336) was a weak man whose reign was insignificant.

ALPHONSO V. of Aragon (1416–1458), surnamed the Magnanimous, who represented the old line of the counts of Barcelona only through women, and was, on his father's side, descended from the Castilian house of Transtamara, is one of the most conspicuous figures of the early Renaissance. No man of his time had a larger share of the quality called by the Italians of the day "virtue." By hereditary right king of Sicily, by the will of Joanna II. and his own sword king of Naples, he fought and triumphed amid the exuberant development of individuality which accompanied the revival of learning and the birth of the modern world. When a prisoner in the hands of Filipo Maria Visconti, duke of Milan, in 1435, Alphonso persuaded his ferocious and crafty captor to let him go by making it plain that it was the interest of Milan not to prevent the victory of the Aragonese party in Naples. Like a true prince of the Renaissance he favoured men of letters, whom he trusted to preserve his reputation to posterity. His devotion to the classics was exceptional even in that time. He halted his army in pious respect before the birthplace of a Latin writer, carried Livy or Caesar on his campaigns with him, and his panegyrist Panormita did not think it an incredible lie to say that the king was cured of an illness by having a few pages of Quintus Curtius read to him. The classics had not refined his taste, for he was amused by setting the wandering scholars, who swarmed to his court, to abuse one another in the indescribably filthy Latin scolding matches which were then the fashion. Alphonso founded nothing, and after his conquest of Naples in 1442 ruled by his mercenary soldiers, and no less mercenary men of letters. His Spanish possessions were ruled for him by his brother John. He left his conquest of Naples to his bastard son Ferdinand, his inherited lands, Sicily and Sardinia, going to his brother John.

ALPHONSO I. (1094–1185), the first of the PORTUGUESE KINGS, son of Henry of Burgundy, count of Portugal, and Teresa of Castile, succeeded his father in 1112, and was placed under the tutelage of his mother. Being proclaimed sole ruler of Portugal in 1128, he defeated his mother's troops near Guimaraës, making her at the same time his prisoner. He also vanquished Alphonso Raymond of Castile, his mother's ally, and thus freed Portugal from dependence on the crown of Leon. Next turning his arms against the Moors, he obtained, on July 26, 1139, the victory of Ourique, and immediately after was proclaimed king by his soldiers. He assembled the Cortes of the kingdom at Lamego, where he received the crown from the archbishop of Braganza; the assembly also declared that Portugal was no longer a dependency of Leon. Alphonso wrested from the Moors Santarem in 1146, and Lisbon in 1147. Some years later he became involved in a war that had broken out among the kings of Spain; and in 1167 he was made prisoner by the soldiers of the king of Leon, and was obliged to surrender as his ransom almost all the conquests he had made in Galicia. In 1184, in spite of his great age, he had still sufficient energy to relieve his son, Sancho, who was besieged in Santarem by the Moors. He died shortly after, in 1185. Alphonso was a man of gigantic stature, being, according to some authors, 7ft. high. He is revered as a saint by the Portuguese, both on account of his personal character and as the founder of their kingdom.

ALPHONSO II., "the Fat" (1185–1223), succeeded his father, Sancho I. in 1211. He gained a victory over the Moors at Alcácer do Sal in 1217. He was excommunicated by Honorius III. for trying to seize part of the Church revenues for public purposes.

ALPHONSO III. (1210–1279), son of Alphonso II., succeeded his brother, Sancho II., in 1248. Besides making war upon the Moors, he was, like his father, frequently embroiled with the Church. In his reign Algarve became part of Portugal.

ALPHONSO IV. (1290–1357) succeeded his father, Dionis, whose death he had hastened by his intrigues and rebellions, in 1325. Alphonso connived at the barbarous murder of Iñez de Castro, who had secretly married his son, Peter. In revenge Peter devastated the whole of the country between the Douro and the Minho before he was reconciled to his father.

ALPHONSO V., "Africano" (1432–1481) succeeded his father, Edward, in 1438. During his minority he was placed under the regency, first of his mother, and latterly of his uncle, Dom Pedro. In 1448 he assumed the government and married Isabella, Dom Pedro's daughter. Next year, being led by what he afterwards discovered to be false representations, he declared Dom Pedro a rebel and defeated his army in a battle at Alfarrobeira, in which his uncle was slain. In 1458, and with more numerous forces in 1471, he invaded the territories of the Moors in Africa and by his successes there acquired his surname of "the African." On his

return to Portugal in 1475 he invaded Castile, where two princesses were disputing his succession to the throne. Alphonso was betrothed to the princess Juana, and was proclaimed king of Castile and Leon; but in 1476 he was defeated at Toro by Ferdinand, the husband of Isabella of Castile. He sought in vain the assistance of Louis XI., and was compelled to abdicate in favour of his son John. John refused the crown, and Alphonso ruled for two years longer. He then retired into a monastery at Cintra.

ALPHONSO VI. (1643–1675), the second king of the house of Braganza, succeeded his father in 1656. In 1667 he was compelled by his wife and brother to abdicate, and was banished to the island of Terceira. These acts, which the vices of Alphonso had rendered necessary, were sanctioned by the Cortes in 1668.

ALPHONSO I. (739–757), the first of the Kings of Spain, is said to have married Ormesinda, daughter of Pelayo, who was raised on the shield in Asturias as king of the Goths after the Arab conquest. He is also said to have been the son of Peter, duke of Cantabria. It is not improbable that he was, in fact, an hereditary chief of the Basques, but no contemporary records exist. His title of "the Catholic" itself may very well have been the invention of later chronicles.

ALPHONSO II. (789–842), his reputed grandson, bears the name of "the Chaste." The Arab writers who speak of the Spanish kings of the north-west as the Beni-Alfons, appear to recognize them as a royal stock derived from Alphonso I. The events of his reign are in reality unknown. Poets of a later generation invented the story of the secret marriage of his sister Ximena with Sancho, count of Saldaña, and the feats of their son, Bernardo del Carpio. Bernardo is the hero of a *cantar de gesta* (*chanson de geste*) written to please the anarchical spirit of the nobles.

The first faint glimmerings of mediaeval Spanish history begin with ALPHONSO III. (866–914) surnamed "the Great." Of him also nothing is really known except the bare facts of his reign, and of his comparative success in consolidating the kingdom known as "of Galicia," or "of Oviedo," during the weakness of the Omayyad princes of Cordova. ALPHONSO IV. (924–931) has a faint personality. He resigned the crown to his brother, Ramiro, and went into a religious house. A certain instability of character is revealed by the fact that he took up arms against Ramiro, having repented of his renunciation of the world. He was defeated, blinded, and sent back to die in the cloister of Sahagun. It fell to ALPHONSO V. (909–1028) to begin the work of reorganizing the Christian kingdom of the north-west after a most disastrous period of civil war and Arab inroads. Enough is known of him to justify the belief that he had some of the qualities of a soldier and a statesman. His name, and that of his wife Geloria (Elvira), are associated with the grant of the first franchises of Leon. He was killed by an arrow while besieging the town of Viseu in northern Portugal, then held by the Mohammedans. (For all these kings *see* SPAIN: *History*.)

With ALPHONSO VI. (1065–1109) we come to a sovereign of strong personal character. Much romance has gathered round his name. In the *cantar de gesta* of the Cid he plays the part attributed by mediaeval poets to the greatest kings, to Charlemagne himself. He is alternately the oppressor and the victim of heroic and self-willed nobles—the idealized types of the patrons for whom the jongleurs and troubadours sang. (For the events of his reign *see* the article SPAIN: *History*.) He is the hero of a *cantar de gesta* which, like all but a very few of the early Spanish songs, *e.g.*, the *cantar* of Bernardo del Carpio, and the *Infantes* of Lara, exists now only in the fragments incorporated in the chronicle of Alphonso the Wise, or in ballad form. His flight from the monastery of Sahagun, where his brother Sancho endeavoured to imprison him, his chivalrous friendship for his host Almamun of Toledo, *caballero aunque mon*, a gentleman although a Moor, the passionate loyalty of his vassal, Peranzules, and his brotherly love for his sister, Urraca of Zamora, may owe something to the poet who took him for hero. They are the answer to the poet of the nobles who represented the king as having submitted to take a degrading oath at the hands of Ruy Diaz of Bivar (the Cid), in the church of Santa Gadea at Burgos, and as having then persecuted the brave man who defied him. When every allowance is made, Alphonso VI. stands out as a strong man fighting for his own hand, which in his case was the hand of the king whose interest was law and order, and who was the leader of the nation in the reconquest. On the Arabs he impressed himself as an enemy very fierce and astute, but as a keeper of his word. A story of Mohammedan origin, which is probably no more historical than the oath of Santa Gadea, tells of how he allowed himself to be tricked by Ibn Ammar, the favourite of Al Motamid, the king of Seville. They played chess for an extremely beautiful table and set of men, belonging to Ibn Ammar. Table and men were to go to the king if he won. If Ibn Ammar gained he was to name the stake The latter did win and demanded that the Christian king should spare Seville. Alphonso kept his word. Whatever truth may lie behind the romantic tales of Christian and Mohammedan, we know that Alphonso represented in a remarkable way the two great influences then shaping the character and civilization of Spain. At the instigation, it is said, of his second wife, Constance of Burgundy, he brought the Cistercians into Spain, established them in Sahagun, chose a French Cistercian, Bernard, as the first archbishop of Toledo after the reconquest in 1085, married his daughters, legitimate and illegitimate, to French princes, and in every way forwarded the spread of French influence—then the greatest civilizing force in Europe. He also drew Spain nearer to the papacy, and it was his decision which established the Roman ritual in place of the old missal of Saint Isidore—the so-called Mozarabic. On the other hand he was very open to Arabic influence. He protected the Mohammedans among his subjects and struck coins with inscriptions in Arabic letters. After the death of Constance he perhaps married, and he certainly lived with Zaida, said to have been a daughter of "Benabet" (Al Motamid), Mohammedan king of Seville. Zaida, who became a Christian under the name of Maria or Isabel, bore him the only son among his many children, Sancho, whom Alphonso designed to be his successor, but who was slain at the battle of Uclés in 1108. Women play a great part in Alphonso's life.

ALPHONSO VII, "the Emperor" (1126–1157), is a dignified and somewhat enigmatical figure. A vague tradition had always assigned the title of emperor to the sovereign who held Leon as the most direct representative of the Visigoth kings, who were themselves the representatives of the Roman empire. But though given in charters, and claimed by Alphonso VI. and the Battler, the title had been little more than a flourish of rhetoric. Alphonso VII. was crowned emperor in 1135, after the death of the Battler. The weakness of Aragon enabled him to make his superiority effective. He appears to have striven for the formation of a national unity, which Spain had never possessed since the fall of the Visigoth kingdom. The elements he had to deal with could not be welded together. Alphonso was at once a patron of the Church and a protector if not a favourer of the Mohammedans, who formed a large part of his subjects. His reign ended in an unsuccessful campaign against the rising power of the Almohades. Though he was not actually defeated, his death in the Pass of Muradel in the Sierra Morena, while on his way back to Toledo, occurred in circumstances which showed that no man could be what he claimed to be—"king of the men of the two religions" His personal character does not stand out with the emphasis of those of Alphonso VI. or the Battler. Yet he was a great king, the type and, to some extent, the victim of the confusions of his age—Christian in creed and ambition, but more than half oriental in his household.

ALPHONSO VIII (1158–1214), king of Castile only, and grandson of Alphonso VII., is a great name in Spanish history, for he led the coalition of Christian princes and foreign crusaders which broke the power of the Almohades at the battle of the Navas de Tolosa in 1212. The events of his reign are dealt with under SPAIN. His personal history is that of many mediaeval kings. He succeeded to the throne on the death of his father, Sancho, at the age of a year and a half. Though proclaimed king, he was regarded as a mere name by the unruly nobles to whom a minority was convenient. The devotion of a squire of his household, who carried him on the pommel of his saddle to the stronghold of San Esteban de Gormaz, saved him from falling into the hands of the contending factions of Castro and Lara, or of his uncle, Ferdinand of Leon, who claimed the regency. The loyalty of the town of Avila pro-

tected his youth. He was barely 15 when he came forth to do a man's work by restoring his kingdom to order. It was only by a surprise that he recovered his capital, Toledo, from the hands of the Laras. His marriage with Leonora of Aquitaine, daughter of Henry II. of England, brought him under the influence of the greatest governing intellect of his time. Alphonso VIII. was the founder of the first Spanish university, the *studium generale* of Palencia, which, however, did not survive him.

ALPHONSO IX. (1188–1230) of Leon, first cousin of Alphonso VIII. of Castile, and numbered next to him as being a junior member of the family (*see* the article SPAIN for the division of the kingdom and the relationship), is said by Ibn Khaldun to have been called the "Baboso" or Slobberer, because he was subject to fits of rage, during which he foamed at the mouth. Though he took a part in the work of the reconquest, this king is chiefly remembered by the difficulties into which his successive marriages led him with the pope. He was first married to his cousin, Teresa of Portugal who bore him two daughters and a son who died young. The marriage was declared null by the pope, to whom Alphonso paid no attention till he was presumably tired of his wife. It cannot have been his conscience which constrained him to leave Teresa, for his next step was to marry Berengaria of Castile, who was his second cousin. For this act of contumacy the king and kingdom were placed under interdict. The pope was, however, compelled to modify his measures by the threat that if the people could not obtain the services of religion they would not support the clergy, and that heresy would spread The king was left under interdict personally, but to that he showed himself indifferent, and he had the support of his clergy. Berengaria left him after the birth of five children, and the king then returned to Teresa, to whose daughters he left his kingdom by will.

ALPHONSO X., *El Sabio,* or "the Learned" (1252–1284), is perhaps the most interesting, though he was far from being the most capable, of the Spanish kings of the middle ages. (His merits as a writer are dealt with in the article SPAIN: *Literature*) His scientific fame is based mainly on his encouragement of astronomy. As a ruler he showed legislative capacity, and a very commendable wish to provide his kingdoms with a code of laws and a consistent judicial system. The *Fuero Real* was undoubtedly his work, and he began the code called the *Siete Partidas,* which, however, was only promulgated by his great-grandson His descent from the Hohenstaufen, through his mother, a daughter of the emperor Philip, gave him claims to represent the Suabian line. The choice of the German electors, after the death of Conrad IV. in 1254, misled him into wild schemes which never took effect, but caused immense expense. To obtain money he debased the coinage, and then endeavoured to prevent a rise in prices by an arbitrary tariff. The little trade of his dominions was ruined, and the burghers and peasants were deeply offended. His nobles, whom he tried to cow by sporadic acts of violence, rebelled against him. His second son, Sancho, enforced his claim to be heir, in preference to the children of Ferdinand de la Cerda, the elder brother, who died in Alphonso's life. Son and nobles alike supported the Moors, when he tried to unite the nation in a crusade; and when he allied himself with the rulers of Morocco they denounced him as an enemy of the faith. A reaction in his favour was beginning in his later days, but he died defeated and deserted at Seville, leaving a will by which he endeavoured to exclude Sancho.

ALPHONSO XI. (1312–1350) is variously known among Spanish kings as the Avenger or the Implacable, and as "he of the Rio Salado." The first two names he earned by the ferocity with which he repressed the disorder of the nobles after a long minority; the third, by his victory over the last formidable African invasion of Spain in 1340. The chronicler who records his death prays that "God may be merciful to him, for he was a very great king." The mercy was needed. Alphonso XI. never went to the insane lengths of his son, Peter the Cruel, but he could be abundantly sultanesque in his methods. He killed for reasons of state, without form of trial, while his open neglect of his wife, Maria of Portugal, and his ostentatious passion for Leonora de Guzman, who bore him a large family of sons, set Peter an example which he did not fail to better. It may be that his early death, during the great plague of 1350, at the siege of Gibraltar, only averted a desperate struggle with his legitimate son, though it was a misfortune in that it removed a ruler of eminent capacity, who understood his subjects well enough not to go too far.

BIBLIOGRAPHY.—The lives of all the early kings of Spain will be found in the general histories (*see* the article SPAIN: *Bibliography*), of which the most trustworthy is the *Anales de la Corona de Aragon,* by Geronimo Zurita (Saragossa, 1610). *See* also the Chronicles of the Kings of Castile in the *Biblioteca de Autores Españoles de Riva deneyra* (1846–80, vols. lxvi., lxviii., lxx.). (D. H.)

ALPHONSO XII. (1857–1885), first of the Kings of ALL SPAIN, became king of Spain, son of Isabella II. and Maria Fernando Francisco de Assisi, eldest son of the duke of Cadiz, was born on Nov. 28, 1857. When Queen Isabella and her husband were forced to leave Spain by the revolution of 1868, he accompanied them to Paris, and from thence he was sent to the Theresianum at Vienna to continue his studies On June 25, 1870, he was recalled to Paris, where his mother abdicated in his favour, in the presence of a number of Spanish nobles who had followed the fortunes of the exiled queen. He assumed the title of Alphonso XII ; for although no king of *united* Spain had previously borne the name, the Spanish monarchy was regarded as continuous with the more ancient monarchy, represented by the 11 kings of Leon and Castile already referred to. Shortly afterwards he proceeded to Sandhurst to continue his military studies, and while there he issued, on Dec. 1, 1874, in reply to a birthday greeting from his followers, a manifesto proclaiming himself the sole representative of the Spanish monarchy At the end of the year, when Marshal Serrano left Madrid to take command of the northern army, General Martinez Campos entered Valencia in the king's name. Thereupon the president of the council resigned, and the power was transferred to the king's plenipotentiary and adviser, Canovas del Castillo. In 1876 a vigorous campaign against the Carlists, in which the young king took part, resulted in the defeat of Don Carlos and his abandonment of the struggle. Early in 1878 Alphonso married his cousin, Princess Maria de las Mercedes, daughter of the duc de Montpensier, but she died within six months of her marriage. Towards the end of the same year a young workman of Tarragona, Oliva Marcousi, fired at the king in Madrid. On Nov. 29, 1879, he married Maria Christina, daughter of the archduke Charles Ferdinand. During the honeymoon a pastrycook named Otero fired at the young sovereigns as they were driving in Madrid The children of this marriage were Maria de las Mercedes, titular queen from the death of her father until the birth of her brother, born on Sept. 11, 1880, married on Feb 14, 1901, to Prince Carlos of Bourbon, died on Oct. 17, 1904; Maria Teresa, born on Nov. 12, 1882, married to Prince Ferdinand of Bavaria on Jan. 12, 1906; and Alphonso. In 1881 the king refused to sanction the law by which the ministers were to remain in office for a fixed term of 18 months, and upon the consequent resignation of Canovas del Castillo, he summoned Sagasta, the Liberal leader, to form a cabinet. Alphonso died of phthisis on Nov. 24, 1885. Coming to the throne at such an early age, he had served no apprenticeship in the art of ruling, but he possessed great natural tact and a sound judgment ripened by the trials of exile. In his short reign peace was established both at home and abroad, the finances were well regulated, and the various administrative services were placed on a basis that afterwards enabled Spain to pass through the disastrous war with the United States without even the threat of a revolution.

ALPHONSO XIII. (1886–), king of Spain, was born in Madrid, May 17 1886, the posthumous son of Alphonso XII. Belonging to the House of Bourbon-Habsburg, he was baptized as Leon Fernando Maria Jaime Isidoro Pascual Antonio. Born a king, he was proclaimed at birth sovereign under the regency of his mother. Great care was taken to remedy the delicacy of his physique, with the result that in his 16th year he was hale and vigorous. His education was not neglected. He mastered thoroughly English, French and German and acquired a fair knowledge of history and the elements of agriculture.

On coming of age in 1902 Alphonso XIII. endeavoured to get into touch with his subjects in various provinces of his realm, entered into personal relations with the representatives of science,

art, and labour and sought everywhere to awaken enterprise and encourage effort. In 1905 he visited Austria, Germany, England and France. One day while driving in Paris, with the president of the French republic, he narrowly escaped death from the bomb of an unknown criminal.

On May 31 1906, Alphonso married Victoria Eugénie, daughter of Princess Henry of Battenberg, and granddaughter of Queen Victoria. On the same day a bomb was thrown at their carriage by Mateo Morral, but happily neither of the sovereigns was injured. After the birth of his eldest son Alphonso (May 10 1907), who was proclaimed prince of the Asturias, the king renewed his travels in Spain, France and England, and at the close of the undecided African campaign of 1909 visited Melilla, where he familiarized himself with the scenes of the fighting. At the funeral of his murdered premier, Canalejas, Alphonso XIII. fearlessly followed the coffin on foot amid a great concourse of people. In April 1913, when returning from the ceremony of the oath to the national flag in Madrid, the king was fired at three times and again he escaped unhurt. His coolness and dignified behaviour on this occasion won for him enthusiastic ovations, and the generosity that prompted him to commute the death sentence on his would-be assassin intensified his popularity.

In the early days Alphonso had been singled out as the innocent symbol of an odious régime, but later he was charged with being the fomentor of a shameful system of favouritism. The Melilla campaign brought home the evils of bad government alike to the listless masses, who furnished the blood and money to carry it on, and to the officers' corps, who complained that rewards and promotion were lavished on drones while those who bore the brunt of the struggle were systematically ignored; and the monarch's popularity began to decline. By way of lessening the dissatisfaction the king, after a visit to President Poincaré, announced Spain's adherence to the Franco-Anglo-Russian entente respecting Morocco (1913) and in the same year he strove to settle the Catalonian difficulty by adopting decentralization and bestowing a large measure of autonomy on various provinces for administrative purposes But the Morocco problem seemed perennial and the concession of home rule failed to satisfy the extremists in Catalonia, who forthwith clamoured for a degree of political independence incompatible with Spanish unity and destructive of their own economic prosperity.

Then it was that Antonio Maura (q v), having outgrown parties and factions, emerged as one of the few genuine statesmen produced by Spain in modern times. His measures of reform were root-reaching, but he was thwarted by the machinations of his adversaries, the perfidy of his partisans, and his own lack of peremptory energy, and was therefore unable to enforce the restraints prescribed by the Constitution. With the failure of Maura's experiment the last flicker of hope for Spain seemed extinguished. The position of the king became increasingly difficult, notwithstanding his efforts to better it. At the outbreak of the Portuguese revolution his official attitude, despite his dream of an Iberian union and the temptation to realize it, was irreproachable, and during the World War, when Spain's position was superlatively difficult, the king remained scrupulously neutral and rendered immense services to the cause of humanity.

At home, he was less fortunate. The war, by depriving the Rif tribes of arms and ammunitions, had placed them at the mercy of Spain, but the parliamentarians allowed the opportunity to slip and the Moors to bleed the nation white (*see* MOROCCO, CAMPAIGN IN). The monarch was held partly responsible for this disaster and also for the serious abuses prevalent throughout the army and the Government. Education was almost non-existent; the army was inefficient; the navy a fiction; justice itself was a sham and a snare, and the nation was but a shuttlecock in the hands of two parties tossed between hopeless ineptitude and insatiable greed. Discerning no prospect of redress, the officers' corps, which was the only organ of remedial action in the peninsula, drafted a reform programme and through the intermediary of the Infantry Union summoned the Government in June 1917 to accept it without restriction or delay. The arrest of its spokesmen only served to reveal the solidarity of the army while the impotence of the cabinet and the triumph of the officers dealt a blow to parliamentary government from which it has not since recovered. But before its final collapse the rulers allowed a tidal wave of syndicalist terrorism to invade Catalonia and render normal existence impossible there.

At this conjuncture Gen. Primo de Rivera (q.v.), aided by a group of resolute comrades and trusting in the king's official acquiescence in an accomplished fact, seized the reins of power, dismissed the cabinet, proclaimed the directorate, suspended the Constitution, introduced censorship, and suppressed for the time syndicalism, separatism, and wholesale assassination. After two years' tenure of office he lost the support of some of his partisans and aroused the active hostility of many passive adversaries, while conspiracies were hatched in Paris, Barcelona and Madrid, some for the purpose of assassinating the king, in June 1925, others with the object of overturning the directorate in Nov. 1925. In Sept 1927 the king authorized Primo de Rivera to convene a consultative national assembly consisting mainly of supporters of the dictator, for the purpose of drawing up a definitive Constitution. It was announced that in the year 1930 a "real parliament" would be convoked which would accept this Constitution with suitable modifications, and that Spain would return to normal political life. The dictator emphasized the fact that the assembly of 1927 made no claim to be a parliament and added that the restrictions with which it was hedged round were imposed for the purpose of keeping the members to their main task, the drafting of the new Constitution. (E J. D)

ALPHONSUS A SANCTA MARIA, or ALPHONSO DE CARTAGENA (1396–1456), a Spanish historian, was born at Carthagena, succeeded his father, Paulus, as bishop of Burgos, and was sent by John II. of Castile to the Council of Basle in 1431.

His principal work is *Rerum Hispanorum Romanorum imperatorum, summorum pontificum, nec non regum Francorum anacephaleosis*, a history of Spain from the earliest times down to 1456; it was printed at Granada in 1545, and also in the *Rerum Hispanicarum Scriptores aliquot*, by R. Bel (Frankfort, 1579). Alphonsus died on July 12, 1456.

ALPINI, PROSPERO, or PROSPER ALPINUS (1553–1617), Italian physician and botanist, was born at Marostica, in the republic of Venice. He studied medicine at Padua, and practised as a physician. During a three years' residence in Egypt as physician to the Italian consul in Cairo he studied the palm-tree, and he seems to have deduced the doctrine of the sexual difference of plants, which was adopted as the foundation of the Linnaean system. He says that "the female date-trees or palms do not bear fruit unless the branches of the male and female plants are mixed together; or, as is generally done, unless the dust found in the male sheath or male flowers is sprinkled over the female flowers." In 1593 he was appointed professor of botany at Padua. He was succeeded in the botanical chair by his son Alpino Alpini (d. 1637). His best-known work is *De Plantis Aegypti liber* (Venice, 1592). His *De Medicina Egyptiorum* (Venice, 1591) is said to contain the first account of the coffee plant published in Europe.

ALPS, the collective name for one of the great mountain systems of Europe stretching from the Gulf of Genoa to Vienna, and rising between the plains of northern Italy and of southern Germany. The Alps do not present so continuous a barrier as the Himalayas, the Andes or even the Pyrenees. They are less extensive than the Urals or the Scandinavian highlands. They are formed of numerous ranges, divided by comparatively deep valleys. This mountain mass forms a broad band, convex towards the north, while most of the valleys lie between the directions west to east and south-west to north-east. Many deep transverse valleys intersect the prevailing direction of the ridges and facilitate the passage of man, animals and plants, as well as of currents of air which mitigate the contrast that would otherwise be found between the climates of the opposite slopes. The derivation of the name Alps is uncertain; in all parts of the great chain itself the term *Alp* (or *Alm* in the Eastern Alps) is strictly applied to the high mountain pastures (*see* ALP), and not to the peaks and ridges of the chain.

Limits of the Alps.—If we merely desire to distinguish the Alps from minor ranges the best limits are on the west (strictly speaking, south), the Col d'Altare or di Cadibona (1,624ft.), leading from Turin to Savona and Genoa, and on the east the line of the railway over the Semmering Pass (3,215ft.) from Vienna to Marburg in the Mur valley, and on by Laibach to Trieste. An Italian commission in 1926 placed the limit on the east at a line from Vienna through Graz to Fiume. But if we confine the term to those parts where the height is sufficient to support perpetual snow, the limit to the west will be the Col di Tenda (6,145ft.), leading from Cuneo (*Coni*) to Ventimiglia, while on the east our line will be the route over the Radstädter Tauern (5,702ft.) and the Katschberg (5.384ft) from Salzburg to Villach in Carinthia, and thence by Klagenfurt to Marburg and so past Laibach in Carniola on to Trieste.

On the north side, the Alps (in either sense) are definitely bounded by the Rhine from Basle to the Lake of Constance, the plain of Bavaria and the low foot-hills from Salzburg to the neighbourhood of Vienna. The waters of the northern slope of the Alps find their way either into the North sea through the Rhine, or into the Black sea by means of the Danube, not a drop reaching the Baltic sea. On the south side the mountains from near Turin to near Trieste subside into the great plain of Piedmont, Lombardy and Venetia. The true west section of the Alps runs, from near Turin to the Col di Tenda, in a southerly direction, then bends east to the Col d'Altare, which divides it from the Apennines.

Divisions.—The Alps consist of a main chain, with ramifications, and of several minor chains. They form a single connected whole as contrasted with the plains at their base, the only breaks in them being mountain passes at high altitudes. For the sake of convenience the best marked passes have long been used to serve as limits within the chain, whether to distinguish several great divisions or to break up these into smaller ones. W. A. B. Coolidge's system considers only its topographical aspect. The divisions given lie between the Col di Tenda and the route over the Radstädter Tauern. Three main divisions are generally distinguished: the Western Alps, extending from the Col di Tenda to the Simplon Pass; the Central Alps from the Simplon Pass to the Reschen Scheideck Pass, and the Eastern Alps from the latter to the Radstädter Tauern route, with a bend outwards towards the south-east in order to include the higher summits of the South-Eastern Alps. Assuming these divisions, it is found convenient to subdivide the whole mountain system into 18 smaller groups—5 in the Western Alps, 7 in the Central Alps and 6 in the Eastern Alps. These, with the limits of each subdivision, are as follow:—

Western Alps.—The Maritime Alps (from the Col di Tenda to the Col de l'Argentière). The Cottian Alps (from the Col de l'Argentière to the Mont Cenis Pass and west to the Col du Galibier). The Dauphiné Alps (from the Col du Galibier, westwards and southwards). The Graian Alps (from the Mont Cenis to the Little St. Bernard Pass). These are usually divided into three groups, the Central (the watershed between the two passes named), the Western or French, and the Eastern or Italian. The Pennine Alps (from the Little St. Bernard to the Simplon Pass).

Central Alps.—The Bernese Alps (from Lake Geneva to the Furka Pass, the Reuss valley and Lake Lucerne). The Lepontine Alps (from the Simplon to the Splügen and south to the Furka and the Oberalp Passes). The eastern portion of this range is sometimes named the Adula Alps (from the St. Gotthard to the Splügen Pass). The Tödi Range (from the Oberalp to the Klausen Pass). The Glarus Alps (north of the Klausen Pass) The Bernina Alps (from the Maloja to the Reschen Scheideck and the Stelvio, south and east of the Val Bregalia and of the Engadine and north of the Valtellina). The Albula Range (from the Splügen to the Fluela Pass, north and west of the Val Bregalia and of the Engadine). The Silvretta and Rhätikon Ranges (from the Fluela to the Reschen Scheideck and the Arlberg Pass).

Eastern Alps.—The Alps of Bavaria. Vorarlberg and Salzburg (north of the Arlberg Pass, Innsbruck, the Pinzgau and the Enns valley). The Central Tirol Alps (from the Brenner to the Radstädter Tauern Pass, north of the Drave valley and south of the Pinzgau and the Enns valley). This includes the Zillerthal and the Tauern ranges. The Ortler, Stubai and Oetzthal ranges (from the Reschen Scheideck and the Stelvio to the Brenner Pass, south of the Inn valley, and north of the Tonale Pass). The Lombard Alps (from Lake Como to the Adige valley, south of the Valtellina and the Aprica and the Tonale Passes). This division includes the Adamello, Presanella, Brenta and Bergamasque ranges. The Dolomites of south Tirol (from the Brenner to the Monte Croce Pass, and south of the Pusterthal). The South-Eastern Alps (east of the Monte Croce Pass). This division includes the Julian, Carnic and the Karawanken Alps.

In 1926 an Italian commission considered the subdivision of the Alps and their suggestions embodied several modifications of the above. (*See* Douglas W. Freshfield, *Geog. Journ.* Jan. 1928, p. 37.)

Geology and Structure.—The Alps form but a small portion of a great zone of crumpling which stretches in a series of curves from the Rif mountains of Morocco to beyond the Himalayas The whole group of mountains may be conveniently called the Alpine-Himalayan group. Within this zone the crust of the earth has been ridged up into a complex series of creases and folds, out of which the great mountain chains of southern Europe and Asia have been carved by atmospheric and other agencies. Superficially, the continuity of the zone is broken at intervals by gaps of greater or less extent; these are due in part at least to the subsidence of portions of the folded belt and their subsequent burial by more recent accumulations. Such a gap is that between the Alps and the Carpathians.

This mountain system, which stretches a quarter of the way across the globe, is formed not of a single fold of the crust but of a number of such, often parallel to one another and to the general direction (trend) of the chain. The mountains of southern Europe are an exception to the last statement, for we find that five great mountain systems radiate from the Alps themselves. One arm stretches east through the Carpathians and another to the south-east through the Dinaric Alps. The latter passes through Candia and Rhodes into the Taurus mountains, where it is joined by the continuation of the Carpathian branch, and east into the Iran Plateau and the Himalayas. This arm appears to cross southern China whilst there is a loop to the south forming the Burmese-Malayan arc. The third arm stretches west from the mountains of Provence into the Pyrénées and the northern Spanish highlands; a fourth through Liguria, Corsica, Elba, the Apennines, Sicily, the Balearic Islands, the Baetic Cordillera, across the Strait of Gibraltar and into the Rif mountains of Morocco. This latter demarcation of the fourth arm is according to Staub, but Kober considers the Baetic Cordillera as part of the Provence-Pyrenees branch, and thinks that the Apennines branch continues by way of Sicily directly into the Rif mountains. A fifth narrow chain stretches from Grenoble into the Jura mountains. These several chains, forming one great mountain system, were uplifted during the same period of earth-movement and by the same set of causes. Each branch is in a certain sense a separate unit but each is represented in the Alps which is the narrowest portion of the whole mountain belt, and in consequence every aspect of the geology of the Alps is of paramount importance when the whole chain is considered.

Sedimentary rocks form a large part of the Alps. These range from the Trias to the Miocene, but older rocks (Permian, Carboniferous, Devonian, Silurian and possibly Cambrian) also occur and are of considerable importance, especially in the Eastern Alps. Crystalline gneisses and schists and igneous rocks also occur. There are many rock types of local importance which need special mention. Here we find the characteristic Tertiary rocks, Molasse, Nagelfluh and Flysch. The former consists of a remarkably uniform series which crops out along the northern border of the Alps in the Great Swiss plateau. To the south of this is the Flysch zone which attains more important dimensions in the east than in the west. Other types which have commanded universal interest are the Gosau beds, Verrucano and Schistes Lustrés. An intensive study of the geology and structure of the Alps has been carried out during the last decade.

The Alps stand upon the site of a geosyncline which, from late Carboniferous times, through the whole of the Mesozoic period until the Miocene period, existed between the Eurasian (Foreland) landmass to the north and the African (Hinterland) landmass to the south. The sea which occupied this depression has been called by Suess and others the "Tethys." Great thicknesses of deposits were laid down in it, causing the floor to sink and thus enabling the sediments to be deposited at approximately the same depth below the sea level. Termier compared this geosyncline to a huge vice, the jaws of which moved slowly inwards concurrently as deposition was taking place between them. The Hinterland moved northward toward the Foreland. Argand has suggested that, by this movement two geanticlines (arches) arose within the geosyncline, thus bringing about the following subdivision:—the Valais Geosyncline (north), the Briançonnais Geanticline, the Piedmont Geosyncline, the Dolin Geanticline and the Canavese Geosyncline. The two geanticlines continued to increase in size as compression proceeded during the whole of the Mesozoic period until the culmination of the movement in the Miocene. The compression was so great that the geanticlines rose completely out of the Tethys and were driven northward on to the Foreland in the form of huge recumbent folds, to which the name of "Nappes" is given. The geanticlines can now be identified in the Pennine Alps as the Great St. Bernard Nappe and the Dent Blanche Nappe. Further, the rise of these two structures also brought about the formation of other structures within the Alpine geosynclines; the Great St. Bernard Nappe forcing upward and forward the three Simplon Nappes which lie beneath it, and the Dent Blanche Nappe similarly bringing into being the Monte Rosa Nappe. There are thus in the Pennine Alps six major tectonic elements which arose from the Alpine geosyncline.

Apart from these, the Foreland and the Hinterland both played important rôles and large tracts of the mountains belong to these divisions. Sedimentary rocks were laid down in epicontinental seas upon the peneplained Hercynian surfaces of these continental masses and these rocks, as well as the fundamental crystalline rocks, were affected by the Alpine earth-movements. The northward movement of the Hinterland was so great that portions of it were driven completely over the geosynclinal rocks on to the Foreland itself. Sedimentary rocks of the same age belong to the Foreland, the Hinterland and the Geosyncline, but there are distinct differences in facies between them as well as differences within each group. Recumbent folding and overthrusting are common throughout the whole of the Alps, but the particular type of structure found in any locality depends upon the nature of the rocks and their location in one or other of the main divisions.

From a geological point of view it is convenient to divide the Alps into Western Alps and Eastern Alps along the Rhine-line (a north-south line through the Lake of Constance, Coire and the Septimer Pass). The following is a summary of the chief tectonic divisions:—

Western Alps.—(*a*) The Jura mountains; (*b*) the great Swiss plateau of Tertiary rocks; (*c*) the Prealps, with exotic Palaeozoic, Mesozoic and Tertiary rocks; (*d*) the zone of the high Calcareous Alps of Switzerland (the Helvetide zone of Staub); (*e*) the "zone of Mont Blanc" in which are the crystalline Hercynian massifs, Mercantour, Pelvoux and Belledonne, Mont Blanc and Aiguilles Rouges, Gotthard, Aar and Gastern-Erstfeld (the Autochthonous massifs of Heim); (*f*) the Pennine zone, in which occur the Pennine Nappes (Pennides of Staub); (*g*) the zone of the "Inner Roots," containing the "roots" of the Pennine, Austride and Dinaride Nappes.

Eastern Alps.—(*a*) The great Swiss plateau with Tertiary rocks; (*b*) the northern Flysch zone (the East Alpine equivalent of the zone of the high Calcareous Alps); (*c*) the zone of the Eastern Alps; (1) the northern Limestone zone of Triassic, Jurassic and Cretaceous rocks; (2) the Greywacke zone of schists and limestones of Palaeozoic age; (3) the central zone, forming the chief mountain tracts of the Eastern Alps and built up chiefly of Austride Nappes; (4) the Pennine "windows" which occur within the central zone and in which Pennine Nappes are found; (*d*) the Dinaride zone in which the Dinaride Nappes occur and which is formed of Palaeozoic and Mesozoic rocks and several plutonic intrusions.

Of these divisions the Jura mountains, the great Swiss plateau, the zone of the high Calcareous Alps, the northern Flysch zone and the "zone of Mont Blanc" belong to the Foreland; the Pennine zone, the Pennine "windows" and part of the zone of the "Inner Roots" belong to the Alpine geosyncline, whilst the northern Limestone zone, the Greywacke zone, the central zone, the Prealps, part of the zone of the "Inner Roots" and the Dinaride zone belong to the Hinterland.

Although the Foreland acted as a single unit during the Alpine earth-movements it did not possess a simple homogeneous structure. Some portions of it (*e g.*, the central plateau of France, the Vosges, the Black Forest, the Bohemian mountains and the massifs of the "zone of Mont Blanc") resisted the northward advance of the folds, and the effect of this is well seen in the trend of the chain. To assist in forming a clear idea of this, a simple illustration will suffice.

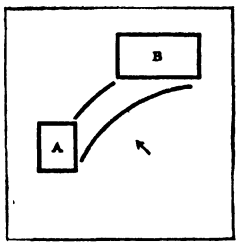


DIAGRAM ILLUSTRATING FORMATION OF THE ALPS
If two books, A and B, are placed on a cloth-covered table, and pressure is exercised on the cloth in direction of the arrow, folds resembling in miniature the "nappes" of the Alps will be produced

Upon a table covered by a thick cloth lay two books (A and B) in the positions shown in the figure. If the two hands are placed flat upon the table and the cloth pushed in the direction indicated, it will at once be rucked up into a fold which will follow a curve not unlike that of the Alps The precise form and character of the folds will depend upon the nature of the cloth, position and number of obstructions, and other accidental circumstances. Moreover, if sufficient pressure be exerted, the folds will lie one above the other as in the Alps themselves. Here also there were two sets of obstructions, an outer group comprising the Maures-Esterel massif, central plateau of France, Vosges-Black Forest and Bohemian massifs; and an inner group, the "zone of Mont Blanc." The outer group, well within the Foreland, determined the trend of the chains of the Basses and Dauphiné Alps, the Jura mountains and Swabian Alps. The effect of the "zone of Mont Blanc," nearer the southern edge of the Foreland, is seen in the Pennine and Eastern Alps. Here Staub has identified ten distinct arcs, five in the Eastern Alps and five in the Western Alps. The latter are more distinct than those east of the Rhine-line, for the massifs of the "zone of Mont Blanc" all occur in the Western Alps, but the occurrence of arcs farther east indicates the presence of similar massifs buried beneath the Austrides. The presence of these is further indicated by the occurrence of culminations, which are portions of the true nappe mountains in which the lower elements have been forced to high altitudes, having been driven over elevated portions of the Foreland. Denudation, especially river action, has brought about the removal of much of these upper structures and has revealed different lower units in different districts. Vertical movement, during and since the orogenic period, has made this type of segmentation more marked. Between two culminations a tectonic depression occurs in which, owing to downward sagging, the uppermost tectonic elements have been preserved from denudation Staub has identified eleven culminations and eleven depressions in the Alps, and in the Western Alps the culminations occur in each case directly behind the individual massifs of the "zone of Mont Blanc."

The massifs of the "zone of Mont Blanc" are, generally speaking, large granitic intrusions (batholiths), surrounded by crystalline schists and gneisses with sedimentary rocks more or less highly metamorphosed. In the Aar, Mont Blanc and Pelvoux massifs "fan" structure has been identified, the granitic rocks being subdivided longitudinally by steep-sided synclines of crystalline schists. The larger massifs of the zone, viz , the Aar-Gotthard, Mont Blanc, Pelvoux and Mercantour, form an inner arc, whilst the smaller ones, viz., the Gastern-Erstfeld, Aiguilles Rouges and Belledonne, form an outer arc. Both arcs are open to the south and adjacent massifs are separated by zones of sedimentary rocks, many of which have been so highly metamorphosed as to be

reduced to paragneisses. The Lötschental zone (paragneisses), the Chamonix sedimentary zone and the zone between the Pelvoux and the Belledonne occur between the two arcs. In the two former zones and in the adjacent massifs the "roots" of the nappes of the high Calcareous Alps are located. The sedimentary cover of the Aiguilles Rouges and the Gastern massifs has been called the Autochthon. This term is also applied by some authorities to all that portion of the sedimentary cover of the Hercynian peneplained surface which has not suffered acute folding, such as is found in the zone of the high Calcareous Alps. Heim further calls the massifs of the "zone of Mont Blanc" the Autochthonous massifs. The Autochthon (in its wider sense) has not suffered acute folding such as is found in the other parts of the Alps, but the rocks are in contact with the surface upon which they were originally deposited.

In the high Calcareous Alps six nappes have been identified. These are called the Helvetides by Staub, but simply the nappes of the high Calcareous Alps by Collet and others. They are named as follows (from the highest to the lowest):—(6)The Oberlaubhorn Nappe, (5) the Mont Bonvin Nappe, (4) the Plaine Morte Nappe, (3) the Wildhorn Nappe, (2) the Diablerets Nappe, (1) the Morcles Nappe.

The Morcles Nappe lies as a great recumbent fold upon the Autochthon, and has its "roots" in the zone of Chamonix. It is composed of sediments ranging from the Trias to the Eocene. Above it lies the Diablerets Nappe, the "roots" of which probably lie in the Mont Blanc massif. This nappe does not possess a reversed limb, this and much of the upper limb having been replaced by a "slide" (Bailey). The Wildhorn Nappe is the greatest of this group and is characterized by a number of digitations in the front of the structure, by disharmonic folding, and a large "involution." Its "roots" probably occur on the south side of the Mont Blanc massif. The three higher nappes (the Ultra-Helvetian Nappes of Heim) crop out in a belt 16m. long on the south side of the Wildhorn-Wildstrubel range, and again on the north side of the high Calcareous Alps in the "zone of Cols," where they form the Internal Prealps. In Eastern Switzerland (*i.e.*, East of the Hasli-Tal) the following units occur:—The Säntis-Drusberg Unit, the Axen Unit, the Glarner-Mürtschen Unit, the Parautochthonous Nappes.

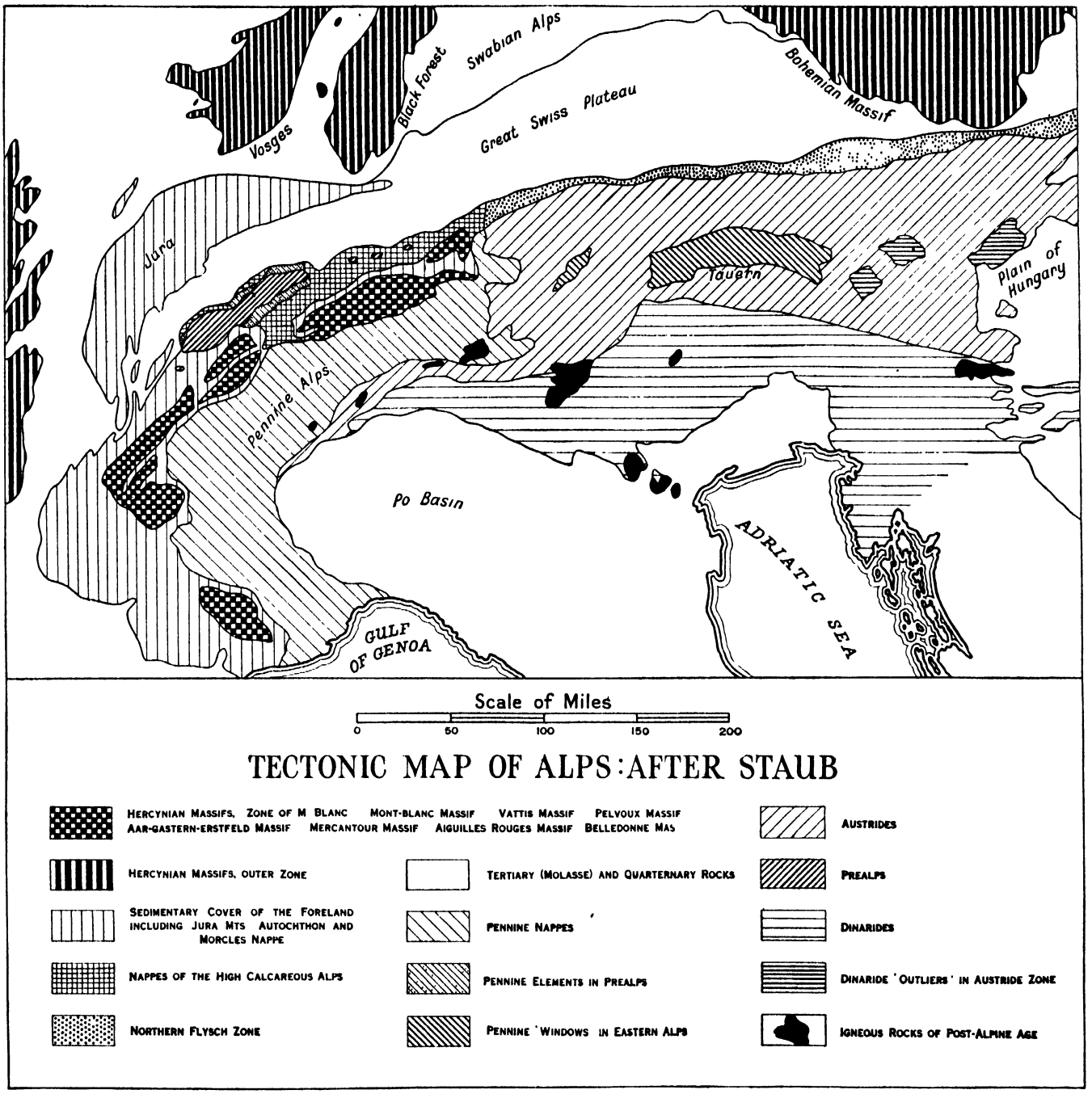
The upper unit (Säntis-Drusberg) is an eastward extension of the Wildhorn Nappe, the Glarner-Murtschen unit is homologous to the Diablerets Nappe, and the Parautochthonous Nappes rest upon the Autochthon and are homologous to the Morcles Nappe. The Axen unit is not represented in West Switzerland Three nappes, digitations of one structure, are distinguished in the Säntis-Drusberg unit, four in the Axen unit and two in the Glarner-Mürtschen unit.

With the exception of the Prealps, the great Swiss plateau bounds the high Calcareous Alps on the north. The plateau is underlain by Tertiary rocks, covered by glacial, fluvio-glacial and alluvial deposits. It forms a wide syncline between the Jura mountains and the Western Alps, and in it are gentle flexures, the most important of which is a central anticline which passes from Lake Constance to Lake Geneva. The sedimentary rocks of the Jura mountains are continuous with those of the Autochthon beneath the Tertiary rocks of the great Swiss plateau, but they do not show the same facies. They have been folded into anticlines and synclines, the trend of which is parallel to that of the Alps, but the folds are bunched together in the neighbourhood of the central plateau of France and the Vosges-Black Forest massifs. In the eastern part of the mountains the folding is complicated by block faulting. This portion is known as the Jura tableland whilst the remainder is called the Folded Juras. The folding has only a superficial character, for it dies out downward, the Anhydrite group (Middle Muschelkalk) not being folded. The beds of this latter horizon acted as a plane along which the folding took place, so producing a "décollement." A study of the tectonics of the Jura mountains reveals a remarkable association between them and the Alps.

The Pennine Nappes (Pennides of Staub), being great recumbent folds which arose out of the Alpine geosyncline, consist of Palaeozoic rocks as crystalline cores, with envelopes of newer sedimentary rocks now highly metamorphosed and known as "schistes lustrés." The evidence for the age of the schistes lustrés is sufficient to prove that they range from the Lower or Middle Trias to the Nummulitic Limestone (Eocene). They occur in the synclinal structures between the crystalline cores of the nappes and also along the frontal archbends of the latter. The three Simplon Nappes, Monte Leone (III.), Lebendun (II.), Antigorio (I.), crop out in the Ticino district, in the Lepontine culmination brought about by the obstacle of the Aar massif. (The figures I., II., etc., after the names of the nappes indicate the relative position of the structures, I. to VI. being Pennine Nappes and VII–X. Austrides) The nappes pass round the culmination and are directly connected in the south with their roots. The schistes lustrés associated with them are not so thick as elsewhere in the Pennine Alps. The Great St. Bernard Nappe (IV.), which arose from the Briançonnais geanticline, occurs above the Simplon Nappes, the latter being regarded as major digitations of the higher structure. The Great St. Bernard Nappe is the most extensive of the Pennine units and stretches in an almost unbroken outcrop from the Gulf of Genoa to the Simplon Pass. Schistes lustrés mark the front of it and also separate it from the crystalline core of the Monte Rosa (V.) Nappe, which forms the massifs of Monte Rosa, Grand Paradis, Ambin and Dora Maira and is in fact a major digitation of the highest Pennine Nappe. The Dent Blanche (VI.) Nappe, which arose from the Dolin geanticline, has suffered considerable denudation and its main outcrop in the Dent Blanche-Weisshorn mountain mass is now isolated from the "roots." Here the nappe is in contact with the Great St. Bernard Nappe, for the Monte Rosa Nappe does not reach so far north and the Great St. Bernard has suffered backward folding.

The country east of the Rhine-line belongs principally to the Hinterland. In it we find several tectonic units, named the Austrides by Staub, who also recognizes two divisions in the group, the Upper (Tirolides) and the Lower (Grisonides), both so named because of the location of their main outcrops. This is Staub's scheme, but Kober uses the name East Alpine Nappes for the Austrides and recognizes in them four main divisions. The Austrides overlie the Pennine Nappes in the Eastern Alps, for where denudation has been great the lower structures are exposed beneath the Austrides in what are known as "windows." In the Lower Engadine window, schistes lustrés occur surrounded by Grisonide elements, whilst in the Hohe Tauern window there are tectonic elements correlated by Staub with the Monte Rosa and the Dent Blanche Nappes as well as schistes lustrés. (Kober considers that the lowest elements here are homologous with the higher Simplon Nappes.) In the Semmering window, denudation has revealed the Grisonides beneath the Tirolides.

The Grisonides are divided into two major structures, the Campo (VIII.) Nappe and the Err-Bernina (VII.) Nappe, each of which has several digitations in its frontal portion. The lower of the two rests on the Margna (VI.) Nappe, which is homologous to the Dent Blanche Nappe. The Grisonides consist of crystalline cores surrounded by sedimentary rocks, the latter being peculiar in age and facies to each nappe. In the Rhätikon the Grisonides show "schuppen" structure (*i.e.*, slices overthrust one upon another) and parts of them exhibit interesting sedimentary types, which are important in a study of the Prealps. The Tirolides are similarly divided into two major structures, the Oetztal (X.) Nappe and the Silvretta (IX.) Nappe. The latter nappe is the greatest East Alpine structure and, being the lower of the two Tirolide elements, will occur to the north of the Oetztal Nappe in the "root" region, but the sedimentary cover of the latter has been driven over the Silvretta Nappe and forms the northern Limestone zone. The main outcrop of the Oetztal Nappe is in the Mur Alps of Styria, whilst the other forms the Silvretta mountain mass. The northern Limestone zone forms a wide belt from the Rhine-line to Vienna and has the structure of a great pile of overthrust masses of rocks ranging from the Trias to Cretaceous, the dolomite of the Trias being the principal member of the group. North of this zone is the northern Flysch zone, which is the eastern representative of the high Calcareous Alps.



MAP OF THE GEOLOGICAL FORMATION OF THE ALPS, SHOWING THE OUTCROPS OF THE CHIEF TECTONIC ELEMENTS

Austride elements occur west of the Rhine-line, in the Prealps, which lie between the great Swiss plateau and the high Calcareous Alps and between the River Arve and the Lake Thun. The following tectonic elements have been identified in this region:—the External Prealps forming the northern portion and being overthrust upon the Molasse of the great Swiss plateau; and the Internal Prealps on the southern margin. The Internal and External Prealps are probably connected and completely underlie the basin-like structure filled by the higher elements of the Prealps. In these two zones the higher units of the high Calcareous Alps occur. Above the Internal Prealps is the Niesen Nappe (chiefly sandstones and conglomerates), which shows Pennine affinities; whilst above the External zone there are similar sandstones, etc., forming the zone of Gurnigel which is considered by some to represent the Niesen Nappe. The Median Prealps Nappe occurs above the zones mentioned and forms the greater part of the Prealps. Above it are the Simme Nappe and the Brèche Nappe. These structures seem to show Austride affinities, and the association between them and the Austrides is further established by the occurrence of "Klippen" (*ie*, frontal portions of nappes isolated by erosion) which have the character of a connecting link, resting upon the Mesozoic rocks of the high Calcareous Alps in the central Swiss region. According to Argand the "roots" of the Simme Nappe occur in the zone of Canavese, south of the Lepontine culmination. These also are west of the Rhine-line, but they are continuous with the "roots" of the other Austride elements farther east. In the zone of Canavese the Dent Blanche Nappe is "rooted" together with the Austrides, and in consequence of this Kober considers that this nappe must belong to the East Alpine group (Austrides) and not to the Pennine chain.

The "roots" of the Pennine Nappes (the "inner roots") lie in a zone which stretches eastward from near Ivrea, through Locarno. The "roots" of the Austrides are in contact with these but on the south side of them. The nappes are vertical in this zone or even overturned toward the south. To the south again are the Dinaride Nappes. The boundary between the Austrides and the Dinarides

(the Dinaric boundary) passes from the neighbourhood of the Italian Lakes to Meran, then east through the Drau Range to the south-east end of Bacher mountains, where it disappears beneath the Hungarian Plain. The tectonics of the Dinarides are comparatively simple. The term "nappes" is still used here by some authorities to designate the tectonic units; but the latter are very different from the nappes of other parts of the Alps, being essentially thrust masses. The extent of the thrusting is never very large. Moreover the units are not so strikingly different from one another in facies as is the case in other parts of the Alps. Kober recognizes four zones here, the Outer Zone (Adriatic), the Lower Dinaric Nappe, the Upper Dinaric Nappe and the High Dinaric Nappe. The stratigraphy of the Dinaric zone shows an important development of Up. Palaeozoic rocks, Silurian, Devonian, Carboniferous, Permian and Trias. Jurassic, Cretaceous and Flysch are also important in some units. This southern belt of the Alps is noted for its rich development of calcareous rocks. "Klippen" (outliers) of Dinaride elements occur resting upon the Oetztal Nappe in the Mur Alps district. The tectonics of the structures south of the Dinaric boundary show a southward direction of movement. This reverse direction of movement probably indicates one of the latest phases of the Alpine movements. There has been considerable igneous activity in this region, but the intrusions are not all of the same age. The following are affected by Tertiary movements and must therefore belong to an earlier period:— the Kreuz, Iffinger, Brixen, and Riesenferner intrusions. The "Peri-Adriatic Intrusion Zone" (Salomon) contains the following igneous bodies:—Ivrea, Baveno, Bergeller, Adamello, the tonalite of Eisenkappel and the granites of the Bacher mountains. These were not affected by Alpine movements and are, by many authorities, thought to be of slightly later date than those movements.

Main Chain.—Several important mountain groups are situated on one or other side of the watershed of the Alps and form almost independent ranges, connected with the main chain by a kind of isthmus: such are the Dauphiné Alps, the Eastern and Western Graians, the entire Bernese Oberland, etc. The Alps, therefore, are not composed of a single range but of a great "divide," flanked on either side by other important ranges.

Starting from the Col d'Altare or di Cadibona (west of Savona), the main chain extends first south-west, then north-west to the Col di Tenda, though nowhere rising much beyond the zone of coniferous trees Beyond the Col di Tenda the direction is first west then north-west to the Rocher des Trois Évêques (9,390ft), just south of the Mont Enchastraye (9,695ft.), several peaks of about 10,000ft. rising on the watershed, though the highest of all, the Punta dell'Argentera (10,794ft.) stands a little way to its north. From the Rocher des Trois Évêques the watershed runs due north though of the two loftiest peaks of this region; one, the Aiguille de Chambeyron (11,155ft.) to the west and the other, the Monte Viso (12,609ft.) to the east of the watershed. From the head of the Val Pellice the main chain runs north-west and diminishes much in average height till it reaches the Mont Thabor (10,449ft.), which forms the apex of a salient, which the main chain here presents towards the west. Hence the main watershed extends east, culminating in the Aiguille de Scolette (11,500ft.) but makes a great curve to the north-west and back to the south-east before rising in the Rochemelon (11,605ft.), a re-entering angle in the great rampart by which Italy is guarded. Thence the direction taken is north as far as the east summit (11,693ft.) of the Levanna, the watershed rising in a series of snowy peaks, though the loftiest point of the region, the Pointe de Charbonel (12,336-ft.), stands a little to the west. Once more the chain bends north-west rising in several lofty peaks (the highest is the Aiguille de la Grande Sassière (12,323ft.), before attaining the considerable depression of the Little St. Bernard Pass (7,179ft.). Thence for a short way the direction is north to the Col de la Seigne (8,242ft.), and then north-east along the crest of the Mont Blanc chain, which culminates in the peak of Mont Blanc (15,782ft.), the loftiest in the Alps A number of high peaks crown our watershed before it attains the Mont Dolent (12,543ft.). Thence after a short dip south-east, our chain takes near the Great St. Bernard Pass (8,111ft.) the general easterly direction that it maintains throughout the Pennine Alps till it reaches Monte Rosa, whence it bends north, making one small dip to the east as far as the Simplon Pass. In the Pennine Alps the main chain maintains a greater average height than in any other part, but, though it rises in a number of lofty peaks, such as the Mont Velan (12,353ft.), the Matterhorn (14,782ft.), the Lyskamm (14,889ft.), the Nord End of Monte Rosa (15,132ft.) and the Weissmies (13,226ft.), yet many of the highest points such as the Grand Combin (14,164ft.), the Dent Blanche (14,318ft.), the Weisshorn (14,804ft.), the true summit or Dufourspitz (15,217ft.) of Monte Rosa itself, and the Dom (14,942ft.), rise on its northern slope and not on the main watershed. The chain between the Great St. Bernard and the Simplon sinks at barely half a dozen points below a level of 10,000ft. Eastward from the Simplon (6,592ft.) through the Lepontine Alps so far as the St. Gotthard (6,935ft.) the divide runs north-east, all the higher summits (including the Monte Leone, 11,684ft , and the Pizzo Rotondo, 10,489ft.) rising on it, a curious contrast to the long stretch just described. From the St. Gotthard to the Maloja (5,960ft.) the watershed between the basins of the Rhine and Po runs east as a whole, though making two great dips towards the south first to near the Vogelberg (10,565ft.) and again to near the Pizzo Gallegione (10,201ft.), so that it presents a broken and irregular appearance. Its highest point is the Rheinwaldhorn (11,149ft.).

From the Maloja Pass the main watershed dips south-east for a short distance, and then east and nearly over the highest summit of the Bernina group, the Piz Bernina (13,304ft.) to the Bernina Pass (7,645ft) Thence to the Reschen Scheideck Pass (4,954ft.) the main chain is ill-defined, though on it rises the Corno di Campo (10,844ft.), beyond which it runs slightly north-east, past the sources of the Adda and the Frael Pass (6,398ft.), sinks to form the depression of the Ofen Pass (7,523ft.), soon bends north and rises once more in the Piz Sesvenna (10,568ft.). The break in the continuity of the Alpine chain marked by the deep valley, the *Vintschgau*, of the upper Adige is one of the most remarkable features in the orography of the Alps. The chief source of the Adige is the little Reschen lake, which is only 13ft. below the Reschen Scheideck Pass (4,902ft.) and but 5m. from the Inn valley. East of this pass the main chain runs north-east to the Brenner Pass along the snowy crest of the Oetzthal and Stubai Alps, the loftiest point on it being the Weisskugel (12,291ft., Oetzthal), for the highest summits both of the Oetzthal and of the Stubai districts, the Wildspitze (12,382ft.) and the Zuckerhütl (11,520ft), stand a little to the north.

The Brenner (4,495ft.) is almost the lowest of all the great motor road passes across the main chain, and has always been the chief means of road communication between Germany and Italy. For some way beyond it the watershed runs east over the Hochfeiler (11,559ft.) the highest crest of the Zillerthal Alps. A little farther, at the Dreiherrenspitze (11,500ft.), we have to choose between following the watershed south, or keeping due east along the highest crest of the Greater Tauern Alps. (*a*) The latter course is adopted by many geographers. The watershed (though not the chief Alpine watershed) continues east through the Greater Tauern Alps, culminating in the Gross Venediger (12,008ft.), for the Gross Glockner (12,461ft.) rises to the south. Our chain bends north-east near the Radstädter Tauern Pass (5,702ft.) and preserves that direction through the Lesser Tauern Alps to the Semmering Pass (3,225ft.). (*b*) On the other hand, from the Dreiherrenspitze the true main watershed of the Alpine chain dips south, passes over the Hochgall (11,287ft.), the culmination of the Rieserferner group, and then sinks to the Toblach Pass (3,967ft.) but a little east of the great Dolomite peak of the Drei Zinnen (9,837ft.) it bends east again and rises in the Monte Cogliano (9,128ft., the monarch of the Carnic Alps). Soon after our watershed makes a last bend to the south-east and culminates in the Terglou (9,400ft.), the highest point of the Julian Alps, though the Grintovc (8,429ft., the culmination of the Karawanken Alps) stands more to the east. Finally our watershed turns south and ends near the great limestone plateau of the Birnbaumerwald, between Laibach and Görz.

Principal Passes.—The Alps have never formed an impassable barrier. The spots at which they are crossed are called passes and are the points at which the great chain sinks to form depressions. Hence the oldest name for such passes is *Mont* (still retained in cases of the Mont Cenis and the Monte Moro); it was long before this term was especially applied to the peaks of the Alps, which, with a few rare exceptions (*e.g.*, the Monte Viso was known to the Romans as Vesulus), were simply disregarded. The native inhabitants of the Alps were naturally the first to use the alpine passes, but to the outer world these passes first became known when the Romans traversed them in order to conquer the world beyond. For obvious reasons the Romans, having once found an easy pass did not trouble to seek for harder routes. The passes known to them were comparatively few: they are, in topographical order from west to east, the Col de l'Argentière, the Mont Genèvre, the two St. Bernards, the Splugen, the Septimer, the Brenner, the Radstädter Tauern, the Solkscharte, the Plocken and the Pontebba (or Saifnitz). The Mont Genèvre and the Brenner were the most frequented, while it will be noticed that in the Central Alps only two passes (the Splügen and the Septimer) were certainly known to the Romans. The Simplon is first certainly mentioned in 1235, the St. Gotthard (without name) in 1236, the Lukmanier in 965, the San Bernardino in 941. Even the Mont Cenis (from the 15th to the 19th century the favourite pass for travellers) is first heard of in 756 only. In the 13th century many hitherto unknown passes came into prominence, even some of the easy glacier passes. In the Western and Central Alps there is but one ridge to cross, to which access is gained by a deep-cut valley, though often it would be shorter to cross a second pass in order to gain the plains, *e g.*, The Mont Genèvre, that is most directly reached by the Col du Lautaret. In the Eastern Alps it is generally necessary to cross three distinct ridges between the north and south plains, the central ridge being the highest and most difficult. The passes which crossed a single ridge, and did not involve too great a detour through a long valley of approach, became the most important and the most popular, *e g.*, the Mont Cenis, the Great St. Bernard, the St. Gotthard, the Septimer and the Brenner. As time went on the travellers who used the great alpine passes could not put up any longer with the bad old mule paths. A few passes (*e.g.*, the Semmering, the Brenner, the Tenda and the Arlberg) can boast of carriage roads constructed before 1800, while those over the Umbrail and the Great St. Bernard were not completed till the early 20th century. Many of the carriage roads across the great alpine passes were constructed in the 19th century, largely owing to the impetus given by Napoleon. As late as 1905, the highest pass over the main chain that had a carriage road was the Great St. Bernard (8,111ft). More recently railway lines have been carried over or through the chain—there being the Brenner and Pontebba lines, both over passes, and the Col di Tenda, Mont Cenis, Simplon, St. Gotthard, Lötschen, Arlberg, Albula and Pyhrn through tunnels. There are also schemes for piercing the Splügen and the Hohe Tauern, both on the main ridge. Since the advent of motor-cars several old road-passes have been improved and new ways made.

Glaciers.—Because the Alps were explored and studied earlier than the other mountain systems of the world, the type of glaciation found there has received the name "Alpine Type." It is similar to that of parts of the Himalayas, Andes, Rockies and the mountains of New Zealand but is different from that of Spitzbergen, Greenland, Alaska and the Polar regions (*see* GLACIERS). The main characteristics of the Alpine type consist of an elevated "catchment area" from which valleys pass down to lower altitudes. The highest peaks do not necessarily form the centres from which the largest glaciers radiate, but these latter arise where the topography of the mountain masses is that of numerous depressions and wide hollows separated by rounded snow-capped peaks, as Mont Blanc or by steep-sided frost-eaten peaks and ridges as the Aiguilles. Snow accumulates in these hollows and is compacted into ice which differs in appearance and internal structure from ice formed in the normal way by freezing. It is known as "*névé*" (Fr.) or "*firn*" (Ger.). This ice is forced downward by the weight of the accumulated snow above, or falls down as avalanches into the valley below, forming the valley glaciers characteristic of the Alps. The boundary between the *névé* and the valley glacier (the *firn*-line) is marked by a change in the character of the surface of the ice. Above the *firn*-line precipitation is greater than melting and so snow covers the surface, but below it the reverse is the case and the ice is exposed In summer the *firn*-line is quite distinct, but generally some hundreds of feet below the limit of perpetual snow.

It is estimated that there are 1,200 separate glaciers and *névé* fields in the Alps, but many are mere accumulations of snow in small hollows which really form part of larger basins The largest glacier in the Alps is the Aletsch Glacier which is 16m long and with its *névé* and catchment area covers an area of over 50sq miles. The lowest point reached by glaciers varies considerably; it is as low as 3,200ft. above sea-level at Grindelwald, but the height is more often quite 1,000ft. higher than this The line of perpetual snow lies between 8,000ft. and 9,500 feet Its exact position varies locally; regions which rise above these limits form centres for the radiation of valley glaciers The largest of such centres are in the Mont Blanc group, the Bernese Oberland (from Blumlisalp to the Wetterhorn) and in the Pennine Alps (from the Grand Combin to the Mischabel) The main chain boasts of more glaciers and *névé* than the subsidiary chains. Nevertheless, the three longest glaciers of the Alps, the Greater Aletsch (16m) and the Unteraar and the Viescher (each 10m), are in the Bernese Oberland. The longest glaciers in the main chain are the Mer de Glace and the Gorner (each 9½m).

During the Pleistocene Ice Age the whole chain was more than once covered by an ice sheet above which perhaps the main peaks stood out. Penck infers four ice-maxima, Bayer thinks there were only two. One of the intervals, it is generally agreed, witnessed a return of warm temperate conditions The final retreat of the Pleistocene Ice Sheet proceeded by stages, and it has been suggested there was a serious regrowth of glaciers in early centuries of the last millenium B C. Each stage was marked by a continuous retreat of the ice front to higher altitudes, no movement or perhaps even a temporary advance occurring in the intervals. During historical times the movement of the fronts has not been very marked. In 1918 a general forward movement was noticed in most Alpine glaciers, the previous great advance commencing in 1818 and finishing in 1822. The smaller glaciers will, of course, show movement more quickly than the larger. This is illustrated in the case of the Aletsch Glacier, which has maintained the same position of its front for many years In 1823 this glacier suddenly dropped its level (for reasons not understood) causing the level of Lake Märjelen, which is formed by the glacier obstructing the mouth of a tributary stream, to fall

Lakes and Water Power.—The lakes of the Alps are of several types. (*See* LAKE) Lakes of the barrier type are formed in various ways, principally by terminal and lateral moraines, in rarer cases by land slides, alluvial fans or a glacier Lake Zürich shows interesting phases of damming by various moraines; Lake Mattmark is formed by a lateral moraine; Lake Märjelen is a classic example of a glacier acting as a dam. Examples of lakes of tectonic origin are Lake Joux, in the Jura region, which occurs in a syncline, and Lake Fahlen near Säntis. Lakes formed by the solution of calcareous rocks are of two types: the "polje" and the "doline" types. Frequently the depressions occupied by these lakes were the sites of former glaciers, as proved by the lining of glacial clay which the lakes now possess. Lakes of these types are quite frequent in the limestone areas and examples are Lakes Dauben, Mutten and Seewli (the latter also being in a corrie) Lakes in depressions in water-bearing strata occur on moraines or on fluvioglacial material. No rivers feed them and they have no visible effluents Examples of the formation of two small lakes from a large one by a lacustrine delta are the lakes of Thun and Brienz and of Silser and Silvaplana.

In recent years the Alps have become a most important source of hydro-electric power for industry, railway transport and lighting, and the amount of coal used is diminishing. Nowhere, even in the limestone districts, is the amount of water so small as to warrant the exclusive use of coal or other fuels. As the water is

derived from melting snow and ice, there is no fear of summer shortage, but a winter stoppage may occur. Most of the great lakes of the subalpine region are used as sources of supply, as also are many of the smaller ones; in the latter cases the level of water is frequently raised by a dam. The water is drawn from the bottom of the lake in order to ensure a constant supply in winter. Reservoirs are also constructed in suitable places. The choice of site depends upon several factors, *e.g.*, the impermeable nature of the rocks forming the basin, an adequate supply of water, a minimum amount of deposition of sediment within the basin and the geographical position. Old lake basins have been transformed into reservoirs, *e.g*, the Barbarine, and many deep gorges have been so utilized. Electric power and lighting are to be found in remote villages.

In the Alps are the sources of the great rivers of western Europe—the Po, Rhone, Rhine and Danube (the actual source of the latter is in the Black Forest, but its main tributaries rise in the Alps). These rivers drain the south, west, north and east slopes respectively, and the Danube also drains the north slope. There exists a very close connection between the direction of the river valleys in the Alps and the geological structure. Most of the valleys are either parallel to or at right angles to the trend of the chains. Examples of the former are the Isère, the Upper Rhone and the Upper Rhine, and of the latter the rivers of the Pennine Alps.

Climate.—It is well known that as we rise from the sea-level into the upper regions of the atmosphere the temperature decreases. Mountain chains cause the prevailing winds to rise to higher altitudes, thus frequently bringing about the precipitation of snow or rain principally upon the windward side. The vast mass of snow, converted into glaciers, maintains a gradation of very different climates within the narrow space that intervenes between the foot of the mountains and their upper ridges; it cools the breezes that are wafted to the plains on either side, but its most important function is to regulate the water-supply of the large region traversed by Alpine streams. Nearly all precipitation during six or seven months is in the form of snow, gradually released by melting in the course of the succeeding summer; even in the hottest and driest seasons the reserves accumulated in the form of glaciers maintain the regular flow of the greater streams. Nor is this all; the lakes that fill several main-valleys on the south side are somewhat above the level of the Lombardy plain, and afford inexhaustible water for that system of irrigation to which it owes its proverbial fertility.

Six regions or zones, which are best distinguished by their characteristic vegetation, are found in the Alps. They are (*a*) the olive region, (*b*) the vine region, (*c*) the mountain region or the region of deciduous trees, (*d*) the subalpine region or the region of coniferous trees, (*e*) the Alpine region, (*f*) the glacial region Local conditions of exposure to the sun, protection from cold winds or the reverse, as well as height above sea-level, are of primary importance in determining the climate and the corresponding vegetation.

(a) The great plain of Upper Italy is colder in winter than the British Isles. The olive and the characteristic shrubs of the North Mediterranean coasts do not thrive in the open, but olives ripen in sheltered places at the foot of the mountains and along the deeper valleys and the lake shores. The evergreen oak is wild about Lake Garda, and lemons are cultivated on a large scale, with partial protection in winter.

(b) The vine is far more tolerant of cold than the olive, but to produce tolerable wine it demands, at the season of ripening, not much less warmth than the olive, about 68° F average. These conditions are satisfied in the deeper valleys of the Alps, and up to a considerable height on slopes exposed to the sun. Winter snow-covering helps the plant to resist severe and prolonged frosts.

(c) So many varieties of grain are grown under various climatic conditions that their limits of cultivation are less useful for determining zones than are those of the chief deciduous trees—oak, beech, ash and sycamore. These do not reach exactly to the same elevation, nor are they often found growing together; but their upper limit corresponds accurately enough to the change from a temperate to a colder climate. This limit lies about 4,000-ft. above sea-level on the north side of the Alps, but on the southern slopes it often rises to 5,000ft., sometimes even to 5,500 feet. The interference of man has in many districts almost extirpated these trees. Their place has been occupied by the Scotch pine and spruce, which suffer less from goats, the worst enemies of trees. The mean annual temperature differs little from that of the British Islands; but snow usually lies for several months, till it gives place to a spring and summer considerably warmer than the average of British seasons.

(d) The Subalpine is the region which mainly determines the manner of life of the peasant population of the Alps. Of the space lying between the summits of the Alps and the low country on either side roughly one-quarter is available for cultivation of which about one-half may be vineyards and corn-fields, while the remainder produces forage and grass. About another quarter is utterly barren, consisting of snow-fields, glaciers, bare rock, lakes and the beds of streams. There remains about one-half, which is divided between forest and pasture, and it is the produce of this half which mainly supports the relatively large population. For a quarter of the year the flocks and herds are fed on the upper pastures; but the true limit of the wealth of a district is the number of animals that can be supported during the long winter, and while one part of the population is engaged in tending the beasts and in making cheese and butter, the remainder is busy cutting hay and storing up winter food for the cattle. The larger villages are mostly in the mountain region, but in many parts of the Alps the villages stand in the subalpine region at heights varying from 4,000ft. to 5,500ft. above sea-level, more rarely extending to about 6,000 feet. Coniferous trees, where they have not been artificially kept down, form vast forests. They protect the valleys from destructive avalanches, and, retaining the superficial soil by their roots, they mitigate the destructive effects of heavy rains On very steep slopes avalanches have frequently torn up the trees, leaving long avenues of varying width through the forests In such places and in valleys where they have been rashly cut away, and the waters pour down the slopes unchecked, every tiny rivulet becomes a raging torrent, that carries away the soil and subsoil from the grassy slopes and devastates the floor of the valley, covering it with debris and gravel. The prevailing species are the common spruce, the silver fir, the larch and the Scotch pine. The Siberian fir is also found. In the northern Alps the pine forests rarely surpass the limit of 6,000ft. above the sea, but on the south side they commonly attain 7,000ft , while the larch, Siberian fir and mughus often extend above that elevation.

(e) Throughout the Teutonic region of the Alps the word *Alp* is used specifically for the upper pastures where cattle are fed in summer, but this region is held to include the whole space between the uppermost limit of trees and the first appearance of permanent snow. Here the characteristic vegetation of the Alps is developed in its full beauty and variety. Shrubs are not wanting. Three species of rhododendron give masses of red or pink flowers; the common juniper rises higher still, along with three species of bilberry; and several dwarf willows attain nearly to the utmost limit of vegetation, the so-called limit of perpetual snow.

(f) On the higher parts of lofty mountains more snow falls in each year than is melted on the spot. A portion of this is carried away by the wind before it is consolidated, a larger portion accumulates in hollows of the surface, and, gradually converted into glacier ice, descends slowly into the deeper valleys, to swell perennial streams. As on a mountain the snow does not lie in beds of uniform thickness, and some parts are more exposed to the sun and warm winds than others, we commonly find beds of snow alternating with exposed slopes covered with brilliant vegetation; and to the observer near at hand there is no appearance in the least corresponding to the term *limit of perpetual snow*, though the case is otherwise when a high mountain-chain is viewed from a distance, for the level at which large snow-beds show themselves along its flanks is approximately horizontal, in so far as conditions are similar. On the opposite sides of the same chain, exposure to sun or to warm winds may cause a wide difference in the level of

permanent snow; but in some cases the increased fall of snow on the side exposed to moist winds may more than compensate increased influence of the sun's rays. Still, even with these reservations, the so-called line of perpetual snow is not fixed. In some parts of the Alps the limit may be set at about 8,000ft. above the sea, while in others it cannot be placed much below 9,500 feet. As very little or no snow can rest on rocks that lie at an angle exceeding 60°, some steep masses of rock remain bare even near the summits of the highest peaks, but as almost every spot offering the least hold for vegetation is covered with snow, few flowering plants are seen above 11,000 feet. It is, however, want of soil rather than climatic conditions that checks the upward extension of the alpine flora. Increased direct effect of solar radiation compensates for the cold nights, and in the few spots where plants have been found in flower up to a height of 12,000ft., nothing has indicated that the processes of vegetation were arrested by the severe cold which they must sometimes endure. The climate of the glacial region has often been compared to that of the polar regions, but they are widely different. Here, intense solar radiation by day, which gives the surface when dry a temperature approaching 80° F, alternates with severe night frost. There, a sun which never sets sends feeble rays that maintain a low equable temperature rarely rising more than a few degrees above the freezing-point. Hence the upper region of the Alps sustains a far more varied and brilliant vegetation.

Flora.—The Alps owe the richness and beauty of their plant life partly to their position as the natural boundary between "Baltic" and "Mediterranean" floras, but chiefly to the presence on their heights of a third flora which has but little in common with either of the others The stronghold of this last, the distinctively "Alpine" flora, is the region above the tree-limit. Its closest relationship is with the flora of the Pyrenees; but an alpine flora is characteristic of all the lofty mountains of central Europe According to J Ball, 2,010 well marked species of flowering plants occur within the limits of the Alps. If now we confine our attention to the alpine and higher regions of the Alps and exclude from our list all those plants which are not less abundant in the lowlands, we have left some 700 species. We must observe, as regards the plants of the lower alpine region, that it is the actual presence of a forest vegetation, rather than the theoretical tree-limit, which affects their vertical distribution; so that, *e g*, they overflow into the extensive clearings made by man in the primaeval mountain forests Indeed, an analysis of the composition of the alpine flora as a whole leads to the conclusion that the chief bond of union between its members consists in the treeless character of their habitat.

We may broadly distinguish two main geographical elements in the alpine flora, namely, the northern element and the endemic element. This division (which is not, however, strictly exhaustive) directs special attention to what is undoubtedly the most striking feature of the flora, namely, that of its 693 species no less than 271 reappear in the extreme north. This relation of the arctic to the alpine flora is all the more remarkable in view of the very important differences between the arctic and alpine climates. The following circumpolar species are common, and widely diffused throughout the whole of the Alps: *Silene acaulis, Dryas octopetala, Saxifraga oppositifolia, S. aizoides, S. stellaris, Erigeron alpinus, Azalea procumbens, Myosotis alpestris, Polygonum viviparum, Salix retusa, S. herbacea, Phleum alpinum, Juniperus nana.* The proportion of northern forms, as regards both species and individuals, increases until, on islands of rock above the snow-line, it is equal to the endemic element. Northern flowers of the snow-region include *Silene acaulis, Eritrichium nanum,* and *Arenaria ciliata.* On the other hand, typical endemic species of this highest zone are *Androsace helvetica, A. glacialis, Petrocallis pyrenaica,* and *Cherleria sedoides.* All the plants just named are "cushion-plants." Their compact, moss-like growth and general structural peculiarities are analogous adaptations to the dry cold of their habitat. Among the northern plants of the alpine zone, in the narrower sense of the term (*i.e.,* of the region between the tree-limit and the snow-line), there is a marked predominance of species that affect moist localities; and, conversely, the majority of alpine flowers of wet habitat are found also in the north. For example, in the genus *Primula,* a highly characteristic genus of the alpine flora, whose members are among the most striking ornaments of the rocks, the single northern species, *P. farinosa,* grows only in marshy meadows. On the whole, then, adaptation to cold and wet is the note of the northern element.

During the glacial period, in the ice-free belt, between the northern ice-sheet and the vastly extended glaciers of the Alps, the two floras found refuge and congenial conditions; fossils confirm this view. With the return of a milder climate, the so-called northern forms of the present alpine flora were split in two, one portion following close on the northern ice in its gradual retreat to the Arctic, the other following the shrinking glaciers till the plants were able to establish (or re-establish) themselves on the slopes of the Alps. The same explanation covers the case of the similarity of the flora (not merely as regards the northern element) on all the high mountains of central Europe. Beyond this, disagreement begins between the most eminent writers on the subject. While some (*e g.,* Sir J. D. Hooker, Heer) regard the Arctic, and some (*e g*, Wettstein) the Alps, as the original home of the bulk of the "northern" element, others (*e g*, Ball, Christ) locate this in the highlands of temperate Asia For it is a remarkable fact that, of the 230 northern species which are most typical of the far north, 182 are found also in the Altai (taking this as a collective name for the mountains that form the southern boundary of Siberia). In any case, however, the migration of these plants to the Alps must for the most part have taken place via the Arctic. The possibility of any extensive east to west migration having taken place direct from the Altai to the Alps seems excluded by the fact that 50% of the arctico-altaic alpine plants are absent from the Caucasus. On the whole, a common origin in the north for at least the arctico-altaic group of alpine plants seems to be the most reasonable hypothesis. A score of species are common to Alps and Altai, but a larger number of arctic-alpine forms are absent from the Altai

Side by side with the northern element we find a group of species usually spoken of as the xerothermic or meridional element. These do not, however, form an "element," in the strict geographical sense in which this term is otherwise used here They are those species which, on general phyto-geographical grounds, must be regarded as having originated under steppe-like conditions. Their affinities are chiefly, with the present Mediterranean flora—about 50 are of presumably Mediterranean origin—and a large proportion of them are restricted to the southern slopes of the Alps. The following, however, among others, are distributed throughout the whole, or a great part, of the range:—*Colchicum alpinum, Crocus vernus, Orchis globosa, Petrocallis pyrenaica, Astragalus depressus, A. aristatus, Oxytropis Halleri, Eryngium alpinum, Erica carnea, Linaria alpina, Globularia nudicaulis, G. cordifolia, Leontopodium alpinum.* The last named (the well-known "edelweiss") is at the present day characteristic of the Siberian steppes. The presence of these plants among the alpine flora is traceable to the steppe-like conditions which prevailed in central Europe both during the warmer inter-glacial periods and (probably) for a time after the close of the ice-age Subsequently, as the climate of the plains assumed a colder and more humid character, they retired before the invading forests to the high mountains. Here, in the intenser insolation which they enjoy, they seem to find a compensation for the drawbacks incidental to the altitude.

As regards the endemic element as a whole, the question as to the time and place of its origin is of a highly complicated and controversial nature. The question, too, in the case of this element, is necessarily of genetic rather than purely geographical scope. It must suffice to say that the weight of scientific opinion inclines to the view that at least the majority of endemic species are of pre-glacial origin, and are either strictly indigenous or products of the neighbouring lowlands. About 40% of the endemic element in the alpine flora are endemic also in the narrower sense, *i.e.,* they are confined to the Alps. The following is a list of the most thoroughly characteristic alpine plants—all of them *ipso facto* members of the endemic element—which are at once peculiar to the Alps (or practically so) and widely distributed within the limits

of the chain. These are:—*Festuca pulchella, Carex microstyla, Salix caesia, Rumex nivalis, Alsine aretioides, Aquilegia alpina, Thlaspi rotundifolium, Saxifraga seguieri, S. aphylla, Astragalus leontinus, Daphne striata, Eryngium alpinum, Bupleurum stellatum, Androsace helvetica, A. glacialis, Gentiana bavarica, Phyteuma humile, Campanula thyrsoidea, C. cenisia, Achillea atrata, Cirsium spinosissimum, Crepis terglouensis.*

Fauna.—The fauna of the lower zones in the Alps is, on the northern side of the chain, practically identical with that of central Europe, and on the southern side with that of the Mediterranean basin. But in the higher regions it presents many features of special interest. It seems, therefore, best to treat here principally of the animal inhabitants of the high Alps.

Though among mammalia—as also birds—there are but few forms peculiar to the Alps, many interesting animals have found in the high mountains at least, a temporary refuge from man The European bison, the urus, the elk, the wolf and the wild swine have disappeared. But the lynx (*Lynx lynx*) lingers in remote parts, as also the brown bear (*Ursus arctos*) in the dense forests of the Lower Engadine. The fox (*Vulpes vulpes*), the stone-marten (*Martes foina*) and the stoat or ermine (*Putorius erminea*) range in summer above the tree-limit. The Ungulata are represented by a few chamois (*Rupicapra tragus*) and a rare bouquetin or steinbock (*Capra ibex*). The former—the sole representative, in western Europe, of the antelopes—is found elsewhere only in the Pyrénées, Carpathians, Caucasus and the mountains of eastern Turkey; the latter survives only in the eastern Graian Alps. Of the Rodentia the most interesting and conspicuous is the marmot (*Arctomys marmota*), which lives in colonies close to the snow-line. The snow-mouse (*Arvicola nivalis*) is confined to the alpine and snow regions, and is abundant at these levels throughout the whole chain of the Alps. The mountain hare (*Lepus variabilis*) replaces the common hare (*Lepus europaeus*) in the higher regions; though absent from the intervening plains it again appears in the north of Europe and in Scotland. Among the Insectivora, the alpine shrew (*Sorex alpinus*) is restricted to the Alps. Of the Cheiroptera (bats) only *Vesperugo maurus* is characteristically alpine.

The birds of the Alps are proportionately very numerous. The lammergeyer (*Gypaetus barbatus*), once common, is now extremely rare, but the golden eagle (*Aquila chrysaetos*) still holds its own. Some of the smaller birds of prey are not uncommon, but there is none that can be regarded as specially characteristic either of the Alps as a whole or of the alpine region As characteristic birds of the snow-region may be mentioned the alpine chough (*Pyrrhocorax alpinus*), which is frequently seen at the summits even of the loftiest mountains, the alpine swift (*Apus melba*), the wall-creeper (*Tichodroma muraria*), snow-finch (*Montifringilla nivalis*) and ptarmigan (*Lagopus mutus*); the geographical distribution of this last being similar to that of the mountain hare. The black redstart (*Ruticilla titys*), though common in the lower regions, is also met with in fair numbers almost up to the snow-line. The raven (*Corvus corax*) is fairly common in the alpine and sub-alpine regions. On the highest pastures we find, further, the alpine accentor (*Accentor collaris*) and the alpine pipit (*Anthus spipoletta*). The crag-martin (*Cotyle rupestris*) haunts lofty cliffs. On the upper verge of the pine forests, or in the scrubby vegetation just beyond, the following are not uncommon:—black woodpecker (*Picus martius*), ring-ousel (*Turdus torquatus*), Bonelli's warbler (*Phylloscopus bonellii*), crested tit (*Parus cristatus*), citril finch (*Citrinella alpina*), siskin (*Chrysomitris spinus*), crossbill (*Loxia curvirostra*), nutcracker (*Nucifraga caryocatactes*), blackcock (*Tetrao tetrix*) and the alpine varieties of the marsh-tit (*Parus palustris borealis*) and tree-creeper (*Certhia familiaris costae*).

The remaining classes of Vertebrata are sparsely represented in the high Alps, and what species occur are mostly common to the plains as well. Among the remaining land vertebrates only the black salamander (*Salamandra atra*) is exclusively alpine. This animal, though a member of the Amphibia, is terrestrial and viviparous.

The former connection between the Arctic and the Alps, which has left such unmistakable traces in the present alpine flora, affords, as regards the fauna also, the only possible explanation of the present geographical distribution of many alpine forms; but it is chiefly among the Invertebrata that we find this collateral testimony to the influence of the glacial period. In this respect we may note that two small crustaceans, *Diaptomus bacillifer* and *D. denticornis*, swarm in the ice-cold waters of the highest alpine tarns throughout the entire chain; and the former of these is also a characteristic inhabitant of pools formed from melting snow in the extreme north. Among the remaining divisions of Invertebrata special mention may be made of the air-breathing Arthropoda—on the whole the most important and interesting group. About one-third of the animals belonging thereto that occur in the higher regions are exclusively alpine (or alpine and northern); these characteristically alpine forms being furnished chiefly by the spiders, beetles and butterflies. Most numerous are the beetles. Those of the highest zone are remarkable for the great predominance of predacious species and of wingless forms. In this last respect they present a striking analogy with the endemic coleopterous fauna of oceanic islands. As for the butterflies, not more than one-third of the species found in the alpine region occur in the neighbouring lowlands. The relations between alpine butterflies and plants are especially interesting, as regards not only their bionomic interdependence but also the analogies of their geographical distribution. It should be noted that butterflies are the chief agents in securing the continued existence of such alpine flowers as depend on insect fertilization, the other insect fertilizers being mostly wanting at great heights.

Inhabitants of the Alps.—From ancient times we have only scanty mention of Alpine peoples by classical writers, with a few references to conquests by Augustus and to later movements of Teutonic tribes of the 5th and 6th centuries. To them, as to Frankish kings and emperors, the Alps offered a route rather than a residence. In the case of the Western Alps (minus the bit from the chain of Mont Blanc to the Simplon, which followed the fortunes of the Valais), a prolonged struggle for the Alpine region took place between the feudal lords of Savoy, the Dauphiné and Provence. In 1349 the Dauphiné fell to France, while in 1388 the county of Nice passed from Provence to the house of Savoy, which also held Piedmont as well as other lands on the Italian side of the Alps. The struggle henceforth was limited to France and the house of Savoy, but little by little France succeeded in pushing back the house of Savoy across the Alps, thus forcing it to become a purely Italian power. One turning-point in the rivalry was the treaty of Utrecht (1713), by which France gave up to Savoy the districts (all forming part of the Dauphiné and lying on the Italian slope of the Alps) of Exilles, Bardonnèche, Oulx, Fénestrelles and Château Dauphin, while Savoy handed over to France the valley of Barcelonnette, situated on the western slope of the Alps and forming part of the country of Nice. The final act in the long-continued struggle took place in 1860, when France obtained by cession the rest of the county of Nice and also Savoy, thus remaining sole mistress on the western slopes of the Alps

In the Central Alps the chief event, on the north side of the chain, is the gradual formation from 1291 to 1815 of the Swiss Confederation and the independent confederations of the Grisons and the Valais, which became full members of the Swiss Confederation only in 1803 and 1815 respectively. The Forest Cantons in the 15th century won the Val Leventina as well as Bellinzona and the Val Blenio (though the Ossola valley was held for a time only), while the Grisons added to the Val Bregaglia (which had been given to the bishops of Coire in 960 by the emperor Otto I.) the valleys of Mesocco and of Poschiavo. Further, in 1512, the Swiss Confederation won the valleys of Locarno with Lugano, which, combined with the 15th century conquests by the Forest Cantons were formed in 1803 into the new Canton of Ticino or Tessin. On the other hand, the Grisons won in 1512 the Valtellina, with Bormio and Chiavenna, but in 1797 these regions were finally lost to it as well as to the Swiss Confederation, though the Grisons retained the valleys of Mesocco, Bregaglia and Poschiavo, while in 1762 it had bought the upper bit of the valley of Münster that lies on the southern slopes of the Alps.

In the Eastern Alps the political history relates simply to the advance or retreat of the house of Habsburg. The Habsburgers' ruined castle still stands in the lower valley of the Aar; they lost this district to the Swiss in 1415, and won the duchy of Austria with Styria in 1282, Carinthia and Carniola in 1335, Tirol in 1363 and the Vorarlberg in bits from 1375 to 1523, not to speak of minor "rectifications" of frontiers on the northern slope of the Alps. But on the other slope their progress was slower, and finally less successful. It is true that they early won Primiero (1373), as well as (1517) the Ampezzo valley and several towns to the south of Trent. In 1797 they obtained Venetia proper, in 1803 the secularized bishoprics of Trent and Brixen (as well as that of Salzburg, more to the north) besides the Valtellina region, and in 1815 the Bergamasque valleys, while the Milanese had belonged to them since 1535. But in 1859 they lost to the house of Savoy both the Milanese and the Bergamasca, and in 1866 Venetia proper also, and in 1918–19 the Trentino. The gain of the Milanese in 1859 by the future king of Italy (1861) meant that Italy then won the valley of Livigno (between the Upper Engadine and Bormio), besides the county of Tenda (obtained in 1575, and not lost in 1860), with the heads of certain glens in the Maritime Alps, reserved in 1860 for reasons connected with hunting. After a decisive plebiscite, Vorarlberg requested to be admitted into the Swiss Confederation in 1919, but the request was not granted in the Treaty of St. Germain. By this same treaty, a large portion of the Southern Alps, much of which was held by them at the close of the World War (1914–18), passed into the legal possession of Italy, and the boundary between that country and Austria was readjusted. The southern frontier of Austria was not altered along the Swiss section, but eastward from Gruben it now passes through Dreiherrn Spitz, then south-east of Helm Spitz and along the summit ridge of the Carnic Alps to Grintove, and northward to Unter Drauberg, where it again turns east, and on to Spielfeld. The frontier between Italy and Yugoslavia branches off and passes southward from Tarvis (south-west of Villach). By the addition of this territory of German-speaking peoples to Italy the number of sections of the Alps in which the natives do not speak the tongue of the country was increased. In Italy there are also some French-speaking districts (the Waldensian valleys as well as the Aosta and Oulx valleys). In Switzerland there are Italian-speaking regions, as well as some spots (in the Grisons) where the old Romance dialect of Romansch or Ladin survives; while in Austria, besides German, Italian and Ladin, we have a Slavonic-speaking population in the South-Eastern Alps. The highest permanently inhabited village in the Alps is Juf, 6,998ft. (Grisons); while in the French Alps, L'Écot, 6,713ft. (Savoy), and St. Véran, 6,726ft. (Dauphiné), are rivals; the Italian Alps boast of Trepalle, 6,788ft. (between Livigno and Bormio), and the Tirolese Alps of Ober Gurgl, 6,322ft., and Fend, 6,211ft. (both in the Oetzthal).

Exploration of the High Alps.—About 20 glacier passes were certainly known before 1600, about 25 more before 1700 and yet another score before 1800; but though the attempt of P. A. Arnod (an official of the duchy of Aosta) in 1689 to "re-open" the Col du Géant may be counted as made by a non-native, we do not come upon another case of the kind till the last quarter of the 18th century. The two earliest recorded ascents of high peaks were due to non-natives, that of the Rochemelon in 1358 having been undertaken in fulfilment of a vow and that of the Mont Aiguille in 1492 by order of Charles VIII. of France, in order to destroy its reputation for inaccessibility; in 1555 Conrad Gesner climbed the grassy mound of the Gnepfstein, the lowest and the most westerly of the seven summits of Pilatus. The two first men who really systematically explored the regions of ice and snow were H. B. de Saussure (1740–99), as regards the Pennine Alps, and the Benedictine monk of Disentis, Placidus à Spescha (1752–1833, most of whose ascents were made before 1806), in the valleys at the sources of the Rhine. In the early 19th century the Meyer family of Aarau conquered in person the Jungfrau (1811) and by deputy the Finsteraarhorn (1812), besides several glacier passes, their energy being entirely confined to the Bernese Oberland. Their pioneer work was continued, by a number of Swiss, among whom were Gottlieb Studer (1804–90) of Bern, and Edouard Desor (1811–82) of Neuchâtel. The first-known English climber in the Alps was Colonel Mark Beaufoy (1764–1827), who in 1787 made an ascent (the fourth) of Mont Blanc, a mountain to which his fellow-countrymen long exclusively devoted themselves, with a few noteworthy exceptions, such as Principal J. D. Forbes (1809–68), A. T. Malkin (1803–88), John Ball (1818–89) and Sir Alfred Wills (b. 1828). Around Monte Rosa the Vincent family, Josef Zumstein (1783–1861) and Giovanni Guifetti (1801–67) did good work during the half century between 1778 and 1842, while in the Eastern Alps the Archduke John (1782–1859), Prince F. J. C. von Schwarzenberg, archbishop of Salzburg (1809–85), Valentine Stanig (1774–1847), Adolf Schaubach (1800–50), above all, P. J. Thurwieser (1789–1865), deserve to be recalled as pioneers in the first half of the 19th century. The English Alpine Club was founded in the winter of 1857–58 followed in 1862 by the Austrian Alpine Club (which in 1873 was fused, under the name of the German and Austrian Alpine Club, with the German Alpine Club, founded in 1869), in 1863 by the Italian and Swiss Alpine Clubs and in 1874 by the French Alpine Club. These clubs have explored the peaks, built huts, trained guides and published journals. The two sub-joined lists give the dates of the conquest of about 50 of the greater peaks (apart from the two climbed in 1358 and in 1492, *see* above), achieved before and after Jan. 1, 1858.

(1) Before Jan. 1, 1858:—Titlis (1744), Ankogel (1762), Mont Vélan (1779), Mont Blanc (1786), Rheinwaldhorn (1789), Gross Glockner (1800), Ortler (1804), Jungfrau (1811), Finsteraarhorn (1812), Zumsteinspitz (1820), Tödi (1824), Altels (1834), Piz Linard (1835), Gross Venediger (1841), Signalkuppe (1842), Wetterhörner (1844–45), Mont Pelvoux (1848), Diablerets and Piz Bernina (both in 1850), highest point of Monte Rosa (1855), Laquinhorn (1856) and Pelmo (1857).

(2) After Jan. 1, 1858.—Dom (1858), Aletschhorn, Bietschhorn and Grand Combin (all in 1859), Grand Paradis and Grande Casse (both in 1860), Weisshorn, Monte Viso, Gross Schreckhorn, Lyskamm and Wildspitze (all in 1861), Dent Blanche, Monte della Disgrazia and Täschhorn (all in 1862), Marmolata, Presanella, Pointe des Ecrins and Zinal Rothhorn (all in 1864), Matterhorn, Ober Gabelhorn, Aiguille Verte and Piz Roseg (all in 1865), Langkofel (1869), Cimon della Pala (1870), Rosengarten (1872), Meije (1877), Aiguille du Dru (1878), Punta dell' Argentera (1879), Aiguille des Charmoz (1880), Aiguille de Grépon (1881) and Aiguille du Géant (1882).

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ALPS, AUSTRALIAN, term applied somewhat loosely to the mountain massif which occupies the south-easternmost corner of Australia (eastern Victoria and south-eastern New South Wales). In a more localized sense it is applied to the higher ranges which stretch across the Victoria–New South Wales boundary and form the water-shed between the upper Murray system (Ovens, Mitta-Mitta, Indi rivers) on the north-west, and the streams (Tambo, Snowy river) flowing to the Pacific on the south-east, the upper Murrumbidgee, owing probably to events of tectonic history, partaking of both characters. The term "Alps" as applied to these mountains denotes their general characteristics as massive and seasonally snow-clad highlands rather than their special structural features. In this latter sense they are not "Alpine" mountains, being a powerfully developed "block" massif composed of elevated "horsts" and down-faulted areas (Senkungsfelder). This faulting affected an area of comparatively homogeneous topography—a peneplanated surface developed on granitic and Palaeozoic rocks—and diversified it into a series of massive flattish uplands and comparatively roomy depressions. These movements, continuing into late Tertiary times or later (late Pliocene–early Pleistocene) were followed by a local glaciation (Pleistocene–Kosciusko ice age) which further emphasized the flatness of the summit topography. The result is an upper surface of broad undulating highlands upon which the highest elevations (Kosciusko, 7,340ft.; a series of heights variously named: 5,000–6,500ft.) are not distinctly remarkable. The areas of depression (*e.g.*, Monaro) are occupied by the headwaters of streams, which, owing to the spasmodic nature of the uplifts, have worked out characteristic "valley-in-valley" forms. There are also evidences of extensive river piracy.

The highlands are snow-clad in winter, though the tree-line lies at 5,000ft. and the area of Alpine flora is small. The rocks of these highlands are extensively, if not richly, mineralized and a good deal of mining mainly in small and scattered workings (*e.g.*, Kiandra [alt. 4,640ft], the highest settlement in Australia; Araluen) is carried on. The valleys and basins have considerable possibilities for closer agricultural settlement, but they and the lower uplands have so far been utilized mainly for pastoral purposes. There are numerous fine sheep-stations and in the Monaro uplands in particular (Cooma: alt. 2,657 ft.; pop. *c.* 3,000) are good cattle, grain and fruit lands. The chief importance, however, of the Australian Alps is as a source of water-supply. The snows feed perennially the streams of south-east Australia and are thus the basis of the present and potential development of irrigation agriculture, and of inland navigation, in the adjoining areas. Physical features also—particularly the presence of long narrow valleys cut in hard rocks—have facilitated water conservation on a large scale and form thus a foundation of permanent wealth.

In addition, this area is becoming increasingly a national playground and health-resort. Kosciusko is approached chiefly from the Monaro side (Cooma is a growing tourist centre), and the cor-

responding Victorian district is the Wangaratta–Bright–Mt. Buffalo tourist route.

ALPUJARRAS, THE, a district of southern Spain, in the provinces of Granada and Almería, from the Nevada to the coast between Motril and Almería. A structural depression between the Nevada and the coastal sierras contains the mid-courses of Nevada streams which have wild gorges above and below. These mid-courses are in beautiful fertile secluded valleys with villages often on ledges overhanging the streams, and to them the name Alpujarras is often exclusively applied. The vegetation ranges from sugar cane and palm in the valleys to Alpine flora on the heights through belts of orange, lemon and fig, of vine and olive, of chestnut and walnut and of oak and has no parallel in Europe.

The treaty of Granada assigned the district to Boabdil but it was not observed. The descendants of the Moors were removed in 1570 after long rebellions, and colonists, especially from Estremadura, came in. An Alpujarras militia for coast-defence was dependent on Velez-Málaga. Ugíjar was formerly the capital, Orgiba is another town; Lanjarón has a castle and chalybeate baths, Trevelez is the highest village.

See Boletin de la *Real Soc. Geogr. Madrid,* xlviii., 1906 pp. 426–99.

'ALQAMA IBN 'ABADA, generally known as 'ALQAMA AL-FAHL, an Arabian poet of the tribe Tamīm, who flourished in the second half of the 6th century. His diwān consists of three qasīdas (elegies) and 11 fragments. Asma'ī considered three of the poems genuine.

The poems were edited by A. Socin with Latin translation as *Die Gedichte des 'Alkama Alfahl* (Leipzig, 1867), and are contained in W. Ahlwardt's *The Diwans of the six ancient Arabic Poets* (1870); *cf.* W. Ahlwardt's *Bemerkungen über die Aechtheit der alten arabischen Gedichte* (Greifswald, 1872), pp. 65–71 and 146–168.

ALSACE, EARLY OPERATIONS IN: *see* FRONTIERS, BATTLES OF THE.

ALSACE-LORRAINE, a territory which has been the subject of many disputes and which was largely responsible for the difficulties that led up to the wars of 1870–71 and 1914–18. Alsace is essentially the part of the great trough between the Vosges and the Black Forest which lies west of the Rhine, but it extends to the highest Vosges. Lorraine stretches between the Vosges and the Ardennes and includes a portion which remained French 1871–1914, and the north-eastern zone, which was in German possession during that period. There is no doubt that these important regions are in many respects transitional between France and Germany in culture, and in parts the dialect is Germanic while in others it is French. If a general statement is possible it is that Alsace is more German and Lorraine more French in speech, but the influence of politics and education makes a true judgment difficult. The regions are further discussed geographically under the names of the French departments, Haut-Rhin, Bas-Rhin (parts of Alsace) and Moselle, Meurthe et Moselle, Meuse, Vosges (parts of Lorraine). Haut-Rhin, Bas-Rhin and Moselle represent the land returned to France after 1918.

In October, 1928, M. Poincaré opened the new railway tunnel through the Vosges, reducing the rail distance between St. Dié and Strasbourg from 105 m. to 62 m.

See P. Vidal de la Blache, *La France de L'Est* (1918).

HISTORY

The term Alsace-Lorraine came into use only after the Peace of Frankfurt (May 1871). It was used to describe a hybrid creation, artificially forged by Bismarck out of the whole of Alsace and part of Lorraine; both provinces having been annexed from France. These two countries (from earliest times a part of Belgian Gaul) had hitherto lived a separate existence since the 5th century when, after 450 years of Roman domination and civilization, they were invaded by Germans (principally Alemanni), who had crossed the Rhine.

Lorraine.—Since her true history began, Lorraine had preserved her Latin-speaking population through the greater part of her territory; the German barbarians having established themselves only in the north-east, on the borders of the Moselle, the Sarre and the Nied, beyond a line running approximately from Thionville to Sarrebourg. Besides its dependency, together with the county (later duchy) of Bar, and the three bishoprics of Metz, Toul and Verdun, Lorraine included the duchy of that name, the capital of which was at Nancy. Long disputed between the kingdom of France and the Germanic Holy Roman empire, these countries, which, after the Frank era (511–925), had belonged to Germany, *de facto* up to the end of the 13th century, and nominally up to the 16th century, had retained a real independence, under their dukes, until the 18th century; at which epoch, after the rule of the dethroned king of Poland, Stanislaus Augustus, father-in-law of Louis XV., king of France, Lorraine was reunited to the French crown in 1766.

Alsace.—During this time Alsace had become a purely Germanic country in consequence of the invasions and penetration of the Alemanni in the 5th and 6th centuries. Its civilization and religion had, however, come from the West—brought by the Merovingian kings and Irish, Scottish and Anglo-Saxon monks. After Charlemagne, it was at first a frontier country (bi-lingual Oath of Strasbourg, 842; Treaty of Verdun, 843, constituting "Lotharingia" a buffer state between France and Germany). Then, in the period of decadence of the Frank monarchy and of the constitution of the Germanic empire, which in 962 became the Holy Roman empire, it formed part of the Germanic world (as a portion of the duchy of Suabia or Alamania) from 870 or 887 to 1648, or seven and a half centuries.



BY COURTESY OF ELLA JANET HARDCASTLE

A PEASANT WOMAN OF ALSACE-LORRAINE, IN THE TRADITIONAL ALSATIAN COSTUME

During this long period Alsace enjoyed, actually, a large degree of independence. For a hundred years only (the 12th century) the imperial house of Hohenstaufen was popular in the provinces, during which time the emperors visited the country more than once; but this popularity was due to the municipal franchises granted by them to the cities. There was an intense municipal activity throughout the middle ages, witnessed by the league of the ten free "Imperial" cities, or "Decapolis." The representatives of the emperor (imperial bailiwick and subordinate bailiffs) enjoyed no real influence, and were frequently defied by the barons of fortified towns situated on the escarpments of the Vosges. But the clergy exercised a strong authority in a country which is deeply religious (Saint Odil is the patron saint of Alsace), and the bishops of Strasbourg and Basle were the real masters of lower and upper Alsace.

In the 14th and 15th centuries, the Habsburgs of Vienna, the successors of the Hohenstaufen in the imperial dignity, exercised only a purely nominal power over Alsace. In the 16th century the Reformation was at first very successful throughout the country. In the 17th century the religious Thirty Years War brought thither the Protestant Swedes, followed by their ally, the king of France, who annexed the country under the Treaty of Westphalia (1648). It was thus as ally of the Protestants of Germany and as adversary of the imperial unity that the king of France conquered Alsace.

The treaties of Westphalia had left the ten imperial free cities and the rights of the German princes holding lands in Alsace outside the authority of the French king. The former were annexed by Louis XIV. in peace-time (Chambers of Reunion, 1681), while the latter were suppressed by the French Revolution.

The *ancien régime* had respected the *status quo* in Alsace, and left Protestantism undisturbed, even after the revocation of the Edict of Nantes. Alsatian manners, customs and tongue had, as a rule, been preserved. The Revolution, which was hailed with enthusiasm throughout the country, popularized the French language, which was looked on as the "language of liberty." The festivals of the "Federation of the Rhine," or "Confederation of Strasbourg," June 11–13, 1790 (oath of the Butchers' Field), laid the foundations of that Alsace which henceforward, like Lorraine,

was to partake of the life of France until the day when Bismarck annexed the whole of Alsace and part of Lorraine, to "form a glacis" against France. The German law of June 3, 1871, declared these territories imperial territories (Reichsland). On that day Alsace-Lorraine was born.

THE GERMAN PERIOD

Its history under German domination falls into three periods:

(1) **1871–90: the Period of Organization.**—At first (until the constitution of July 4, 1879) Alsace-Lorraine was organized under decrees issued in Berlin and applied by an *Oberpräsident;* after 1879, by an imperial representative with the powers of a chancellor, or statthalter (Manteuffel, later Prince Hohenlohe-Schilling), residing at Strasbourg and assisted by two under-secretaries of state. The administration was organized by the imperial rescript of Dec. 30, 1871, under para. 10 of which the head of the administration received dictatorial powers. The territory was divided into three administrative districts: Upper Alsace, Lower Alsace, and Lorraine. A formidable army of occupation was maintained, but an autonomous network of railways helped to develop Strasbourg's commercial life. In 1874, an electoral assembly, or *Landesausschuss,* was granted, to sit at Strasbourg. Nevertheless, the inhabitants continued to protest. Hohenlohe's severities, and especially his system of passports, strengthened the opposition. The provinces longed for the arrival of the French, in whom the spirit of revenge was kept alive by such frontier incidents as the Schnaebelé in 1887, by the "Boulangiste" movement and Déroulède's (*q.v.*) *"Ligue des patriotes."* (*See* also FRANCE: *History*). But in France, at the general elections of 1889, the Republican Party, the advocates of peace, triumphed, while in Germany Bismarck was dismissed in March 1890 by the young emperor, William II., who immediately inaugurated a new policy, abolishing passports, and allowing greater liberality in the granting of *permis de séjour.*

(2) **1890–1902.**—The second period was one of calm, of economic development and of material prosperity. The inhabitants of the Reichsland ceased to wage against the empire a necessarily barren opposition; and at the Reichstag elections of 1890 not a single irreconcilable was left. The "autonomist" party itself disappeared in the elections of 1898. The chief party was the Clerical; beside this, there were the Socialists, and even some German *immigrés.* The new statthalter, Hohenlohe-Langenbourg (1894), an oldish man, appointed native under-secretaries (Zorn de Bulach, Pétri). This was the epoch when the German emperor was coquetting with France. The Alsatians believed it possible to show loyalty to the empire without failing in their allegiance to France. They cajoled their masters (for instance by the reconstruction of Hoh-Königsberg, 1901–02), but claimed in return liberties equal to those enjoyed by other Germans. These the German Government refused to grant until they had become more than loyal subjects—enthusiastic Germans. This was too much to ask. Meanwhile, the Alsatians complained that they were left with "secondary rights of citizenship"

(3) **1902–18.**—The third period began with an attempt to form a constitution. William II., through the chancellor, von Bülow, proposed, by rescript of May 9, 1902, the suppression of the notorious "dictatorship paragraph" (para. 10 of the rescript of Dec. 30, 1871); and this was abolished on June 9. Now that the press enjoyed more liberty, its power rapidly developed. The presiding minister, M. de Koeller, was able, thanks to his jovial frankness, to direct the *Landesausschuss* as he would. "Protests" had ceased completely. The process of Germanization made rapid progress in the country districts, chiefly owing to the bad impression made on the Alsatian Clerical Party by the campaign against the Catholic Church initiated by the French Government. The Clerical Party, the strongest numerically of all the Alsatian parties, now formed part of the German Centre Party. The best minds in Alsace, however, worked particularly through the medium of the Alsatian theatre, the *Revue Alsacienne,* and lectures were delivered in French to save French culture from extinction, while the desire for a liberal constitution grew stronger every day among the masses.

While the semi-official press, such as the *Strassburger Post*—the mouthpiece of Pan-Germanism—denounced and maligned everything connected with France, provoking ironical and biting retorts from the Alsatian caricaturists, the Government, to give a semblance of satisfaction to Alsatian opinion, passed the constitution of May 31, 1911, through the Reichstag. This established a diet (*Landtag*) of two chambers, which cancelled each others' activities, while the upper house was entirely subservient to the German Government; the statthalter was not responsible to them. To counter the *"Union nationale alsacienne-lorraine,"* the Government supported the Socialists and the Centre Party at the elections to the *Landesausschuss* of Oct. 1911; but the new house although elected with the support of the Government, was soon in conflict with it, on account of the excesses of the Pan-Germanists. A vote of censure was passed upon the Government for their conduct in the notorious incident of Grafenstaden (April 1912)—when the Government demanded the dismissal of the director of the locomotive works on the ground of French intrigues. Germany's preparations for war rendered the German army in Alsace-Lorraine more insolent than ever and the Zabern incident (1913–14), which amounted to an organized militarist insult to things Alsatian, resulted in further votes of censure and finally in the formation of the *Ligue pour la défense de l'Alsace-Lorraine* (March 1914).

In spite of the continuous and partially successful efforts of Germany from 1871 to 1914 to assimilate Alsace-Lorraine, the divorce between the Alsatian and the German mentality was thus more complete than ever on the eve of the World War At its very outset, some 1,000 suspected persons, whose names were on a black list, were arrested. When the German reserve troops entered Alsace to attack France, their officers warned their men that on crossing the Rhine they would enter "hostile territory." At the end of the first year of the War, the German Government, confident of victory, were deciding on the partition of Alsace-Lorraine between Bavaria and Prussia immediately on the conclusion of peace, deportations and the confiscation of landed property on the widest scale, and colonization by large numbers of ex-soldiers of Prussian stock During the four years of the War, the inhabitants of Alsace and Lorraine lived under a reign of terror; they were forbidden to speak French in the streets, numbers were denounced by the gendarmerie, and many deported to Germany; 19,000 persons were still in exile in 1918.

In Sept. and Oct. 1918, the evacuation of Alsace was anxiously awaited, and it was rumoured that the Germans in their rage would leave no stone upon another. Thus, when the collapse of Germany came, the concessions extorted from the Germans by the fear of reprisals in Oct. 1918 could not prevent the long-pent up feelings of the population from finding enthusiastic outlet, and the French were everywhere welcomed as liberators.

POST-WAR PROBLEMS

The previous history of Alsace-Lorraine explains the difficulties met by France in this country since the armistice. Many institutions had been introduced by the Germans during the half-century of their occupation—the land survey, the German civil code, social legislation, etc.—and the population had grown accustomed to German administration, which in certain respects was far in advance of the French. Certain urgent problems arose immediately after the armistice, and these were solved by France in the most liberal and generous spirit; the German mark was accepted at the exchange rate of 1fr. 25c.; the railways, which had once formed an integral part of the French *chemin de fer de l'est,* were maintained as an autonomous system, etc.

France is a unified and centralized state, although of democratic spirit and admitting freedom of discussion. Germany was an aristocratic and authoritative state, but its constitution was federal. The Alsatians, moreover, being fundamentally democratic and impatient of authority, like the true French, had got into the habit under the German rule of looking to Strasbourg rather than to Berlin. These habits have inclined them to resist a complete assimilation with the rest of France, despite the obvious kinship of the two mentalities. To satisfy the peoples of the

recovered provinces, the French Government thought it better at first not to hurry things overmuch; a *Haut-Commissariat* was therefore established at Strasbourg, followed by a *Commissariat général*, a provisional arrangement that was maintained until 1925, the successive commissioners being Maringer, Millerand, Alapetite and Cacaud. They were assisted by a *conseil régional* composed of native notabilities. Since 1925 there has been a Government department for Alsace-Lorraine at Paris, consisting of an under-secretary of state and an advisory council. These changes, although inevitable—they could, indeed, have been foreseen from the beginning—were destined to afford a pretext for malcontent agitation. A new political party was formed under the name of "autonomists" (manifesto of the *Heimatbund*, June 1926). Emboldened by the passivity of the French authorities, who have respected, perhaps too scrupulously, liberty of opinion, this party is supported by all the German immigrants who became French citizens under the Treaty of Versailles, and also by propaganda from beyond the Rhine. Already it aims at the separation of Alsace-Lorraine from France. In 1926 it demanded autonomy *"dans le cadre de la France,"* but in 1927 this no longer satisfied it. Its manifesto of Sept. 1927 showed that it had ceased to be autonomist and become separatist.

Backed by the clerical press and by the Communists, the Autonomist Party set itself to oppose France by every means in its power. In 1928 the arrest of the chiefs of the party on a charge of plotting against the state gave them the opportunity of posing before the electorate as martyrs—which secured their election in April to the *Chambre des députés*. The trial which followed at Colmar in May, and which ended with the condemnation of the principal offenders further excited popular passion for some considerable time.

Two burning questions make this agitation formidable—that of religion and that of education. As all its history demonstrates, religion is almost as strong a factor in Alsace as democracy. In France, although complete freedom of conscience is assured, yet the neutrality of the state in religious matters is absolute. The Germans, however, cast their net round both the Catholic and Protestant clergy; intending priests and pastors were obliged to attend German universities. The denominational schools were maintained. Modern France, therefore, with its lay schools and its separation of Church and State, was suspect in the eyes of the clericals of Alsace and Lorraine. The French Government wisely decided to maintain the existing state of things in the recovered territories; and when, as sometimes happens, it establishes here and there an "interdenominational" school (different from a lay school) it is in no way hostile to the habits of the country, and only acts as it does at the request of the population interested. This does not, however, prevent the Clerical Party (the *Union populaire républicaine*) from uttering strongly worded protests; so that it has been suspected in many quarters of secret complicity with the autonomists.

The question of education bulks equally large. While Germany forbade the teaching of French, France has retained that of German. There are protests, however, against a system which forces a German-speaking population to devote more time to French than to German. Against this it is urged that it is natural that France should wish her citizens to understand the language of their country. Moreover, the Government has made certain concessions (Sept. 1927).

Behind all these divergences of view lies, of course, the opposition of the two civilizations. But the two civilizations should rather supplement each other, and the solution of this question is easy enough if history be consulted, and with it the secret feelings of the immense majority of the inhabitants of Alsace-Lorraine. From the remotest times, Alsace has formed the arena in which two civilizations have either met or replaced one another. Goethe studied, and Pasteur taught, at Strasbourg. Autonomy for Alsace-Lorraine is totally impracticable. The chief ambitions of its people are first to have done, once and for all, with swinging backwards and forwards between France and Germany; secondly, to act as a connecting link and as the messengers of peace between the two countries. To do this they must learn to know France. But this requires time.

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ALSATIA (the old French province of Alsace), long a "debatable ground" between France and Germany, and hence a name applied in the 17th century to the district of Whitefriars, between the Thames and Fleet street, in London, which gave sanctuary (*q.v.*) to debtors and criminals. The privileges were abolished in 1697.

ALSBERG, CARL LUCAS (1877–), American biochemist, was born in New York city, on April 2, 1877. He graduated at Columbia university in 1896 and from the College of Physicians and Surgeons in 1900. Following three years' study in 1900–03 at the universities of Berlin and Strassburg, Germany, he was an assistant and instructor in biological chemistry in Harvard university until 1908. From 1908 to 1912 he was chemical biologist in the bureau of plant industry and from 1912 to 1920 he was chief of the bureau of chemistry in the U S. Department of Agriculture. In 1920 he was made director of the Stanford Food Research Institute, Stanford university, California. His researches include investigations on the biology and toxicology of moulds, cyanogenesis in plants, poisonous plants, phosphoric acid metabolism, nucleic acids, proteins, cystinuria, enzymes and the chemistry of foods.

ALSEN, a Danish island in the Baltic, off the coast of Slesvig, in the Little Belt. It was Danish property until 1864 when it was incorporated with Germany. It was of strategic importance as it guarded an approach from the North sea to the Baltic. After 1919 it was again in Danish hands. The island is fertile and well wooded and Sondorborg, the capital, has a good harbour. Most of the inhabitants speak Danish. Area of island 105 sq m.

ALSIETINUS LACUS (mod. LAGO DI MARTIGNANO), small lake, south Etruria, 15m. due N.N.W. of Rome, in an extinct crater. Augustus drew from it the Aqua Alsietina; the water was hardly fit to drink, and was mainly intended to supply his naumachia (lake made for a sham naval battle) at Rome, near S. Francesco a Ripa, on the right bank of the Tiber. The aqueduct, mainly subterranean, is practically untraced. Frontinus tells us that it received water from the lake of Bracciano near Careiae (Galera); and an inscription relating to it has been found in this district, while the only known remains of the channel were found on the Janiculum in 1927.

ALSIKE, also called Swedish clover, the name by which *Trifolium hybridum* is known to farmers and agriculturists. It is a perennial form resembling the white or Dutch clover (*T. repens*) and, like it, has white or rosy flowers. Alsike was introduced into Great Britain from south Sweden in 1834. It has also become widely naturalized in North America. In the eastern United States and in south-eastern Canada it is an important agricultural clover. Although alsike has been regarded as intermediate between the white species *T. repens* and the red species *T. pratense*, it is not a hybrid, but a distinct species. (*See* CLOVER)

ALSIUM (mod. PALO), ancient town, Etruria, on the Via Aurelia, about 22m. from Rome. It was one of the oldest cities of Etruria, colonized by Rome in 247 B C, but was of importance only as a resort of wealthy Romans, many of whom (*e g*, Pompey and the Antonine emperors) had villas there, considerable remains of which exist. The mediaeval castle belongs to the Odescalchi family.

ALSOP, VINCENT (*c.* 1630–1703), English Nonconformist divine, was ejected from his living under the Act of Uniformity in 1662. He had a great reputation as a pamphleteer in his day. Even with Dr. Goodman and Dr. Stillingfleet as opponents he held his own. His *Mischief of Impositions* (1680), in answer to Stillingfleet's *Mischief of Separation*, and his *Melius Inquirendum* (1679), in answer to Goodman's *Compassionate Inquiry*, remain historical landmarks in the history of Nonconformity.

See Wood's *Athenae* (Bliss) iv. 106; Calamy's *Life of Baxter*, ii. 487; Wilson's *History and Ant. of Dissenting Churches*, iv. 63–66.

ALSTED, JOHANN HEINRICH (1588–1638), German Protestant divine. He was sometime professor of philosophy and theology at Herborn, in Nassau, and afterwards at Weissenburg in Transylvania, where he remained till his death in 1638. He was a marvellously prolific writer. His *Encyclopaedia* (1630), the most considerable of the earlier works of that class, was long held in high estimation.

ALSTON, market town, Cumberland, England, on a branch of the L.N E.R. from Haltwhistle. Population of parish (Alston with Garrigill) (1921) 3,344. It lies in the uppermost part of the valley of the South Tyne, among the high bleak moors of the Pennines. Copper and blende are found, and there are limestone quarries. The mines of argentiferous lead, belonging to Greenwich hospital, London, were formerly of great value, and it was in order that royalties on the Alston lead mines and on those elsewhere in the county might be jointly collected that the parish was first included within the borders of Cumberland in the 18th century. As many as 119 lead mines were worked in the parish in 1768, but the supply of metal has been almost exhausted. Coal is worked in the neighbourhood. Thread and flannels are also made. Whitley castle, 2m. N., was a Roman fort, the original name of which is not known, guarding the road which ran along the South Tyne valley and over the Pennines. It has no connection with Alston itself.

ALSTONITE, a member of the aragonite group of minerals. It consists of an isomorphous mixture of calcium and barium carbonates in various proportions $(Ca,Ba)CO_3$, and thus differs chemically from barytocalcite (*q.v.*) which is a double salt of these carbonates in equal molecular proportions. Being isomorphous with aragonite, it crystallizes in the orthorhombic system, but simple crystals are not known. The crystals are invariably complex twins and have the form of doubly terminated pseudohexagonal pyramids, like those of witherite but more acute. The crystals are translucent and white, sometimes with a shade of pink. Sp. gr. 3·706; hardness 4–4½. The mineral has been found at only three localities, all of which are in the north of England. It takes its name from Alston in Cumberland, where it occurs in veins of lead ore.

ALSTRÖMER, JONAS (1685–1761), pioneer of Swedish industrialism, was born at Alingsås in Vestergötland, Jan 7, 1685 He left his native village at an early age, and in 1707 became clerk to Alberg, a merchant of Stockholm, whom he accompanied to London. After carrying on business for three years, Alberg failed, and Alströmer (who changed his name from Alström on receiving letters of nobility) engaged in the business of shipbroker on his own account. He returned to Alingsås, and in 1724 established a woollen factory there. After preliminary difficulties it became a very profitable business. He next established a sugar refinery at Gothenburg, introduced improvements in the cultivation of potatoes and of plants suitable for dyeing, and directed attention to improved methods in shipbuilding, tanning and the manufacture of cutlery. But his most successful undertaking was the importation of sheep from England, Spain and Angora. He died June 2, 1761, leaving several works on practical industrial subjects.

ALT, ALTISSIMO. In music, the notes of the octave beginning with the G above the treble stave are said to be "in alt" and those of the succeeding octave "in altissimo," although by some the F instead of the G is taken as the beginning of the higher octave. The same notes are also indicated by the employment of italic type followed by two and three strokes respectively, e g., g'' and g'''.

ALTAI (in Mongolian *Altain-ula,* the "Mountains of Gold"), a term used with various significations The *Altai region,* in west Siberia and Mongolia, is similar in character to the Alps, but covers a much greater area. It extends from the river Irtysh and the Dzungarian depression (46°–47°N.) northwards to the Siberian railway and to the Sayan mountains. The backbone of the region is the Sailughem mountains (Silyughema or Kolyvan Altai), which stretch north-eastwards from 49°N. and 86°E. towards the west end of the Sayan mountains (51° 60′N. and 89°E.). Their mean elevation is 5,000–5,500ft. The snow-line runs at 6,700ft. on the northern versant and at 7,800ft. on the southern, the rugged peaks standing 3,200ft. above it. Passes are few and difficult, the chief being Ulan-daban at 9,275ft. (9,445ft. according to Kozlov) and Chapchan-daban, at 10,555ft., in the south and north respectively. On the east and south-east this range is flanked by the great plateau of Mongolia, the transition being effected gradually by means of several minor plateaus, such as Ukök (7,800ft.), Chuya (6,000ft.), Kendykty (8,200ft.), Kak (8,270ft.), Suok (8,500ft.) and Juvlu-kul (7,900ft.). This region, which is not accurately known, is studded with large lakes, *e g.,* Ubsa-nor (2,370ft. above sea-level), Kirghiz-nor, Durga-nor and Kobdo-nor (3,840ft.), and crossed by mountain ranges, the principal being the Tannu-ola, roughly parallel with the Sayan mountains as far east as the Kosso-gol (100°–101°E.), and the Khan-khu mountains, also stretching west to east.

The *Altai proper* (the Ek-tagh, Mongolian Altai, Great Altai or Southern Altai) likewise extend in two twin parallel chains eastwards as far as 99°, if not farther. The Ek-tagh, which separates the Kobdo basin (north) from the Irtysh basin (south), is a true border-range, in that it rises in a steep and lofty escarpment from the Dzungarian depression (1,550 to 3,000ft), but descends on the north by a relatively short slope to the plateau (4,000–5,500ft) of north-western Mongolia. East of 94° the range is continued by a double series of quite distinct chains. The southern chain bears the names of Karaadzirga and Burkhan-ola, and terminates in about 99°; but the northern range, the principal names of which are Artsi-bogdo and Saikhat, extends probably most of the way to the great northward bend of the Hwang-ho round the desert of Ordos. Whereas the western Ek-tagh Altai rises above the snow-line and is destitute of timber, the eastern double ranges barely touch the snow-line and are clothed with thick forests to an altitude of 6,250ft. The slopes of these chains are inhabited principally by nomad Kirghiz.

The north-western and northern slopes of the Sailughem mountains are extremely steep and very difficult of access. On this side lies the culminating summit of the range, the double-headed Byelukha, whose summits reach 14,890 and 14,560ft. respectively, and give rise to several glaciers Here also are the Kuitun (12,000ft) and several other lofty peaks. There are numerous spurs, striking in all directions to the lowlands of Tomsk, but their mutual relations are not well known. Such are the Chuya alps (average altitude 9,000ft , with summits from 11,500 to 12,000ft., and at least ten glaciers on their northern slope); the Katun alps (mean elevation about 10,000ft. and mostly snow-clad); the Kholzun range; the Korgon (6,300 to 7,600ft.), Talitsk and Selitsk ranges; the Tigeretsk alps, and so on. Several secondary plateaus of lower altitude are also distinguished The River Katun begins in a wild gorge on the south-west slope of Byelukha; then pierces the Katun alps, and enters a wider valley, at an altitude of from 2,000 to 3,500ft., which it follows until it joins the River Biya, to form the River Ob. The River Charysh has the Korgon and Tigeretsk alps on one side and the Talitsk and Bashalatsk alps on the other, and its valley, like the others, is very fertile. Farther west the valleys of the Uba, the Ulba and the Bukhtarma open south-westwards towards the Irtysh. The lower part of the first, like the lower valley of the Charysh, is thickly populated; in the valley of the Ulba is the Riddersk mine, at the foot of the Ivanovsk peak (6,770ft.). The valley of the Bukhtarma also has its origin at the foot of the Byelukha and the Kuitun peaks, and it falls some 5,000ft. in less than 200m. to the Bukhtarma fortress (1,130ft.). Its upper parts abound in glaciers, the best known of which is the Berel, which comes down from the Byelukha. On the northern side of the range which separates the upper Bukhtarma from the upper Katun is the Katun glacier, in which the Katun river rises. The middle and lower parts of the Bukhtarma valley have been colonized since the 18th century by runaway Russian peasants who created there a free republic on Chinese territory; and after this part of the valley was annexed to Russia, in 1869, it was rapidly colonized. The high valleys farther north, on the same western face of the Sailughem range, are little known, their only

visitors being Kirghiz shepherds. Those of Bashkaus, Chulyshman, and Chulcha, all three leading to Lake Teletskoye (length, 48m.; max. width, 3m.; altitude, 1,700ft.; area, 87sq.m.; max. depth, 1,020ft.; mean depth, 660ft.), are only inhabited by nomad Telenghites or Teleuts. The shores of the lake rise almost sheer to over 6,000ft. and are too wild to accommodate a numerous population. From this lake issues the Biya, which joins the Katun at Biysk. Farther north the Altai highlands are continued in the Kuznetsk district, which has a slightly different geological aspect, but still belongs to the Altai system. But the River Abakan, which rises on the west of the Sayan mountains, belongs to the system of the Yenisei. The Kuznetsk Ala-tau range, on the left bank of the Abakan, runs north-east while a complexus of imperfectly mapped mountains (Chukchut, Salair, Abakan) fills up the country northwards towards the Siberian railway and westwards towards the Ob. The Tom and its numerous tributaries rise on the northern slopes of the Kuznetsk Ala-tau, and their fertile valleys are occupied by a dense Russian population, the centre of which is Kuznetsk, on the Tom.

Geology.—The Altai mountains consist of two distinct elements which differ considerably in geological formation. The Mongolian, or Great Altai, consists essentially of Archaean rocks (gneisses, etc.), in which there is no folding of Hercynian or Alpine age, but the strike of the rocks is independent of the direction, determined by fault fractures, of the chains. The region forms a horst. In the Russian Altai we find various Archaean schists with Palaeozoic rocks, predominantly limestones with Devonian and Carboniferous fossils. They were folded during the Hercynian period, the general trend of the folds being north-north-east. Of the same age as the folding are intrusions of granitic and other igneous bodies with which are associated the famous ore deposits.

Flora.—The flora of the Altai is rich and very beautiful. Up to a level of 1,000ft. on the northern and 2,000ft. on the southern slopes, plant life belongs to the European flora, which extends into Siberia as far as the Yenisei. The steppe flora penetrates into the mountains, ascending some 1,100–1,200ft., and in sheltered valleys even up to 5,500ft., when it comes into contact with the purely alpine flora. Tree vegetation, which reaches up as high as 6,500 and 8,150ft., the latter limit on the north and west consists of magnificent forests of birch, poplar, aspen and Coniferae, such as *P. cembra*, though the fir is not found above 2,500ft., while the meadows are abundantly clothed with brightly-coloured, typical assortments of herbaceous plants. The alpine meadows, which have many species in common with the European Alps, have also a number of their own peculiar Altaian species.

For population, administrative divisions and mining activities, etc., *see* SIBERIAN AREA, KUZNETSK ALTAI REGION.

ALTAIR, the brightest star in the constellation Aquila (*q.v.*), and, on this account, also known as α Aquilae. It is the middle member of the group β, α, γ in the constellation, and is of the first magnitude, being one of the nearest stars. Its distance from the solar system is four parsecs or 14 light-years. (*See* LIGHT-YEAR.) It is a globe giving out 12 times as much light as the sun.

ALTAMURA, Apulia, Italy, province of Bari, 28m. S.W. of the city Bari, and 56m. by rail via Gioia del Colle. Pop. (1921) 26,877 (town), 27,155 (commune). It possesses a fine Romanesque cathedral begun in 1232 and restored in 1330 and 1543, the portal being especially remarkable. It is one of the four Palatine churches of Apulia. The mediaeval walls, erected by the emperor Frederick II., rest upon the walls of a pre-Roman city of unknown name. There is some trade in wool.

ALTAR, a base or pedestal used for sacrifice or prayer to a deity.

Mesopotamia.—Altars are found from the earliest times in the remains of Babylonian cities; the oldest are square erections of sun-dried bricks. In Assyrian mounds limestone and alabaster are the chief material. They are of varying form; an altar shown in a relief at Khorsabad has stepped battlements, corresponding to the Hebrew "altar-horns." An altar also from Khorsabad (now in the British Museum) has a circular table and a solid base, triangular in plan, with pilasters ornamented with animals' paws at the angles. An 8th century B.C. altar from Nimrûd (also in the British Museum) is a rectangular block with cylindrical rolls at the ends. These altars are 2ft. to 3ft. high. According to Herodotus (i. 183) the great altars of Babylonia were made of gold.

Egypt.—In Egypt altars took the form of a truncated cone or of a cubical block of polished granite or of basalt, with one or more basin-like depressions (with drainage channels) in the upper surface for receiving libations. The surface was plain, inscribed with dedicatory or other legends, or adorned with symbolical carving.

Palestine.—Recent excavations, especially at Gezer, have shown that the earliest altars, or rather sacrifice hearths, in Palestine, were circular spaces marked out by small stones set on end. At Gezer a pre-Semitic place of worship was found in which three such hearths stood together, and drained into a cave which may reasonably be supposed to have been regarded as the residence of the divinity. These circular hearths persisted into the Canaanite period, but were ultimately superseded by the Semitic developments. To the primitive nomadic Semite the presence of the divinity was indicated by springs, shady trees, remarkable rocks and other landmarks; from this conception grew the theory that a *numen* might be induced to take up an abode in an artificial heap of stones, or a pillar set upright for the purpose. The blood of the



THE CATHEDRAL, ALTAMURA, BUILT IN THE 13TH CENTURY
Altamura, an ancient town of Italy situated in fertile farm country at the foot of the Apennines, is famous locally for its fairs

victim was poured over the stone as an offering to the divinity dwelling within it; and the stone came finally to be used as a table on which the victim was to be burned.

A very remarkable altar, at present unique, was found at Taanach by the Austrian excavators. It is pyramidal in shape, and the surface is ornamented with human-headed animals in relief. This, like the earliest Babylonian altars, is of baked earth. These primitive altars were of the simplest possible description—in accordance with the regulation preserved in Exod. xx. 24–26, that *in every place where Yahweh records his name* an altar of earth

or of unhewn stone, without steps or other ornamentation, shall be erected.

The priestly regulations affecting altars are of a very elaborate nature, and are framed with a single eye to the essential theory of later Hebrew worship—the centralization of all worship at one shrine. These recognize two altars, which by the authors of this portion of the Pentateuch are placed in the tabernacle in the wilderness.

The first, that for burnt-offering, was in the centre of the court of the tabernacle, of acacia wood, 3 cubits high and 5 square. It was covered with copper, was provided with "horns" at the corners, hollow in the middle, and with rings on the sides into which the staves for its transportation could be run (Exod. xxvii. 1–8). The altar of the Solomonic temple is on similar lines, but much larger. It is now generally recognized that the description of the tabernacle altar is intended to provide a precedent for this vast structure, which would otherwise be inconsistent with the traditional view of the simple Hebrew altars. In the second temple a new altar was built after the fashion of the former (I. Macc. iv. 47) of "whole stones from the mountain." In Herod's temple the altar was again built after the same model. It is described by Josephus (v. 5, 6) as 15 cubits high and 50 cubits square, with angle horns, and with an "insensible acclivity" leading up to it (a device to evade the pre-Deuteronomic regulation about steps). It was made without any use of iron, and no iron tool was ever allowed to touch it. The blood and refuse were discharged through a drain into the brook Kedron; this drain probably still remains, in the *Bir-el-Arwah,* under the "Dome of the Rock" in the mosque which covers the site of the temple.

The second altar was the altar of incense, in the holy place of the tabernacle. It was of similar construction to the altar of burnt-offering, but smaller, being 2 cubits high and 1 cubit square (Exod. xxx. 1–5). It was overlaid with gold. Solomon's altar of incense (I. Ki. vi. 20) would appear to have been of cedar. But the authenticity of the passages describing the altar of incense in the tabernacle, and the historicity of the corresponding altar in Solomon's temple, are matters of keen dispute among critics. The incense altar in the second temple was removed by Antiochus Epiphanes (I. Macc. i. 21) and restored by Judas Maccabaeus (I. Macc. iv. 49). That in the temple of Herod is referred to in Luke i. 11.

On the first of these altars was a fire continually burning, in which the burnt-offerings were consumed. On the second an offering of incense was made twice a day. The use of the altar as an asylum is implied in Exod. xxi. 14. From I. Ki. i. 50, ii. 28, it would appear that the suppliant caught hold of the altar-horns (compare I. Ki. ii. 28).

Greece and Rome.—According to their respective uses, altars fell into two classes. Those of the first class were pedestals, so small and low that the suppliant could kneel upon them; these stood inside the temples, before the sacred image. The second class consisted of larger tables destined for burnt sacrifice; these were placed in the open air, and, if connected with a temple, in front of the entrance. The second class of altars, called *βωμοί* by the Greeks and *altaria* by the Romans, appears to have originated in temporary constructions such as heaps of earth, turf or stone, made for kindling a sacrificial fire as occasion required. But sacrifices to earth divinities were made on the earth itself, and those to the infernal deities in sunk hollows (*Odyss.* x. 25; Festus *s. v. Altaria*). The note of Eustathius (*Odyss.* xii. 252) seems to suggest survival of a primitive custom of offering sacrifice without an altar at all. Pausanias (vi. 20. 7) speaks of an altar at Olympia made of unbaked bricks. In some primitive holy shrines the bones and ashes of the victims sacrificed were allowed to accumulate, and upon this new fires were kindled. Altars so raised were considered as endowed with particular sanctity; notable instances are the altars of Hera at Samos, of Pan at Olympia, of Heracles at Thebes and of Zeus at Olympia (Paus. v. 14, 6; v. 15, 5; ix. 11, 7; v. 13, 5). The last-mentioned stood on a platform (*πρόθυσις*) measuring 125ft. in circumference, and led up to by steps, the altar itself being 22ft. high. Women were excluded from the platform. Where hecatombs were sacrificed, the *πρόθυσις* necessarily assumed colossal proportions, as in the case of the altar at Parion, where it measured on each side 600ft. The altar of Apollo at Delos (*κεράτινος βωμός*) was made of the horns of goats believed to have been slain by Diana; at Miletus was an altar composed of the blood of victims sacrificed (Paus. v. 13, 6). The altar of Phorae in Achaea was of unhewn stones (Paus. vii. 22, 3); that used at the festival in honour of Daedalus on Mt. Cithaeron was of wood, and was consumed along with the sacrifice (Paus. ix. 3, 4). Others of bronze are mentioned. But these were exceptional. The usual material of an altar was marble, and its form, both among the Greeks and Romans, was either square or round; polygonal altars, of which examples still exist, being exceptions. When sculptured decorations were added they frequently took the form of festoons like those used to ornament altars, or of symbols, such as crania and horns of oxen, referring to the victims sacrificed. Altars apart from temples usually bore the name of the person by whom they were dedicated, and the name, or a representation, of the deity in whose service they were. An altar was usually retained for the service of one particular god, but joint dedications occur, as in the case of the altar at Olympia to Artemis and Alpheus jointly, or that of Poseidon and Erechtheus in the Erechtheum at Athens; at Oropus the altar was divided into five parts, one dedicated to Heracles, Zeus and Paean Apollo, a second to heroes and their wives, a third to Hestia, Hermes, Amphiaraus and the children of Amphilochus, a fourth to Aphrodite Panacea, Jason, Health and Healing Athene, and the fifth to the Nymphs, Pan and the rivers Archelous and Cephissus (Paus. i. 34. 2). Deities of an inferior order, who were conceived as working together—*e.g.*, the wind gods—had an altar in common. In the same way, the "unknown gods" were regarded as a unit, and had in Athens and at Olympia one altar for all (Paus. i. 1, 4; v. 14, 5; *cf.* Acts xvii. 23). An altar to all the gods is mentioned by Aeschylus (*Supp.* 222). Other exceptional classes of altars are those on which fire could not be kindled (*βωμοὶ ἄπυροι*), and those which were kept free from blood (*βωμοὶ ἀναλμακτοι*), of which in both respects the altar of Zeus Hypatos at Athens was an example. The *ἑστία* was a round altar; the *ἐσχάρα,* one employed apparently for sacrifice to inferior deities or heroes (but *ἐσχάρα Φοίβου,* Aesch. *Pers.* 205). In Rome an altar erected in front of a statue of a god was always required to be lower than the statue itself (Vitruvius iv. 9). Altars were always places of refuge, and even criminals and slaves were there safe, violence offered to them being insults to the gods whose suppliants the refugees were for the time being.

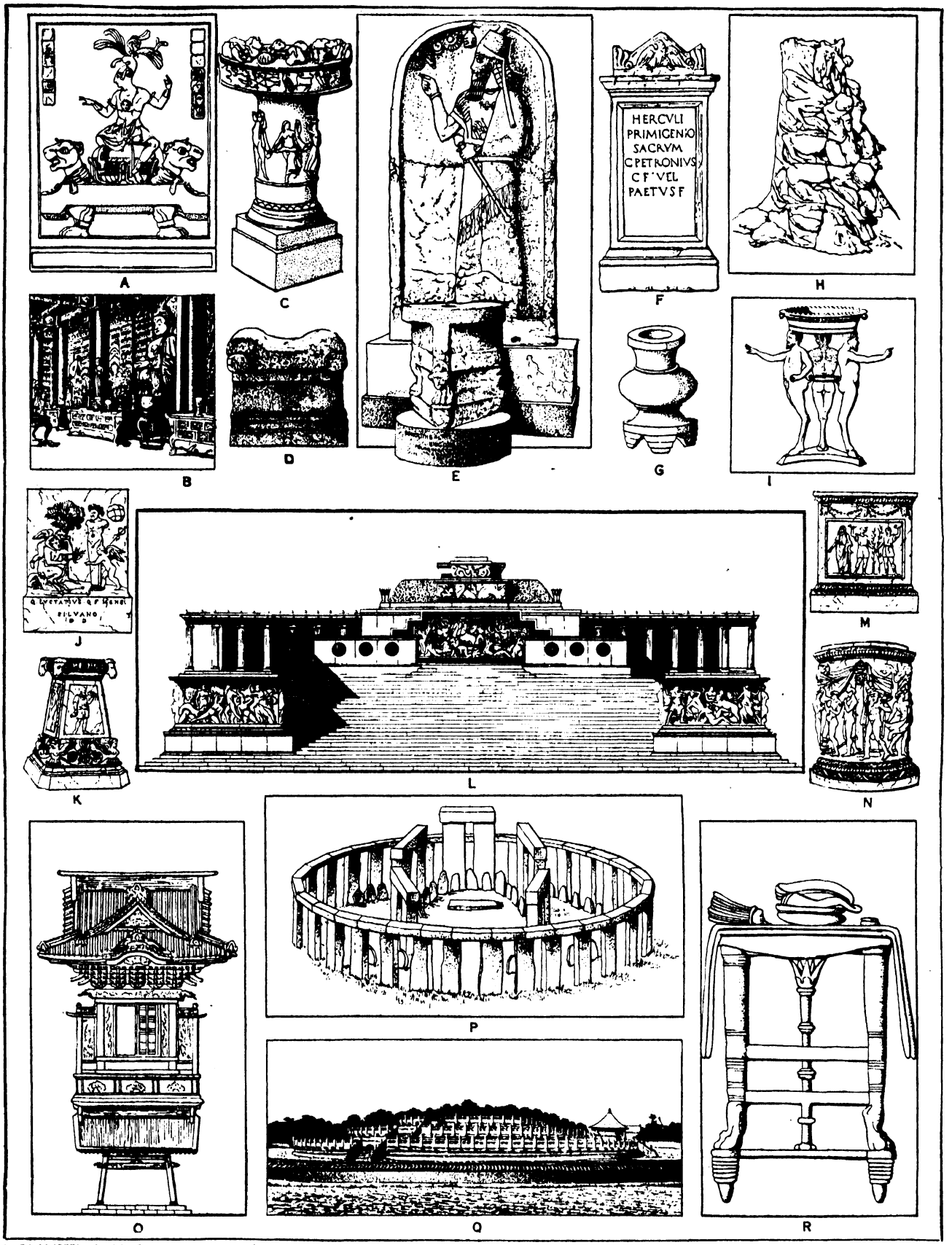
Ancient America.—As a single specimen of an altar, wholly unrelated to any of the foregoing, we may cite the ancient Mexican example described by W. Bullock (*Six Months in Mexico,* London, 1824, p. 335). This was cylindrical, 25ft. in circumference, with sculpture representing the conquests of the national warriors in 15 different groups round the side.

Portable altars and tables of offerings were used in pre-Christian as well as in Christian ritual. One such was discovered in the Gezer excavations, dating about 200 B.C. It was a slab of polished limestone about 6in. square with five cups in its upper surface. Another from the same place was a small cubical block of limestone bearing a dedication to Heracles. They have also been found in Assyria. Pocket altars are still used in some forms of worship in India. *See* the *Journal of the Royal Asiatic Society,* 1852, p. 71.

ALTARS IN THE CHRISTIAN CHURCH

I. The Early Church.—The altar is spoken of by the early Greek and Latin ecclesiastical writers under a variety of names:—*τράπεζα,* the principal name in the Greek fathers and the liturgies; *θυσιαστήριον* (rarer; used in the Septuagint for Hebrew altars); *ἱλαστήριον*; *βωμός* (usually avoided, because of its pagan associations); *mensa Domini; ara* (avoided like *βωμός* for the same reason); and, most regularly, *altare.*

In his reply to Celsus (p. 389), who has charged the Christians with being a secret society, "because they forbid to build temples, to raise altars," Origen says, "The altars are the heart of every Christian." We gather from this, and from a passage in Lactantius, *De Origine Erroris,* ii. 2, that down to about A.D. 250, or perhaps



A. BY COURTESY OF THE FIELD MUSEUM OF NATURAL HISTORY; D-E. BY COURTESY OF THE TRUSTEES OF THE BRITISH MUSEUM; I, O, AND P. BY PERMISSION FROM SIR BANISTER FLETCHER'S "HISTORY OF ARCHITECTURE ON THE COMPARATIVE METHOD," EIGHTH EDITION, 1928 (BATSFORD)

A. MAYAN ALTAR, STUCCO ALTAR-PIECE KNOWN AS THE BEAU RELIEF; B. YELLOW TEMPLE, PEKING; C. ROMAN ALTAR; D. STATUE SEAT, BIT-KIDMURI; E. ALTAR AND STELE IN TEMPLE OF ADAR OR NINIB, ASSYRIA; F. ROMAN ALTAR OF HERCULES PRIMIGENIUS; G. ASSYRIAN ALTAR; H. ALTAR OF INCENSE, EXCAVATED AT TAANACH, PALESTINE; I. ROMAN TRIPOD ALTAR; J. ROMAN ALTAR; K. ROMAN ALTAR FROM CAVICIPPI; L. RESTORATION OF THE GREAT HELLENISTIC ALTAR AT PERGAMUM, ASIA MINOR, BY PONTREMOLI; M. ANTIQUE ROMAN ALTAR; N. ANTIQUE ROMAN ALTAR; O. ALTAR SHRINE, TEMPLE OF MIYO-JIN, JAPAN; P. STONEHENGE, AS RESTORED BY WALTIRE; Q. ALTAR OF HEAVEN, PEKING; R. ASSYRIAN SLAB

a little later, the communion was administered on a movable wooden table. In the Catacombs, the *arcosolia* or bench-like tombs are said (though the statement is doubtful) to have been used for this purpose. The earliest church altars were certainly made of wood; and it appears from a passage in William of Malmesbury (*Gesta Pontif.* iii. 14) that in the diocese of Worcester altars were of wood down to the middle of the 11th century.

II. The Mediaeval Church.—It will be convenient now to pass to the fully-developed altar of the Western Church with its accessories.

In the Roman Catholic Church the component parts of a fixed altar are the table (*mensa*), consisting of a stone slab; the support (*stipes*), either a solid mass or four or more columns; the *sepulchrum*, or altar-cavity, a small chamber for the reception of relics. If the support consist of columns, the intervals may be filled with other materials, *e.g.*, brick or cement. The table alone is consecrated, and in sign of this are cut in its upper surface five Greek crosses, one in the centre and one in each corner. These crosses must have been anointed by the bishop with chrism in the ritual of consecration before the altar can be used. Crosses appear on the portable altar buried with St. Cuthbert (A.D. 687), but the history of the origin and development of this practice is not fully worked out.

According to the *Caeremoniale* (i. 12, 13) a canopy (*baldachinum*) should be suspended over the altar; this should be square and large enough to cover the altar and the *predella* on which the celebrant stands. It is sometimes hung from the roof by chains so that it can be lowered or raised; sometimes it is fixed to the wall or reredos; sometimes it is a solid structure of wood covered with metal or of marble supported on four columns. This last form is, however, usual only in large churches, more especially of the basilica type, *e g.*, St. Peter's at Rome or the Roman Catholic cathedral at Westminster. The origin of the canopy (called liturgically the *ciborium*) is uncertain, but it appears in a mosaic at Thessalonica of a date not later than A.D. 500. The Congregation of Rites (May 27, 1697) ordered it to be placed over all altars, but even at Rome it is usually only found over the high altar and the altar of the Blessed Sacrament.

Multiplication of altars is a mediaeval characteristic, no trace of which appears before the 4th century. In the church of St. Gall, Switzerland, in the 9th century there were 17. In the modern Latin Church almost every large church contains several altars. Archbishop Wulfred in 816 ordered that beside every altar there should be an inscription recording its dedication. This regulation fell into abeyance after the 12th century, and such inscriptions are very rare. One remains mutilated at Deerhurst (*Archaeologia*, vol. 50, p. 69).

The principal altar, in a church having more than one, is called a "high altar." Where there is a second high altar, it is generally at the end of the choir or chancel. In monastic churches (*e g.*, formerly at St. Albans) it sometimes stands at the end of the nave close to the choir screen.

Beside the altar was a drain (*piscina*) for pouring away the water in which the communion vessels were rinsed. This seems originally to have been under the altar, as it is still in the Eastern Church.

In the time of Optatus (*c.* A.D. 370), bishop of Milevis, and probably earlier, the altar was covered with a cloth. This had developed by the 14th or 15th century into a cerecloth, or waxed cloth, on the table itself; and three linen coverings one above the other, two of about the size of the table and one rather wider than the altar, and long enough to hang down at each end. In front was often a hanging panel of embroidered cloth (the frontal); but frontals of wood, ornamented with carving or enamel, etc., are also to be found. These embroidered frontals are changeable, so that the principal colour in the pattern can accord with the liturgical colour of the day. A similar panel of needlework (the dossal) is suspended behind the altar.

Portable altars have been used on occasion since the time of Bede. They are small slabs of hard stone, just large enough for the chalice and paten. They are consecrated and marked with the five incised crosses in the same way as the fixed altar, but they may be placed upon a support of any suitable material, whether wood or stone.

III. Post-Reformation Altars.—At the Reformation the altars in churches were looked upon as symbols of the unreformed doctrine. In England the name "altar" was retained in the English Communion Office printed in 1549, and in the First Prayer Book of Edward VI. But the altars were soon after ordered to be destroyed, and replaced by movable wooden tables; while in the revised Prayer Book of 1552 the term "God's board" or "the table" was substituted for "altar." After a temporary reaction under Mary, the work of reformation was resumed under Elizabeth.

The name "altar" has been retained in the English Coronation Office. In the canons of 1640 it was recognized, but with the reservation that "it was an altar in the sense in which the primitive church called it an altar and in no other"; and the rule for the position of the communion tables, which has been since regularly followed throughout the Church of England, was formulated. In the primitive church the altars seem to have been so placed that, like those of the Hebrews, they could be surrounded on all sides by the worshippers. The chair of the bishop or celebrant was on their east side, and the assistant clergy were ranged on each side of him. But in the middle ages the altars were placed against the east wall of the churches, or against a *reredos* erected at the east side of the altar; the celebrant was thus brought round to the west side and caused to stand between the people and the altar. When tables were substituted for altars in the English churches, these were not merely movable, but at the administration of the Lord's Supper were actually moved into the body of the church, and placed *table-wise*—that is, with the long sides turned to the north and south, and the narrow ends to the east and west—the officiating clergyman standing at the north side. In the time of Archbishop Laud, however, the present practice of the Church of England was introduced. The communion table, though still of wood and movable, is, as a matter of fact, never moved; it is placed *altar-wise*—that is, with its longer axis running north and south, and close against the east wall. Often there is a reredos behind it; it is also fenced in by rails to preserve it from profanation of various kinds.

In 1841 a stone altar, consisting of a flat slab resting on three upright slabs, was set up by the Camden society in the ancient church of the Holy Sepulchre at Cambridge, at the east wall of the chancel. But the Court of Arches in 1845 ordered it to be removed, on the ground that a weighty stone structure was not a communion-table in the sense recognized by the Church of England.

BIBLIOGRAPHY.—For altars in the ancient East *see* M. Jastrow, *Religion of Assyria and Babylonia;* Perrot and Chipiez, *Art in Chaldea* (i. 143, 255); Sir J. Gardiner Wilkinson, *A Second Series of the Manners and Customs of the Ancient Egyptians*, ii. 387; Benzinger's and Nowack's works on *Hebräische Archaologie*. For classical altars, much information can be obtained from the notes in J. G. Frazer's *Pausanias*. *See* also Schömann, *Griechische Alterthümer*, vol. ii.; the volume on "Gottesdienstliche Alterthumer" in Hermann's *Lehrbuch der griechischen Antiquitäten*. On domestic altars and worship *see* Petersen, *Hausgottesdienst der Griechen* (Cassel, 1851). On plural dedications consult Maurer, *De aribus graecorum pluribus deis in commune positis* (Darmstadt, 1885). For Christian altars, reference is best made to the articles on the subject in the dictionaries of Christian and liturgical antiquities of Cabrol, Migne, Martigny, Smith and Cheetham, and Pugin, where all the available information is collected. *See* also Ciampinus, *Vetera Monumenta* (Rome, 1747), where numerous illustrations of altars are to be found; Martene, *De antiquis Ecclesiae ritibus*, iii. vi. (Rouen, 1700); Voigt, *Thysiasteriologia sive de altaribus veterum Christianorum* (Hamburg, 1709); and the liturgical works of Bona. Many articles on various sections of the subject have appeared in the journals of archaeological societies; we may mention Nesbitt on the churches of Rome earlier than 1150 (*Archaeologia*, xl. p. 210), Didron, "L'Autel chrétien" (*Annales archéologiques*, iv. p. 238), and a paper by Texier on enamelled altars in the same volume.

ALTAZIMUTH, an astronomical telescope of a pattern similar to a theodolite but on a much larger scale. It is used principally to observe positions of the moon before first quarter and after last quarter, when the moon passes across the meridian in daylight. In order to secure more favourable nocturnal observations at such times it is necessary to have an instrument which can be turned out of the meridian but in other respects is used similarly to a meridian circle.

ALTDAMM, a town on the Oder, opposite Stettin, in the district of Stettin, in the Prussian province of Pomerania. Pop. (1925) 8,678. Its manufactures (starch, cellulose and syrup) are mainly based on potato cultivation.

ALTDORF, capital of the Swiss canton of Uri, 1,516ft. above sea-level, a little above the right bank of the Reuss, not far above the point where this river is joined on the right by the Schächen torrent, 34m. from Lucerne by the St. Gotthard railway and 22m. from Göschenen. Pop. (1920), 4,163, Roman Catholic and German speaking. Its port on the Lake of Lucerne, Fluelen, is 2m. distant. There is a stately parish church, while above the little town is the oldest Capuchin convent in Switzerland (1581). William Tell shot the apple from his son's head, according to tradition, in the market-place, where in 1895, at the foot of an old tower (with rough frescoes commemorating the feat), there was set up a fine bronze statue (by Richard Kissling of Zürich) of Tell and his son. In 1899 a theatre was opened for the performance of Schiller's play of *Wilhelm Tell.* The same year a new carriage-road was opened from Altdorf through the Schachen valley and over the Klausen Pass (6,404ft) to the village of Linththal (30m.) and so to Glarus Near Altdorf is the village of Bürglen, where by tradition Tell was born; while he is also said to have lost his life, while saving that of a child, in the Schächen torrent. On the left bank of the Reuss, opposite Altdorf is Attinghausen, where the ruined castle now houses the cantonal museum.

ALTDORFER, ALBRECHT (?1480–1538), German painter and engraver, was born at Regensburg (Ratisbon), where in 1505 he was enrolled a burgher, and described as "twenty-five years old." Soon afterwards he is known to have been prosperous, and as city architect he erected fortifications and a public slaughter-house Altdorfer has been called the "Giorgione of the North." His paintings are remarkable for minute and careful finish, and for close study of nature. The most important of them are to be found in the Pinakothek at Munich. A representation of the battle of Arbela (1529), included in that collection, is usually considered his chief work. His engravings on wood and copper are very numerous. The most important collection is at the Berlin museum. Albrecht's brother, Erhard Altdorfer, was also a painter and engraver, and a pupil of Lucas Cranach.

ALTEN, SIR CHARLES (KARL) (1764–1840), Hanoverian and British soldier, son of the Hanoverian Baron Alten, took service in the King's German Legion in British pay, and commanded the light infantry in the Hanoverian expedition of 1805, at the siege of Copenhagen in 1807, with Moore in Sweden and Spain, and in the Walcheren expedition. He commanded a brigade at Albuera, and in 1813 the famous "Light Brigade" in Spain. In 1815 he was in command of the 3rd Division, and was wounded at Waterloo. His conduct won for him the rank of Count von Alten. He returned in 1818 to Hanover, where he rose to the rank of field-marshal. Count von Alten, however, remained in the British Army as Major-Gen. Sir Charles Alten.

See *Gentleman's Magazine* (1840); N. L. Beamish, *Hist. of the King's German Legion* (1832–37).

ALTENA, a town in Westphalia, Germany, 30m. S S E. of Dortmund. Pop. (1925) 16,192. It lies in the deep valley of the Lenne, and forms a single street 3m. in length. The Schlossberg is the ancestral castle of the counts of La Marck. Metal industries and especially wire making are carried on.

ALTENBURG, a town in Thuringia, Germany, formerly capital of the duchy of Saxe-Altenburg, 23m. south of Leipzig. Pop. (1925) 42,109. From its ancient castle, on a lofty porphyry rock, Kunz von Kaufungen carried off, in 1455, the young princes Albert and Ernest, founders of the royal and ducal families of Saxony. Altenburg has local courts subordinate to those of Jena and a cathedral and various learned societies. There is also a museum, with natural history, archaeological and art collections, and among other buildings St. Bartholomew's church (1089) and the town hall (1562–64). There is considerable traffic in grain, horses and cattle of the surrounding districts. There are lignite mines in the vicinity. The town has foundries and machinery works. Hats, gloves, shoes, metal objects, brushes, musical instruments, paper and paper bags, cigars, playing cards and chemicals are made. The card-game of "Skat," universal in Germany since 1835, originated among the peasantry here.

ALTENSTEIN, a castle in Saxe-Meiningen, Germany, on the S.W. slope of the Thüringerwald not far from Eisenach. It has associations with Boniface (*c.* 724) and with Martin Luther.

ALTERATIVE, an old term in the *materia medica* which comprised a group of substances which had, or were supposed to have, a specific influence on the nutritional processes of the body. They were mainly of the metal or metalloid class and included such things as iron, mercury, phosphorus, manganese and arsenic. Their mode of action was to "change" the metabolism of the organism as a whole or in any of its parts. Thus arsenic acts on the skin, causing changes in its rate of growth and nutrition. Iron exerts a profound influence on the blood. This rather vague group has fallen into disrepute and is not even mentioned in several of the more recent books on *materia medica.* The reason for this is that further research has brought to light the biochemical reactions underlying the "alterations," and some of these excellent remedies have been removed to more scientific groups.

ALTERNATING CURRENT, electric current which grows to a maximum value, decreases, changes its direction (with respect to a datum line), reaches a maximum value in the new direction (which is equivalent to a minimum value for the original direction), and returns to its original value, whence it repeats this cycle an indefinite number of times. The interval which elapses between the attainment of a definite value on two successive occasions is called the *period,* and the number of cycles or periods per second, the *frequency* of the alternating current, high frequency currents having several thousand cycles per second. The *amplitude* is the deviation of the maximum (or of the minimum) from the datum line. (*See* ELECTRICITY)

ALTERNATION, process of "alternating," *i.e.*, of two things following one another regularly by turns, as night and day. In American political representative bodies and in the case of company directors, a substitute is sometimes called an "alternate." An "alternative" is that which is offered as a choice of two things, the acceptance of the one implying the rejection of the other.

ALTERNATOR, a dynamo generating alternating current. (*See* DYNAMO; DYNAMO-ELECTRIC MACHINES.)

ALTGELD, JOHN PETER (1847–1902), American politician, was born in Nieder Selters, Prussia, Germany, on Dec 30, 1847. In infancy he was brought to the United States by his parents who settled near Mansfield, Ohio In 1863 he entered the Union army and served until the end of the Civil War. For a time he was a school teacher, subsequently he studied law, and in 1869 he was admitted to the bar. From 1886 to 1891 he was a judge of the superior court in Chicago and from 1893 to 1897 he was governor of Illinois. His pardon, while governor, of the Chicago anarchists, imprisoned for participation in the Haymarket riot (*q.v.*), caused extensive comment. He was a convincing public speaker and effectively promoted the cause of prison reform. Espousing the financial doctrine of free silver, he became one of its leading advocates, and, in the presidential campaigns of 1896 and 1900, vigorously supported the candidacy of William Jennings Bryan. He published *Our Penal Machinery and Its Victims* (1890) and *Live Questions* (1890). He died in Joliet, Ill, on March 12, 1902.

See W. R. Browne, *Altgeld of Illinois* (1924); Edgar Lee Masters, "John Peter Altgeld" in *American Mercury,* vol. IV., pp. 161–174 (1925).

ALTHAEA, in Greek and Roman mythology, daughter of Thestius, king of Aetolia, wife of Oeneus, and mother of Meleager (*q.v.*).

ALTHIBUROS (mod. MEDEINA), an ancient city of Numidia on the road between Carthage and Theveste (Tebessa), which was constructed by Hadrian in 123 A.D., 22m. S. of Kef. The town, originally an indigenous settlement, obtained municipal rights from Hadrian, like several other cities of North Africa. It enjoyed considerable prosperity in the 2nd and 3rd centuries after Christ, and was the seat of a bishop from the 5th

to the beginning of the 8th century. There is a well-preserved triumphal arch on the site, and excavations have brought to light the ancient forum and the buildings surrounding it, including two temples, a fallen arch erected in honour of Hadrian, the theatre and some houses with fine mosaic pavements.

See A. Merlin, *Forum et Maisons d'Althiburos* (1913).

ALTHING, the legislative assembly of Iceland (*q.v.*).

ALTICHIERO DA ZEVIO (*c.* 1320–*c.* 1385), Italian painter, of the Veronese school, born at Zevio, a village near Verona. His standard work is the fresco decoration of the San Felice chapel in the church of Sant' Antonio at Padua, representing the "Crucifixion" and "Scenes from the Legend of St. James," painted about 1380. The frescoes in the adjacent capella San Giorgio are not on the same high level and were probably mainly executed by his pupil Jacopo d'Aranzo. The only extant works of Altichiero in Verona are the fresco in the church of Sant' Anastasia representing the "Knights of the Cavalli family kneeling before the Virgin," and another, representing the Crucifixion, in the church of San Zeno. Altichiero was the head of the Veronese School of the Trecento, whose art represented the ideal of a chivalrous aristocracy and embodied the romantic and heroic aspect of the middle ages. In his paintings the pictorial point of view predominates. They are essentially the work of a colourist. Architecture and figures are conceived together; scenes are enacted in roomy interiors. There is, moreover, a certain tendency to depict incidentals, which contrasts with Giotto's concentrated and expressive style, where the figures stand out plastically and everything is subordinated to the main theme. Altichiero's style was not influenced by Giotto.

ALTIMETER. In aerial navigation, an instrument employed to determine the height of aircraft above the ground or, more accurately, above sea level. It is a form of aneroid barometer, for it is based upon the changes of air pressure which are registered as an aeroplane ascends or descends. All altimeters are set at zero when the aircraft leaves the ground and they are calibrated in accordance with a standard atmosphere which has been adopted internationally. The standard atmosphere assumes that, at sea level, the temperature is 15° C and that the barometric height reduced to 0° C is 760mm. of mercury. The decrease of temperature with increase of height is assumed to be 6·5° C per kilometer. Altimeters so calibrated are usually accurate to within 2% to 3%. For some purposes however a greater accuracy is necessary; this can be achieved by applying a correction obtained from a knowledge of the temperature on the ground and at the operating height. Carefully designed altimeters, so corrected, are capable of an accuracy of the order of 1% so long as the conditions of atmospheric temperature and pressure do not vary. An altimeter can not distinguish a change of height from a general fall of atmospheric pressure caused by an approaching depression.

In principle the solution is clear, the height above the ground or sea must be measured directly and not inferred from a knowledge of the atmospheric conditions at the operating height. No instrument for this purpose however is yet in general use. Perhaps the nearest approach to success has been achieved by the Behm height-finding apparatus developed in Germany, and tested during the flight to America of the airship ZR3. In this instrument a very sensitive timing mechanism is started automatically at the instant at which a sound is emitted from the airship. The sound wave travels to the ground and is reflected back to the airship, and the timing mechanism is automatically stopped when the reflected sound wave reaches the airship. The weight of the apparatus—an all important factor when considering the design of aircraft instruments—compares unfavourably with the almost negligible weight of an altimeter.

ALTINUM (mod. *Altino*), Venetia, 12m. S.E. of Tarvisium (Treviso), on the lagoons. From a fishing village it became the junction of the Via Postumia and the Via Popilia (*see* AQUILEIA). Augustus and his successors made it important as a point on the route between Italy and the north-east parts of the empire. After the foundation of the naval station at Ravenna, it became the practice to take ship from there to Altinum, and thence to continue the journey by land. A new road, the Via Claudia Augusta, was constructed by the emperor Claudius from Altinum to the Danube, a distance of 350m.

ALTITUDE, height or eminence, and particularly the height above the ground or above sea-level. In geometry, the altitude of a triangle is the length of the perpendicular from the vertex to the base. In astronomy, the altitude of a heavenly body is the apparent angular elevation of the body above the plane of the horizon (*see* ASTRONOMY: *Spherical*). *Apparent altitude* is the value which is directly observed; *true altitude* is deduced by correcting for astronomical refraction and dip of the horizon; *geocentric altitude* by correcting for parallax.

ALTMAN, BENJAMIN (1840–1913), American merchant and art collector, was born in New York, N.Y., July 12, 1840, where he was educated and achieved his business career. In 1905 he erected a large store on Fifth avenue which, with the additions on Madison avenue built in 1913–14, made his establishment one of the great department stores of the world. Besides his outstanding success as a merchant he won wide reputation as an art collector. He formed a large and exceedingly valuable collection of paintings, especially of the old masters, among them 13 Rembrandts and some fine pictures by Botticelli, Filippo Lippi and Holbein. He purchased in 1912 the Velasquez portraits of King Philip IV. of Spain and of Olivares, for which he was reported to have paid about $1,000,000. He also made extensive collections of Chinese porcelains, rugs, crystals and other objects of art. The major part of his art collections was bequeathed to the Metropolitan Museum of Art, New York city, and constitutes one of the most important gifts received by that institution. He died in New York city, Oct. 8, 1913.

ALTMÜHL, a river in Bavaria, Germany, an important left bank tributary of the Danube, rising in the Franconian plateau, and after a tortuous course of 116m. alternatively through meadows and in romantic gorges, joining the Danube at Kelheim. It is navigable up to Dietfurt (18m), whence the Ludwigscanal (100m. long) leads to Bamberg on the Regnitz, thus establishing communication between Danube and Rhine.

ALTO, a musical term applied to the highest adult male voice or counter-tenor, and to the lower kind of boy's or woman's (contralto) voice. It is typical of the confusing character of musical nomenclature that the term which originally meant "high" should have come to signify the lower of its particular class of voice. It is further applied to the viola as representing the alto voice of the violin family.

ALTON, urban district, Hampshire, England, 46½m. S.W. of London by the S.R. Population (1921) 5,581. It occupies a pleasant, undulating site near the headwaters of the river Wey. Of the church of St. Lawrence, part, including the tower, is Norman; the building was the scene of a fierce conflict between the royalist and parliamentary troops in 1643. There is a museum of natural history; the collection is reminiscent of the famous naturalist, Gilbert White, of Selborne in this vicinity. Large markets and fairs are held for corn, hops, cattle and sheep; and the town contains some breweries and iron foundries.

ALTON, a city of Madison county, Ill., U.S.A., on the Mississippi river, about 5m. above the mouth of the Missouri and 25m. N. of St. Louis. It is on the Mississippi valley highway; is served by the Chicago and Alton, the Big Four, and the Alton and Eastern railways, and for freight also by the Burlington and the Missouri-Kansas-Texas; and has connections for freight through the Illinois Terminal railroad with all the railways entering East St. Louis. The business streets are on the bottom lands, but the residential part of the city lies on picturesque bluffs which rise to a height of 250 feet. The population in 1920 was 24,682, of whom 1,707 were negroes and 1,670 were foreign-born whites; and was estimated locally at 32,650 in 1926.

Transportation facilities, cheap coal, unlimited water, abundant building material, and hydro-electric power have favoured industrial development. The value of the products manufactured in 1925 was $20,896,595, and there are also important establishments near by in the surrounding country, including several large oil refineries, to which crude petroleum is brought by pipe lines from Texas and Oklahoma. The leading manufactures are glass bottles,

brick, ammunition, flour, petroleum products, lime and stone, pig lead, iron and steel, box board and paper. Shurtleff college (Baptist, founded in 1827), at Upper Alton, 1½m. N.E. of Alton, and Monticello seminary for girls, at the village of Godfrey, 5½m. N. (founded 1835), were among the earliest educational institutions in the Mississippi valley.

The first white settler here was Jean Baptiste Cardinal, who built a loose rock shelter in 1783, but was soon taken prisoner by the Indians. Just south of Alton, Lewis and Clark camped through the winter of 1803–04. The town was planned in 1815 by Col. Rufus Easton of St. Louis, who gave it the name of one of his sons. In 1833 it was organized as a town, and in 1837, when the population was about 4,000, it was incorporated as a city. The first State institution in Illinois, a penitentiary, was located here in 1827. Later the prisoners were transferred to Joliet, and during the Civil War the buildings were used as a military hospital and prison. Intense excitement was caused throughout the country in 1837 by the persecution and finally (on Nov. 7) the killing, by a pro-slavery mob, of Elijah P. Lovejoy (b. 1802), the editor of an abolitionist journal. In 1897 on the 60th anniversary of his death a monument, erected by the State and the citizens of Alton, was dedicated to his memory.

ALTONA, a town in Schleswig-Holstein, Germany, on the right bank of the Elbe. Though closely adjoining Hamburg on the west, Altona is administered separately. Pop. (1880) 91,049; (1900) 161,508; (1925) 185,135. The name may be derived from *allzu-nah* ("all too near"), the Hamburgers' designation for an inn which in the 16th century lay too close to their territory. For a long time this was the only house in the locality. When Altona passed to Denmark (1640) it was a small fishing village, but the Danish kings granted it customs privileges and exemptions to make it a formidable rival to Hamburg. Although burnt by the Swedes in 1713, it rapidly recovered and, despite the Napoleonic wars, increased in prosperity. After 1853, when Denmark withdrew the privileges, its trade waned. Occupied in 1864 in the name of the German Confederation it passed to Prussia after the war of 1866, and in 1888, together with Hamburg, joined the Zollverein, while retaining certain free trade rights over the *Freihafengebiet* which it shares with Hamburg and Wandsbek. Lying higher than Hamburg, Altona enjoys a purer and healthier atmosphere. The Palmaille, one of the numerous wide streets, ends in a terrace about 100ft. above the Elbe. An elevated railway connects the town with Hamburg and provides through communication with the main Prussian railway systems. Altona manufactures tobacco and cigars, machinery, woollens, cottons, chemicals, leather, soap and oil. The port carries on an extensive trade with Great Britain, France and America, but most of its business is transacted on the Hamburg exchange; while the magnificent warehouses at Altona are largely used by Hamburg merchants. Since 1888 much has been spent at various times, especially in 1918, upon improvement and enlargement of the harbour. The exports and imports resemble those of Hamburg. In 1925 the net tonnage of boats entering was 557,196. Some fishing is carried on and there are ship-repairing yards. In 1890 the populous suburbs of Ottensen to the west, Bahrenfeld, Othmarschen and Övelgönne were incorporated with the town.

ALTOONA, city of Blair county, Pa., U.S.A., on the Pennsylvania railroad, 114 m. E. by N. of Pittsburgh. It lies in the upper end of Logan valley, 1,180ft. above sea-level, in the "central Pennsylvania" bituminous coal-field, and commands views of some of the most picturesque mountain scenery in the State. The famous Horseshoe curve is 4 m. to the west. The population was 60,331 in 1920, of whom 5,312 were foreign-born whites, and was estimated locally at 72,000 in 1927.

Altoona was created by the Pennsylvania Railroad Company, which in 1849 bought farm lands here and laid out a town, to be the base of operations while it was constructing the pioneer railway across the Alleghenies. The Pennsylvania Railroad Company is still the chief factor in the city's economic life. Its repair shops, freight classification yards, foundries and works for the construction of cars and locomotives (among the largest in the world) employ 16,000 men. The assessed valuation of property in 1927 was $67,980,735. Altoona was incorporated as a borough in 1858 and chartered as a city in 1868. In 1862 the "loyal war governors" of the northern States met here, in the Logan house, to renew their pledge of support to Lincoln.

ALTO-RELIEVO (Ital. for "high relief"), the term applied to sculpture that projects from the plane to which it is attached to the extent of more than one-half the outline of the principal figures, which may be nearly, or in parts, entirely detached from the background, thus distinguishing it from *basso-relievo* (*q.v.*). It is not only the actual degree of relief, high or low, which is implied by these two terms, but a resultant difference also of design and treatment necessitated by the contingent differences of light and shadow. (*See* SCULPTURE: *Technique, Modelling.*)



BY COURTESY OF METROPOLITAN MUSEUM OF ART

AFTER AN ALTO-RELIEVO OF MERCURY, EURYDICE AND ORPHEUS IN THE MUSEO NAZIONALE, NAPLES

ALTÖTTING, a town of Germany, in Bavaria, on the Mörren not far from its junction with the Inn. Pop. (1925) 5,284. The Holy Chapel with its image of the Virgin Mary has long been a place of pilgrimage for Roman Catholics from Central Europe.

ALTRANSTÄDT, a village of Germany, in Prussian Saxony near Merseburg. Altranstädt is famous in history for two treaties concluded here: (1) the peace which Augustus II., king of Poland and elector of Saxony, was forced to ratify (Sept. 24, 1706) with Charles XII. of Sweden, whereby the former renounced the throne of Poland in favour of Stanislaus Leszczynski—a treaty which Augustus declared null and void after Charles XII.'s defeat at Poltava (July 8, 1709); (2) the treaty of Aug. 31, 1707, by which the emperor Joseph I. guaranteed to Charles XII. religious tolerance and liberty of conscience for the Silesian protestants.

ALTRINCHAM or **ALTRINGHAM,** urban district, Cheshire, England, 8m. from Manchester, on the L.M.S. and Cheshire Lines Railways. Population (1911) 17,813, (1921) 20,450. The town of Altrincham (Altringham) was originally included in the barony of Dunham Massey. Hamon de Massey granted a charter to his burgesses, establishing the Court Leet, on receiving a concession of a market and an annual fair from Edward I. in 1290. Edward II. substituted a fair held on the eve, feast and morrow of St. James's day yearly. This fair continued to be held until recently under the name of "Sanjam" fair. It is believed to have been the practice since the charter was granted for the Court Leet to elect a mayor annually; and this is still done by a jury of the Leet of the borough, which consists of burgesses only. The Court Leet was formerly all-powerful in regulating the affairs of the town; and various officials were appointed (*e.g.*, constables, bailiffs, market lookers, scavengers, swine lookers and bellman) by the court to assist the mayor. All these officers performed their duties until the formation of a local board of health; and they are still elected at the autumnal meeting of the Leet, though their duties are purely nominal. Altrincham is now governed by an Urban District Council. Market gardening is carried on, fruit and flowers being grown for sale in Manchester. During the last 25 years, owing to good rail and canal facilities, a large number of works, mostly of an engineering nature, have been built on the north side of Altrincham. The old trades of cotton and worsted are no longer carried on, and although there is still some cabinet-making it is not so important as formerly.

ALTRUISM, a philosophical term used in ethics for that theory of conduct which regards the good of others as the end of moral action. It was invented by Auguste Comte and adopted by the English positivists as a convenient antithesis to egoism. According to Comte the only practical method of social regeneration is gradually to inculcate the true social feeling which subordinates

itself to the welfare of others. The application to sociological problems of the physical theory of organic evolution further developed the altruistic theory. According to Herbert Spencer, the life of the individual in the perfect society is identical with that of the state: in other words, the first object of him who would live well must be to take his part in promoting the well-being of his fellows individually and collectively. Pure egoism and pure altruism are alike impracticable. For on the one hand unless the egoist's happiness is compatible to some extent with that of his fellows, their opposition will almost inevitably vitiate his perfect enjoyment; on the other hand, the altruist whose primary object is the good of others, must derive his own highest happiness—*i.e.*, must realize himself most completely—in the fulfilment of this object. In fact, the altruistic idea, in itself and apart from a further definition of the good, is rather a method than an end.

The self-love theory of Hobbes, with its subtle perversions of the motives of ordinary humanity, led to a reaction which culminated in the utilitarianism of Bentham and the two Mills; but their theory, though superior to the extravagant egoism of Hobbes, had this main defect, according to Herbert Spencer, that it conceived the world as an aggregate of units, and was so far individualistic. Sir Leslie Stephen in his *Science of Ethics* insisted that the social organism is the unit, and therefore that the aim of moralists is not the "greatest happiness of the greatest number," but rather the "health of the organism." The socialistic tendencies of subsequent thinkers have emphasized the ethical importance of altruistic action, but it must be remembered always that it is ultimately only a form of action, that it may be commended in all types of ethical theory, and that it is a practical guide only when it is applied in accordance with a definite theory of "the good." Finally, he who devotes himself on principle to furthering the good of others as his highest moral obligation is from the highest point of view realizing, not sacrificing, himself.

See works of Comte, Spencer, Stephen, and text-books of ethics (*cf.* bibliography at end of article ETHICS).

ALTUS, a city of south-western Oklahoma, U.S.A., 15m. from the Red river; the county seat of Jackson county. It is served by the Frisco, the Kansas City, Mexico and Orient and the Missouri-Kansas-Texas railways. The population in 1920 was 4,522 (95% native white), and in 1928, after annexations of territory, was estimated locally at over 11,000. It is a shipping point for alfalfa, cotton and grain, and has 35 industrial plants and 25 wholesale houses. The city was founded in 1891 and incorporated in 1909.

ALTWASSER, a town in Lower Silesia, Germany, now incorporated in Waldenburg-in-Schlesien.

ALTYN TAGH, the northernmost of the constituent ranges of the Kuenlun (*q.v.*), which separates the high plateau of Tibet on the south from the depression of the Tarim basin on the north (*see* ASIA).

ALUDEL, a pear-shaped pot, generally made of earthenware and open at both ends, so that a series may be formed, the neck of one aludel fitting into the base of the next. Aludels were used by the early chemists and are still employed at Almaden in Spain, in connection with the extraction of mercury (*q.v.*) from its ores.

ALUM, a term primarily indicating a particular one of a whole series of sulphates, which form one of the most important examples of isomorphism (*q.v.*). The double sulphate of potassium and aluminium—the "alum" of commerce and long popular usage, also called potash alum—may have the potassium replaced by ammonium, sodium, potassium, rubidium, silver, caesium, and thallium (and possibly lithium). Further, the aluminium itself, from which the substance derives its name, may also be replaced by other trivalent metals, titanium, vanadium, chromium, manganese, iron, cobalt, gallium, rhodium, indium and iridium, so that there are many possible alums containing neither aluminium or potassium. Also selenium may replace sulphur in the acid radical in some of the alums as, *e.g.*, in aluminium ammonium selenate, $Al_2(SeO_4)_3,(NH_4)_2SeO_4,24H_2O$, or in the sulphate-selenate, $Al_2(SO_4)_3,K_2SeO_4,24H_2O$. An aluminium hydroxylamine alum, and alkyl-ammonium alum, may also be prepared. Thus the term covers the double sulphates or selenates of a univalent and a trivalent element or radicle, crystallizing in octahedra or cubes with 24 molecules of water of crystallization. Of the theoretically possible alum combinations a relatively small number only have been isolated; thus some 47 sulphate alums have been reported.

The alums crystallize in the regular system in octahedra with 24 molecules of water; from a basic solution of ordinary alum the cube tends to predominate. In a practically cold solution of the latter character an octahedron may gradually be grown into the cube, the composition of the crystal remaining unaltered. Owing to the symmetry of the crystal form, perfect single octahedra of large size may be obtained by slow crystallization in the cold. An octahedron weighing 1¼cwts. has been grown in this way in a period of about two years. On the detailed structure of the alums as deduced from X-ray examination, *see* J. M. Cook (*Phil. Mag.*, 1927, 4, p. 688).

The aluminium sulphate alums have an astringent and acid yet sweetish taste. Potassium and ammonium alum crystals are permanent in the air; the sodium salt tends somewhat to effloresce. The alums melt in their crystal water between about 37° C. for ferric thallium alum, and 117° C. for aluminium caesium alum. By careful heating, especially in a current of warm air, ordinary alum may ultimately be completely dehydrated at 100° C. If heated rapidly it intumesces and forms a very light bulky porous mass of "burnt alum." From the ammonium alum further heating at high temperature leaves the pure sesquioxide of aluminium.

The solubilities of the alums vary widely: the quantity dissolved by 100 parts of cold water (15° C.) may be illustrated by the following figures for some of the aluminium alums—caesium alum 0·35 part, potassium alum 9·59 parts, ammonium alum 12·66 parts, sodium alum 51 parts (16° C.). Water will dissolve several times its own weight of potassium alum at 90° C. The aqueous solutions act as weak acids. Aluminium alums find employment in a wide range of industries among which are dyeing, paper-making, tanning, water purification, pigment lakes, and plaster: chromium alum is used in dyeing and tanning

Preparation.—The very early history of the manufacture of alum is unknown. Potash alum, aluminium sulphate, and ferrous and ferric sulphates all occur native as efflorescent salts or earthy impregnations in varying degree of admixture and purity, and the *alumen* of Pliny (*Natural History*, Bk. xxxv., Ch. 15) would appear to have covered a number of salts or their mixtures: he refers to methods of test by means of galls and pomegranate juice (the tannin of which would serve to indicate the presence of iron) to determine the qualities suitable for dyeing bright colours. In the 15th century the Turkish Mediterranean trade in dyed fabrics and wool, in which alum was employed as a mordant, amounted to a very large annual sum; but the preparation of native salts by lixiviation and evaporation and, later, that of potassium alum from the mineral alunite, a basic sulphate of alumina and potash which is found in a number of places in the Near East, was probably practised much earlier.

About the year 1460, John di Castro learned the art at Constantinople and began to make alum at Tolfa from an important local deposit of alunite which has remained in use to within the present century. The introduction of the manufacture into Italy (where it shortly afterwards became a papal monopoly) was announced as a great victory over the Turks. In England Sir Thomas Chaloner began the preparation of alum from the schists on his Yorkshire estate about the year 1600. Despite papal denunciation, the manufacture extended considerably, and the method continued largely unchanged down to about the middle of last century in the neighbourhood of Whitby and Guisborough, employing the Lias schists, and, at Hurlet and Campsie, with mineral of very similar character from the base of the much older carboniferous limestone series of Scotland. This type of deposit also occurs in Belgium, Germany, the former Austrian empire and other countries, and has been worked for centuries for the same purpose in a number of places on the Continent.

Both the Italian method of manufacture from alunite and that from the alum schists were carried on, of necessity, in the absence of any extraneous supply of sulphuric acid, the production of which only assumed importance towards the end of the 18th and

early part of the 19th centuries. When alunite [$K_2SO_4,(Al_2O_3\cdot SO_3)_3,6H_2O$, if pure] is calcined at a temperature below that at which SO_3 would be driven off, a part of the alumina together with the major portion of the sulphuric acid and potash is rendered soluble in water, although much of the alumina remains insoluble. The solution obtained was basic and gave rise to a largely cubic alum which, although tending to be tinted by a very small amount of insoluble iron oxide, was otherwise of a very high degree of purity and was known as Roman alum.

Similarly the value of the Lias and other alum schists depended mainly upon their self-contained source of sulphuric acid Much finely divided pyrites is present and also a varying proportion of carbonaceous matter and when subjected to slow combustion in very large heaps, over a period of many months, the pyrites gradually oxidized with the production of sulphurous and sulphuric acids and concurrent formation of the sulphates of iron and aluminium. The calcined material was systematically lixiviated in large stone or brick-built tanks, the liquor settled, concentrated by the aid of surface heat, and any excessive proportion of iron allowed to crystallize out as copperas. Very little natural potash is present in these schists and the addition of a potash salt, derived from kelp, wood ashes or other source, was necessary. The fine meal of alum octahedra first obtained was submitted to a second crystallization to purify it. In spite of the fact that from 80–130 tons of schist were required to produce one ton of alum, the process continued in successful competition with Roman alum for between two and three hundred years.

In 1845 the manufacture of alum in England was radically altered by the substitution, by Peter Spence, of the alum schists by aluminous shales from the coal-measures. These shales contained more alumina, less iron and some potash and, after regulated calcination, were found to be reasonably soluble in sulphuric acid. The weight of aluminous material required per ton of alum was reduced from about 100 tons to two-thirds of a ton, the time required for the process was shortened very greatly, and the old method of manufacture gradually died out. This process, in which the by-product ammonia from the coal-gas industry largely substitutes the potash salts hitherto employed, has since accounted for the major proportion of the world's output. Bauxite has also been used as a source of the alumina component.

Potash alum is again the principal alum of commerce and is largely obtained from the Italian mineral leucite, a double silicate of alumina and potash or soda. In the lava flows from certain extinct volcanoes in the Apennines, the leucite is almost entirely potassic and constitutes some 30–40% of the whole. The mineral is crushed, graded and subjected to electro-magnetic treatment for the separation of the gangue The substantially pure leucite meal or grain is then treated with sulphuric acid in which its alumina and potash are soluble and the solution, which already contains these oxides in almost equi-molecular ratio, is crystallized and purified in the ordinary way

Iron alum (ferric ammonium sulphate) is prepared technically to a small extent, but the only other alum of commercial importance is the chromium potassium sulphate salt which is obtained as a by-product from the reduction of potassium bichromate in the manufacture of alizarin.

BIBLIOGRAPHY.—For the older methods of obtaining alum: Ure's *Dictionary of Arts, Manufactures and Mines* (7th ed, 1878); also Geschwind's *Manufacture of Alum and the Sulphates of Alumina and Iron* (1901). (H. SP.)

ALUMINA, the only aluminium (*q.v.*) oxide. It occurs as corundum, which is a hard colourless crystalline solid, as ruby, sapphire, topaz, etc. (tinted by other metallic oxides), and in bauxite (*q.v.*). Amorphous alumina may be obtained by ignition of aluminium hydrate, or aluminium sulphate, etc. Synthetic rubies are made by heating together alumina, barium fluoride and a trace of potassium dichromate. (*See* GEMS, ARTIFICIAL.) Alumina, when precipitated from a solution containing a colouring matter, will form an insoluble pigment, called a *lake*. It is also commonly used as a mordant in dyeing. Alumina is next in hardness to the diamond (*see* ABRASIVES), crystallizes in the rhombohedral system and has the chemical formula Al_2O_3.

ALUMINIUM, a metallic element which owes its name to the Romans, who called certain salts, now believed to be the mixed sulphates of iron and aluminium, *alumen* These salts were found in the volcanic districts washed by the Mediterranean and were much used by the ancients in medicine and the dyer's art. In the 18th century it was first recognized that a salt with similar properties could be produced from clays by the action of sulphuric acid; and the base contained in clay, from which it was realized that this salt must be derived, was, in France, at first called *terre argilleuse*, but later *alumine*. In England this became *alumina*, whilst the Germans adhered and still adhere to the word *Thonerde*. Sir Humphry Davy, although he failed to isolate the metal of which it had been recognized that alumina was the oxide, suggested *aluminum* as a suitable name for it, a name still used in America, but elsewhere converted to the more euphonious *aluminium* (symbol Al, atomic number 13, atomic weight 27·1).

Occurrence and Ores.—Aluminium is not found in a metallic state in nature, a fact sufficiently explained by its great affinity for oxygen. Combined, however, it is one of the most widespread of the elements, only oxygen and silicon being more abundant in the earth's crust, of which it is computed that aluminium forms a 13th part. Its compounds exist in many forms, from mountainous masses to rare gems. Of these may be named the oxides, corundum, ruby and sapphire; their hydrates, gibbsite and bauxite; and their compounds with magnesium and beryllium, spinell and chrysoberyl respectively. The double fluoride of aluminium and sodium, cryolite or "ice-stone" is found in southern Greenland as a vast dyke in porphyritic granite. The sulphate of aluminium occurs in many volcanic districts, whilst, in combination with the sulphates of the alkali metals, it forms the natural alums. Of the phosphates only turquoise need be cited, whereas the silicates include such diverse materials as the micas and clays, garnets, topaz, the felspars, etc Many natural waters contain alumina, sometimes in considerable proportions, whilst it is found in the ash of numerous plants.

Despite this wide distribution the ore from which the metal is to-day derived is, with few exceptions, the hydrate bauxite, itself a decomposition product of silicate containing rocks, such as the granites, basalts, syenites, etc. Vast deposits of this material, suitable for the extraction of the metal, have now been located in every continent, so that a shortage is unlikely for many years to come Yet continuous efforts (and some apparently on the point of success) are directed to making such silicates as felspar, china clay and the leucites available for the purpose. Finally, we must note that cryolite, either natural or artificial, though not an ore, is indispensable in the present commercial production of the metal.

ISOLATION AND EXTRACTION

When in the middle of the 18th century it was recognized that alumina was the oxide of a metal, all means available at the time were employed, though unsuccessfully, to smelt it. Indeed, Lavoisier, in 1782, expressed the belief that alumina could not be reduced by carbon, a belief maintained until, almost a century later, the brothers E. H and A. H. Cowles, heating alumina mixed with other metal oxides and carbon by electricity, produced aluminium alloys commercially. They failed, however, to win the pure metal and not until 1907 was it shown that alumina alone could be reduced by carbon though only at a temperature (2,200° C) at which the metal produced was volatilized and lost or recombined with the oxides of carbon formed. At the same time the function of the alloying metal used by them was found to be the prevention of this recombination and the absorption of the aluminium vapours set free.

Returning to 1809, we find Sir Humphry Davy passing an electric current derived from a voltaic pile through fused aluminium into iron molten in an atmosphere of hydrogen. Although there resulted an alloy of aluminium and iron in place of the metal he had hoped to isolate, Davy had thus accomplished the first and, perhaps, the greatest step toward the production of aluminium, for he had definitely proved that its oxide was reducible.

Abandoning electricity, which had failed Davy, H. C. Oersted

and after him F. Wöhler, attempted the displacement of aluminium from its chloride by the alkali metal, potassium. It is uncertain whether Oersted succeeded: it is certain that in 1827 Wöhler produced metallic aluminium as a grey powder and, subsequently, in metallic pellets. Twenty-five years later, F. Rose, substituting, for volatile aluminium chloride, the newly imported and more stable double fluoride, cryolite, and H. St. Clair Deville, replacing potassium by the cheaper sodium, converted Wöhler's laboratory method into successful technical processes, which were practised in several countries until both were alike swept from the field when the evolution of the dynamo made it possible to produce aluminium electrolytically.

A method, based on the power of electricity to split metal salts into their components, had been discovered many years before it was possible to apply it commercially. Earlier attempts to electrolyse aqueous solutions had failed because, as we now know, the aluminium produced at once recombined with water. In 1854, however, Robert Bunsen passed a current through a molten mixture of aluminium chloride and common salt, splitting the former into chlorine, which escaped, and aluminium which he collected as metallic beads. Bunsen's method was developed 30 years later into the process by which aluminium is produced today. Once more cryolite replaced the volatile chlorides and this led to a further step of the utmost importance. It was found that molten cryolite readily dissolves alumina and that a current passed through such a solution decomposes, not the cryolite, but the cheaper and more easily resolved alumina, thus economizing both power and material, and, as will be shown, making possible a continuous process. It was Paul Héroult in France and Charles Hall in America who, in the '80s made this great advance, the Frenchman as the result of an accident, the significance of which he had the wit to recognize and the energy to turn to account; the American as the result of a definite quest doggedly pursued.

Modern Method of Manufacture.—The processes evolved by Hall and Héroult were identical and have remained in all essentials unchanged. Carefully purified alumina is dissolved in molten cryolite and the solution is electrolysed, the heat necessary to fuse the cryolite being supplied by the electrolysing current.

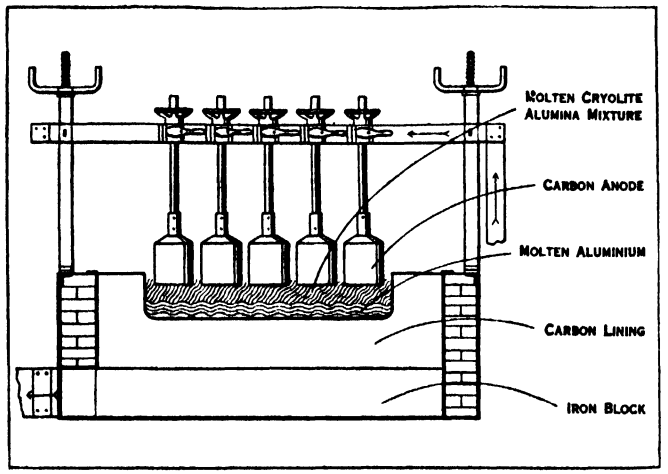


FIG. 1.—ALUMINIUM EXTRACTION BY MEANS OF THE ELECTRICAL FURNACE

The alumina, or aluminium oxide is shown dissolved in molten cryolite at a temperature of 950° C. The oxygen given off combines with the carbon anodes, which are thus burnt away and must be constantly replaced. The pure molten aluminium sinks and is drawn off periodically

Since cryolite is excessively corrosive the operation is carried out in open-topped iron casings, thickly lined with carbon. The current is led into the furnace by a number of carbon blocks suspended in the bath and leaves through the furnace lining. Alumina is decomposed into aluminium and oxygen and the latter consumes the carbon anode blocks, forming gaseous oxides of carbon (*see* fig. 1). The operation is carried on at about 950° C. or far above the melting point of aluminium (659° C.) which is, therefore, liquid when produced. Being heavier than the electrolyte it sinks to the bottom of the bath, the current passing through it to the lining, thence to the furnace casing and away. As the alumina is consumed fresh quantities are added and as the carbon anodes burn away they are replaced, whilst the aluminium is tapped from the furnace periodically, so that the process is practically continuous. The baths are about 1ft. deep, 5ft. long and 2½ to 3½ft. wide. Heavy currents of from 8,000 to 20,000 amps. are used, the voltage for each bath, of which 40–50 are placed in series, being about 5·5–6·5. Theoretically, the voltage should be only 2·79 and 10,000 amps. should produce about 177 lb. of aluminium per day. In practice this becomes about 150 lb. and it takes 3½–3¾h.p. to produce 1 ton of aluminium per year. Theory demands 1·88 tons of alumina per ton of aluminium and this figure is but very slightly exceeded, whilst about ½ ton of carbon is consumed. Theoretically no cryolite is used but in practice there are losses amounting to about 0·1 ton per ton of aluminium.

PROPERTIES

Form and Structure.—Aluminium when cast from the furnaces solidifies in crystal masses, as may be seen if an ingot be broken at temperatures just below the melting point. Mechanical working deforms and partly shatters the original crystals, but subsequent heating causes recrystallization. When the degree of deformation and temperature of heating are suitable, some crystal grains grow at the expense of others and, under carefully selected conditions, one grain alone may grow and thus convert large pieces of metal into a single crystal Exaggerated grain size such as this is avoided in practice, metal showing this phenomenon being defective in mechanical properties.

Composition.—Whereas such metals as copper and zinc can be deposited electrolytically from aqueous solutions almost chemically pure, aluminium which can only be deposited from fused electrolytes carries with it whatever metallic impurities the raw materials and electrodes used in its manufacture contain. The best metal leaves the furnaces with not less than 0·2% of impurities, whilst commercial metal generally contains only 99–99 6% of aluminium. The remainder consists mainly of iron and silicon in approximately equal proportions, with 0·01–0·1% of copper derived from the furnace equipment. Small quantities of nitrogen are regularly found, as also of carbon, although the latter cannot be accurately estimated; but sodium, contrary to earlier statements, is never present in appreciable quantity. The same holds good of oxygen and aluminium oxide, but hydrogen may be a cause of serious trouble. Dissolved in overheated metal it separates on slow cooling, producing porosity, which can only be eliminated by remelting and so allowing the gas to escape. The following analysis (W. H. Withey) is typical of high grade commercial aluminium:

Iron	0·183
Silicon	0 154
Copper	0 026
Nitrogen	0·040
Zinc	0 006
Sodium	Trace
Carbon	Not estimated
Aluminium (diff.)	99·591

Until recently no practicable method of purifying aluminium was available. During the last few years several methods have, however, been elaborated and, by one, considerable quantities of refined metal have been made. A heavy alloy of aluminium and copper is melted under fused cryolite to which barium fluoride is added. When an electric current is passed from the alloy below to an electrode above, aluminium alone passes out from the alloy. In the reduction furnaces we have seen that aluminium sinks. Here, however, the gravity of the bath has been raised by the barium fluoride, so that the aluminium floats on the surface and can be removed. Metal containing 99·98% aluminium has been prepared in this way. The following is a typical analysis of purified aluminium.

Iron	0·014
Silicon	0·012
Copper	0·020
Zinc	0·00
Aluminium (diff.)	99·954

Physical Properties of Commercial Aluminium.—The specific gravity is 2·70–2·71. Hence, equal volumes of the common metals have the following relative weights: aluminium 1, magnesium 0·65, zinc 2·6, steel 2·9, brass 3, copper 3·25, nickel 3·25, lead 4·2 The specific gravity of aluminium at its melting point is about 2·40. Cast or annealed wrought aluminium breaks under a load of 11–13,000 lb per sq.in., but when hardened by working under 22–28,000 lb. Hence the specific tenacity or breaking load for unit weight $\frac{(\text{tenacity})}{(\text{sp. gr.})}$, which largely determines the relative values of light constructional materials, is 2 and 4 in the two cases, compared with 3·3 for hard copper, 4·2 for mild steel and 5·9 for tempered nickel steel. At high temperatures aluminium is very weak, whilst after being heated for a few hours to 350° C. work hardness is permanently lost. At 250° C. this takes longer whilst after 5 years at 200° C. and 100° C. respectively 50% and 86% of work hardness still remain. Aluminium ranks as a soft metal, its hardness being about half that of copper and zinc but double that of tin. The ductility and malleability of annealed aluminium are very high and it may, therefore, be drawn to the finest wire or beaten to the thinnest leaf. In tension a 2in. length may be elongated by 30% before fracturing, but heavy cold working reduces this figure to 3% or less. Elasticity is very low. Work hardened aluminium ceases to be elastic when loaded to 7–8,000 lb. per sq in., and to 2–2,500 lb. when in the soft state. Moreover, as with other soft metals, the effect of loading develops slowly and recovery therefrom is very slow. Thermal expansion (0·0000237 per degree from 10° C.–100° C) is two and a half times that of steel, double that of nickel and one and a half times that of copper, whilst shrinkage on solidification is high (about 7%). Specific heat (about 0·24 from normal temperature to melting point) and latent heat of fusion (probably 90 calories per gram) are both high, so that notwithstanding the low melting point of 658·7° C. it requires much heat to melt aluminium. Heat conductivity (0 504 calories per second per c.c. per ° C.) is about three times that of tin, nickel and iron but little more than half that of copper and silver. Electrical conductivity is also high, namely about 60% of that of copper and resistivity (2·6–2·8 microhms per c c.) therefore low. Aluminium is non-magnetic. In the electro-chemical series the position of aluminium is not quite certain. Probably it is less noble than all the common metals except magnesium and the alkali and alkaline earth metals.

The physical properties of the purest metal so far made by refining vary somewhat from those given above. It may be said that the strength and hardness are definitely lower, and that the melting point is about 1° C. higher and the electrical conductivity about 4% higher.

COMPOUNDS OF ALUMINIUM

Aluminium and Oxygen.—Aluminium (which is trivalent) forms one oxide—alumina (Al_2O_3). A film of this oxide normally covers the metal and upon this its character, its behaviour under chemical attack, indeed its whole utility may be said to depend. Generally invisible, the film may be seen if a thin foil of metal be heated for a prolonged period and then placed in hot nitric acid. The metal dissolves leaving the skin as glistening scales. Normally the thickness of the film is 0·00001mm., increasing twentyfold to 0·0002mm. after prolonged heating of the metal. It is impervious to many reagents and it is due to this fact that so highly reactive a material as aluminium resists attack by many agencies to which, if this film be perforated, it immediately succumbs. Most important is the protection given against further attack by oxygen itself, but for which aluminium would oxidize in air as readily as sodium or potassium. This may be appreciated if a strip of aluminium be amalgamated with mercury. Some aluminium dissolves in the latter and, being no longer protected, immediately combines with oxygen and water vapour to form hydrated oxide, long fibres of which grow from the amalgamated surface. At high temperatures aluminium burns in air with great evolution of heat and the finely divided metal ignites readily, burning with a brilliant flame or even explosively, whilst, mixed with oxides of other metals and ignited, violent interaction takes place, the aluminium depriving the other metal of its oxygen and itself burning to alumina. (*See* THERMIT.) In pure oxygen aluminium ignites at about 580° C. As we have seen, alumina occurs in many forms in nature. It is manufactured on a very large scale from the hydrate as a white crystalline powder for use in the production of aluminium. Fused in electric furnaces it forms alundum or artificial corundum, a valuable abrasive; whilst mixed with colour-giving oxides it yields artificial rubies, sapphires, etc.

Aluminium and Water.—Distilled water and the soft waters of peaty districts dissolve aluminium extremely slowly, but hard fresh waters and sea water cause rapid local corrosion of commercial metal unless air be entirely excluded. Recent work on the corrosion of aluminium seems to show it clearly due to local breakdown of the protective film and accumulation in the minute recesses formed in the surface of the metal, of hydrated oxide. This prevents access of the oxygen to the points it covers. Such differences are known to promote solution of metals. Corrosion by water may be slight or very serious, according to the state of the metal, its purity, temper and the perfection of its surface, the composition of the water; and the ease with which the products of corrosion can accumulate. Damp air merely causes a roughening of the surface. Stagnant or flowing water may cause superficial blisters, beneath which in time deep-seated cavities may form. These may, in turn, perforate the metal or disintegrate its surface.

Many methods have been suggested for obviating what is one of the chief disadvantages from which aluminium and its alloys suffer. Against atmospheric corrosion painting or varnishing is usually effective. Pure aluminium immersed in water may be effectively protected if connected to one of its more easily corrodible alloys, as iron boilers are protected by zinc plates. Aircraft parts are largely protected by strengthening the natural film upon them, to which end they are made the anodes in an electrolytic bath containing chromic acid.

The Hydrates.—All three possible hydrated oxides occur in nature, the monohydrate ($Al_2O_3{\cdot}H_2O$) as diaspore, the dihydrate ($Al_2O_3{\cdot}2H_2O$) as bauxite and the trihydrate ($Al_2O_3{\cdot}3H_2O$) as gibbsite or hydrargillite. These hydrates behave both as bases, dissolving in acids to form salts, and as weak acids, dissolving in strong bases to form the aluminates. On this property the process most frequently used for the preparation of pure alumina depends Bauxites, which contain iron and other impurities, are heated with caustic soda solution, whereby the aluminium hydrate is alone dissolved to form sodium aluminate. From the filtered solution the purified trihydrate is precipitated by various methods. On being heated aluminium hydrates give up water and are converted into alumina. When crystallized the trihydrate is insoluble in water but readily assumes the state of extremely fine division known as collodial solution. In this state it absorbs many other bodies, notably dyestuffs, and its use as a mordant in dyeing, as well as for other purposes, is due to this property. Produced within the fibres of textiles the hydrate serves to fix the colouring matters which the fibres themselves are not capable of retaining.

Aluminium and Alkalis.—In the absence of water aluminium is not attacked by the fixed alkalis, but it dissolves in their caustic solutions to form aluminates, hydrogen being evolved. Solutions of sodium and potassium carbonate rapidly attack the metal but silicate of soda solutions do not and, moreover, prevent attack by the carbonates. For this reason commercial mixtures of carbonate and silicate of soda form excellent detergents for aluminium domestic utensils and are widely used for this purpose. Ammonium hydrate attacks aluminium much less actively than do the fixed alkalis and the only product is aluminium hydrate. To ammonium carbonate, aluminium is entirely resistant. At high temperatures gaseous ammonia is decomposed by aluminium, yielding aluminium nitride (AlN) which is also formed when aluminium burns in air.

Aluminium and Acids.—As might be assumed of so active a substance, aluminium may be caused to unite with almost all acids. Hydrochloric and the other halogen acids readily dissolve the metal under all conditions, although even to hydrochloric acid the very purest metal shows considerable resistance. Aluminium is

but very slowly dissolved by cold, fully concentrated nitric and sulphuric acids; rise of temperature and increasing dilution however, increase the rate of attack, especially by sulphuric acid. Dilute organic acids dissolve aluminium very slowly, those occurring naturally in foodstuffs so slowly that attack is generally negligible. It is particularly noteworthy that even where the pure acids dissolve the metal comparatively readily, the presence of other bodies in the foodstuff frequently inhibits their action altogether. Thus, a hot 0·2% solution of lactic acid attacks aluminium, but to milk of similar acidity aluminium is completely resistant. On the other hand, the presence of salts of those acids, which themselves readily attack aluminium, naturally enhances attack by organic acids. Vinegar mixed with common salt is much more active than vinegar alone. To concentrated organic acids aluminium is generally indifferent, but in the complete absence of water, boiling fatty acids as well as many alcohols and phenols rapidly dissolve aluminium, regardless of its purity. Minute traces of water suffice to prevent this form of attack, the cause of which has not yet been ascertained.

Aluminium is not attacked by sulphuretted hydrogen, ammonium sulphide or sulphur dioxide, but combines directly with fluorine, chlorine, bromine or iodine, to form the respective halides At ordinary temperatures it is not attacked by oxides of carbon, but at high temperatures forms with them or with carbon the carbide Al_4C_3, with nitrogen the nitride (AlN) and with sulphur the sulphide (Al_2S_3): these are decomposed by water yielding methane (CH_4), ammonia (NH_3) and sulphuretted hydrogen (H_2S) respectively. Similar combinations are formed with phosphorus, arsenic, etc.

As its position in the electro-chemical series indicates, aluminium decomposes many metallic salts, replacing the metal in them. Thus copper, silver, gold, etc , may be precipitated from solutions of their salts by aluminium. Finally, reactions at high temperatures similar to those described as occurring with metallic oxides take place with sulphides, sulphates and other metallic salts.

Aluminium Salts.—Salts of a great variety of acids are known, some only in aqueous solution. All are, when pure, colourless and have an astringent taste, and readily form mixed salts with the corresponding salts of other metals. In aqueous solution aluminium salts are hydrolysed (or partially resolved into hydrate and acid) to a very marked extent, the hydrate remaining colloidally dissolved. To this property the industrial importance of many aluminium salts is due. As the hydrate is a weak base these solutions show an acid reaction. The more important aluminium salts and their uses are: aluminium chloride ($AlCl_3$)—volatile crystals, readily decomposed by water vapour, of great importance in synthetic organic chemistry; aluminium sodium fluoride or cryolite ($3NaF,AlF_3$), used as a solvent for alumina in the production of aluminium as well as in the manufacture of opaque glass and enamels; aluminium sulphate ($Al_2[SO_4]_3$)—widely used in the dyeing industry for mordanting, for coagulating impurities in water and in paper making, also as an astringent in medicine; the alums or mixed sulphates of aluminium and alkali metals—used for similar purposes; aluminium silicates and mixed silicates (*see* CLAY and FELSPAR); aluminium acetate ($Al[C_2H_3O_2]_3$)—existing only in solutions more strongly hydrolysed than those of any other aluminium salts used technically and for this reason of particular value to the dyer, to whom they are known as red liquor, also used as an antiseptic; aluminium oleate, palmitate, etc., used as thickeners for lubricating oils; ultramarine—a sulphide containing sodium and aluminium with silica occurring in nature as the much prized lapis lazuli, also manufactured on a large scale as a colouring matter, the laundry blue.

Physiological Properties.—Aluminium may be taken into the stomach without ill effect. Long series of experiments made with aluminium salts on animals and men indicate that, when ingested, aluminium does not pass through the wall of the stomach, is never found in the urine, but is totally rejected with the faeces. Under correct experimental conditions the organs of animals treated are found completely free from aluminium compounds.

Injected subcutaneously, however, aluminium salts, like those of other metals, are toxic, although poisoning develops slowly and discontinuation of the injections is followed by recovery and clearance of the system. From the earliest times aluminium salts have been used in therapy, generally as astringents, but also as antiseptics and as mild caustics.

INDUSTRIAL ALLOYS

These alloys may be divided into two main classes: those in which small proportions of aluminium modify the properties of other metals and those in which other metals are added for this purpose to aluminium. The first category includes the aluminium bronzes (*q.v.*) which are mainly copper with up to 11% aluminium, aluminium amalgam (or aluminium dissolved in mercury) used in organic chemistry, and some aluminium solders which are mainly zinc or tin with varying proportions of aluminium. Finally, some *super-light alloys* consist of magnesium with small proportions of aluminium (*see* MAGNESIUM).

The present section deals with the second category, the light alloys of aluminium, containing 96–65% aluminium with copper, magnesium, manganese, nickel, silicon, tin and zinc.

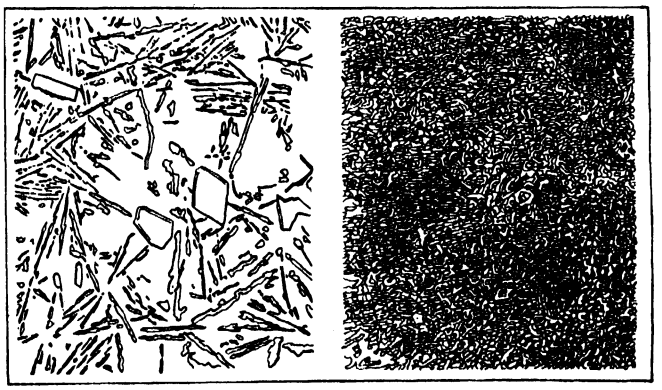
Preparation and General Properties.—Preparation of these alloys follows customary lines where, as with zinc and tin, the alloying metal melts at as low a temperature as does aluminium. Where, as with copper, manganese and nickel, the melting point is much higher than that of aluminium and the latter would have to be seriously overheated before solution took place, it is customary first to prepare hardeners or alloys containing high proportions of the alloying metal. Such alloys not only dissolve readily in aluminium, the main bulk of which need not, therefore, be overheated, but can also be easily broken to sizes suitable for weighing and adding to the crucible. Special methods are adopted in the case of magnesium and silicon.

The light alloys are mechanically stronger than pure aluminium and especially have a much wider elastic range, but they are for the most part far less resistant to corrosion and have lower electrical and heat conductivities. Magnesium and silicon lower the specific gravity of aluminium, the other metals mentioned raise it.

Binary Alloys.—The useful light copper alloys contain 4 to 14% copper and their utility is due to the fact that the two metals form a definite compound, $CuAl_2$. Aluminium can hold 2% (recent work places this figure lower) of copper dissolved at ordinary temperatures, so that alloys containing up to this proportion are composed of one constituent only, a solid solution of copper in aluminium. If, however, an alloy with 5% of copper is held at 525° C. all of this copper becomes dissolved. Such alloys, slowly cooled, deposit their excess copper in large crystals of $CuAl_2$, mainly between the grains of the metal, which is strengthened thereby. If instead of being slowly cooled the hot alloy be suddenly quenched, the compound is not given time to separate and the alloy is still further strengthened but remains ductile. On the temperature being slightly raised the $CuAl_2$ is precipitated, but in a very finely divided state instead of in large crystals. As with many alloys here also such fine structures are accompanied by good mechanical properties. Thus the 5% alloy in the form of hard rolled sheet, as normally prepared, has a tenacity of 35–40,000 lb. but is brittle (3% elongation). Annealed the tenacity falls to 25,000 lb. whilst the elongation rises to 30%. Heat treated as described above, the tenacity may rise to 45–50,000 lb. whilst the ductility is only slightly impaired (25% elongation). As the specific gravity is about 2·8 such an alloy has the high specific tenacity of 7·5. A casting alloy containing 4–5% copper with other and minor constituents is widely used in America where it is known as No. 195. As cast, the tenacity is 17,000 lb. with 4% elongation. Heat-treated and quenched the tenacity rises to about 30,000 lb. with 8% elongation. Subsequent re-heating increases the tenacity to 40,000 lb., but lowers the elongation to 1·5%. Susceptibility to heat treatment is of great importance in the alloys of the duralumin type (*q.v.*) in which it has long been known but only recently explained. Copper in excess of 5% cannot be dissolved and alloys with more than this amount are increasingly brittle and can, therefore, not be wrought, although still suitable for castings. In America the alloy with 8% copper, known as No. 12,

is the most popular alloy for general automobile castings (crank cases, etc.) and similar purposes where high mechanical properties are a secondary consideration. It has a tenacity of 20,000 lb. with low ductility (1–2% elongation). The English alloy L.8 contains 11–13% copper and is specially suited and largely used for casting in permanent iron moulds and notably for the pistons of internal combustion engines. All these alloys corrode much more rapidly than pure aluminium. The alloy containing 1·5% manganese, known as 3.S, is widely used in America, where it is rolled into sheet, to be spun and pressed into cooking utensils. Without increased tendency to corrosion it is considerably stronger than pure aluminium, breaking under a load of 30,000 lb. when work hardened and 15,000 lb. when annealed. It apparently owes these properties to the simultaneous (eutectic) crystallization of pure aluminium and a compound, Al_3Mn, which produces a fine grained structure. No other binary manganese alloys are used.

The presence of silicon was formerly considered harmful in every way to aluminium. Recently, alloys with 11–13% have been introduced and promise to be the most valuable light casting alloys offered to engineers for a generation. Normally aluminium and silicon crystallize simultaneously in large plates, giving coarse structures and, with high silicon content, brittle and useless alloys. Various agencies, notably metallic sodium, have been found to cause the silicon to separate in an extremely fine state of division, even, as has been suggested, colloidally (fig. 2). Such modified alloys have high tenacities (25–30,000 lb.), low specific gravity (2·66) and, therefore high specific tenacity (5). High ductility (12–14% elongation) is frequently attained in practice but cannot be relied on at present and the British Air Ministry specification only calls for not less than 7%. They are very fluid when molten and contraction on solidification is low (4%) whilst they resist corrosion well. Alloys containing up to 5% silicon, with or without the addition of other metals, are largely used when their great fluidity is of special advantage. Such alloys are as a rule not modified. Alloys with up to 35% zinc have been used. They are



BY COURTESY OF THE INSTITUTE OF METALS

FIG. 2.—ALUMINIUM SILICON ALLOY BEFORE AND AFTER MODIFICATION
The presence of silicon was formerly considered harmful to aluminium, since both crystallize simultaneously giving coarse structures and brittle and useless alloys. This is now overcome by causing the silicon to separate in an extremely fine state of division and the resulting alloys are of great utility. The illustration is drawn after microphotographs magnified about 140-fold

very weak at high temperatures and, therefore, somewhat difficult to cast; they may, however, be rolled to sheets and bars of great strength.

Ternary and Quaternary Alloys.—Aluminium with 2% copper and 1% manganese is used in America for light forgings, having a tenacity of 27–28,000 lb. and 12% elongation. Alloys with 12–14% copper and 4–2% manganese maintain their strength well at high temperatures and are, therefore, specially suitable for the pistons of internal combustion engines. An alloy with 1% tin and 7% copper (the English 3.L.11) is considered specially suitable for articles subject to hydraulic pressure. In Europe, and especially England, copper and zinc alloys of aluminium are preferred for sand castings for automobile and general use. Three per cent. copper and 13% zinc (2.L.5) give a tenacity of 25,000 lb. with 3% elongation. The zinc content makes for cheapness but raises the specific gravity to 3, so that the specific tenacity is only 3·7. With 20% zinc (L 28) these alloys can still be rolled and after suitable heat treatment have a tenacity of 55,000 lb. with 15% elongation and a specific tenacity of about 7·6. Alloys with copper and zinc are not well suited to casting in permanent moulds owing to weakness at high temperatures.

Aluminium with 7–9% copper and 1–3% nickel are favoured in America for pressure die casting. An alloy with 4% copper and 2% silicon known as lautal is used, mainly in Germany, in sheet form. Its mechanical properties approach those of duralumin.

Minute quantities of magnesium and silicon, when associated, confer on aluminium the property of age hardening. Their compound (Mg_2Si) is soluble to about 1·6% in solid aluminium at 580° C. but only to 0·5% at ordinary temperature. If, therefore, aluminium containing sufficient magnesium and silicon be held at high temperatures and suddenly quenched the excess magnesium silicide is thrown out, but not in its normal stable condition. In course of time (3–4 days), the newly precipitated crystals undergo secondary changes, which are not yet fully explained. When first quenched these alloys are soft and can be worked in various ways. During the subsequent changes they stiffen rapidly and, finally, give products with very great strength and other valuable characteristics. Magnesium silicide confers this property on various light alloys as well as on pure aluminium. (*See* DURALUMIN.)

THE ALUMINIUM INDUSTRY

In general, raw aluminium is converted into commodities by methods analogous to those used for other metals. The few radical differences are alone discussed here. Aluminium is melted in reverberatory furnaces or crucibles heated by oil, coke, gas or electricity, as circumstances and the scale of operations dictate. The pure metal requires no flux but a little zinc chloride is used with zinc alloys.

Ingots for rolling, extrusion, etc., are cast into iron moulds. Industrial castings are, however, prepared by three methods: large parts or those required in small numbers, in sand (sand castings); smaller parts required in numbers, by hand into permanent cast iron moulds (chill castings); whilst latterly considerable progress has been made in forcing the molten metal into closed moulds under pressure (die castings). Die castings are accurate to $\frac{3}{1,000}$in. so that no subsequent machining is required, but very large numbers are required to justify the costly dies.

Rolling into sheets, foil, rods and sections, beating to leaf, extruding and drawing tubes and wire, spinning, pressing, riveting, machining, etc., follow customary practice, only minor modifications being demanded by the physical properties of aluminium or its alloys.

Annealing of work-hardened material is effected rapidly at 350° C. to 400° C., a temperature recognizable by the charring of a soft wood splinter drawn across the metal. Scaling does not take place so that no protection from the flame or furnace gases is necessary. Pickling or frosting is effected by immersion in a hot 10% caustic soda solution followed by dipping in dilute nitric acid. The alkali lightly attacks the surface of the metal giving a smooth, white finish. Forging is confined to certain alloys, notably duralumin (*q.v.*). Contrary to general opinion, soldered joints are easily made and are as strong, when first made, as those of other metals. They fail, however, without exception after a few weeks or even hours exposure to mild corrosives, because during soldering the solder dissolves some aluminium, forming alloys, generally of tin or zinc. These corrode so readily that they freqeuntly disintegrate in damp air; but where complete protection can be afforded, as by painting, immersion in oil, etc., soldering is sometimes useful.

Welding, unlike soldering, demands no second metal and aluminium is successfully welded on a very large scale by several methods. At about 575° C. aluminium is very soft and two pieces hammered or pressed together at this stage unite as steel unites, giving very durable welds (hammer welding). The process is, however, difficult and expensive except on bars and wires and is not applicable to alloys. Using fluxes, principally mixtures of

TABLE NO. I.

Production, Exports and Imports in long tons of raw and semi-manufactured aluminium (based on Imperial Institute statistics)

Year	1923			1924			1925			1926		
Country	Production	Exports	Imports	Production	Exports	Imports	Production	Exports	Imports	Production	Exports	Imports
Austria	1,500	1,896	371	2,200	2,255	765	3,000	2,017	600	3,000	3,626	446
Australia			255			798			981			471
Argentine			121			75			109			138
Belgium		217	1,532		214	1,537		271	1,553	..	266	1,268
Brazil			762			381		..	300			?
Canada	12,000	6,960	445	12,000	8,101	388	12,000	12,173	458	18,000	11,240	569
Czechoslovakia			17			90			182			278
France	14,112	1,207	1,430	16,053	911	1,288	24,000	3,244	253	20,000	1,412	1,299
Germany	15,600	3,246	5,366	18,400	4,694	5,431	25,800	7,489	10,732	29,000	16,211	5,619
Greece	..		115			192		..	101		..	
India			3,845			4,142		..	3,962			4,499
Italy	1,449	196	1,938	2,025	43	2,887	1,850	65	6,578	1,898	49	3,508
Japan			3,625			4,121			4,612			7,425
Netherlands		163	265		234	361		203	365		266	355
Norway	13,105	12,695	6	19,632	18,953		20,962	20,280	1	24,036	21,825	?
Poland	..	27	92		14	222			302		..	212
Spain			982			1,138			1,351		..	1,222
Sweden		22	987		60	1,177		80	1,285			1,424
Switzerland	15,000	11,254	171	20,000	14,385	197	17,000	16,105	433	20,000	17,307	392
United Kingdom	9,000	5,970	5,198	8,000	4,478	12,212	9,500	6,003	12,251	8,000	6,654	15,485
United States	57,500	2,473	19,797	67,200	2,832	13,475	67,100	5,644	19,303	84,000	3,398	33,485
Totals	140,000			166,000			182,000			208,000		

alkaline chlorides and fluorides, which dissolve the oxide film, the edges of two pieces of aluminium and many aluminium alloys may be molten by the oxy-acetylene flame and caused to flow together, whilst additional metal may be applied by means of an aluminium welding rod (autogenous welding). This method is widely used for making articles of sheet metal too large to be pressed or spun, such as petrol tanks, vats, stills, etc. Broken castings are also repaired by autogenous welding, sometimes without the use of flux.

Electrical welding is mainly confined to the butt-welding of rods and wires, the ends to be joined being pressed together while partially fused by the passage of a current. Spot-welding is also practised for special purposes.

Near its melting point aluminium loses all cohesion and the grains may be separated. Alternatively, the molten metal is run into specially constructed disintegrators, the product after solidification being classified by sieving. This type of powder is in Europe known as granulated aluminium, a name reserved in the United States for molten metal which has been passed through sieves into water. Aluminium bronze powder is produced from pure aluminium sheet scrap by progressive stamping in cast iron mortars with mechanically operated stamps. The finest particles are separated from the coarse by air classifiers and are then polished by rotating brushes in a sheet iron drum.

Approximately 2 tons of alumina, ½ ton of carbon and 25,000 kilowatt hours are required to make a ton of aluminium. As about two tons of bauxite and several tons of chemicals and fuel are required for every ton of alumina, large quantities of materials have to be assembled. In most cases the production of the metal has become centred near the cheap sources of electricity, namely, hydro-electric power stations. As a notable exception, in northern Germany, steam stations fed by cheap and abundant lignite, provide the necessary motive power. Table No. 1 gives a picture both of the distribution of the producing countries and the movements of the metal when produced. From this it is seen that production is confined to 9 countries and that some 40% of the world's output is derived from the United States which, nevertheless, import in addition some 10–15% of what the world manufactures. From a comparison of the three columns in any year the amount converted into commodities in any country may also be gauged. Thus Norway, one of the largest producers, has but a poorly developed fabricating industry, whereas India and Japan, where no aluminium is produced, absorb large quantities for conversion into utensils and other manufactured products.

Finally, we may note that of the 750,000 tons of bauxite used for conversion into aluminium in 1925, the bulk was produced in 6 countries, viz., France, the United States, British Guiana, Italy, Dutch Guiana and Yugoslavia and none in Great Britain or Ireland.

The following table gives the world prices for ingot metal for the years 1924–27 inclusive.—

Country	England	Germany	United States
Year	£ per ton (2240 lb.)	R. Marks per kilo.	Cents per lb.
1924	110–118	2·24	27·03
1925	118	2·37	27·19
1926	118–105	2·28	26·99
1927	105	2·10	26·25

USES OF ALUMINIUM

The following is an indication of the main classes into which the applications of aluminium fall and shows upon what properties of the metal they depend.

Automobiles and Railway Carriages.—With increasing efforts to reduce the axle load of road vehicles and thereby to economize in upkeep, fuel and tyres, whilst improving acceleration, the uses of aluminium in the automobile industry grow continuously. Such parts as crank cases, differential housings, radiator tops, magneto bodies, brake shoes, etc., are regularly made as castings. Innumerable small cast parts also find their way into motor-car construction and in some cases dashboards, doors and windshields are similarly produced. Connecting rods forged from duralumin are used in some automobile engines and the cast aluminium piston is now standard for many types, since not only does the reduced weight entail greater efficiency and reduced vibration at high speeds, but the higher conductivity entails more rapid dissipation of the engine heat.

In the form of sheet, aluminium is widely used for the panelling of private automobiles and motor omnibus bodies, whilst mouldings, foot plates and floorings are largely of the same material.

With railway carriages, too, the tendency to reduce dead weight and so to increase effective loading is encouraging the use of aluminium. At present sheet metal panelling is the most usual form, but many small parts, such as brackets, door and window furniture, etc., are produced as castings, whilst in some cases seats and other larger parts are also made of light alloys, and the possibility of using special alloys for structural parts is being

seriously explored by experts for this and automotive purposes.

Aircraft, etc.—Aluminium is essential in aircraft construction and, in 1918, the Allies used 90,000 tons for this purpose. As far as the engines are concerned the same remarks hold good as for automobile engines. For the construction of complicated cowls, for fairings, seats, wind shields, etc., aluminium sheet has proved indispensable. For the petrol tanks of airships it has been used almost exclusively, whilst the frameworks of these machines have been built up of light aluminium alloys, chiefly duralumin (*q.v.*) and the same applies to some all-metal heavier-than-air machines.

For the moving parts of many small machines, such as gramophones, piano-players, typewriters, etc., the lightness of aluminium castings makes them particularly suitable, whilst for instruments and equipment which have to be carried aluminium is used wherever possible. In this category may be named photographic cameras, camping and military equipment, etc. Aluminium household furniture is now made on a large scale and finds its chief but by no means exclusive use in the tropics.

Aluminium Paint.—Its power of reflecting light to the extent of 65–75% determines the use of aluminium bronze powder as a paint. Suspended in a suitable vehicle, the minute flakes of which the powder consists have not only a great covering power but offer a brilliant and to many a pleasing surface. This is responsible for the great development in the use of aluminium paints, especially in America. The same property accounts for the use of aluminium powder for covering the fabrics used on aircraft. Sunlight is very destructive to such materials as also to the rubber gas bags of lighter-than-air machines. It has been found that the reflection of so large a part of this light by aluminium greatly lengthens their useful life. Aluminium bronze powder is also largely used in decorative printing. Upon this same property of reflecting light depends the use of aluminium leaf in decorative art. For this purpose it has almost entirely replaced silver leaf.

Electrical Industry.—Here aluminium plays a very large part to-day. For bare conductors and especially for overhead transmission lines, some of them hundreds of miles long, absorbing a thousand tons of metal or more, aluminium has largely replaced copper. In such cases the low tensile strength of aluminium is compensated for by interweaving with it high tensile steel wires. But for insulated wires the heavier cost of insulation due to the larger wire needed for a given current leaves copper supreme. During the copper famine of 1916–18 many electrical machines were made in Germany with aluminium windings, the individual wires being insulated only by thickening the natural film upon them. A special electrical application of aluminium is for transforming alternating into direct current. Aluminium in an electrolytic cell allows current to pass in one direction only, the reverse impulses being entirely suppressed.

The casings and housings of many electrical machines are aluminium castings. In some cases the fact that aluminium and its light alloys are non-magnetic is here of importance.

Foodstuffs Industries.—A great many of the uses to which aluminium is put depend upon the fact that aluminium salts are in no way poisonous. First among these must be named its use for cooking utensils, probably the largest single use of the metal in sheet form. For this purpose its high heat conductivity also commends it, as does the fact that it is uniform throughout its thickness, so that there is no fear of a protecting coating wearing off as is the case with tinned copper or enamelled iron. Upon the same properties depends the use of aluminium steam-jacketed pans in institutional kitchens and in the foodstuffs and chemical industries almost universally. For the wrapping of chocolates and other articles aluminium foil is now very largely used in place of tin foil; whilst in America aluminium collapsible tubes are made on a large scale for the packing of cosmetics, etc. The stamping of thin sheet into bottle and jar covers is alone an industry of no small importance.

The brewing industry makes wide use of aluminium in the form of vats and fermenting vessels, storage vessels for yeast and beer and tanks for the transport of beer by road and rail. In Europe, the dairy industry also uses aluminum widely in the form of tanks and vessels for the storage, pasteurization and transport of milk and cream and for the vats used in cheese-making. For many other foodstuffs which are weakly acid, aluminium finds rapidly extending use, since much closer attention is being paid now than in the past to the presence of minute quantities of copper salts in materials destined for human consumption. Here may be specially named jam-making, fruit-preserving and meat-extracting and the production of high-grade gelatines

Chemical Industry.—The resistance of aluminium to nitric acid has played an important part in the production of this acid and nitrates from the air, as well as in explosives factories, and some of the more recent processes for the production of acetic acid have also depended upon the possibility of using aluminium apparatus.

Many fine chemicals are made in aluminium vessels because the metal imparts no colour to them. For the same reason the palest varnishes are made in aluminium boilers.

The position of aluminium in the electro-chemical series and its consequent ability to displace more noble metals from solutions of their salts has been made use of. Copper is precipitated from solution in this way for analytical purposes and silver and gold have been recovered from cyanide solutions on a large scale.

Because sulphurous vapours do not attack aluminium it can be used to advantage where exposed to fumes and especially to furnace gases. Here, however, its low melting point is a factor to be guarded against. A special application of this property is the use of aluminium to coat other metals by the process known as calorizing. The parts to be coated are heated in aluminium powder (to which certain additions are made) in a non-oxidizing atmosphere. An aluminium alloy which is highly resistant to furnace gases forms on the surface of the metal object.

Its affinity for oxygen accounts for the use of aluminium in refining steel, small quantities being added with other ingredients as deoxidizers to the liquid steel. Its use in steel and iron welding depends on the same property. Aluminium powder, mixed with iron oxide and ignited, deprives the iron of its oxygen, developing so much heat that the resulting metallic iron is molten and may be cast round pieces of the same metal which it is desired to unite (*see* THERMIT). Many refractory metals can be similarly reduced from their oxides. Mixed with ammonium nitrate as a source of oxygen, granulated aluminium forms the powerful explosive ammonal and flash powders used in photography, and pyrotechnics are similarly made.

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ALUMINIUM BRONZE, the name originally given to an alloy containing 90% copper and 10% aluminium. Later, alloys with smaller percentages of aluminium and also those containing, in addition, 1%–4% of manganese and iron were included under the general term "aluminium bronzes." The maximum percentage of aluminium in industrial bronzes is 11%, as larger proportions entail excessive brittleness.

Aluminium bronzes are distinguished by their golden yellow colour, which has led to their extensive use for art-metal work. Mechanically they approach mild steel, being strong and ductile and lending themselves readily to rolling and forging In fact the alloy containing 10% aluminium has been compared with 0·35% carbon Swedish Bessemer steel, by no means to the disadvantage of the former. When cast the 10% alloy has the following properties:

Elastic limit	25—30,000 lb. per sq. in.
Tensile strength	70—80,000 lb. per sq. in.
Elongation on 2″	20%
Brinel number	100

As in the case of steel, these properties may be greatly improved by suitable heat treatment.

Casting in sand offers some difficulties and sound castings are not easy to obtain. Casting in chills or by the centrifugal process yields excellent results, and great quantities of such castings are regularly produced. Machining is troublesome and special precautions are called for owing to its high strength and resistance to alternating stresses. The 10% bronze has been used with great success for the worm wheels of motor cars, many thousands of tons of metal having been cast for this purpose. Aluminium also confers on copper the property of resisting furnace and other sulphurous gases, so that these bronzes have proved themselves well adapted for utensils subjected to direct contact with flames. They have also been used with success to withstand attack by sea-water and the acid waters found in some mines. It may be added that aluminium bronzes containing high proportions of manganese possess well defined magnetic properties.

For structure and mechanical properties *see* 8th and 9th Report of Alloys Research Committee, *Proceedings of the Institute of Mechanical Engineers* (1907, p. 57; 1910, p. 119). (R. S.)

ALUM SHALES, sedimentary rocks, rich in alumina and iron pyrites.

ALUNDUM, a hard material belonging to the class of Abrasives (*q.v.*), also used for the manufacture of laboratory apparatus. It is obtained by fusing bauxite (*q.v.*) in an electric furnace.

ALUNITE or **ALUMSTONE,** a mineral first observed in the 15th century at Tolfa, near Rome, where it is mined for the manufacture of alum. Extensive deposits are also worked in Tuscany and Hungary, and at Bulladelah in New South Wales. By repeatedly roasting and lixiviating the mineral, alum is obtained in solution, and this is crystallized out by evaporation. Alunite occurs as seams in trachytic and allied volcanic rocks, having been formed by the action of sulphurous vapours on these rocks The white, finely granular masses somewhat resemble marble in appearance, and the more compact kinds from Hungary are so hard and tough that they are used for millstones. The hardness is 4 and the specific gravity 2·6. The mineral is a hydrated basic aluminium and potassium sulphate, $KAl_3(SO_4)_2(OH)_6$.

ALUNTIUM, an ancient city of Sicily, (Gr. Ἀλόντιον, mod S. Marco d'Alunzio), 6 m. from the north coast and 25 m. E.N.E. of Halaesa. It was probably of Sicel origin, though its foundation was ascribed to some of the companions of Aeneas. It suffered considerably at the hands of Verres The abandoned church of S. Mark, just outside the modern town, is built into the *cella* of an ancient Greek temple, which measures 62 ft. by 18.

ALUR (Lur, Luri, Lurem), a Negro people of the Nile valley, living on the north-west coast of Albert Nyanza. They are akin to the Acholi (*q.v.*), speaking practically the same language.

ALURE, a rare architectural term for a passageway or gutter behind a parapet or a clerestory; sometimes written *valure* or *valoring*.

ALVA or **ALBA, FERNANDO ALVAREZ DE TOLEDO,** DUKE OF (1508–83), Spanish soldier, was descended from one of the most illustrious families in Spain. Selected for a military command by Charles V., he took part in the siege of Tunis (1535), and successfully defended Perpignan against the dauphin of France. He was present at the battle of Mühlberg (1547), and the victory gained there over John of Saxony was due mainly to his exertions. He took part in the subsequent siege of Wittenberg, and presided at the court-martial which tried the elector and condemned him to death. In 1552 Alva was entrusted with the command of the army intended to invade France, and was engaged for several months in an unsuccessful siege of Metz. He was then made commander-in-chief of all the emperor's forces in Italy. Success did not, however, attend his first attempts, and after several unfortunate attacks he was obliged to retire into winter quarters. After Charles's abdication he was continued in command by Philip II. Alva had subdued the whole Campagna, and was at the gates of Rome, when he was compelled by Philip's orders to negotiate a peace. One of its terms was that the duke of Alva should in person ask forgiveness of the haughty pontiff whom he had conquered. Proud as the duke was by nature, and accustomed to treat with persons of the highest dignity, he confessed his voice failed him at the interview, and his presence of mind forsook him. Not long after this (1559) he was sent at the head of a splendid embassy to Paris to espouse, in the name of his master, Elizabeth, daughter of Henry, king of France.

In 1567 Philip sent Alva to the Netherlands to repress Protestantism there. Alva made the long march from Genoa at the head of a perfectly disciplined army of about 10,000 men. When he presented his credentials as captain-general of the Netherlands at Brussels it was clear that there remained to the regent, Margaret, Duchess of Parma, a mere shadow of power. Before the end of the year she resigned, and Alva succeeded her as governor-general and regent.

Alva's first care was to lure into his power Counts Egmont and Horn, two of the leaders of the malcontent nobles. They were seized and imprisoned, and in the next year brought to the block (June 2 1568). The new governor erected a tribunal, known officially as the "Council of Troubles," but popularly called the "Council of Blood." Alva himself presided, and reserved the decisions to himself. Of the seven Netherlanders who were members, five resigned after the nature of the operations of the court became clear. From the first the business was in the hands of Alva and two Spaniards, one of whom, Juan de Vargas, received the evidence collected from all over the country against heretics and malcontents. It was at the hands of the Council of Blood that Egmont and Horn received their sentence.

William of Orange, summoned before the Council, refused to acknowledge its competence, and left the country to raise troops to meet force with force. But the army of mercenaries which crossed the frontier under Louis of Nassau was destroyed by Alva without difficulty at Jemmingen (July 21 1568). Another army, led by William himself into Brabant, was foiled, and William withdrew and disbanded the force. By the failure of these two attempts Alva's position was made secure, and he was able to devote himself entirely to the crushing of the liberties of the towns and the destruction of heretics. In the terror which followed Alva himself boasted that 18,000 persons were executed, in addition to the numbers killed in battle or massacred after victory.

Alva made a serious blunder when, in desperate straits for money, he attempted in 1569 to levy a property tax and a 10% turnover tax on all sales, for by this measure he united Catholics and Protestants against him. The exiles from the Low Countries encouraged by the general opposition, fitted out a fleet of privateers, which harried the coast towns and seized Spanish ships at sea. On April 1, 1572 the "Sea-beggars" seized Utrecht. They captured Brielle and Flushing, and within a short time four of the northern provinces had declared for the Prince of Orange. Alva's preparations to oppose the gathering storm were made with his usual vigour, and he reduced Mons and Malines while his son Frederick, prior of Toledo, took Zutphen. The towns were sacked and the inhabitants maltreated, Catholic and Protestant alike. With the exception of Zealand and Holland, he regained all the provinces; and at last his son stormed Naarden, and, massacring its inhabitants, proceeded to invest the city of Haarlem, which, after standing an obstinate siege, was taken and pillaged (July 11, 1573).

Their next attack was upon Alkmaar, but the 2,000 burghers repulsed the 16,000 Spanish veterans sent against them with great loss, and Frederick was constrained reluctantly to retire. Alva's feeble state of health and continued disasters induced him to solicit his recall from the government of the Low Countries; a course which was not displeasing to Philip, who was now resolved to make trial of a milder administration. In Dec. 1573 Alva returned to Spain.

On his return he was treated for some time with great distinction by Philip. But he had many enemies, among them Philip's secretary, Antonio Perez. He was banished from court, and confined in the castle of Uzeda. Here he had remained two years, when the success of Don Antonio in assuming the crown of Portugal determined Philip to recall Alva. In 1581 he entered Portugal, defeated Antonio, drove him from the kingdom, and soon reduced the whole under the subjection of Philip.

Entering Lisbon, he seized an immense treasure, and suffered his soldiers, with their accustomed violence and rapacity, to sack the suburbs and vicinity. It is reported that Alva, being requested to give an account of the money expended on that occasion, sternly replied, "If the king asks me for an account, I will make him a statement of kingdoms preserved or conquered, of signal victories, of successful sieges and of 60 years' service." Alva died in Jan. 1583 at the age of 74.

BIBLIOGRAPHY.—*See* the *Life,* by Rustant (Madrid, 1751). His correspondence during his Flemish government has been published by M. Gachard (Brussels, 1850). *See* also *Coleccion de documentos ineditos para la historia de España,* vols. iv., vii., viii., xiv., xxxii. and xxxv. (Madrid); and Motley's *Rise of the Dutch Republic* (1856).

ALVA, municipal burgh, Clackmannanshire, Scotland, 3¼m. N. of Alloa, terminus of a branch line of the L N E R. Pop. (1921) 4,107. It is situated at the foot of three front peaks of the Ochils—West Hill (1,682ft.), Middle Hill (1,436ft.) and Wood Hill (1,723ft.). There are spinning-mills, and also manufactures of tweeds, tartans and other woollen goods. Silver, lead and other metals have been found in the hills, in small quantities.

ALVARADO, PEDRO DE (1495–1541), one of the Spanish leaders in the discovery and conquest of America, was born at Badajoz about 1495. He held a command in the expedition sent from Cuba against Yucatan in the spring of 1518, and returned in a few months, bearing reports of the wealth and splendour of Montezuma's empire. In Feb. 1519 he accompanied Hernando Cortez in the expedition for the conquest of Mexico, being appointed to the command of one of the 11 vessels of the fleet He acted as Cortez's principal officer, and on the first occupation of the City of Mexico was left there in charge. When the Spaniards had temporarily to retire before the Mexican uprising, Alvarado led the rear-guard (July 1, 1520), and the *Salto de Alvarado*—a long leap with the use of his spear, by which he saved his life—became famous. He was engaged (1523–24) in the conquest of Guatemala, of which he was subsequently appointed governor by Charles V. In 1534 he attempted to bring the province of Quito under his power, but had to content himself with the exaction of a pecuniary indemnity for the expenses of the expedition. During a visit to Spain three years later, the governorship of Honduras was conferred upon him in addition to that of Guatemala. He died in Guatemala in 1541.

ALVAREZ, DON JOSÉ (1768–1827), Spanish sculptor, was born at Priego, in the province of Cordova, in 1768, the son of a stonemason. His full name was José Alvarez de Pereira y Cubero. In 1799 he obtained from Charles IV. a pension of 12.000 reals to enable him to visit Paris and Rome. In Paris he executed in 1804 a statue of Ganymede which is now in the sculpture gallery of the Prado, Madrid. Shortly afterwards he left Paris for Rome, where he remained till within a year of his death. His son, Don José Alvarez y Bougel (1805–29) also distinguished himself as a sculptor and a painter in his short life. One of the most successful works of the elder Alvarez was a group representing Antilochus and Memnon, now in the museum of Madrid. He also modelled portrait busts of Ferdinand VII., Rossini, and the duchess of Alba, which are remarkable for their vigour and fidelity.

ALVAREZ, DON MANUEL (1727–1797), Spanish sculptor, was born at Salamanca. He followed classical models so closely that he was styled by his countrymen *El Griego,* "The Greek."

ALVAREZ DO ORIENTE, FERNÃO (1540–1595), Portuguese poet, was born in Goa and served in the Indies His incomplete *Lusitania Transformada* (1607) is an elegant pastoral poem.

ALVAREZ, FRANCISCO (*c.* 1465–1541 ?), Portuguese missionary and explorer, born at Coimbra, was sent in 1515 as secretary to Duarte Galvão and Rodrigo da Lima on an embassy to the negûs of Abyssinia (Lebna Dengel Dawit [David] II.). It was not until 1520 that he reached Abyssinia, where he remained six years, returning to Lisbon in 1526–27. In 1533 he was sent to Rome on an embassy to Pope Clement VII.

His account of his travels, *Verdadera Informaçam das terras do Presto Joam,* was published in 1540 at Lisbon, and translated into English (Sam. Purchas, *Pilgrimes,* part ii., 1625).

ALVAREZ, JUAN (1780–1867), Mexican general, was born at Concepción de Atoyac (now Ciudad Alvarez), territory of Guerrero, Mexico, on Jan. 27, 1780 He joined the revolt of Morelos against the Spanish rule in Nov. 1810, and in various battles in the ensuing struggle for independence won distinction as a cavalry officer. He had a prominent part in the revolt led by Santa Anna in 1822–23 which overthrew the Government of Iturbide and in 1847 served with the Mexican army in the war with the United States. He began the revolt of 1854–55 which ended the despotic rule of Santa Anna. His civil career began in 1849 when he became the first governor of the new State of Guerrero, formed from the territory of his birth At Cuernavaca, on Oct. 4, 1855, he was made acting president of the republic but was unable to unite the conflicting elements among his followers. On Dec. 8, 1855, therefore, he transferred the office to Comonfort, and retired to his home at Acapulco Throughout the period of the Second Empire, 1863–67, he was a resolute opponent of Maximilian. Though his liberal principles led him to participate in many revolutions, he was singularly free from selfish ambitions. He died on Aug. 21, 1867.

ALVAREZ QUINTERO, the name of two brothers, SERAFIN (1871–) and JOAQUIN (1873–), Spanish dramatists, born at Utrera. They revived in their graceful plays the traditional humour of Rueda's *pasos.* These plays deal chiefly with scenes of Andalusian life and include such subjects as *Los Galeotes* (1900), *El Patio* (1900), *Las Flores* (1901), *Malvaloca* (1912) and *La Calumniada* (1919). They are characterized by sparkling dialogue rather than by analysis of character or depth of thought.

See *Four Plays by Joaquin and Serafin Quintero,* tr. by Helen and Harley Granville-Barker (1928).

ALVEAR, MARCELO TORCUATO DE (1868–), Argentine politician, was born at Buenos Aires, on Oct. 4, 1868, the son of Torcuato de Alvear, several times mayor of Buenos Aires, and grandson of General Carlos de Alvear, first Argentine minister to the United States. After graduating from the University of Buenos Aires, he joined the Radical party, and in 1912, after study and travel in Europe, was elected to the lower house of the Argentine Congress, from the city, and then from the province of Buenos Aires. As a congressman he promoted social service legislation, notably for the improvement of housing and civil service conditions. He served as Argentine minister to France from 1916 until his election as president of Argentina in 1922, when he received a large majority over his opponent, Dr. Lisandro de la Torre. On the whole he continued the policies of his predecessor Hipólito Irigoyen, though his long residence in Europe gave him a somewhat broader view of foreign affairs As president he gradually became more influential in the affairs of the Radical party, in whose councils he assumed an outstanding position.

ALVEARY (Lat *alvearium*), a beehive; used, like *apiarium,* figuratively for a collection of hard-working people, or a scholarly work (*e g*, dictionary) involving bee-like industry By analogy the term is used for the hollow of the ear, where the wax collects.

ALVENSLEBEN, CONSTANTIN VON (1809–1892), Prussian general, was born on Aug. 26, 1809, at Eichenbarleben in Prussian Saxony, and entered the Prussian guards from the cadet corps in 1827 He served with distinction in the campaign of 1866. In 1870, on the outbreak of war with France, von Alvensleben succeeded Prince Frederick Charles in command of the III. army corps which formed part of the II. German army commanded by the prince. Under their new general, the Brandenburg regiments forming the III. corps proved themselves collectively the best in the whole German army, with the possible exception of the Prussian guards, and, if Prince Frederick Charles may have the chief credit in training the III. corps, Alvensleben had contributed in almost equal degree to the efficiency of the Guard infantry, while his actual leadership of the III. corps in the battles of 1870 and 1871 showed him as a fighting general of the very first rank. The battle of Spicheren, on Aug 6, was initiated and practically directed throughout by him, and in the confusion which followed this victory, for which the superior commanders were unprepared, Alvensleben showed his energy

and determination by resuming the advance on his own responsibility. This led to the great battles of Aug. 14, 16 and 18 around Metz, and again the III. corps was destined, under its resolute leader, to win the chief credit. Crossing the Moselle the instant that he received permission from his army commander to do so, Alvensleben struck the flank of Bazaine's whole army (Aug. 16) in movement westward from Metz. The III. corps attacked at once, and for many hours bore the whole brunt of the battle at Vionville. By the most resolute leading, and at the cost of very heavy losses, Alvensleben held the whole French army at bay while other corps of the I. and II. German armies gradually closed up. In the battle of Gravelotte, on the 18th, the corps took little part. Its work was done, and it remained with the II. army before Metz until the surrender of Bazaine's army. He became full general of infantry in 1873 and retired immediately afterwards. He died on March 28, 1892, at Berlin.

His brother, GUSTAV VON ALVENSLEBEN (1803–81), Prussian general of infantry, and another brother, ALBRECHT, COUNT VON ALVENSLEBEN (1794–1858), Prussian statesman, also had distinguished careers in the Prussian service.

ALVEOLATE, a word used in biology, to mean pitted like a honeycomb.

ALVERSTONE, RICHARD EVERARD WEBSTER, 1ST BARON (1842–1915), lord chief justice of England, was born Dec. 22 1842, being the second son of Thomas Webster, Q.C., and died Dec. 15 1915, at Cranleigh, Surrey. He was educated at King's College and Charterhouse schools, and Trinity College, Cambridge; was called to the bar in 1868, and became Q.C. only ten years afterwards. His practice was chiefly in commercial, railway and patent cases until (June 1885) he was appointed attorney-general in the Conservative Government, in the exceptional circumstances of never having been solicitor-general, and not at the time occupying a seat in parliament. He sat in the House of Commons first for Launceston and then for the Isle of Wight. Except under the brief Gladstone administration of 1886, and the Gladstone and Rosebery cabinets of 1892–95, Richard Webster was attorney-general from 1885 to 1900. In 1890 he was leading counsel for *The Times* in the Parnell enquiry; in 1893 he represented Great Britain in the Bering Sea arbitration; in 1898 he discharged the same function in the matter of the boundary between British Guiana and Venezuela; and in 1903 he was one of the members of the Alaska Boundary Commission. He was well known as an athlete in his earlier years, having represented his university as a runner, and his interest in cricket and foot-racing was kept up in later life.

In the House of Commons, and outside it, he was throughout his political career prominently associated with church work; and his speeches were distinguished for gravity and earnestness. In 1900 he succeeded Sir Nathaniel Lindley as Master of the Rolls, being raised to the peerage as Baron Alverstone, and in October of the same year he was elevated to the office of lord chief justice upon the death of Lord Russell of Killowen. He retired in Nov. 1913.

See his *Recollections of Bar and Bench* (1914).

ALVORD, CLARENCE WALWORTH (1868–1928), American educator and historical scholar, was born in Greenfield, Mass., May 21, 1868. He graduated from Williams college in 1891 and pursued further studies at the universities of Berlin, Chicago and Illinois, from the last mentioned of which he received in 1908 the degree of doctor of philosophy. During the period 1891–1901 he devoted six years to teaching in preparatory schools. Entering the faculty of the University of Illinois in 1901 as instructor, he became in 1907 assistant professor, in 1909 associate professor and in 1913 professor of history, and occupied this chair until 1920. From 1920 to 1923 he was professor of history in the University of Minnesota. In 1906 he was appointed editor of publications for the Illinois State Historical Society. In this capacity he edited *Cahokia Records* (1906); with E. B. Greene, *Governors' Letters* (1909); *Kaskaskia Records* (1909); with C. E. Carter, *The British Series* (1915); and *Governor Edward Coles* (1920). His published writings include *Mississippi Valley in British Politics* (1917), which was awarded the Loubat prize of that year; *The Illinois Country, 1673–1818* (1920); *Lord Shelburne and the Founding of British-American Goodwill* (1925); and numerous contributions to historical journals. He died at Diano Marino, Italy, Jan. 27, 1928.

ALWAR, an Indian State in the Rajputana agency. Its configuration is irregular, the greatest length from north to south being about 80m., and breadth from east to west about 60m., with a total area of 3,141sq.m. The eastern portion of the State is open and highly cultivated; the western is diversified by hills and peaks, which form a continuation of the Aravalli range, from 12 to 20m. in breadth. These hills run in rocky and precipitous parallel ridges, in some places upwards of 2,200ft. in height. The Sabhi and Ruparel are the only streams of importance. The pop. in 1921 was 701,154. The maharaja Jai Singh, who succeeded in 1892 at the age of ten, represented India at the Imperial Conference in London in 1923. Alwar was the first Indian State to accept a currency struck at the Calcutta mint, of the same weight and assay as the imperial rupee, with the head of the British sovereign on the obverse. Imperial service troops are maintained, consisting of both cavalry and infantry, with transport.

The State was founded by the Rajput chieftain Pratap Singh (1740–91), and increased by his adopted son Bakhtawar Singh. The latter joined the British against the Mahrattas, and in 1803, after the battle of Laswari, signed a treaty of offensive and defensive alliance with the British Government.

The city of Alwar stands in a valley overhung by a fortress 1,000ft. above. It is surrounded by a rampart and moat, with five gates, and contains fine palaces, temples and tombs. The water-supply is brought from a lake 9m. distant. It has a school for the sons of nobles, founded to commemorate the Diamond Jubilee of Queen Victoria. Pop. (1921), 44,760.

ALYATTES, king of Lydia (609–560 B.C.), the real founder of the Lydian empire, was the son of Sadyattes, of the house of the Mermnadae. He carried on the war against Miletus begun by his father, until 604, when it was ended by a treaty of peace and alliance (Hdt. i. 18–23). He next came into conflict with the rising power of Media, but on May 28, 585, a pitched battle was interrupted by an eclipse of the sun (Hdt. i. 74). A peace was concluded, through the mediation of Babylon and Cilicia, which fixed the Halys as the boundary between the two kingdoms (Hdt. i. 102). Alyattes drove the Cimmerii (*see* SCYTHIA) from Asia, subdued the Carians, and took several Ionian cities (Smyrna, Colophon). He was succeeded by his son Croesus. His tomb still exists on the plateau between Lake Gygaea and the River Hermus to the north of Sardis—a large mound of earth, with a substructure of huge stones. It was excavated by Spiegelthal in 1854, who found that it covered a large vault of finely cut marble blocks approached by a flat-roofed passage of the same stone from the south. The sarcophagus and its contents had been removed by early plunderers of the tomb, all that was left being some broken alabaster vases, pottery and charcoal. On the summit of the mound were large *phalloi* of stone (Hdt. i. 93).

See A. von Ölfers, "Über die lydischen Königsgräber bei Sardes," *Abh. Berl. Ak.*, (1858).

ALYPIUS, a Greek writer on music whose works, with those of six others, were collected and published with a commentary and explanatory notes (*Antiquae Musicae Auctores Septem*, Amstel., 1652), by Mark Meibomius (1630-1711). He is said to have written before Euclid and Ptolemy; and Cassiodorus arranges his *Introduction to Music* between those of Nicomachus and Gaudentius. The work consists solely of a list of symbols of the various scales and modes, and is probably only a fragment.

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ALYPIUS OF ANTIOCH, a geographer of the 4th century, who was sent by the Emperor Julian into Britain as first prefect, and was afterwards commissioned to rebuild the temple of Jerusalem. Among the letters of Julian are two (29 and 30) addressed to Alypius, one inviting him to Rome, the other thanking him for a geographical treatise, which no longer exists.

See also Ammianus Marcellinus xxiii. i. §2.

ALYTES, a genus of batrachians of which the best known is the midwife toad, *Alytes obstetricans,* two inches in length, of dull greyish coloration, plump form with warty skin and large eyes. Although toad-like it belongs to another family, *Discoglossidae.* It inhabits most of western Europe. A second species, *A. cisternasii,* occurs also in Spain and Portugal.

Alytes is nocturnal and slow in its movements. It is thoroughly terrestrial. Towards evening it reveals its presence by a clear whistling note. The breeding season lasts throughout spring and summer, and the female spawns two, three or even four times in the year. Pairing and oviposition take place on land; the male seizes the female round the waist. The eggs are large and yellow, and produced in two rosary-like strings, as if strung together by elastic filaments continuous with the gelatinous capsules. After impregnation, the male twists them round his legs and returns to his usual retreat, resorting to a short immersion in the water during exceptionally dry nights. When the time for hatching has come, after about three weeks, the male enters the water; the larvae, measuring 14 to 17 millimetres, bite their way through their tough envelope, which is not abandoned by the father until all the young are liberated. The tadpoles grow to a large size before metamorphosis. (*See* LAMARCKISM.)

See R. Lydekker, J. T. Cunningham, G. A. Boulenger and J. A. Thomson, *Reptiles, Amphibia, Fish and Lower Chordata* (1912).

ALZEY, a town in Hesse, Germany, 20m. S.S.W. of Mainz. Pop. (1925) 9,200. It is mentioned in the *Nibelungenlied.* In 1277 it became an imperial city, and in 1620 was sacked by the Spaniards and in 1689 burnt by the French. During the Napoleonic wars it was annexed to France and in 1815 passed to the grand-duchy of Hesse-Darmstadt. It has considerable trade in wine.

ALZOG, JOHANN BAPTIST (1808–78), German theologian, was born at Ohlau, in Silesia, June 29 1808. Together with Döllinger, Alzog was instrumental in convoking the famous Munich assembly of Catholic scholars in 1863. He also took part, with Bishops Hefele and Haseberg, in the preparatory work of the Vatican Council, and voted in favour of the doctrine of papal infallibility but against the opportuneness of its promulgation.

Alzog's fame rests mainly on his *Handbuch der Universal-Kirchengeschichte* (Mainz, 1841, often reprinted under various titles; Eng. trans. by Pabisch and Byrne, *A Manual of Church History,* Cincinnati, 1874). Alzog was an active collaborator in the great *Kirchenlexicon* of Wetzer and Welte and was also the author of *Grundriss der Patrologie* (Freiburg, 1866, 4th ed. 1888), a scholarly work, though since superseded

A full list of Alzog's writings is given in H. Hurter's *Nomenclator literarius recentioris theologiae catholicae,* vol. iii. For an account of his life *see* the funeral oration by F. X. Kraus, entitled *Gedächtnissrede auf Johannes Alzog* (Freiburg, 1879).

AMADIS DE GAULA. This famous romance of chivalry survives only in a Castilian text, but it is claimed by Portugal as well as by Spain. The date of its composition, the name of its author, and the language in which it was originally written are not yet settled. It is not even certain when the romance was first printed, for though the oldest known edition (a unique copy of which is in the British Museum) appeared at Sargasso in 1508, it is highly probable that *Amadis* was in print before this date; an edition is reported to have been issued at Seville in 1496. As it exists in Spanish, *Amadis de Gaula* consists of four books, the last of which is generally believed to be by the *regidor* of Medina del Campo, Garci Rodriguez de Montalvo. Montalvo alleges that the first three books were arranged and corrected by him from "the ancient originals," and a reference in the prologue to the siege of Granada points to the conclusion that the Spanish recast was made shortly after 1492; it is possible, however, that the prologue alone was written after 1492, and that the text itself is older. The number of these "ancient originals" is not stated, nor is there any mention of the language in which they were composed; Montalvo's silence on the latter point might be taken to imply that they were in Castilian, but any such inference would be hazardous. Three books of *Amadis de Gaula* are mentioned by Pero Ferrús who was living in 1379, and there is evidence that the romance was current in Castile more than a quarter of a century earlier; but again there is no information as to the language in which they were written. Gomes Eannes de Azurara in his *Chronica de Conde D. Pedro de Menezes* (*c.* 1450) states that *Amadis de Gaula* was written by Vasco de Lobeira in the time of King Ferdinand of Portugal who died in 1383. Recent critics have inclined to the belief that *Amadis de Gaula* was written by João de Lobeira, a Galician knight who frequented the Portuguese court between 1258 and 1285, and to whom are ascribed two fragments of a poem in the Colocci-Brancuti (*Canzoniere* (Nos. 240 and 240^b), which reappears with some unimportant variants in *Amadis de Gaula* (book ii., chapter 2). The coincidence may be held to account in some measure for the traditional association of a Lobeira with the authorship of *Amadis de Gaula;* but, though curious, it warrants no definite conclusion being drawn from it. Against the Portuguese claim it is argued that the *Villancico* corresponding to João de Lobeira's poem is an interpolation in the Spanish text, that Portuguese prose was in a rudimentary stage of development at the period when—*ex hypothesi*—the romance was composed, and that the book was very popular in Spain almost a century before it is even mentioned in Portugal. Lastly, there is the incontrovertible fact that *Amadis de Gaula* exists in Castilian, while it remains to be proved that it ever existed in Portuguese. As to its substance, it is beyond dispute that much of the text derives from the French romances of the Round Table; but the evidence does not enable us to say (1) whether it was pieced together from various French romances; (2) whether it was more or less literally translated from a lost French original; or (3) whether the first Peninsular adapter or translator was a Castilian or a Portuguese. On these points judgment must be suspended. There can, however, be no hesitation in accepting Cervantes' verdict on *Amadis de Gaula* as the "best of all the books of this kind that have ever been written." It is the prose epic of feudalism, and its romantic spirit, its high ideals, its fantastic gallantry, its ingenious adventures, its mechanism of symbolic wonders, and its flowing style have entranced readers of such various types as Francis I and Charles V., Ariosto and Montaigne.

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AMADOU, a soft tough substance once frequently used as tinder, derived from *Polyporus fomentarius,* a fungus belonging to the group Basidiomycetes and growing upon old trees, especially the oak, ash, fir and cherry. The fungus is cut into slices and then steeped in a solution of nitre. Amadou is prepared on the continent of Europe, chiefly in Germany, but the fungus is a native of Britain. *Polyporus igniarius* and other species are also used, but yield an inferior product.

AMAKUSA, an island of about 200sq.m. off the west coast of the larger island of Kyushu in south Japan (32° 25′ N, 130° E). Its conformation is typical of that of the whole west flank of Kyushu, a hilly country broken up along north-east to south-west lines; and its terrace cultivation is that found not only in Kyushu but in most of south Japan. (*See* JAPAN)

AMAL, the name of the noblest family among the Ostrogoths and that from which nearly all their kings were chosen. The family first appears in history in the 4th century A.D.

AMALARIC (died 531), king of the Visigoths, son of Alaric II., was a child when his father fell in battle against Clovis, king of the Franks (507). He was carried for safety into Spain, which country and Provence were thenceforth ruled by his maternal grandfather, Theodoric the Ostrogoth, acting through his vice-regent, an Ostrogothic nobleman named Theudis. In 522 the young Amalaric was proclaimed king, and four years later, on Theodoric's death, he assumed full royal power in Spain and a part of Languedoc, relinquishing Provence to his cousin Athalaric. He married Clotilda, daughter of Clovis; but his disputes

with her, he being an Arian and she a Catholic, brought on him a Frankish invasion, in which he lost his life in 531.

AMALASUNTHA or **AMALASUENTHA,** queen of the Ostrogoths (d. 535), daughter of Theodoric, king of the Ostrogoths, was married in 515 to Eutharic, an Ostrogoth of the old Amal line, who had previously been living in Spain. Her husband died, apparently in the early years of her marriage, leaving her with two children, Athalaric and Matasuentha. On the death of her father in 526 she succeeded him at Ravenna, acting as regent for her son; but being herself deeply imbued with the old Roman culture, she gave to that son's education a more refined and literary turn than suited the ideas of her Gothic subjects. Conscious of her unpopularity she banished, and afterwards put to death, three Gothic nobles whom she suspected of intriguing against her rule, and at the same time opened negotiations with the emperor Justinian with the view of removing herself and the Gothic treasure to Constantinople. Her son's death in 534 made but little change in the situation. Amalasuntha, now queen, invited her cousin Theodahad to share her throne. Theodahad, notwithstanding a varnish of literary culture, was a coward and a scoundrel. He fostered the disaffection of the Goths and, either by his orders or with his permission, Amalasuntha was imprisoned on an island in the Tuscan lake of Bolsena, where in the spring of 535 she was murdered in her bath.

The letters of Cassiodorus, chief minister and literary adviser of Amalasuntha, and the histories of Procopius and Jordanes give us our chief information as to the character of Amalasuntha.

AMALEKITES, an ancient tribe, or collection of tribes, belonging to the Bedouin type, familiar from their relations to Israel. Though Hebrew ethnology made them a subordinate branch of Edom (Gen.xxxvi.12), and (if the text of Judges v 14 and xii 15 be correct) even connected them closely with the tribe of Ephraim, they are uniformly represented as enemies of Israel. Thus they harried the fugitives as they escaped from Egypt at the Exodus (Deut xxv.17–19), were included among the foes through whom a passage must be forced into southern Palestine from Kadesh (Num. xiv. 43–45), attacked Israel at Rephidim, where they were utterly defeated by Joshua (Exod. xvii. 8–16), were doomed to ultimate destruction by Balaam (Num. xxiv. 20), formed part of the coalition which Eglon, king of Moab, used to oppress Israel (Judges iii. 13), were included among the hordes of Bedouin raiders defeated by Gideon (Judges vi. 3,33), were condemned to annihilation—put to the "herem"—by Saul (I. Sam. xv), though the king incurred the anger of Yahweh by sparing Agag and the cattle; and yet enough of them survived to raid Ziklag in David's absence and to be overwhelmed by his vengeance (I. Sam. xxx.). It is not surprising to find them described as "enemies of Yahweh" (I. Sam. xxx. 26), and the objects of a perpetual "Jihād," or sacred war (Deut. xxv. 19, Ex. xvii. 16).

The district over which Amalek ranged lay to the south of Judah, probably between Kadesh and Hormah, though they may at times have been located further east; and the interchange of the ethnic with "Canaanites" and "Amorites" suggests that the Amalekites were merely one of Israel's traditional enemies of the older period. Even in one of the Psalms (lxxxiii. 7) Amalek is mentioned among the foes of Israel, and the same feeling is reflected still later in the book of Esther, where Haman the Agagite is pitted against Mordecai the Benjamite. The name of Amalek is celebrated in Arabian tradition, but the confused and conflicting stories are, for historical purposes, practically worthless.

AMALFI, town and archiepiscopal see, Campania, Italy, in the province of Salerno, 12m. W.S.W. by road from the town of that name, on the north coast of the Gulf of Salerno. Pop. (1921), 7,300. This picturesque old city lies at the mouth of a deep ravine, sheltered at the foot of Monte Cerreto (4,314ft), in the centre of splendid coast scenery. The cathedral of San Andrea is in Lombard-Norman style (11th century) with façade in black and white stone, bronze doors executed at Constantinople before 1066, and campanile (1276). The conspicuous Capuchin monastery on the west with fine cloisters (partly destroyed by landslip, 1899) is now an hotel. Amalfi, first mentioned in the 6th century, soon became a naval power; in the 9th century it shared with Venice and Gaeta the Italian trade with the East, and in 848 its fleet went to the assistance of Pope Leo IV. against the Saracens. It was then an independent republic with a population of some 70,000, but in 1131 it was reduced by King Roger of Sicily. In 1135 and 1137 it was taken by the Pisans, and rapidly declined in importance, though its maritime code, known as the *Tavole Amalfitane,* was recognized in the Mediterranean until 1570. It now has no harbour.

AMALGAM, the name applied to an alloy containing mercury, and said by Andreas Libavius to be a corruption of μάλαγμα; in the alchemists the form *algamala* is also found. Many amalgams are formed by the direct contact of a metal with mercury, sometimes with absorption, sometimes with evolution, of heat. Other methods are to place the metal and mercury together in dilute acid, to add mercury to the solution of a metallic salt, to place a metal in a solution of mercuric nitrate, or to electrolyse a metallic salt using mercury as the cathode or negative electrode. Some amalgams are liquids, especially when they contain a large proportion of mercury; others are crystalline. In some cases definite compounds have been isolated from amalgams, which may be regarded as mixtures of one or more of such compounds with mercury in excess. In general these compounds are decomposable by heat, but some of them, such as those of gold, silver, copper and the alkali metals, even when heated above the boiling point of mercury retain mercury and leave residues of definite composition. The use of tin amalgam in "silvering" mirrors, and of gold and silver amalgams in gilding and silvering has been almost completely superseded by chemical deposition of silver and by electroplating respectively. Cadmium and copper amalgam are employed in dentistry, and an amalgam of zinc and tin for the rubbers of electrical machines. The zinc plates of electric batteries are amalgamated in order to reduce polarization. Native amalgams of gold and silver have been found in various parts of the world, and the "amalgamation process" has been a standard method for the extraction of these two metals from their ores. Although it is still used to a reduced extent on gold ores, its use for silver ores is now practically obsolete.

AMALGAMATION. The term amalgamation, in its industrial sense, is one of a number of terms used to denote the process whereby previously independent and probably competing business concerns join forces and become a single concern conducted under a unified financial and industrial control. Amalgamation is usually spoken of as taking place between two firms only, and it is usually implied that the two previously independent establishments will continue, after the amalgamation, their outwardly separate existence. The four main methods of carrying out an amalgamation are:—

(a) One of the two companies purchases the whole or a controlling part of the share capital of the other company;

(b) A new company is formed to purchase the whole or a controlling part of the share capitals of both companies;

(c) One company purchases outright the other's business; and

(d) A new company is formed to purchase outright both businesses.

Amalgamation is a particular form of that movement towards combination and centralization in industry which has been an increasingly prominent feature of industrial development in all the principal industrial countries for well over half a century. (*See* ASSOCIATIONS, *Industrial;* COMPETITION; COMBINES; also TRUSTS.) (J. H.)

IN METALLURGY

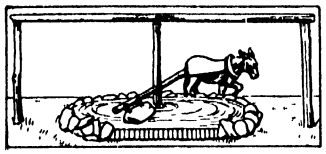
Amalgamation is the process of extracting gold and silver from their ores by means of mercury. It depends on the fact that mercury, or quicksilver as it is usually called by metallurgists, "wets" and adheres to metallic gold and silver and penetrates them, forming pasty amalgams of a silvery colour. Particles of amalgam readily adhere to each other, and the aggregates become large and heavy enough to sink in running water which carries away sand and other earthy materials. Pieces of gold, if not too small, sink perfectly well of themselves and adhere to mercury or amalgam lying at the bottom of the stream, and gold ores have

been widely amalgamated on this principle. Coarse gold can be saved without the aid of mercury but finely divided gold is more likely to escape. Grains of silver naturally settle also, but most silver ores do not contain metallic silver. They contain compounds such as silver sulphide (silver combined with sulphur), and the compounds will not settle in water and must be decomposed to set free the silver before it can be amalgamated.

In amalgamation, ores are crushed to pulp in water and mixed with mercury with violent agitation in order to break up the mercury into minute globules and disperse them throughout the mass, and so enable them to be brought into contact with the gold or silver. Afterwards by dilution with water and gentle stirring, or by a running stream of water, the amalgam and surplus mercury are induced to coalesce and settle to the bottom, where they are caught in a pool of mercury or on the surface of copper plates to which they adhere. When the earthy matter has been washed away, the mixture of metals is put into filter bags and squeezed to remove the surplus mercury. The liquid mercury passes through, containing a minute quantity of gold and silver dissolved in it, and pasty amalgam containing from 25% to 50% of gold remains in the bag. The amalgam is heated in retorts (fig. 5), the mercury driven off as vapour, only to be condensed in a cool chamber for use again, and the gold and silver now nearly pure are melted down and cast into bars. Since all gold ores contain some silver and silver ores some gold, the bars consist of a mixture of gold and silver which are afterwards parted (*see* GOLD). The process is a very old one. The extraction of gold by mercury is mentioned by Pliny in his *Natural History,* and descriptions of amalgamation processes for both gold and silver are to be found in various 16th century treatises. The history of the process is given in detail by Percy.

Mercury may, however, become so excessively subdivided, as the result of too violent agitation or pounding, especially when mixed with grease or certain kinds of ore, that it becomes "floured" or "sickened." Floured mercury is a white powder like flour, although under the microscope it is seen to consist of minute globules of apparently ordinary mercury, heaped together. The globules will not coalesce and are carried away and lost in the tailings or refuse. They are generally separated only by films of air, and may be made to coalesce by the action of acids or in other ways entailing expense or loss. Again, although earthy matter and mercury have no action on each other, nevertheless mercury attacks and amalgamates copper, lead, zinc and some other metals, especially when they are present in the metallic state. The amalgam thus becomes debased and powdery so that part is lost and the remainder is costly to refine. There is also the case of ores which do not yield a reasonable percentage of their values when treated by amalgamation; these are called refractory and those which are amenable to amalgamation are described as free-milling.

Patio or Mexican Process.—Silver ore was ground by mule power in *arrastras* or shallow circular pits paved with stone (fig. 1). Large blocks of stone attached by beams to a central rotating post were dragged round the arrastra and reduced the ore to fine mud which was taken out and spread over a courtyard or *patio* in low heaps. It is then sprinkled with mercury and chemicals (common salt and copper sulphate) and mixed by mules which were driven over every part of the heaps. Complicated chemical reactions took place, never fully understood, the effect of which was to free the silver from its intractable compounds and enable it to be taken up by the mercury. The heaps were trodden by the mules every day or two until the amalgamation was complete, which might require a month. Lastly the material was agitated with water in large tubs and the mud run off through the plug holes. The amalgam found at the bottom was collected and treated as already described. The process was especially suitable for the silver ores of the dry barren districts of Mexico, where water and fuel are scarce, and was not finally displaced by the cyanide process (*q.v.*) until early in the 20th century. It was used in the production of a large proportion of the world's silver for 350 years.



FROM ROSE, "METALLURGY OF GOLD"

FIG. 1.—THE ARRASTRA, USED BY THE MEXICANS FOR HUNDREDS OF YEARS IN GRINDING SILVER ORE

Pan Amalgamation Process.—The process was used for silver ores, especially in the United States, in the latter half of the 19th century and was superseded by the cyanide process and by smelting. Silver ore was ground to a fine paste with water in iron pans (fig. 2) by rotating iron shoes. The shoes were then raised a little, so as to agitate the pulp without further grinding, and mercury was sprinkled into the pan. The agitation was continued until amalgamation was completed, and the end in view was assisted by heating the pan with steam and by the addition of chemicals, especially common salt and copper sulphate. The amalgam was separated by diluting the pulp and stirring and finally by running off the charge into large settling tanks. The amalgamation pans were about 5ft in diameter and the charge was 2,000 or 3,000lb

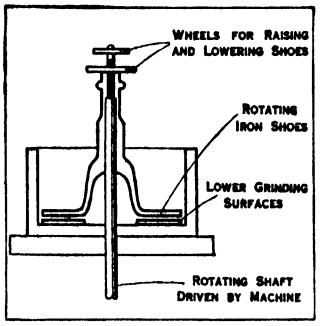


FIG. 2.—AMALGAMATION PAN
Diagram of iron pan used for silver ore in the United States in 19th century. The ore, first ground with water, was then mixed with mercury

Complex silver ores containing minerals not amenable to amalgamation (such as the arsenical and antimonial sulphides, galena and blende) were roasted in furnaces at a red heat with common salt as a preliminary, when silver chloride was formed, a compound from which the silver can be extracted by mercury.

Amalgamation of Gold Ores.—This is simpler and cheaper than that of silver ores. The machine used more than any other for the reduction of gold ores between 1850 and 1925 was the stamp mill or battery (figs. 3 and 4). The stamp mill is worked on the principle of the pestle and mortar. The mortar is long and narrow, and ore, water and mercury are fed into it continuously. Five heavy steel stampers, each weighing from 800 to 2,000lb, are ranged in a row in one mortar. They are raised and let fall in succession, crushing the lumps of ore and driving the pulp through screens set in one side of the mortar. The old-fashioned wire screens were later replaced by perforated steel plates. The pulp coming from the screens is still further reduced by grinding in tube mills (rotating cylinders half filled with large pebbles, or lumps of unbroken ore) and then flows over sloping electro-silvered copper plates or tables, whose surface is amalgamated by rubbing with mercury. In older practice the copper plates were placed just outside the screens (fig 4). The particles of gold adhere to the surface of the plate. Earlier still, amalgamated plates were fixed inside the mortar. The size and weight of stamps in the 20th century caused excessive loss of mercury by flouring and the addition of mercury and the fixing of plates in the mortars were given up, the battery reverting to its original use as a mere crushing machine. Stamps forced down by springs or by power applied in various ways are sometimes used instead of gravity stamps and rotating crushers of various kinds (ball mills, tube mills, etc.) replace them in some new plants.

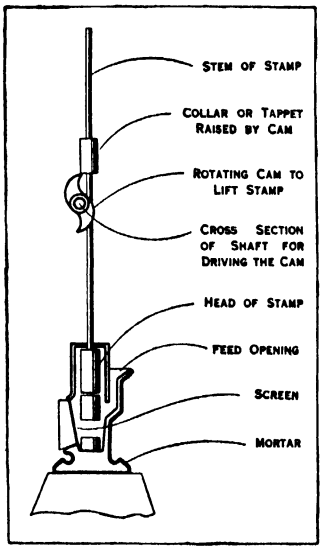
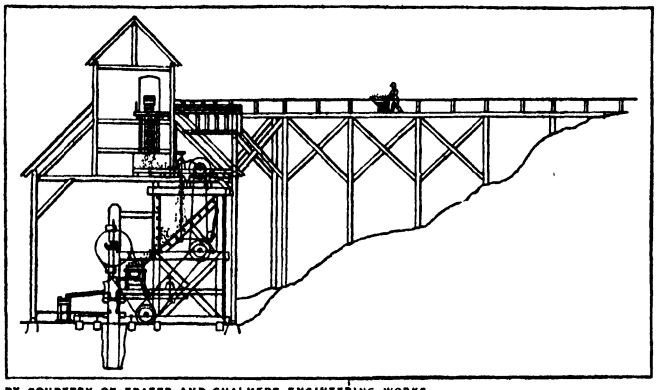


FIG. 3.—STAMP AND MORTAR
California stamp, an improved form of the old German type of 1556, is used for crushing gold ore in all countries. The stamp is raised, slightly rotated and falls by gravity

The clean-up takes place at intervals of a fortnight or a month. The stamps are hung up, the sand is washed away, the amalgamated plates are scraped and the amalgam after careful cleaning is squeezed and retorted as usual (fig 5). The percentage yield of

gold varies with the conditions and the nature of the ore. Coarse gold is easily caught, but finely divided gold escapes in great part. Generally about 60% of the gold in the ore was recovered by amalgamation, and the remainder by cyanide. Ores containing only ¼oz. gold or even less per ton of ore have been treated at a profit.

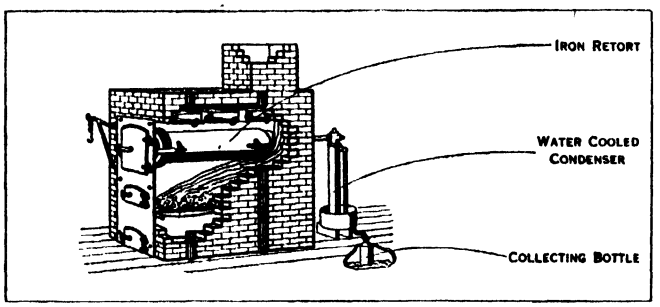
On the Rand, amalgamation on copper plates had been generally discarded by 1925, owing to the difficulty of preventing the theft



BY COURTESY OF FRAZER AND CHALMERS ENGINEERING WORKS

FIG. 4.—GENERAL SECTION OF A GOLD STAMP MILL ON A HILL-SIDE, SHOWING SUPPLY OF ORE AND ITS PASSAGE THROUGH THE MACHINES

by Kafirs of the amalgam and the danger from mercury poisoning. Instead of passing the crushed ore from the tube mills over amalgamated plates it is concentrated on a surface of corduroy, which retains the heavy particles including all coarse gold. This is a reversion to the primitive practice of the gold-diggers of California in 1849 who used their blankets in concentrating gold sands. At intervals the corduroy is taken up and washed in boxes and the coarse gold is extracted from the contents of the boxes by further concentration. The fine gold left in the ore is extracted in the cyanide plant. The corduroy also catches osmiridium and other valuable metals of the platinum group which had previously been lost. The changes on the Rand appear to foreshadow the end of the old amalgamation process. Amalgamation on copper



FROM ROSE, "METALLURGY OF GOLD"

FIG 5.—AMALGAM RETORT FOR SEPARATING GOLD FROM MERCURY
The wall of the furnace is partly removed to show the iron retort. The amalgam of gold and mercury is placed in the retort and heated to redness. The mercury is separated and as vapour passes to the condenser and then to the collecting bottle. The gold remains in the retort

plates lingers only in the Kolar gold-field in India, and in a few mills in Canada and some less important fields. (T. K. R.)

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These technical books give full details. F. Wartenweiler, *Jour. Chem. Nat. and Mng. Soc. of S. Africa*, vol. xxiii., p. 150 (1923). H. A. White *Trans. Instn. of Mining and Metallurgy*, vol. xxxiv., part 2, p. 222 (1925).

AMALRIC, the name of two kings of Jerusalem. AMALRIC I, king from 1162 to 1174, was the son of Fulk of Jerusalem and the brother of Baldwin III. He was twice married; by his first wife, Agnes of Edessa, he had issue a son and a daughter, Baldwin IV. and Sibylla; while his second wife, Maria Commena, bore him a daughter Isabella, who ultimately carried the crown of Jerusalem to her fourth husband Amalric of Lusignan (Amalric II.). The reign of Amalric I. was occupied by the Egyptian problem. It became a question between Amalric and Nureddin which of the two should control the discordant viziers who vied with one another for the control of the decadent caliphs of Egypt. For some five years a contest was waged between Amalric and Shirguh (Shirkuh), the lieutenant of Nureddin, for the possession of Egypt. Thrice (1164, 1167, 1168) Amalric penetrated into Egypt; but the contest ended in the establishment of Saladin, the nephew of Shirguh, as vizier—a position which, on the death of the puppet caliph in 1171, was turned into that of sovereign. The extinction of the Latin kingdom then seemed imminent, and envoys were sent to the West with anxious appeals for assistance in 1169, 1171 and 1173. But though in 1170 Saladin attacked the kingdom and captured Aila on the Red Sea, the danger was not so great as it seemed. Nureddin was jealous of his over-mighty subject, and his jealousy bound Saladin's hands. This was the position of affairs when Amalric died, in 1174; but, as Nureddin died in the same year, the position was soon altered and Saladin began the final attack on the kingdom. Amalric I., the second of the native kings of Jerusalem, had the qualities of his brother Baldwin III. (*q.v.*). He was something of a scholar, and it was he who set William of Tyre to work. He was perhaps still more of a lawyer; his delight was in knotty points of the law, and he knew the *Assises* better than any of his subjects.

William of Tyre is our original authority: *see* xix. 2–3 for his sketch of Amalric. Rohricht narrates the reign of Amalric I., *Geschichte des Konigreichs Jerusalem*, c. xvii.–xviii.

AMALRIC II., king from 1197 to 1205, was the brother of Guy of Lusignan. He married Isabella, the daughter of Amalric I., by his second marriage, and became king of Jerusalem in right of his wife in 1197. In 1198 he was able to procure a five years' truce with the Mohammedans, owing to the struggle between Saladin's brothers and his sons for the inheritance of his territories. The truce was disturbed by raids on both sides, but in 1204 it was renewed for six years. Amalric died in 1205. The kingdom of Cyprus, which he had inherited from his brother, passed to Hugh, his son by an earlier marriage; while that of Jerusalem fell to Maria, the daughter of Isabella by her previous marriage with Conrad of Montferrat.

AMALRIC OF BENA (Fr. AMAURY) (d. *c.* 1204–1207), French theologian, who taught philosophy and theology at the University of Paris, and enjoyed a great reputation as a subtle dialectician. His lectures developing the philosophy of Aristotle attracted a large circle of hearers. In 1204 his doctrines were condemned by the university, and, on personal appeal to Pope Innocent III., the sentence was ratified, Amalric being ordered to return to Paris and recant his errors. His death was caused, it is said, by grief at the humiliation to which he had been subjected. In 1209 ten of his followers were burned before the gates of Paris, and Amalric's own body was exhumed and burned. The doctrines of his followers, known as the Amalricians, were formally condemned by the fourth Lateran Council in 1215.

Amalric appears to have derived his philosophical system from Erigena (*q.v.*), whose principles he developed in a one-sided and strongly pantheistic form. Three propositions only can with certainty be attributed to him: (1) that God is all; (2) that every Christian is bound to believe that he is a member of the body of Christ, and that this belief is necessary for salvation; (3) that he who remains in the love of God can commit no sin. These three propositions were further developed by his followers, who maintained that God revealed Himself in a threefold revelation—the first in Abraham, marking the epoch of the Father; the second in Christ, who began the epoch of the Son; and the third in Amalric and his disciples, who inaugurated the era of the Holy Ghost.

Under the pretext that a true believer could commit no sin, the Amalricians indulged in every excess, and the sect does not appear to have long survived the death of its founder.

See W. Preger, *Geschichte der deutschen Mystik im Mittelalter* (Leipzig, 1874, i. 167–173); Hauréau, *Hist. de la phil. scol.* (Paris, 1872); C. Schmidt, *Hist. de l'Église d'Occident pendant le moyen âge* (Paris, 1885); Hefele, *Conciliengesch.* (2nd ed., Freiburg, 1886).

AMALTEO, the name of an Italian family belonging to Oderzo, Treviso, several members of which were distinguished in literature. The best known are three brothers, Geronimo (1507–74), Giambattista (1525–73) and Cornelio (1530–1603), whose Latin poems were published in one collection under the title *Trium Fratrum Amaltheorum Carmina* (Venice, 1627; Amst., 1689). The eldest brother, Geronimo, was a celebrated physician; the second, Giambattista, accompanied a Venetian embassy to England in 1554, and was secretary to Pius IV. at the council of Trent; the third, Cornelio, was a physician and secretary to the republic of Ragusa.

AMALTEO, POMPONIO (1505–1584), Italian painter of the Venetian school, was born at San Vito in Friuli. He was a pupil and son-in-law of Pordenone, whose style he closely imitated. His works consist chiefly of frescoes and altar-pieces and many of them (*e.g.*, in the church of Santa Maria de' Battisti, at San Vito) have suffered greatly from the ravages of time.

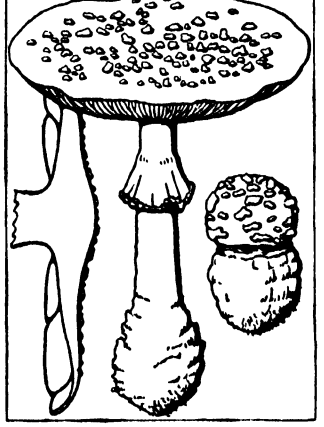
AMALTHEIA, in the earlier Greek mythology, the foster-mother of Zeus. She is sometimes represented as the goat which suckled the infant god in a cave in Crete, sometimes as a nymph of uncertain parentage, who brought him up on the milk of a goat. This goat having broken off one of its horns, Amaltheia filled the horn with flowers and fruits and presented it to Zeus, who placed it, together with the goat, amongst the stars. According to another story, Zeus himself broke off the horn and gave it to Amaltheia, promising that it would supply in abundance whatever she desired. Amaltheia gave it to Achelous (her reputed brother), who exchanged it for his own horn which had been broken off in his contest with Heracles for the possession of Deianeira. Speaking generally, it was regarded as the symbol of inexhaustible riches and plenty, and became the attribute of various divinities and of rivers as fertilizers of the land. Cretan coins represent the infant Zeus being suckled by the goat; other Greek coins exhibit him suspended from its teats or carried in the arms of a nymph. (Ovid, *Fasti,* v. 115; *Metam.,* ix. 87.)

AMA MPONDO: *see* MPONDO.

AMA MPONDOMISE: *see* MPONDOMISE.

AMA NDEBELE: *see* NDEBELE.

AMANITA. The amanitas include some of the most showy representatives of the Agaricineae or mushroom order of fungi (*q.v.*). In the first stages of growth, they are completely enveloped by an outer covering called the veil. As the plant develops the veil is ruptured; the lower portion forms a sheath or volva round the base of the stem, while the upper portion persists as white patches or scales or warts on the surface of the cap. The stem usually bears an upper ring of tissue, the remains of an inner veil, that stretched from the stem to the edge of the cap and broke away from the cap as the latter expanded. The presence of the volva, and the clear white gills and spores, distinguish this genus from all other agarics. They are beautiful objects in the autumn woods; *Amanita muscaria,* the fly fungus, formerly known as *Agaricus muscarius,* being especially remarkable for its bright red cap covered with white warts. Others are pure white or of varying shades of yellow or green. Several of the species are exceedingly poisonous.



FROM COOK, "ILLUSTRATION OF BRITISH FUNGI"

THE AMANITA, A GENUS OF FUNGI FAIRLY ABUNDANT IN THE WOODS OF THE NORTHERN HEMISPHERE
Right, young plant, Centre, mature plant, Left, part of longitudinal section through mature plant

AMANUENSIS, one who writes, from dictation or otherwise, on behalf of another (from Lat. *servus a manu,* slave of the hand). An amanuensis differs from a secretary in that, as a rule, he is a copyist only.

AMANULLAH KHAN (1892–), Amir of Afghanistan, was born June 1, 1892, being the third son of Habibullah Khán by his principal wife, Ulya Hazrat. On Feb 20, 1919, Habibullah Khán was assassinated, whereupon his brother, Nasrullah Khán, seized the reins of government. Six days later, however, Amanullah Khán declared himself Amir. In Aug. 1919, following fighting between British troops and Afghans, the new Amir successfully negotiated a treaty of peace by the terms of which Afghanistan was left officially free and independent. From this time onward the Amir consistently adopted a policy of westernization. He even went so far as to advocate the emancipation of women by female education, which roused the opposition of the Mullas and was one of the causes of the rebellion which broke out in Khost in 1924. (*See* AFGHANISTAN.) In the winter and spring of 1927–28 the Amir and his consort visited the principal European States On his return, he introduced unpopular reforms, causing a revolt late in 1928. Amanullah abdicated on Jan. 14, 1929, but later made a determined effort to recover the throne.

AMAPALA, the Pacific port of Honduras, Central America. Population, about 3,000. Amapala is located on Tigre island, in the Gulf of Fonseca, and passengers and freight to and from the interior are carried on barges or launches to San Lorenzo, on the mainland, the terminus of the highway to Tegucigalpa and the interior.

AMARANTH or **AMARANT,** a name chiefly used in poetry, and applied to certain plants which, from not soon fading, typified immortality (from the Gr. ἀμάραντος, unwithering).

The plant genus *Amarantus* (of the family Amarantacea) contains several well-known garden plants, such as love-lies-bleeding (*A. caudatus*), a native of India, a vigorous hardy annual, with dark purplish flowers crowded in handsome drooping spikes. Another species, *A. hypochondriacus,* is prince's feather, another Indian annual, with deeply-veined lance-shaped leaves, purple on the under face, and deep crimson flowers densely packed on erect spikes. "Globe amaranth" belongs to an allied genus, *Gomphrena,* and is also a native of India. It is an annual about 18in. high, with solitary round heads of flowers; the heads are violet from the colour of the bracts which surround the small flowers.

In North America upwards of 30 species of amaranth occur, chiefly in the southern and southwestern United States, several of which are introduced weeds, mostly from tropical America. Among the most widely distributed are the green amaranth or rough pigweed (*A. retroflexus*), the red amaranth or pilewort (*A. hybridus*), the spiny amaranth (*A. spinosus*), the prostrate amaranth (*A. blitoides*) and the tumble-weed (*A. graecizans*), found almost throughout the continent except the far north.

In ancient Greece the amaranth (also called χρυσάνθεμον and ἐλίχρυσον) was sacred to Ephesian Artemis. It was supposed to have special healing properties, and as a symbol of immortality was used to decorate images of the gods and tombs. In legend, Amarynthus (a form of Amarantus) was a hunter of Artemis and king of Euboea; in a village of Amarynthus, of which he was the eponymous hero, there was a famous temple of Artemis Amarynthia or Amarysia (Strabo x. 448; Pausan. i. 31, p.5).

See Lenz, *Botanik der alt. Griech. und Röm.* (1859); J. Murr, *Die Pflanzenwelt in der griech. Mythol.* (1890).

AMARAPURA, a suburb of Mandalay, Burma; pop. (1921) 8,497. The town was founded in 1783 to form a new capital about 6m. to the north-east of Ava. In 1810 it was estimated to contain 170,000 inhabitants; but a fire in that year and the removal of the native court to Ava in 1823 caused a decline. In 1827 its population was estimated at only 30,000. An earthquake in 1839 destroyed the greater part of the city. It was finally abandoned in 1860, when King Mindōn occupied Mandalay. Amarapura was laid out on much the same plan as Ava. The ruins of the city wall, now overgrown with jungle, show it to have been a square with a side of about three-quarters of a mile in length. At each corner stood a solid brick pagoda about 100ft. high A celebrated temple, adorned with 250 lofty pillars of gilt wood, contained a colossal bronze statue of Buddha. The remains of the former palace of the Burmese monarchs still survive in the centre of the town. Amara-

pura was defended by a rampart and a large square citadel, with a broad moat, the walls being 7,000ft. long and 20ft. high, with a bastion at each corner. The Burmans know it now as Myohaung, "the old city." It has a station on the Rangoon-Mandalay railway, and is the junction for the line to Maymyo and Lashio and for the Sagaing-Myitkyina railway. Amarapura is known to the Burmans as Taung-myo, "the southern city," as distinguished from Mandalay, the Myauk-myo, or "northern city."

AMARAR (UM 'AR'AR OR BENI 'AMIR), a tribe of African "Arabs" inhabiting the mountainous country on the west side of the Red Sea from Suakin northwards towards Kosseir. The tribe is divided into four great families: (1) Weled Gwilei, (2) Weled Aliab, (3) Weled Kurbab Wagadab and (4) the Amarar proper of the Ariab district. They claim to be of Koreish blood.

See *Anglo-Egyptian Sudan,* edited by Count Gleichen (London, 1905); Sir F. R. Wingate, *Mahdism and the Egyptian Sudan* (London, 1891); A. H. Keane, *Ethnology of Egyptian Sudan* (London, 1884); H. A. MacMichael, *History of the Arabs of the Sudan* (1922).

AMARA SINHA (*c.* A.D 375), Sanskrit grammarian and poet. He is said to have been "one of the nine gems that adorned the throne of Vikramaditya," and according to the evidence of Hsüan Tsang, this is the Chandragupta Vikramaditya that flourished about A.D. 375. The only work of his which survives is the *Amara-Kosha* (Treasury of Amara), a vocabulary of Sanskrit roots, in three books, and hence sometimes called *Trikanda* or the "Tripartite." It contains 10,000 words, and is arranged, like other works of its class, in metre, to aid the memory.

The first chapter of the *Kosha* was printed at Rome in Tamil character in 1798. An edition of the entire work, with English notes and an index by H. T. Colebrooke, appeared at Serampore in 1808. The Sanskrit text was printed at Calcutta in 1831. A French translation by A. L. A. Loiseleur-Deslongchamps was published at Paris in 1839.

AMARAVATI, a ruined city of India in the Guntur district of the Madras presidency, on the south bank of the Kistna river, 62m. from its mouth, a centre of the ancient Buddhist kingdom of Vengi, with a famous *stupa* (sepulchral monument). Its elaborate carvings illustrate the life of Buddha. Some are preserved in the British Museum; others in the museum at Madras. Amaravati has been identified with Hsüan Tsang's To-na-kie-tse-kia and with the Rahmi of Arab geographers. Subsequent to the disappearance of Buddhism from this region the town became a centre of Sivaism

AMARI, MICHELE (1806–1889), Italian orientalist and patriot, born at Palermo. He joined the Carbonari, and had to leave Italy because he had written a work on the Sicilian Vespers, entitled *Un periodo delle storie Siciliane del XIII. Secolo* (1839), containing many political allusions reflecting on the Bourbon Government of Naples. As a refugee in Paris he divided his time between political work and mental studies. The revolution of 1848 found him in Sicily once more, but on the restoration of the Bourbons he was once more an exile. He returned to Italy in 1859, and taught Arabic at Pisa and afterwards at Florence. A strong supporter of Cavour, he was minister of education in the Farini and Minghetti cabinets. On the fall of the latter in 1864, he resumed his chair at Florence, where he lived until his death in 1889.

His interest in Arabic studies had been first awakened by French translations of Arabic works on his native island, and his principal work is connected with the history of Sicily. This book, *La Storia dei Musulmani in Sicilia,* was begun in 1844, and the fourth and last volume was printed in 1873. He is still the standard authority on the Muslim rule in Sicily.

Even more important are his collections of Arabic sources for the history of Sicily: *Biblioteca Arabo-Sicula; con appendice* (Leipzig, 1857–75), Italian trans. (Rome, 1880); *I diplomi arabi del archivio florentino* (Florence, 1863).

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AMARILLO, a city of Texas, U.S.A., about 250m. W. of Oklahoma City, at an altitude of 3,660ft.; the county seat of Potter county. It is on Federal highways 66, 164, 366, 370 and 385; and is served by the Rock Island, the Colorado and Southern, and the Panhandle and Santa Fe railways. The population, which in 1890 was only 482, was 15,494 in 1920; and was estimated locally at 27,000 in 1925. Its rapid growth is due to the development of the entire Texas "Panhandle," of which it is the commercial centre. The wholesale and jobbing business amounts to $100,000,000 a year; the bank deposits aggregated $25,000,000 in 1927; and the assessed valuation of property was $39,000,000. There are large business buildings and the hotels have 3,000 guest rooms. The building permits issued in 1926 represented values of $16,400,000. A water-supply system sufficient for a city of 100,000 has been undertaken. There are grain elevators, packing houses, creameries, a zinc smelter, an oil refinery and large railway shops. Amarillo was incorporated in 1887 and adopted a commission-manager form of government in 1913.

AMARNA TABLETS, a collection of clay tablets with cuneiform inscriptions, a poem, letters and other documents, discovered at El Amarna. These inscriptions have materially advanced our knowledge of the languages and legends of Babylonia and Assyria. (See *Cambridge Ancient History,* vol. i. 2nd ed. 1924.)

AMARYLLIDACEAE, the amaryllis family, a numerous group of monocotyledonous plants, closely allied to the lily family (Liliaceae). Familiar representatives are the daffodil, jonquil, snowdrop, snowflake and tuberose (*qq.v.*). The family comprises about 90 genera and 1,050 species, found chiefly in tropical and subtropical regions. Many are bulbous plants of arid lands, leafing only in spring or after rains. A large number bear handsome lily-like flowers, often popularly called lilies, as Amazon lily (*Eucharis grandiflora*), spider lily (*Hymenocallis* sp., *Pancratium,* sp.) and zephyr lily (*Zephyranthes* sp.). Among the larger genera are *Agave, Crinum, Hippeastrum, Hypoxis* and *Narcissus.* Various species of *Agave* yield valuable fibres, as henequen, pita and sisal hemp; the bulbs of some species are used in medicine, while those of the South African belladonna lily (*Amaryllis Belladonna*) and the buphane (*Buphane disticha*) are highly toxic, the latter furnishing a Kafir arrow-poison. Representatives of more than 40 genera are grown as ornamental plants in greenhouses and gardens. Native plants of the family in the British Isles are the yellow daffodil (*Narcissus Pseudo-Narcissus*), the snowdrop (*Galanthus nivalis*) and the summer snowflake (*Leucojum aestivale*). In North America there are more than 40 native species; these are found chiefly in the southern and the south-western United States and belong mostly to the genera *Agave, Hymenocallis* and *Zephyranthes* Of those native to the eastern United States, the best known are the atamasco lily (*Zephyranthes Atamasco*), cultivated for its handsome flowers, and the yellow star-grass (*Hypoxis hirsuta*), the only representative extending northward into Canada. (*See* AGAVE; AMARYLLIS; HEMP; HIPPEASTRUM; LILIACEAE; NARCISSUS; SISAL HEMP.)

AMARYLLIS (the name of a girl in classical pastoral poetry), in botany, a genus of the family Amaryllidaceae, containing the belladonna lily (*Amaryllis Belladonna*), a native of South Africa, which was introduced into cultivation at the beginning of the 18th century. This is a half-hardy bulbous plant, producing in the spring a number of strap-shaped, dull green leaves, 1–1½ft. long, arranged in two rows, and in autumn a solid stem, bearing at the top a cluster of 6–12 funnel-shaped flowers, of a rose colour and very fragrant. Several forms are known in cultivation. Most of the so-called Amaryllis of gardens belong to the allied genus *Hippeastrum* (*q.v.*).

AMASIA, the chief town of the Amasia vilayet of Asia Minor and an important trade centre on the Samsun-Sivas road, beautifully situated on the Yeshil Irmak (*Iris*). Pop. (1927), 60,527, including many Kizilbash (Shia). It was one of the chief towns of the kingdom of Trebizond and of the Seljuks, one of whose sultans, Kaikobad I., enriched it with fine buildings and restored the castle, which was thus enabled to stand a seven months' siege by Timur. It was also much favoured by the early Osmanli sultans, one of whom, Selim I., was born there. Bayezid II. built a fine mosque. Amasia is an unusually well-built Turkish

town with a good bazaar and khans and a fine clock-tower. It has extensive fruit gardens. Wheat, flour and silk are exported.

Ancient Amasia has left little trace of itself except on the castle rock, on the left of the river, where the acropolis walls and a number of splendid rock-cut tombs, described by Strabo as those of the kings of Pontus, can be seen. Amasia rose to historical importance after the time of Alexander as the cradle of the power of Pontus; but the last king to reign there was the father of Mithradates Eupator "The Great." The latter, however, made it the base of his operations against the Romans in 89, 72 and 67 B.C. Pompey made it a free city in 65, after Mithradates' fall. It was the birthplace of Strabo.

AMASIS or **AMOSIS** (the Greek forms of the Egyptian name *Ahmase, Ahmosi,* "the moon is born," often written *Aahmes* or *Ahmes* in modern works), the name of two kings of ancient Egypt.

Amasis I., the founder of the 17th dynasty, is famous for his successful wars against the Hyksos princes who still ruled in the north-east of the Delta (*see* EGYPT: *History*).

Amasis II. was the last great ruler of Egypt before the Persian conquest, 570–526 B.C. Most of our information about him is derived from Herodotus (ii. 161 *et seq.*) and can only be imperfectly controlled by monumental evidence. According to the Greek historian he was of mean origin. A revolt of the native soldiers gave him his opportunity. These troops, returning home from a disastrous expedition to Cyrene, suspected that they had been betrayed in order that Apries, the reigning king, might rule more absolutely by means of his mercenaries, and their friends in Egypt fully sympathized with them. Amasis, sent to meet them and quell the revolt, was proclaimed king by the rebels, and Apries, who had now to rely entirely on his mercenaries, was defeated and taken prisoner in the ensuing conflict at Momemphis; the usurper treated the captive prince with great lenity, but was eventually persuaded to give him up to the people, by whom he was strangled and buried in his ancestral tomb at Sais. An inscription confirms the fact of the struggle between the native and the foreign soldiery, and proves that Apries was killed and honourably buried in the third year of Amasis. Although Amasis thus appears first as champion of the disparaged native, he had the good sense to cultivate the friendship of the Greek world, and brought Egypt into closer touch with it than ever before. Herodotus relates that under his prudent administration Egypt reached the highest pitch of prosperity; he adorned the temples of Lower Egypt especially with splendid monolithic shrines and other monuments (his activity here is proved by remains still existing). Amasis confirmed the Greeks in possession of the commercial colony of Naucratis on the Canopic branch of the Nile, apparently with a definite charter, and when the temple of Delphi was burned he contributed 1,000 talents to the rebuilding. He also married a Greek princess named Ladice, the daughter of Battus, king of Cyrene, and he made alliances with Polycrates of Samos and Croesus of Lydia. His kingdom consisted probably of Egypt only, as far as the First Cataract, but to this he added Cyprus, and his influence was great in Cyrene. At the beginning of his long reign, before the death of Apries, he appears to have sustained an attack by Nebuchadrezzar (568 B.C.). Cyrus left Egypt unmolested; but the last years of Amasis were disturbed by the threatened invasion of Cambyses and by the rupture of the alliance with Polycrates of Samos. The blow fell upon his son Psammetichus III., whom the Persian deprived of his kingdom after a reign of only six months.

See NAUCRATIS; also W. M. Flinders Petrie, *History,* vol. iii.; Breasted, *History* and *Historical Documents,* vol. iv. p. 509; Maspero, *Les Empires.*

AMA SWAZI: *see* SWAZI.

AMA TEMBU: *see* TEMBU.

AMATEUR, a person who takes part in any art, craft, game or sport for the sake of the pleasure afforded by the occupation itself and not for pecuniary gain (Lat. *amator,* lover). Being thus a person for whom the pursuit in question is a recreation and not a business, and who therefore presumably devotes to it a portion only of his leisure and not his working hours, the average amateur usually possesses less skill than the average professional, whose livelihood and reputation depend on his proficiency, and who therefore concentrates all his energies on the task of attaining the greatest possible mastery in his chosen career. In the arts, such as music, painting and the drama, the best amateurs are outdistanced as executants not merely by the best professionals but by professionals far below the highest rank; and although the inferiority of the amateur is not perhaps so pronounced or so universal in the case of games and outdoor sports, the records of such pastimes as boxing, billiards, motor-cycle racing and golf prove that here also the same contrast is to be found. Hence it has come about that the term "amateur" has acquired a secondary meaning, usually employed somewhat contemptuously, signifying inefficiency, unskilfulness, superficial knowledge or training.

The immense increase in popularity of athletic contests and games of all kinds in modern times, and especially the keen competition for "records" and championships, often of an international character, have made it a matter of importance to arrive at a clear and formal definition of the amateur as distinguished from the professional. The simple, straightforward definition of the amateur given above has been evaded. Cases are not unknown in the history of county cricket where players preserve their amateur status who, although they are not directly paid wages for cricket, are provided with the money enabling them to take a regular part in the sport by means of a salaried secretaryship or other office, very liberal grants for expenses, etc. Similarly "gentlemen riders" sometimes receive indirect remuneration. The various associations controlling the different branches of sport have therefore devised working regulations to be observed so far as their jurisdiction extends. Thus the Amateur Athletic Association of Great Britain defines an amateur as "one who has never competed for a money prize or staked bet, or with or against a professional for any prize, or who has never taught, pursued or assisted in the practice of athletic exercises as a means of obtaining a livelihood." The rules of the Amateur Rowing Association are stricter, denying amateur status to anyone who has ever steered or rowed in a race with a professional for any prize, or who is or has been by trade or employment for wages a mechanic, artisan or labourer, or engaged in any menial duty, besides insisting upon the usual restrictions in regard to taking money and competing with professionals. In association football the rules are much more lax, for although amateurs are clearly distinguished from professionals, an amateur may even become a regular member, though unsalaried, of a professional team without losing his amateur status. The Rugby game was, up to 1895, entirely controlled by the Rugby Football Union, which, by the strictness of its laws, effectually prevented the growth of professionalism, but there had been much dissatisfaction in the provinces with the Union's decision against reimbursing day-working players for "broken time," *i.e.*, for that part of their wages which they lost by playing on working days, and this resulted in the formation (1895) of the Northern Union, which permitted remuneration for "broken time" but allowed no person who worked for his living to play football unless regularly employed at his trade. Later the Northern Union became purely professional in character and developed into the Rugby league. In 1927 the International Olympic Committee was persuaded to announce that payment for "broken time" might in the case of Association football be made to the employer(s) of the player(s) affected. This announcement was completely contrary to the whole spirit of these modern games, as revived by Baron Pierre de Coubertin, and as defined in 1908 in legislation accepted by all the nations then competing. The British Football Association therefore withdrew from the Olympic Games (1928); and other developments of the same kind will probably occur. In the United States the amateur question has been less vexed than in Great Britain and is less complicated in theory, although the intensely businesslike character of the American conception of sport has encouraged professionalism. The Amateur Athletic Union of the United States recognizes all amateur sports and claims jurisdiction over certain important branches, excepting, however, baseball, football, golf, rowing and tennis (*see* ATHLETIC SPORTS IN THE UNITED STATES).

The A.A.U. rules on the amateur status define an amateur sportsman as "one who engages in sport solely for the pleasure and physical, mental or social benefits he derives therefrom, and to whom sport is nothing more than an avocation."

The rules, so far as they relate to professionalism, are: No person shall be eligible to compete in any athletic meeting, game or entertainment, given or sanctioned by this Union, who has (1) received or competed for compensation or reward in any form for the display, exercise or example of his skill or knowledge of any athletic exercise, or for rendering personal service of any kind to any athletic organization, or for becoming or continuing a member of any athletic organization; or (2) has entered any competition under a name other than his own, or from a club of which he was not at that time a member in good standing; or (3) has knowingly entered any competition open to any professional or professionals, or has knowingly competed with any professional for any prize or token; or (4) has issued or allowed to be issued in his behalf any challenge to compete against any professional or for money; or (5) has pawned, bartered or sold any prize won in athletic competition. It will be seen that by rule 3 the American Union enacts a standard for all athletes not much different from that of the British Amateur Rowing Association. The rules for the sports not within the Union's jurisdiction are practically the same, except that in baseball, cricket and golf, amateurs may compete with professionals, though not for cash prizes. The number of professional football players has grown in recent years and many of the more widely known recruits have come from college football. Not a few of the greatest of the professional baseball players have played the game at college. The question whether a college undergraduate may legally play baseball for pay during the summer months has not yet been definitely answered. The Rugby Football Union recognizes no such person as a professional player.

It is probably impossible to produce any definition of an amateur which will cover all sports in any single nation. It is hopeless to try to define an amateur for all sports all over the world. The only reasonable method of getting amateurs together in any great international meeting is to lay the responsibility for their selection and appearance upon the governing body of the sport in which they compete in the nation which they represent. These governing bodies at least will have fairly similar rules in all countries, because, in nearly every case, they are affiliated to international associations of the particular sport concerned; and therefore practical justice will be as nearly as possible satisfied. (*See* also ATHLETIC SPORTS IN UNITED STATES, and Savage, *Games and Sports in British Schools and Universities*, ch. vii., 1927.)

AMA THONGA: *see* THONGA.

AMATHUS, ancient city, Cyprus, on the south coast, about 24m. W. of Larnaka and 6m. E. of Limassol, among sandy hills and sand-dunes, which perhaps explains its name (Greek ἄμαθος, sand). The earliest remains hitherto found on the site are of the early iron age (1000–600 B.C.). Amathus maintained strong Phoenician sympathies, and refused to join the revolt of Cyprus against Persia (500–494 B.C.) (Herod. v. 105). Evagoras of Salamis was similarly opposed by Amathus about 385–380 B.C. in conjunction with Citium and Soli (Diod. Sic. xiv. 98); and even after Alexander the city resisted annexation (Diod. Sic. xix. 62). Its temple of Adonis and Aphrodite (*Venus Amathusia*) remained famous in Roman time but is quite destroyed. Amathus derived its wealth from corn and from copper mines, of which traces can be seen inland; Ovid also mentions its sheep (*Met.* x. 227). But the epithet *Amathusia* in Roman poetry often means little more than "Cypriote." Amathus still flourished and produced a patriarch of Alexandria (Johannes Eleëmon), as late as 606–616, but it was almost deserted when Richard Coeur de Lion won Cyprus by a victory there over Isaac Comnenus in 1191. The rich necropolis has yielded valuable works of art; but the city has vanished, except fragments of a Byzantine church, and a great stone bowl on the acropolis. A similar vessel was transported to the Louvre in 1867. (*See* also CYPRUS.)

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AMATI, the name of a family of Italian violin makers, who flourished at Cremona from about 1550 to 1692. According to Fétis, Andrea and Nicolo Amati, two brothers, were the first Italians who made violins. They were succeeded by Antonio and Geronimo, sons of Nicolo. Another Nicolo, son of Geronimo, was born on Sept. 3, 1596, and died on Aug. 12, 1684. He was the most eminent of the family. He improved the model adopted by the rest of the Amati and produced instruments capable of yielding greater power of tone. His pattern was usually small, but he also made the so-called "Grand Amatis." Of his pupils the most famous were Andrea Enamieri and Antonio Stradivari.

AMATITLÁN or **SAN JUAN DE AMATITLÁN,** the capital of a department bearing the same name in Guatemala, on Lake Amatitlán, 15m. S.W. of Guatemala city by the transcontinental railway from Puerto Barrios to San José. The population in 1921 was 37,705. The town consists almost entirely of one-storeyed adobe huts inhabited by mulattos and Indians, whose chief industry is the production of cochineal. In 1840 only a small Indian village marked its site, and its subsequent growth was due to the sugar plantations established by a Jesuit settlement. The wells of the town are strongly impregnated with salt and alum, and in the vicinity there are several hot springs. Lake Amatitlán, 9m. long and 3m. broad, lies on the northern side of the great Guatemalan Cordillera. Above it rises the four-cratered volcano of Pacaya (8,390 ft.), which was in eruption in 1870. The outlet of the lake is a swift river 65m. long, which cuts a way through the Cordillera, and enters the Pacific at Istapa, after forming at San Pedro a fine waterfall more than 200ft. high.

AMAUROSIS, a term for "deprivation of sight," limited chiefly to those forms of defect or loss of vision which are caused by diseases not directly involving the eye.

AMAURY: *see* AMALRIC OF BENA.

AMA XOSA: *see* XOSA.

AMAZON, the great river of South America and the largest in the world in volume although exceeded in length by the Mississippi–Missouri. In the year 1500, Vicente Yañez Pinzon, in command of a Spanish expedition, discovered and ascended the Amazon to a point about 50 m. from the sea. He called it the *Rio Santa Maria de la Mar Dulce,* which soon became abbreviated to *Mar Dulce.* For some years after 1502 it was known as the *Rio Grande.* The companions of Pinzon, in giving evidence in 1515, mention it as *El Ryo Marañón.*

The first descent of the river from the Andes to the sea was made in 1541 by Orellana who reached the main stream by way of the Napo River. It is rather generally accepted that the name *Amazonas* was given to the river by Orellana after a battle with the Tapuyas savages in which he believed that the women of the tribe fought with the men. The first ascent of the river was made in 1638 by Pedro Texiera, a Portuguese, who reversed the route of Orellana and reached Quito by way of the Mapo.

The Amazon River has a drainage area of 2,722,000 sq.m. if the Tocantins is included. It drains four-tenths of South America and gathers its waters from 5° N. to 20° S. latitude. The main stream rises in a chain of glacier-fed lakes on the eastern border of the main range of the Andes in Central Peru, about 1,000 m. N.N.E. of Lima, and flows for 4,000 m. across Peru and Brazil to enter the Atlantic on the equator. While Amazon, or *Amazonas,* is popularly applied to the whole of the main stream it is properly applied only to sections of it in Peruvian and Brazilian nomenclature. In Peru the upper stream from its source to Iquitos is called Marañón and, from there to the sea, Amazonas. In Brazil the name Solimões is used from Iquitos to the mouth of the Negro River and Amazonas only from the Negro River to the sea. Beginning with the lower river the great tributaries to the main stream will be discussed in order, beginning with the southern or larger affluents.

TRIBUTARIES

The TOCANTINS is not really a branch of the Amazon. It is the central fluvial artery of Brazil, running from south to north for

a distance of about 1,500 miles. It rises in the mountainous district of Pyrenopolis, but its more ambitious western affluent, the Araguay, has its extreme southern headwaters on the slopes of the Sierra Cayapó, and flows 1,080m. before its junction with the parent stream, which it appears almost to equal in volume. Besides its main tributary, the Rio das Mortes, it has 20 smaller branches, offering many miles of canoe navigation. The Pará river, generally called one of the mouths of the Amazon, is only the lower reach of the Tocantins.

The XINGÚ, the next large river west of the Tocantins, was first explored by Karl von den Steinen in 1884–87. The river is formed at about 12° S. lat., by the union of three large headwater streams, the Ronuro, the Tamitatoala, and the Kuluene, all of which, together with their more important tributaries, rise in an area only about 80m. long from west to east and some 200m. N.E. of Cuyabá. From a point about 75m. from the union of these streams the Xingú enters a 400-mile stretch of rapids that are serious obstacles even to canoe navigation.

The TAPAJOS, running through a humid, hot and unhealthy valley, pours into the Amazon 500m. above Pará and is about 1,200m. long. It rises on the lofty Brazilian plateau near Diamantino in 14° 25′ S. lat. Near this place a number of streams unite to form the river Arinos. The Arinos, the Alto Tapajos and the Tapajos to the last rapid, the Maranhão Grande, is a continuous series of formidable cataracts and rapids; but from the Maranhão Grande to its mouth, about 188m., the river can be navigated by large vessels.

The MADEIRA has its junction with the Amazon 870m. by river above Pará, and almost rivals it in the volume of its waters. It rises more than 50ft. during the rainy season, and the largest ocean steamers may ascend it to the Fall of San Antonio, 663m. above its mouth; but in the dry months, from June to November, it is only navigable for the same distance for craft drawing from 5 to 6ft. of water. According to the Treaty of San Ildefonso, the Madeira begins at the confluence of the Guaporé with the Mamoré. The Guaporé has its headwaters almost in contact with those of the Paraguay River, but the idea of a connecting canal is based on ignorance of local conditions. San Antonio is the first of a formidable series of cataracts and rapids, 19 in number, which, for a river distance of 263m., obstruct the upper course of the Madeira until the last rapid, called Guajará Mirim (small pebble), is reached, about 120m. below the union of the Guaporé with the Mamoré. The Beni River joins the Madeira at the Madeira Rapids, a stretch of nearly 5 miles of reefs, whirlpools and rapids, about 40m. below the Guajará Mirim Rapids. From the Guaporé, Mamoré and Beni rivers the Madeira receives the drainage from the whole of the eastern and north-eastern slopes of the Andes from the southernmost sources of the Rio Grande (a tributary of the Mamoré) at about 20° S. lat. to the northernmost sources of the Madre de Dios River (a tributary of the Beni) at about 12° S. lat., the whole of the south-western slope of the Brazilian Matto Grosso, and the northern slope of the Sierra de Chiquitos in the Gran Chaco. All of the upper branches of the Madeira flow across open, almost level plains, which, although some 35,000 sq.m. of them are yearly flooded to an average depth of 3ft. for a period of from three to four months, form an agricultural and grazing region that is probably the most healthful and most inviting of the whole Amazon Basin.

The PURÚS, a very sluggish river, enters the Amazon about 230m. west of the Madeira, which it parallels as far as the falls of the latter stream. It is practically only a drainage ditch for the half-submerged, lake-flooded district it traverses. Chandless found its elevation above sea-level to be only 107ft. 590 miles from its mouth. It is due to this extremely gentle gradient that the river, although a young stream, exhibits the meandering character of a mature stream. It is one of the most crooked rivers in the world, its length in a straight line being less than half that by its meanders. One of its marked characteristics is the five parallel *furos*, side channels to the main stream, by which its lower course is connected with the Amazon; the largest and most westerly one connecting with the Purús about 150m. above its mouth. Its width is very uniform for 1,000m. up, and for 800m. its depth is never less than 45 feet. It is navigable by steamers for 1,648m. as far as the little stream, the Curumahá, but only by light-draught craft. Chandless ascended it 1,866 miles. At 1,792m. it forks into two small streams.

The JURUÁ is the next great southern affluent of the Amazon west of the Purús and traverses the same sort of low, half-flooded country as the latter. It has the same character as the Purús as regards gentleness of gradient, meanders and sluggishness. It rises in the highlands east of the Ucayali which carry the Peru-Brazil boundary and is navigable for a distance of 1,133 m. above its junction with the Amazon.

The JAVARY, the boundary line between Brazil and Peru, is another Amazon tributary of importance. It is navigable by canoe for 900m. above its mouth to its sources among the Ucayali highlands, but only 260m. have been found suitable for steam navigation. The Brazilian Boundary Commission ascended it in 1866 to the junction of the Shino with its Jaquirana branch. The country it traverses in its extremely sinuous course is very level, similar in character to that of the Juruá.

The UCAYALI is second only in size to the Madeira among the tributaries of the Amazon. Its headwaters drain a great section of the Peruvian plateau from the source of the Vilcanota River only 70 m. N W. of Lake Titicaca to the sources of the Mantaro west of Cerro de Pasco. The lower 500 m. of the main channel is bordered by large islands formed by numerous side-channels; the whole being very low and flooded in the rainy season. The Ucayali is navigable for light draft launches as far as the Tambo-Urubamba junction but the main Lima–Iquitos route follows the Pichis–Pachitea tributary.

The HUALLAGA which joins the Marañón about midway between the Pongo de Manseriche and the mouth of the Ucayali has its true source in the Yanahuanca River, a stream flowing from a series of glacier-fed lakes which lie north-west of the famous mining centre of Cerro de Pasco on the eastern slope of the main range of the Andes between the sources of the Marañón and Mantaro rivers. The name Huallaga is applied, however, to a more easterly and much less important headwater tributary which rises a short distance east of Cerro de Pasco. The whole stream is deeply entrenched and from the town of Huánuco to the mouth of the river much of its course is impeded by rapids and gorges. Between the Huallaga and the Ucayali lie the famous Pampas de Sacramento, vast plains broken by low outliers of the Andes, forested in part, but said to consist largely of grass-covered areas suited to cattle raising.

The MARAÑÓN River rises in Lake Lauricocha, the northernmost of a chain of glacier-fed lakes about 100 m. N.N E. of Lima and flows northward in a deeply eroded valley. It is due to this and other deeply entrenched longitudinal valleys that the tributaries of the Amazon have cut in the Peruvian plateau that the erroneous conception of the Peruvian Andes as three separate mountain ranges has arisen. At about 5° 30′ S. lat. the river makes a great bend toward the north-east and, after passing through a succession of narrows or *pongos* and no less than 35 formidable rapids, it breaks through from the Peruvian plateau to the Amazon Plain by a great canyon known as the Pongo de Manseriche. This canyon is about 2,000ft. deep and narrows in places to a width of only 100ft Through this dark canyon the Marañón flows, at times, at a rate of over 12m an hour. Beyond the *pongo* the river receives several large tributaries from the north and spreads out into a broad stream with numerous channels and islands.

From the north the Amazon receives many tributaries, but their total volume of water is not nearly so great as that contributed to the parent stream by its affluents from the south. The part of Brazil lying between the Amazon and French, Dutch and British Guiana, and bounded on the west by the Rio Negro, is known as Brazilian Guiana. It is the southern slope, very convolved, of the northern section of the Brazilian Archaean block. Their northern slope, which is occupied by the three Guianas first named, is saturated and river-torn; but their southern one, Brazilian Guiana, is in general thirsty and semi-barren, and the driest region of the Amazon valley. It is an area which has been left almost in the

undisturbed possession of nomadic Indian tribes.

The TROMBETAS is the first river of importance we meet on the northern side as we ascend the Amazon. Its confluence with this is just above the town of Obidos. It has its sources in the Guiana highlands, but its long course is frequently interrupted by violent currents, rocky barriers and rapids. The river is navigable for 135m. above its mouth.

The NEGRO, the great northern tributary of the Amazon, has its sources along the watershed between the Orinoco and the Amazon basins, and also connects with the Orinoco by way of the Casiquiare Canal. The Negro is navigable in dry season for 450 m. above its mouth for vessels of 4 ft. draft, but it has many sandbanks and minor obstructions. In the wet season it overflows its banks, in places to a width of 20 miles. Its lower course is very wide and full of long islands and intricate channels. The main headwater affluent of the Negro is the Uaupes. Its principal affluent from the north is the Branco formed by the union of the Uraricuera and Takatú which, with their tributaries drain a large section of the southerly slopes of the Guiana Highlands which separate Brazil from Venezuela and British Guiana. The Branco flows nearly straight south for 350 miles to the Negro which it enters by numerous channels similar to those of the lower course of the latter.

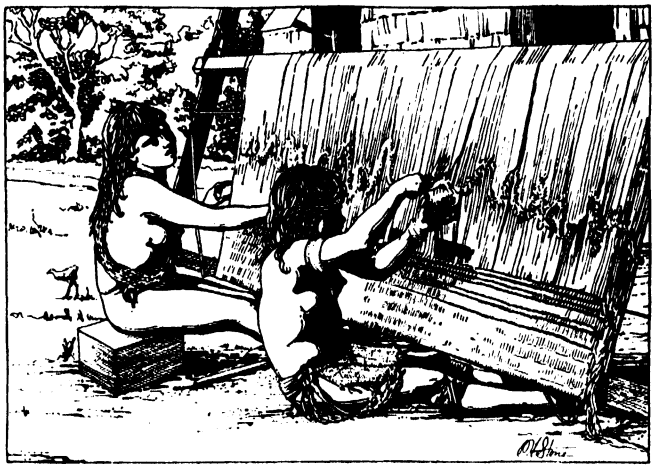
The Casiquiare Canal which connects the upper Orinoco, about 18 m. below the old mission site of Esmeraldas, with the Rio Negro affluent of the Amazon near the village of San Carlos, is a natural waterway, the only one of its kind known in the world. The existence of the canal was first reported by Father Acuña in 1639 but was not confirmed until 1744, when the Jesuit Father Roman, ascending the Orinoco, met Portuguese slave-traders from settlements on the Rio Negro, accompanied them on their return by way of the Casiquiare Canal and returned to the Orinoco by the same route. According to data obtained by the Rice Expedition which made a survey of the canal in 1919, the length of the canal is 227 m. Its width at its beginning in the Orinoco is 758 ft.; but this rapidly narrows down to 150 ft. and widens again to 2,150 ft. at its mouth in the Negro. The level of the water at the Orinoco end was found to be 283 ft. and, at the Rio Negro end, 212 ft. giving the canal an average slope toward the Negro of 7·2 in. per mile. The banks of the canal are heavily forested. The chief inhabitants of the region are Indians of the Maquiratares tribe although there are some whites engaged in rubber gathering. There are several small settlements at the lower end of the canal of which Solano was founded while the Scientific Expedition of the Boundary Commission of 1756 was at work in the region.

The YAPURÁ. West of the Negro the Amazon receives three imposing streams from the north-west—the Yapurá, the Içа or Putumayo and the Napo. The first was formerly known as the Hyapora, but its Brazilian part is now called the Yapurá, and its Colombian portion the Caquetá. Barão de Marajo gives it 600m. of navigable stretches. Jules Crevaux, who descended it, describes it as full of obstacles to navigation, the current very strong and the stream frequently interrupted by rapids and cataracts. It rises in the Colombian Andes, nearly in touch with the sources of the Magdalena, and augments its volume from many branches as it courses through Colombia.

The IÇA or PUTUMAYO, west of and parallel to the Yapurá, was found much more easily navigated by Crevaux. He ascended it in a steamer drawing 6ft. of water, and running day and night. He reached Cuemby, 800m. above its mouth, without finding a single rapid. Cuemby is only 200m. from the Pacific ocean, in a straight line.

The NAPO rises among the volcanoes of the eastern border of the Andes in northern Ecuador. Its headwater tributaries in the Ecuadorian Oriente flow through one of the least known areas of the eastern border of the Andes. The course of only its southernmost headwater tributary, the Anzu, is definitely known. The Coca which is believed to have its source on the slopes of Cayambe Volcano close to the equator, and the Aguarico, an important river with headwaters between Cayambe and the Colombian frontier, join it from the north. The Curaray, a tributary of secondary importance, joins it from the south some 200 miles from its mouth. The Napo is navigable for river craft to this point and by canoes to the mouth of the Coca. The Curaray–Coca section of the river is little-known.

The NANAY is the next Amazon tributary of importance west of the Napo. It belongs entirely to the lowlands, and is very crooked, has a slow current and divides much into *caños* and



BY COURTESY OF THE AMAZON EXPEDITION OF THE MUSEUM OF U. OF PA.

WAPISIANA WOMEN OF THE AMAZON BASIN IN SOUTHERN BRITISH GUIANA ENGAGED IN HAMMOCK WEAVING

strings of lagoons which flood the flat, low areas of country on either side.

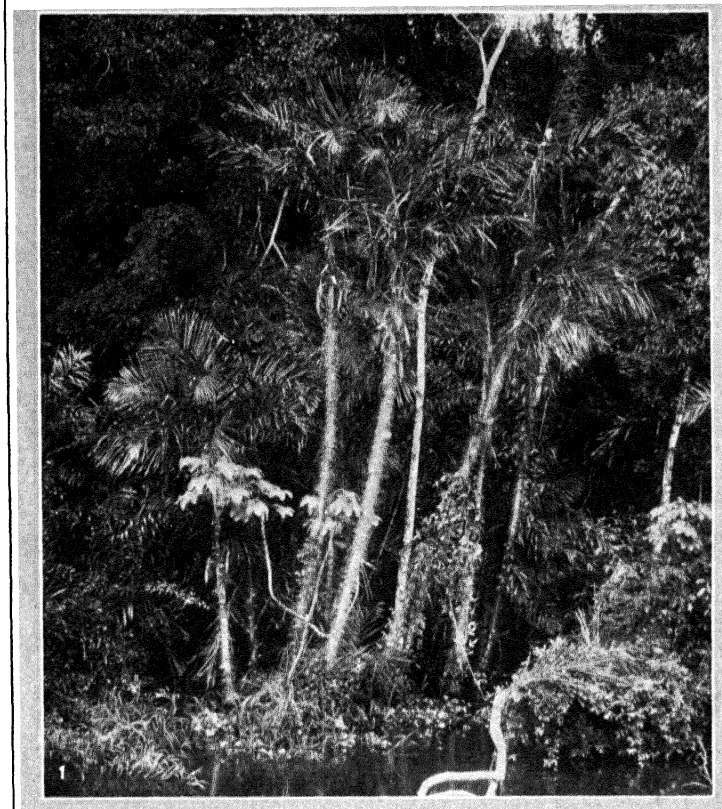
The TIGRE is the next west of the Nanay, and is navigable for 125m. from its confluence with the Amazon. Like the Nanay, it belongs wholly to the plains. Its mouth is 42m. west of the junction of the Ucayali with the Amazon.

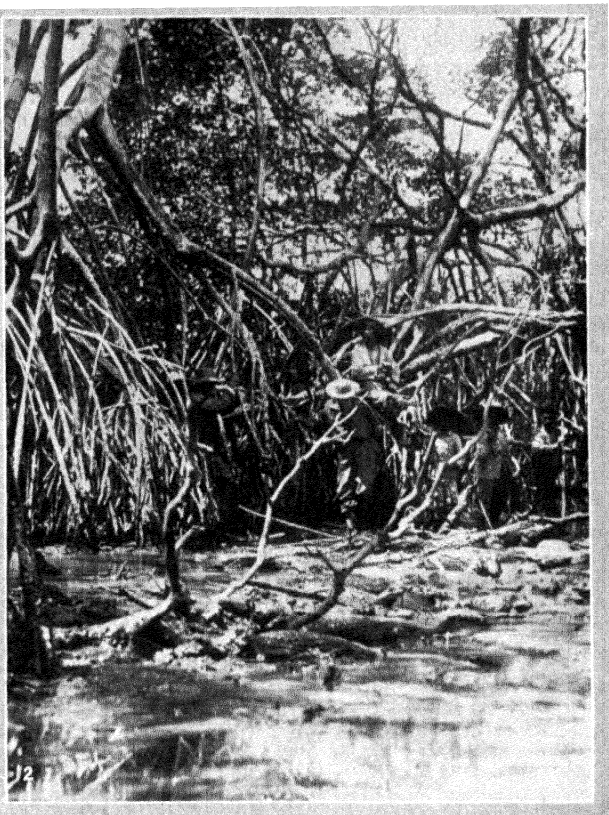
The PASTAZA (the ancient River Sumatara) is the next large river we meet. It rises on the Ecuadorian tableland, where a branch from the valley of Riobamba unites with one from the Latacunga basin.

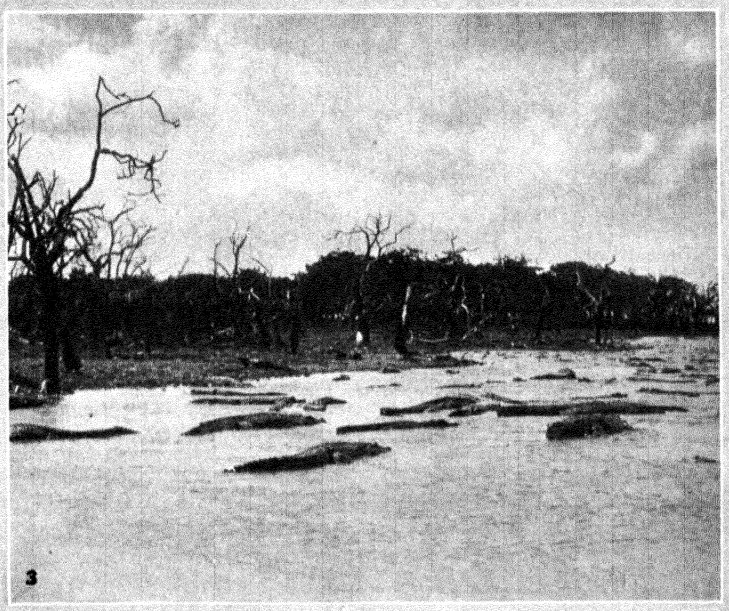
The MORONA flows parallel to the Pastaza and immediately to the west of it, and is the last stream of any importance on the northern side of the Amazon before reaching the Pongo de Manseriche. Above the Pongo de Manseriche two important tributaries, the Santiago and the Chinchipe join the Marañón from the north.

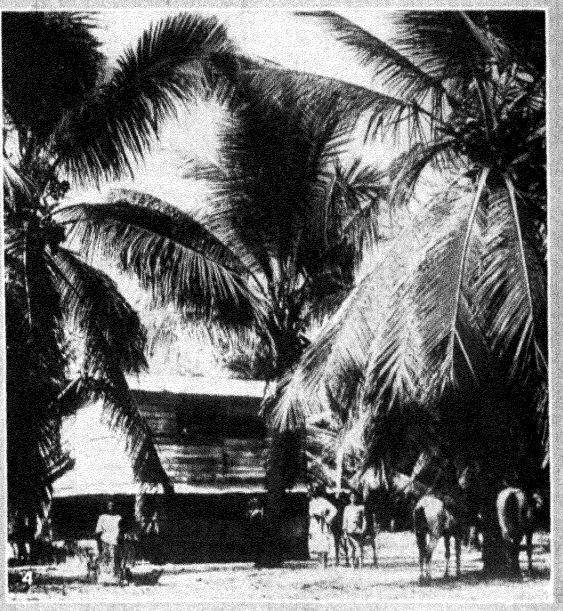
THE MAIN RIVER

Physical Characteristics.—The AMAZON MAIN RIVER is navigable for ocean steamers as far as Iquitos, 2,300m. from the sea, and 486m. higher up for vessels drawing 14ft. of water, as far as Achual Point. Beyond that, according to Tucker, confirmed by Wertheman, it is unsafe; but small steamers frequently ascend to the Pongo de Manseriche, just above Achual Point. The average current of the Amazon is about 3m. an hour; but, especially in flood, it dashes through some of its contracted channels at 5m. an hour. The U.S. steamer "Wilmington" ascended it to Iquitos in 1899. Commander Todd reports that the average depth of the river in the height of the rainy season is 120 feet. It commences to rise in November, and increases in volume until June, and then falls until the end of October. The rise of the Negro branch is not synchronous; for the steady rains do not commence in its valley until February or March. By June it is full, and then it begins to fall with the Amazon. The Amazon at times broadens to 4 and 6 miles. Occasionally, for long distahces, it divides into two main streams, with inland, lateral channels, all connected by a complicated system of natural canals, cutting the low, flat *igapo* (recent alluvial) lands, which are never more than 15ft. above low river, into almost numberless islands. At the narrows of Obidos, 400m. from the sea, it is compressed into a single bed a mile wide and over 200ft. deep, through which the water flows at the rate of 4 to 5m. an hour. In the rainy season it inundates the country throughout its course to the extent of several hundred thousand square miles, covering









BY COURTESY OF UFA

PLANT AND ANIMAL LIFE IN THE BASIN OF THE AMAZON RIVER

1. Typical jungle scenery on the upper Amazon, showing trunks of the palm trees in the foreground covered with a creeping parasitic plant that is very destructive to them
2. Native beaters in the upper region of the Amazon risking their lives in an attempt to round up crocodiles by driving them out of the swamp and up the river
3. Round-up of thousands of crocodiles as a result of efforts of the beaters for several days (*see* fig. 2). Over 2,000 reptiles were killed
4. Native hut which German explorers used as a station when stopping on expedition into the upper Amazon in 1924 and 1925

the flood-plain, called *vargem* (land between the levels of moderate and high floods). The flood-levels are in places from 40 to 50ft. high above low river. Taking four roughly equidistant places, the rise at Iquitos is 20ft., at Teffé 45, near Obidos 35, and at Pará 12.

The first high land met in ascending the river is on the north bank, opposite the mouth of the Xingú, and extends for about 150m. up, as far as Monte Alegre. It is a series of steep, table-topped hills, cut down to a kind of terrace which lies between them and the river. Monte Alegre reaches an altitude of several hundred feet. On the south side, above the Xingú, a line of low bluffs extends, in a series of gentle curves with hardly any breaks nearly to Santarem, but a considerable distance inland, bordering the flood-plain, which is many miles wide. Then they bend to the south-west, and, abutting upon the lower Tapajos, merge into the bluffs which form the terrace margin of that river valley. The next high land on the north side is Obidos, a bluff, 56ft. above the river, backed by low hills. From Serpa, nearly opposite the river Madeira, to near the mouth of the Rio Negro, the banks are low, until approaching Manáos, they are rolling hills; but from the Negro, for 600m., as far up as the village of Canaria, at the great bend of the Amazon, only very low land is found, resembling that at the mouth of the river.

On the south side, from the Tapajos to the river Madeira, the banks are usually low, although two or three hills break the general monotony. From the latter river, however, to the Ucayali, a distance of nearly 1,500m., the forested banks are just out of water, and are inundated long before the river attains its maximum flood-line. Thence to the Huallaga the elevation of the land is somewhat greater; but not until this river is passed, and the Pongo de Manseriche approached, does the swelling ground of the Andean foot-hills raise the country above flood-level.

The Amazon is not a continuous incline, but probably consists of long, level stretches connected by short inclined planes of extremely little fall, sufficient, however, owing to its great depth, to give the gigantic volume of water a continuous impulse towards the ocean. The lower Amazon presents every evidence of having once been an ocean gulf, the upper waters of which washed the cliffs near Obidos. Only about 10% of the water discharged by the mighty stream enters it below Obidos, very little of which is from the northern slope of the valley. The drainage area of the Amazon basin above Obidos is about 1,945,000sq.m., and, below, only about 423,000sq m., or say 20%, exclusive of the 354,000 sq.m. of the Tocantins basin.

The width of the mouth of the river is usually measured from Cabo do Norte to Punto Patijoca, a distance of 207 statute m.; but this includes the ocean outlet, 40m. wide, of the Pará river, which should be deducted, as this stream is only the lower reach of the Tocantins. It also includes the ocean frontage of Marajo, an island about the size of the kingdom of Denmark lying in the mouth of the Amazon. Following the coast, a little to the north of Cabo do Norte, and for 100m. along its Guiana margin up the Amazon, is a belt of half-submerged islands and shallow sand-banks. Here the tidal phenomenon called the *bore*, or Pororoca, occurs, where the soundings are not over 4 fathoms. It commences with a roar, constantly increasing, and advances at the rate of from 10 to 15m. an hour, with a breaking wall of water from 5 to 12ft. high. Under such conditions of warfare between the ocean and the river, it is not surprising that the ocean is rapidly eating away the coast and that the vast volume of silt carried by the Amazon finds it impossible to build up a delta.

The Amazon is not so much a river as it is a gigantic reservoir, extending from the sea to the base of the Andes, and, in the wet season, varying in width from 5 to 400 miles.

Population, Trade, etc.—On Sept. 6, 1850, the emperor, Dom Pedro II., sanctioned a law authorizing steam navigation on the Amazon, and confided to an illustrious Brazilian, Barão Mauá (Irineu Evangilista de Sousa), the task of carrying it into effect. He organized the "Compania de Navigação e Commercio do Amazonas" at Rio de Janeiro in 1852; and in the following year it commenced operations with three small steamers, the "Monarch," the "Marajo" and "Rio Negro." At first the navigation was principally confined to the main river; and even in 1857 a modification of the Government contract only obliged the company to a monthly service between Pará and Manãos, with steamers of 200 tons cargo capacity, a second line to make six round voyages a year between Manãos and Tabatinga, and a third, two trips a month between Pará and Cametá. The Government paid the company a subvention of £3,935 monthly. Thus the first impulse of modern progress was given to the dormant valley. The success of the venture called attention to the unoccupied field; a second company soon opened commerce on the Madeira, Purús and Negro; a third established a line between Pará and Manãos; and a fourth navigated some of the smaller streams; while the Amazonas Company had largely increased its fine fleet.

The economic vicissitudes through which the Amazon basin has passed in late years are traceable largely to changes in the rubber industry. Although crude rubber was sent from the Amazon as early as 1827, several decades passed before the annual exportation attained commercial importance. With the remarkable increase in the demand for rubber, prices rose, and gatherers in the forests were sent further afield.

About 1910–11 prices reached their highest point, yearly exportations amounted to thousands of tons and numerous river craft plied on the Amazon and its tributaries. The inhabitants of the valley were almost exclusively engaged in rubber exploitation. The growing of foods was largely abandoned, even necessary commodities being imported. About this period, however, plantation rubber trees of the East Indies were coming into bearing and the result was a collapse by 1915 of the one great industry of the region. During the five years ending in 1927 there was a gradual increase of rubber exportation from the Amazon region, the total shipments for 1927 being in excess of 28,700 long tons.

A land concession of 3,700,000ac. granted by Brazil in 1927 to the Ford Motor Company, Detroit, Mich., and the formation of a Brazilian subsidiary with Brazilian stockholders provide large capital for the development of plantation rubber. The land lies along the eastern side of the Tapajos river 125 to 150m. south of Santarem on the Amazon. The two rivers afford sufficient water depth for ocean-going vessels to traffic directly with the plantations, work upon which is progressing.

Trading Spheres.—Exporters and importers recognize three trading spheres: the regions, respectively, of Pará (or Belém), Manãos and Iquitos. Numerous European and American steamships call at Pará; some proceed to Manãos, while others go up the river to Iquitos. Motor-cars are numerous in Pará and Manãos, and are being introduced into regions such as Cobija in Bolivia and other primitive settlements. Electric-light plants are in operation in larger cities and in Obidos, Porto Velho, Riberalta, Cobija, Amenquer, etc. River steamers are also thus equipped. The Mamoré–Madeira railroad, 220m around Madeira Falls, opened in 1912, provides access to additional virgin territory. Land telegraph and radio services operate between the several cities of the region and many smaller places, thereby lessening their isolation.

Estimates place the population of the Amazon basin at about 1,500,000, all but 200,000 being credited to Brazil. The city of Pará had 363,466 in 1920; Manãos, 75,704; Iquitos, 8,000; Santarem, 5,000; Obidos, 26,812. It is estimated that in the Amazon basin about 30,000 labourers might be recruited for agricultural or other purposes. Quantities of rubber, Brazil-nuts, fish and other products were being exported in 1925. The region's imports were also on the increase.

Expeditions.—During the period 1910–27 there were numerous expeditions, exploratory and scientific, into regions watered by the Amazon and its tributaries. Roosevelt and Rondon in 1913–14 in a notable trip down the so-called River of Doubt in two months covered 470 miles of this river, hitherto unknown except to rubber-gatherers and found it to be a branch of the Madeira, joining it at 5° 21′ S. lat. The Fleming expedition (1919) studied the industrial possibilities of the region and Rice in a series of expeditions (1910 to 1924) made accurate surveys of the Negro, Uaupes and Branco. A Carnegie Museum expedition made a study of fishes; the Ellsworth, Farabee, Fawcett and other parties obtained geographic, geological and ethnographical

data. In 1923–24 the American Rubber Mission financed by the U.S. Government conducted a survey along a total of 37 waterways including the Tocantins, Xingú, Tapajós, Madeira, Mamoré, Beni, Madre de Dios, Acre, Purús, Ucayali, Huallaga, Negro and Branco. Special parties penetrated inland and examined soils and agricultural possibilities particularly with a view to the cultivation of rubber and sugar cane. Its leader, Dr. W. L. Schurz, was assisted by specialists from the U.S. Departments of Commerce and Agriculture (among them Dr. C. F. Marbut of the Bureau of Soils) and from the business world, and by experts from Brazil, Bolivia and Peru. In 1927 and 1928 the American Geographical Society, in connection with its work of collecting source material for the new map of Hispanic America on the millionth scale which the Society is producing from original sources, sponsored two expeditions to the Amazon Basin. Joseph H. Sinclair, the leader of one of these parties continued his surveys of the sources of the Napo River begun in 1921 and located a new volcano. The other, conducted by O. M. Miller, of the Society's School of Surveying, made reconnaissance surveys in Central Peru, including a topographic survey of the sources of the Marañón.

Early in 1925 Col. P. W. Fawcett, British explorer, with a small party left Cuyabá to explore the Xingú-Tapajós region of Brazil. After some months news ceased to come from the party and it was feared that they were lost. In 1928 Commander G. M. Dyott, of England, sailed from New York with a relief party, retraced Fawcett's route for some distance and reported that he had found evidence that the party had been killed by Indians. (X.)

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Flora.—In diversity of forms and profusion of individuals the plant life of the Amazon river basin is probably the richest on the globe. Within the area drained by this river system, species of practically every oecological type find homes. Here most of the idiosyncrasies of the plant kingdom are in evidence, for this enormous territory presents a myriad-faced environment, and each face has its own peculiar complement of plant inhabitants. There are few parts of the earth's surface where the struggle for existence appears so intense, for plants literally swarm here.

Nearly all types of plant associations occur and many of these have native names, such as *monte, montaña* (forest), *varzia* (overflow forest), *curiche* (swampy meadow), *campo, pampa* (prairie or park-like country), *aninga* (araceous swamps, mostly of the arborescent relative of the calla-lily, *Montrichardia arborescens*), *terra firma* (in Brazil, land rarely, if ever, overflowed), *ceja* (bush, copse or chaparral), *pajonales* (small grass lands), *paramos* and *paramillos* (large and small alpine meadows).

The dominant feature of this area is the great forest—an expanse of green-topped columns that stretch from a 200m. front on the Atlantic in an ever-widening angle, almost across the continent to the snow-capped Andes. It ranges from the swampy tidewater mangrove thickets at sea-level to the bush country that marks the tree limit on the Andes at from 10,000 to 12,000ft. altitude, where the last arborescent remnants hug the stream borders.

The most striking characteristics of these vast woods are the comparative absence of pure stands of any tree species; the paucity of forest giants in large groups; the division of the vertical height of the forest into storeys or floors on account of the mass effects of the various growths as regards size; the multitudes of very different types, both as to form and habit, jumbled together, often in the most tangled confusion; the general absence of seasonal leaf-fall and flowering time; the small percentage of soft woods; the number of tree forms with prop-roots or buttressed trunks; the long distance between the forest floor and the first branches; the absence of great masses of floral colour and, comparatively speaking, the light colour of the bark.

In the temperate zones, solid forests of one or a few species are characteristic, so that they are designated under the name of their dominant species, such as oak or pine forests. On an acre of Amazon forest, in most regions, scores of species occur, but only a few individuals of each, although there are considerable areas that might be called laurel forests.

Palms, myrtles, laurels, acacias, bignonias, cedrelas, cecropias, rosewoods, bombacaceas, Brazil-nuts, rubber trees, figs, purplehearts and dozens of others often grow on one small area. Within a half-mile square, Agassiz counted 117 different woods. In some regions, particularly rain forest on certain mountain slopes, tree-ferns add to the variety. Conifers are practically absent.

In general, forest giants stand alone and are conspicuous against the sky-line because they number so few. They rarely exceed 200ft. and probably the average tree height of the larger growing species is not over 100 feet. Examples of species that attain the greatest height are the Brazilian cow-tree or *massarandúba* (*Mimusops elata*), the silk-cotton (*kapok*) or *samaúma* (*Eriodendron* sp), *pau d'arco* (*Tecoma* sp.), *bacori* (*Symphonea* sp.), Brazil-nut or *castanhéira* (*Bertholletia* sp), and the cream-nut or *sapucaia* (*Lecythis ollaria*). Species of fig and garlic trees (*Gallesia*) also reach huge proportions. As one stands in the midst of a typical section of the Amazonian wilderness, nothing is perhaps more impressive or full of greater contrast than the changing scenes presented as one glances from the forest floor to its blue-apertured, sky-faced ceiling.

Often the floor level is covered by a mosaic of carpet forms (selaginellas, acantheas, thalias, ferns and bromeliads), beautiful both in design and colour. Beneath the willow-like *Tessaria* thickets on the sandy river flats meibomias form extensive mats. Gorgeous-hued amaryllids flower in clumps here and there. Our greenhouse lantana is a colourful fragrant weed. Sprays of various orchids cling to sticks, logs and small twigs Several diminutive species remind one of tiny yellow, brown-splotched pansy sprays made up with equally delicately dimensioned iris leaves. Begonias, various in foliage and flower colour, are common. Profusions of fallen flowers in brilliant vivid shades of red, orange, yellow and pink frequently cover many square yards. Flowering trunks of the wild chocolate, huge buttresses of various forest giants, prop roots of certain palms and many vines and shrubs carry the eye upward to where they branch and leaf.

The second level is where the bushes, tall herbs and slender walking-stick palms flower, leaf and reach their maximum height. Red and yellow heliconias with their enormous banana-like leaves produce luxuriant tropical effects. Slender palms, with orange yellow panicles of male flowers, scent the glades If fortune favours the visitor, the more open areas may be floriferous with the fugitive plum-like bloom of hirtellas and eugenias, or with the clambering types of pink and yellow orchids, sometimes with sprays 5ft. long. Along the river fronts in the higher altitudes (2,000 to 3,000ft.), calliandras with their profusion of brilliant henna-red cockades leave an unforgettable impression. Other typical plants of this level in some regions are the panama-hat plant (*toquilla*), the ivory-nut-palm (*tagua*), various passion-flowers and bignoniad vines, papayas and cassavas.

Still further the eye ascends to meet the crowns of the various shade-loving trees that form the third storey of the Amazonian forest. These include numerous species of palms (*Mauritia, Euterpe, Attalea, Guilielma, Iriartea*), the chocolate-tree, the ant-protected tree member of the buckwheat family, *Triplaris*, or *palo de santo*, besides hordes of perching orchids, pipers, ferns, cacti, tradescantias, bromeliads and aroids. Finally there is the canopy that fronts the sky, where the sun-loving vines, perchers and larger trees flower and fruit.

Although the valley lies wholly within the tropics, on account of the range in altitude, temperate as well as tropical plants occur, and every marked change in elevation results in a consequent change in the characteristic species. The greatest differentiation in plant life between the various areas is found, generally speaking, on the outer edge or rim of the basin, where the streams start and the mountain spurs are barriers to the mixing of floras. Hence each mountain valley may have a distinctive flora, and the greater the distance from the delta, in general, the more varied the vegetation over large areas. In some of the peripheral Andean regions, the ascent is so rapid that within a few miles tropical, subtropical

and temperate climates are experienced. Bananas, coffee and oranges are grown on the valley floor, while toward the top of the mountain, the climate makes potatoes and barley successful crops. Tropical and temperate types under such conditions are present in strange companionships, such as the trail-side alder (*Alnus*) loaded with bright-flowered, perching bromeliads, cousins of the pineapple.

The region of the Amazon basin richest in flowers and colour is the ceja or bush country that fringes the tree limit on the eastern flanks of the Andes. Many of the plants recall the temperate zones, although the species are generally different. Lupines, gentians, barberries, fuchsias, viburnums, lycopodiums, buddleias, raspberries and clematis are typical types.

The high altitudes are treeless and often bleak, barren, stony and full of moors. Grasses (*Stipa, Festuca, Calamagrostis*) and rushes bulk large, while here and there peculiar relatives of the pineapple (*Puya, Pourretia*) form small colonies, sentinel-like in habit. *Yareta* (*Azorella*), a moss-like cushion plant of the carrot family, furnishes the dwellers in the higher altitudes with part of their fuel. Potatoes, barley, broad beans and native root crops thrive. A lichen (*Lecanora subfusca*), growing at 18,000ft., is said to be the highest altitude reached by plants in these regions.

Between the forest and the low water-line, particularly on the upper Amazon and many of its southern tributaries, but not on the Rio Negro and other "black water" rivers, large areas, often a mile or more in width, are dominated by the tall plumed cane-grass, *caña brava,* a giant relative of the well-known pampas-grass. Forest and river usually meet on the "black water" rivers, and small streams of this character are often completely arched by the jungle flora of tree and vine. The grass lands largely lie between the forested valleys of the tributaries or at their head. For the most part, they are park-like in character, sprinkled here and there either with single trees, or with islands of forests from 1ac. to 10ac. or more in extent. Marshy, sluggish, plant-choked streams drain them. Cannas, water-lettuce, water-hyacinth and azolla cover enormous underwater areas, while much of the upland recalls a temperate prairie.

Some of the most valuable economic plants are indigenous to the Amazon valley. In addition to those already cited, mention should be made of quinine, cacao, cassava (*Manihot utilitissima*)



BY COURTESY OF AMAZON EXPEDITION OF THE MUSEUM OF U. OF PA.

THE INTERIOR OF A NATIVE HUT IN THE AMAZON BASIN SHOWING THE SLEEPING ARRANGEMENTS OF THE WAIWAI INDIANS OF NORTHERN BRAZIL

from which tapioca is derived, sarsaparilla, *ipecacuanha* (the source of ipecac), copaiba, tonka-beans for flavouring tobacco, arnotto (*Bixa orellana*) for colouring butter and cheese, Pará rubber (*Hevea*), balata, rosewood, snakewood, guava, calabash, coca from which cocaine is derived, chirimoya (one of the world's premier fruits), beans, pineapple and probably the tomato and potato. The giant water-lily (*Victoria regia*) is not uncommon throughout the basin below 1,000ft. altitude, while here the Brazil-nut, bignonia and the potato families attain their greatest development.

Fauna.—Although the fauna of the Amazon valley is noteworthy for the variety and number of its genera and species, it is very deficient not only in species of the larger mammals but also in the individuals of these comparatively few species. In contrast to other regions of the world, a large percentage of the mammals are tree-dwellers. None of them will attack man unprovoked, under ordinary circumstances. The monkeys are all arboreal and are common below 3,000ft. altitude. The best known are the red howlers, or *guaribas,* which make the great forest resound with their morning and evening chorus. Other common species are the spider, night, saki, marmoset, titi and squirrel-monkeys. A scarlet-faced, almost tailless species occurs near Ega. All forms are hunted and eaten by the aborigines. There are six species of the cat family, among which are the jaguar, puma or cougar and the ocelot. A small fox or fox-like dog lives on the prairies. A species of *Procyon* is described as a crab-eating racoon, and the two species of coati (*Nasua*) also belong with the racoons. The *janauhy* (*Icticyon*) or *cachorro de matto* combines the characteristics of a dog, badger, martin and beaver. Other Amazonian carnivores are the *papa-mel* (*Galictis*), kinkajou, otter, *grison* or ferret (*Grisonia*) and weasel (*Putorius*), the latter rather rare.

This region is particularly rich in rodents, the largest rodent species in the world, the capybara, being indigenous and common along the stream banks. It is said to attain a length of over 3ft. and a weight of over 50 kilograms. Other common rodents are the paca (*Coelogenys*), *cutia* or agouti (*Dasyprocta*), *sauia* or spiny rat, *toro* (*Loncheres*), several species of squirrels, rats and mice, and two species of porcupines. Paca meat is highly esteemed, but the capybara and a number of other forms are frequently used as food.

The largest animal is the *anta* or tapir, which makes its home in the giant cane-brakes along the streams. There are two species of peccary (*Dicotyles*). One of these, the *queixada* or *porco de matto,* lives in bands of 100 or more and twice invaded the small city of Obidos.

Five species of armadillos or *tatú* occur, both the giant and the pygmy species being represented. The former reaches a length of 3 feet. Of the three species of ant-eaters, two of them are tree-dwelling, while the giant ant-eater or *tamandua bandeira* is generally a prairie animal. The two sloths are both forest forms, and one species lives largely on cecropia leaves, while the other has a more varied plant diet of foliage and fruit. The flesh of the latter recalls mutton.

Four species of deer are found on the prairies and neighbouring woods, and thousands of hides are exported. The three species of opossums range in size from the *mucura,* as large as a cat, to the mouse-dimensioned *mucura chichica* with large eyes.

Bats by the million fan the Amazon night air, and represent numerous species and genera. Among them are the blood-sucking vampires (*Dysopes, Phyllostoma*), although these are by no means as dangerous as we are led to infer from travellers' tales.

The sea-cow or manatee is common in the lakes and hunted for its meat, which resembles pork. It is one of the most peculiar mammals of the region, with its cow-like face, its small eyes and its two large, well-developed pectoral mammae. Fresh-water dolphins of several species disport themselves in small schools.

The Avifauna is exceedingly rich. The great valley teems with species, genera and individuals. Vultures are the universal scavengers and always alert for work. Morning and evening the parrots and macaws, two by two, in brilliant aerial processions, fly to and from their feeding grounds, their gorgeous plumage flashing in the sun, and their raucous voices calling out their presence. Toucans cry at sundown a discordant plaint from some tall, trail-side tree. Through the day the hangnests or caciques quarrel in trees where their nests swing by dozens. Doves of various species dolorously coo through the hot afternoons. Hawks and eagles scream from dead tree stumps. The forest aisles ring with the clear, silvery, metallic notes of the *uirá purú* (*Pachysilvia*). At sundown *perdiz* or tinamous call out as do our quail. At night the air vibrates with the "correos" of the goat-suckers and whip-poor-wills. Early morning is full of the clatter-

ing music of the pheasant-like pavas. Hoactzins screech in noisy flocks from stream-side brush. Then there is always the twittering of legions of small birds, the sound of busy woodpeckers and the guttural noises of various water-birds. Parakeets fly about in great flocks, more common than our sparrows.

Humming-birds are not so numerous at low altitudes in the main valley, but in the Andean headwaters region, especially in the bush country, they are a striking feature of the scene. One of the common birds is the Clay-John or oven-bird, with its peculiar oven-shaped nest on a forked prairie-tree limb. Egrets roost beside the campos lakes. Muscovy and teal ducks swim about in quiet lagoons. In the marshes, the *jabirú* or great South American marabou stork is not an infrequent sight. There are two species of geese. Herons, gulls, anhingas, cormorants, roseate spoonbills, scarlet ibises and jacanas are among the common water-birds. Gorgeous trogons, cock-of-the-rocks, cotingas and tanagers are natives, while on the prairies between the Mamoré and the Beni rivers the rhea or South American ostrich is found.

One of the principal food supplies of the valley is the tartaruga turtle (*Podocnemis*). The swamps, sluggish streams and lakes usually contain one or more species of cayman. Lizards of various sizes and colours dart back and forth across the trails. The snakes, relatively speaking, are not numerous, but representatives of both poisonous groups occur (*Lachesis, Crotalus, Cophais, Elaps*). The constrictors (*Eunectes, Epicrates*) reach huge proportions, 18 to 20ft. not being rare. Snakes, however, are not a prominent feature of Amazon life; perhaps the poisonous individuals observed are not more than one in 20 or 30. One of the deadly *Lachesis* species (rattlesnake) is considered a royal dish by the Indians. The frogs and toads abound in vivid contrasts both in shape and colouring; they are very noisy at night, and are not as edible as temperate-zone frogs.

The fish species of the Amazon have been estimated to be anywhere from 521 to 1,800 or 2,000, but only a few of them are of economic importance. Of these, the *pirarucu* is the most sought after. The scales of one species are utilized for making artificial flowers. In the half-covered forest pools, the electric eel is at home Most of the streams are well stocked with the blood-thirsty piranha (*Serrasalmo*). Giant catfish are common and sting rays are present.

As to insects, their name in Amazonia is legion. Countless multitudes of ants work night and day. Their work varies with the species. Some are farmers like the saubas or leaf-cutters, others are always on marauding expeditions, while still others live in certain types of trees, and sting as well as bite. Termites, the so-called "white ants," abound and cause great destruction to nearly anything of wood. Fireflies with yellow, red and green lights make toy fairylands of little brooks, while a host of other insects by various devices, depending on the region, turn a paradise into purgatory. The bees are stingless, but hornets and wasps are plentiful. *Titanus giganteus*, the largest beetle known (5–6in. long), is native. The larvae of some of the palm-beetles are relished when fried. Cockroaches are ever-present. Part of the afternoon and evening music is furnished by several species of cicadas, one of which sounds like a shrill steam whistle. Centipedes, scorpions, ticks, red bugs and giant spiders are often met with. Finally there are the moths and butterflies, hundreds of kinds and thousands of individuals, in marvellous assortments of brilliant colours and patterns. Within an hour's walk of Pará, 700 species have been collected, as compared with 321 species for all Europe. Around Ega, Bates collected 7,000 species of insects, of which 550 were species of butterflies.

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AMAZONAS, the extreme north-western and largest State of Brazil, bounded north by Colombia and Venezuela, east by the State of Pará, south by the State of Matto Grosso and Bolivia, and west by Peru and Colombia. It embraces an area of 731,363 sq m. wholly within the Amazon basin. A small section bordering the Venezuelan sierras is elevated and mountainous, but the greater part forms an immense plain, densely wooded and traversed by innumerable rivers, whose flood-plains are subject to extensive annual inundations. The climate is tropical and generally unfavourable to white settlement. The State is sparsely populated (1920) 363,166; two-thirds of the inhabitants are Indians, forming small tribes, and subject only in small part to Government control. The principal commercial products are rubber, cacao and nuts; cattle are raised on the elevated grassy plains of the north, west and south-west, while curing fish and collecting turtle eggs for their oil give occupation to many people on the rivers. Maize, manioc, rice and various fruits are produced for domestic needs. The capital, Manãos, is the only city and port of general commercial importance in the State; it is situated on the Rio Negro, 10m. above its junction with the Amazon, about 1,000m. from the sea. While rubber production was active along the upper Amazon Manãos attained a population of some 75,000 people (1920), but the decline in rubber gathering brought stagnation in trade and greatly reduced the number of inhabitants. There is but one railway in the State, the Madeira–Mamoré line built around the 20om. of rapids (caxoeiras) on the Madeira river. Transportation depends upon the Amazon river and its tributaries, the Madeira, the Purús, the Jutahy, the Juruá, the Rio Negro and others, a total of some 7,500m. of navigable waterways. Up to 1755 all the Portuguese territory on the Amazon formed part of the capitanía of Pará. The upper districts were then organized into a separate capitanía, called S. José do Rio Negro, to facilitate administration. When Brazil became independent in 1822, Rio Negro was overlooked in the reorganization into provinces, and reverted, notwithstanding the protests and an attempted revolution (1832) of the people, to a state of dependence upon Pará. In 1850 autonomy was voted by the general assembly at Rio de Janeiro, and on Jan. 1, 1852, the province of Amazonas was formally installed. In 1889 it became a federal state in the Brazilian republic. A governor is chosen by direct election for four years and is ineligible for immediate reelection. A single-chambered legislature of twenty-four members elected for three years exists. For purposes of internal administration the state is divided into 28 municipalities. Since the rubber crisis the state, which depended largely on export taxes on rubber for its revenue, has suffered financially and has a large bonded and floating debt. Public education is in a very rudimentary condition.

AMAZONAS, a department of northern Peru, on the eastern slopes of the Cordillera between the departments of Loreto and Cajamarca, with Ecuador on the north (area, 13,947 sq.m., estimated pop. 70,876). The north-eastern part of the territory is a low-lying equatorial virgin forest inhabited by savage tribes. The southern provinces, where the few towns are located, are more rugged. The capital, Chachapoyas, at an altitude of 7,600ft., with about 6,000 inhabitants, has a warm, malarial climate. The chief industry is the plaiting of very fine "Panama" hats. In valleys and on lower slopes, sugar, cotton, coffee, tobacco, cacao, coca and cereals grow luxuriantly. Rainfall is abundant throughout, and the rivers, tributaries of the Marañon which crosses the department, are navigable for canoes and rafts; trails are usually impassable. The great Marañon, parent of the Amazon, crosses the eastern Cordillera at the Pongo de Manseriche (4° 30′ S.), a narrow gorge only a few hundred feet wide. The mountains are rich in minerals, but remoteness from markets as well as lack of transportation facilities make these resources of little value. In Dec., 1926, a contract was signed for the construction of a railway from the coast to Yurimaguas on the Huallaga, which will pass through Chachapoyas.

AMAZONAS, a territory belonging to Venezuela, and occupying the extreme southern part of that republic, adjoining the Brazilian State of Amazonas. It lies partly within the drainage basin of the Orinoco and partly within that of the Rio Negro, an affluent

of the Amazon. The territory is covered with dense forests and is filled with intricate watercourses, one of which, the Casiquiare, forms an open communication between the Orinoco and the Rio Negro and is navigable for large canoes. The capital of the territory is Maroa, situated on the Guainia river, an affluent of the Rio Negro.

AMAZONS, a legendary nation of female warriors, said to have lived in Pontus near the shore of the Euxine sea, where they formed an independent kingdom under the government of a queen, the capital being Themiscyra on the banks of the River Thermodon (Herodotus iv. 110–117). From this centre they made numerous warlike excursions—to Scythia, Thrace, the coasts of Asia Minor and the islands of the Aegean, even penetrating to Arabia, Syria and Egypt. According to one account, they originally came to the Thermodon from the Palus Maeotis (Sea of Azov). No men were permitted to reside in their country; but once a year, in order to prevent their race from dying out, they visited the Gargareans, a neighbouring tribe. The male children who were the result of these visits were either put to death or sent back to their fathers; the females were kept and brought up by their mothers, and trained in agricultural pursuits, hunting and the art of war (Strabo xi. p. 503).



THE MATTEI AMAZON WITH HER BATTLE EQUIPMENT. IN THE VATICAN MUSEUM, ROME

The Amazons appear in connection with several Greek legends. They invaded Lycia, but were defeated by Bellerophon (*Iliad,* vi. 186). They attacked the Phrygians, who were assisted by Priam, then a young man, though later they took his side against the Greeks under their queen, Penthesileia, who was slain by Achilles (Virgil, *Aen.* i. 490). One of the tasks imposed upon Heracles by Eurystheus was to obtain possession of the girdle of the Amazonian queen, Hippolyte. He was accompanied by his friend Theseus, who carried off the princess Antiope, sister of Hippolyte, an incident which led to a retaliatory invasion of Attica, in which Antiope perished fighting by the side of Theseus. They are heard of in the time of Alexander the Great, and Pompey is said to have found them in the army of Mithridates.

The origin of the story of the Amazons has been the subject of much discussion. While some regard them as a purely mythical people, others assume an historical foundation for them. The deities worshipped by them were Ares (who is consistently assigned to them as a god of war, and as a god of Thracian and generally northern origin) and Artemis, not the usual Greek goddess of that name, but an Asiatic deity in some respects her equivalent. Another theory is that, as the knowledge of geography extended, travellers brought back reports of tribes ruled entirely by women, who carried out the duties which elsewhere were regarded as peculiar to men. Hence arose the belief in the Amazons as a nation of female warriors, organized and governed entirely by women. It has been suggested that the fact of the conquest of the Amazons being assigned to the two famous heroes of Greek mythology, Heracles and Theseus, shows that they were mythical illustrations of the dangers which beset the Greeks on the coasts of Asia Minor; rather, perhaps, it may be intended to represent the conflict between the Greek culture of the colonies on the Euxine and the barbarism of the natives.

In works of art, combats between Amazons and Greeks are placed on the same level as, and often associated with, combats of Greeks and centaurs. Their arms were the bow, spear, axe, a half shield, nearly in the shape of a crescent, called *pelta,* and in early art a helmet, the model before the Greek mind having apparently been the goddess Athena. In later art they approach the model of Artemis, wearing a thin dress, girt high for speed; while on the later painted vases their dress is often peculiarly Persian—that is, close-fitting trousers and a high cap called the *kidaris.* The battle between Theseus and the Amazons is a favourite subject on the friezes of temples (*e.g.,* the reliefs from the frieze of the temple of Apollo at Bassae, now in the British Museum), vases and sarcophagus reliefs; at Athens it was represented on the shield of the statue of Athena Parthenos, on wall-paintings in the Theseum and in the Poikile Stoa.

In the 16th century the Spanish explorer Orellana asserted that he had come into conflict with fighting women in South America on the river Marañon, which was named after them the Amazon (*q.v.*) or river of the Amazons, although others derive its name from the Indian *amassona* (boat-destroyer), applied to the tidal phenomenon known as the "bore." The existence of "Amazons" (in the sense of fighting women) in the army of Dahomey (*q.v.*) in modern times is certain, but they are said to have died out during the French protectorate.

See H. L. Krause, *Die Amazonensage* (1893); P. Lacour, *Les Amazones* (1901); articles in Pauly-Wissowa's *Realencyklopädie* and Roscher's *Lexikon der Mythologie;* Grote, *Hist. of Greece,* pt. i. ch. xi.; L. Whibley, *Companion to Greek Studies* (1916).

AMAZON-STONE or Amazonite (named from the Amazon river, its supposed locality), a bright green variety of microcline felspar (*q.v.*) known from Miask in the Ilmen mountains and at Pike's Peak, Colorado, and in Madagascar.

AMA ZULU: *see* ZULU.

AMBACA: *see* ANGOLA.

AMBALAVASI: *see* CASTE.

AMBARVALIA, an annual festival of the ancient Romans, occurring in May, usually on the 29th, the object of which was to secure the growing crops against harm. The priests were the Arval Brothers (*q.v.*), who conducted the victims—ox, sheep and pig (*suovetaurilia*)—in procession with prayer to Ceres round the boundaries of the *ager Romanus.* As the extent of Roman land increased, this could no longer be done, and in the Acta of the Fratres, which date from Augustus, this procession is not mentioned; but in Virgil, *Georg.,* i. 338 et seq., and in Cato's *de Re Rustica* (141) we have full details and the text of the prayers used by the Latin farmer in thus "lustrating" his own land. The Christian festival which seems to have taken the place of these ceremonies is the Rogation or Gang week of the Roman Catholic Church. The perambulation or beating of bounds is probably a survival of the same type of rite.

See W. W. Fowler, *Roman Festivals* (1899).

AMBASSADOR, a public minister of the first rank, accredited and sent by the head of a sovereign State as his personal representative to negotiate with a foreign Government, and to watch over the interests of his own nation abroad. The power thus conferred is defined in the credentials or letters of credence of which the ambassador is the bearer, and in the instructions under the sign-manual delivered to him. The credentials consist of a sealed letter addressed by the sovereign whom the ambassador represents to the sovereign to whom he is accredited, and they embody a general assurance that the sovereign by whom the ambassador is sent will confirm whatever is done by the ambassador in his name. In Great Britain letters of credence are under the royal sign-manual, and are not countersigned by a minister.

It was agreed by the Congress of Vienna, 1815, that three classes of diplomatic agents should be recognized; and a fourth class was added by the Congress of Aix-la-Chapelle. There are, therefore, now four classes of diplomatic agents:

(1) Ambassadors, including papal legates and nuncios, who enjoy the highest rank and are deemed to represent the person and dignity of the sovereign or head of their State, and who are entitled to personal access to the sovereign or head of the State to which they are accredited;

(2) ministers plenipotentiary and envoys extraordinary, including papal internuncios, who are accredited to the head of the State, and may also be resident, but who do not represent the person and dignity of the head of their own State;

(3) ministers resident, who are accredited to the head of the State, but rank below the last class in their official position and dignity; and

(4) *Chargés d'affaires* who are accredited by the Minister of

Foreign Affairs to the Minister of Foreign Affairs and who may be appointed *ad hoc* or *ad interim*. It was also agreed that diplomatic agents of the same class should take precedence according to the date of the presentation of their credentials, but in Catholic countries (except in France since the abrogation of the concordat) precedence is usually given to the papal legate. The senior minister is the *doyen* or dean of the "diplomatic corps," and it is his function to see that the diplomatic privileges and immunities are duly observed.

Ambassadors were formerly accredited only to States enjoying royal honour. Later they were accredited also to republics regarded as of equal rank. By an act of Congress in 1893 the President of the United States was empowered to accredit ambassadors to the Great Powers. Great Britain sends diplomatic agents of the first class only to 11 States, Argentina being the last so promoted.

An ambassador, however, unless specially armed with plenary authority, cannot decide any questions beyond his instructions without reference to his government. Thus Lord Londonderry (Lord Stewart), who represented Great Britain at the conferences of Troppau in 1820 and Laibach in 1821, had not the same standing as the plenipotentiaries of the other Powers present, and efforts were even made to exclude him from some of the more important discussions in consequence, not on the ground of inferior rank, but of defective powers. For the special immunities and privileges of ambassadors *see* EXTERRITORIALITY and DIPLOMACY. *See* also the latter for the history of the subject.

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AMBASSADORS, CONFERENCE OF. The term has been used in times past to denote the sessions or reunions of ambassadors at a certain centre, generally for the period of the execution of a treaty. The best example of this is the Ambassadors' Conference which sat at Paris and Vienna during 1815–26. After the World War a similar conference meeting at Paris became one of the organs concerned with the execution of the Versailles Treaty. It consisted of the representatives of Great Britain, France, Italy and Japan, with the American Ambassador attending in the capacity of a spectator after 1921. Many of the technical decisions under the treaties were actually taken by the ambassadors, and in a large number of cases important interpretations were given.

It is difficult to give details of their activities when so much mystery obtained concerning them. Except in the case of Memel and the plebiscite areas, the complicated frontiers of Poland, left unsettled by the Peace Conference, were decided by the ambassadors. They also reorganized the frontiers established between Poland and Russia by the agreement of Riga. The most important function performed by the Ambassadors' Conference was undoubtedly in Oct. 1921, when the ex-Emperor Karl for the second time returned to Hungary with the intention of regaining his crown. The "Little Entente" (Czechoslovakia, Yugoslavia and Rumania) threatened very strong measures against Hungary. But, largely as a result of the ambassadors' intervention, Karl was arrested (Oct. 24), and a law was passed by the Hungarian Parliament which abrogated his sovereign rights (Nov. 3).

Its action in 1923, in connection with the Corfu incident, brought the conference into some discredit, and shortly after he became prime minister, Ramsay MacDonald announced that its powers would be limited to the execution of the Versailles Treaty, and this policy seems in effect to have been continued.

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AMBATO or **ASIENTO DE AMBATO,** an inland town of Ecuador, capital of the province of Tunguragua, 80m. S. of Quito by the highway, and near the northern foot of Chimborazo. Pop. (1925 estimate) 25,000. The town stands in a bowl-like depression, 8,606ft. above sea-level, surrounded by steep, sandy, barren mountains, and has an equable climate. The immediate environs are fertile and produce a variety of fruits, but the surrounding country is arid and sterile, producing scanty crops of barley, Indian corn and pease. The town is known throughout Ecuador for its manufacture of boots and shoes, and for a cordage made from *cabuya*, the fibre of the agave plant. Ambato was destroyed by an eruption of Cotopaxi in 1698, and has been badly damaged two or three times by earthquakes.

AMBATO is also the name of a range of mountains in northern Argentina, being a spur of the Sierra de Aconquija crossing the province of Catamarca from north to south.

AMBER, a ruined city of India, the ancient capital of Jaipur State in the Rajputana agency. The name of Amber is first mentioned by Ptolemy. It was founded by the Minas and was still flourishing in A.D. 967. In 1037 it was taken by the Rajputs, who held it till it was deserted. In 1728 it was supplanted by the modern city of Jaipur, from which it is 5m. distant. The picturesque situation of Amber at the mouth of a rocky mountain gorge, in which nestles a lovely lake, is enhanced by the beauty of its architecture. The old palace begun by Man Sing in 1600 ranks second only to Gwalior. The chief building is the Diwan-i-'Am, built by Mirza Raja, the pillars of which are still plastered over with the stucco with which Mirza had had them covered to avert the anger of Jahangir; for the emperor had been told that the sculptures on them eclipsed the marvels of the imperial city.

AMBER, a fossil resin much used for the manufacture of ornamental objects. The name comes from the Arabian *anbar*, probably through the Spanish, but this word originally referred to ambergris, which is an animal substance quite distinct from yellow amber. The property which amber possesses of acquiring electrical charge by friction is first recorded by Thales of Miletus, and suggested the word "electricity" from the Greek, ἤλεκτρον, a name applied, however, not only to amber but also to an alloy of gold and silver.

Amber is not homogeneous in composition, but consists of several resinous bodies more or less soluble in alcohol, ether and chloroform, associated with an insoluble bituminous substance. The average composition of amber leads to the general formula $C_{10}H_{16}O$. In concentrated sulphuric acid finely powdered amber is perfectly soluble even in the cold, and it is completely decomposed by boiling nitric acid. Heated rather below 300°C. amber suffers decomposition, yielding an "oil of amber" and leaving a black residue which is known as "amber colophony," or "amber pitch"; this forms, when dissolved in oil of turpentine or in linseed oil, "amber varnish" or "amber lac." True amber yields on dry distillation succinic acid, the proportion varying from about 3 to 8% and being greatest in the pale opaque or "bony" varieties. The aromatic and irritating fumes emitted by burning amber are mainly due to this acid. True Baltic amber is distinguished by its yield of succinic acid, for many of the other fossil resins which are often termed amber contain either none of it, or only a very small proportion; hence the name "succinite" proposed by Prof. J. D. Dana, and now commonly used in scientific writings as a specific term for the real Prussian amber.

The physical characters of amber are in every respect those of a resin. It is perfectly amorphous, as is shown by the recent X-ray investigations of Prof. F. Rinne. It occurs in irregular rounded nodules having the form of rods, drops, plates, etc., and never in masses bounded by plane surfaces. The specific gravity of amber ranges from 1·05 to 1·10; the substance is thus only slightly heavier than water. Its hardness, H = 2½, is a little greater than that of gypsum, and it is therefore just not possible to scratch it with the finger-nail. It is harder than most other resins but is not very brittle and can therefore be carved, worked on the lathe or bored with little difficulty. When rubbed on cloth amber becomes strongly charged with negative electricity, and attracts small light particles. It is also a very good insulator for use in electrical apparatus and is superior to sulphur because of its mechanical properties. The colouring of amber is very uniform in character, no colour but yellow occurring in the great majority of specimens, though all shades of this colour, from the palest yellow to brown, are known.

The turbidity of certain kinds of amber is due to the inclusion

of great numbers of minute air bubbles. Various other enclosures are found in amber, some of which are of special significance. Drops of water sometimes occur, but enclosures of solid matter, either organic or inorganic, are more frequent. The enclosures of organic material, partly of vegetable and partly of animal origin are of great importance, as they have thrown much light on the flora and fauna existing at the time of the exudation of the amber.

Amber is extensively used for beads and other small ornaments, and for cigarette-holders and the mouth-pieces of pipes. Small fragments, formerly thrown away or used only for varnish are now utilized on a large scale in the formation of "ambroid" or "pressed amber." The pieces are carefully heated with exclusion of air and then compressed into a uniform mass by intense hydraulic pressure. Rods of amber are then obtained by forcing the mass of softened amber through holes in a metal plate. The product possesses practically the same physical properties as natural amber.

The greatest amber-producing region is the promontory of Samland in East Prussia, where the amber occurs in a marine glauconitic sand, known as "blue earth," occurring in the Lower Oligocene strata. It appears, however, to have been partly derived from yet earlier Tertiary deposits (Eocene) and it occurs also as a derivative mineral in later formations, such as the drift. Rolled pieces of amber may be picked up at various places along the east coast of England and also on the coasts of Holland, Denmark, Sweden, in Bornholm and other islands and in South Finland. Varieties of amber differing slightly from succinite are found in Rumania, Sicily and Burma

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AMBERG, a town in Bavaria, formerly capital of the Upper Palatinate, on both sides of the Vils, 42m. E. of Nürnberg by rail. Pop. (1925) 26,337. It has eleven churches; St. Martin's (15th century) has good paintings and a tower 300ft. high. A former Jesuit monastery is now a grammar school and seminary There is also a pilgrimage church on a hill (1,621ft). The principal manufactures are enamels, ironmongery and machinery, gold objects and furniture. In the neighbourhood are iron and coal mines The Austrians defeated the French near Amberg in 1796.

AMBERGRIS, a solid, fatty, inflammable substance of a dull grey or blackish colour, the shades being variegated like marble, possessing a peculiar sweet, earthy odour. It occurs as a biliary concretion in the intestines of the spermaceti whale (*Physeter catodon*), and is found floating upon the sea, on the sea-coast or in the sand near the sea-coast. It is met with in the Atlantic ocean; on the coasts of Brazil and Madagascar; also on the coast of Africa, of the East Indies, China, Japan and the Molucca islands; but most of the ambergris which is brought to England comes from the Bahama islands, Providence, etc. It is sometimes found also in the abdomen of whales, always in lumps of various shapes and sizes, weighing from one-half oz. to 100 or more pounds, having a disagreeable smell, and hardening on exposure to air. Its specific gravity ranges from 0·780 to 0·926. It melts at about 62°C. to a fatty, yellow, resinous-like liquid; and at 100° C. it is volatilized into a white vapour. It is soluble in ether, and in volatile and fixed oils; it is only feebly acted on by acids. By digesting in hot alcohol, a substance termed *ambrein*, closely resembling cholesterin, is obtained, which separates in brilliant white crystals as the solution cools.

The use of ambergris in Europe is now entirely confined to perfumery. In minute quantities its alcoholic solution is much used for giving a "floral" fragrance to bouquets, washes and other preparations of the perfumer. It occupies a very important place in the perfumery of the East, and there it is also used in pharmacy and as a flavouring material in cookery. The high price it commands makes it peculiarly liable to adulteration, but its genuineness is easily tested by its solubility in hot alcohol and its uniform fatty consistence on being penetrated by a hot wire.

AMBIDEXTERITY, the ability to use both the right and the left hand with equal ease (Lat. *ambi* both, *dexter* right-handed). Educationalists and physiologists frequently advocate the cultivation of ambidexterity in children on the ground that the brain-centres controlling the motor functions thereby become more highly developed. Since, however, the left hemisphere of the brain controls both the function of speech and the motor functions of the right side, over-development of left-handedness has been known to cause speech impediment and must be avoided.

See F. W. Mott, *The Brain and the Voice in Speech and Song* (1910); H. Macnaughton Jones, *Ambidexterity and Mental Culture* (1914).

AMBIENT (Lat. *ambi*, on both sides, *ire*, to go), surrounding; a word implying a moving rather than a stationary encircling. It is used mostly in the phrase the "ambient air." In astrology it means the sky.

AMBIGU, a French game of cards in which a whist pack with the court cards omitted is used. It is composed of the characteristic elements of whist, bouillotte and piquet.

AMBIGUITY, in law, is of two kinds, *patent* and *latent*. (1) Patent ambiguity is that which is apparent on the face of an instrument to anyone perusing it. In the case of a patent ambiguity parol evidence is admissible to explain only what has been written, not what it was intended to write (*Garrard* v. *Lewis* [1882] 10 Q.B D. 30). Where it appears from the general context what the parties really meant, the instrument will be construed as if there were no ambiguity (*Saye and Sele's* case 10 Mod. 46; *De Rosaz, in the Goods of* [1877] 2 P.D. 66). (2) Latent ambiguity is where the wording of an instrument (on the face of it clear and intelligible) may at the same time apply equally to two different things or subject matters. Latent ambiguity may be explained by parol evidence, as the ambiguity has been brought about by circumstances extraneous to the instrument (*Doe D. Thomas* v. *Beynon* [1840] 12 Ad and E. 431). But a contract that is void for uncertainty will not be rendered certain by part performance (*Waring and Gillow* v. *Thompson* [1913] 29 T.L.R. 154 C.A.). (*See* also CONTRACT; EVIDENCE; PRINCIPAL AND AGENT.)

AMBIORIX, prince of the Eburones, a tribe of Belgian Gaul. Although Caesar (q v.) had freed him from paying tribute to the Aduatuci, he joined Catuvolcus (winter, 54 B C.) in a rising against the Roman forces under Q. Titurius Sabinus and L. Aurunculeius Cotta, and almost annihilated them. An attack on Quintus Cicero (brother of the orator), then quartered with a legion in the territory of the Nervii, failed owing to the timely appearance of Caesar. Ambiorix is said to have found safety across the Rhine.

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AMBLESIDE, urban district of Westmorland, England, a mile from the head of Lake Windermere. Population (1921) 2,876. It is beautifully situated among the bare hills surrounding the richly wooded valley of the Rothay. The hills are Wansfell on the east, Loughrigg Fell on the west, and Rydal Fell and the ridge below Snarker Pike (2,096ft.) to the north. At the head of Windermere is Waterhead, the landing-stage of Ambleside, which is served by the lake steamers of the L.M S.R. The chief roads centring in Ambleside are from Windermere, Ullswater, Keswick, the Brathay valley and the Langdales to the west. There are slate quarries in the neighbourhood.

Close by the lakeside the outlines of a Roman fort, the name of which is not known, are still visible. It appears to have guarded a route over the hills by Hardknott and Wrynose pass to Ravenglass on the coast of Cumberland.

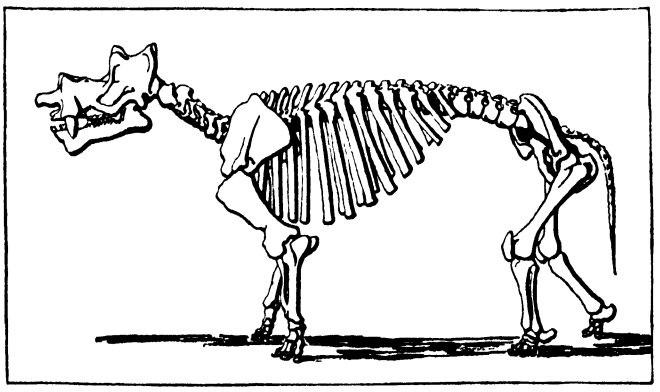
AMBLYGONITE, a mineral usually found as cleavable, compact masses; it is translucent and has a vitreous lustre, and the colour varies from white to pale shades of violet, grey, green or yellow. There are good cleavages in two directions. The mineral is thus not unlike felspar in general appearance, but it is readily distinguished from this by its specific gravity (3·0) and

chemical characters, being an aluminium and lithium fluophosphate, Li (AlF)PO_4, with part of the lithium replaced by sodium and part of the fluorine by hydroxyl. Amblygonite occurs with lepidolite, tourmaline and other lithia-bearing minerals in pegmatite-veins. It was first discovered in Saxony in 1817, and later at Montebras, dep. Creuse, France, and at Hebron in Maine. More recently it has been discovered in considerable quantity at Pala in San Diego county, California, and at Cáceres in Spain.

AMBLYOPIA is a somewhat indefinite term meaning dimness of vision, or loss in the acuity of sight. It is usually restricted to those cases of dim vision which are not due to refractive errors such as can be corrected by glasses and to cases in which there are no visible changes in the exterior or interior of the eye. Loss of vision may be partial or total, temporary or permanent. Total blindness is usually called amaurosis. The symptom may come on suddenly, with immediate total loss of sight, or gradually, with a sense of a blue veil or mist before the eyes, or it may not be noticed until the patient suddenly finds he cannot read. Colour blindness, night blindness, and day blindness are varieties of amblyopia. The causes may be injury to the brain, disease of the nervous and retinal structures involved in vision, drugs, and the poisons of certain diseases, such as chronic nephritis, acute nephritis, toxemias of pregnancy, diabetes and malaria. Other common causes are intoxicating liquor, tobacco, lead, quinine and wood alcohol. It has long been recognized as a manifestation of hysteria and many cases were encountered during the war in soldiers suffering from "shell shock."

AMBLYPODA, an extinct order of hoofed mammals. They inhabited North America, Europe and Asia during the early part of the Tertiary period and were the largest quadrupeds of their time. The limbs and feet were like those of elephants, long, straight, postlike legs with short, rounded, five-toed feet, small hoofs with heavy elastic pads to support the weight of the animal The skull was massive with short-crowned cheek teeth of a peculiar lophiodont or cross-crested pattern and enlarged canine tusks which, in one group, suggest those of pigs, in another those of the tusked deer. These tusks had no likeness to the incisor tusks of elephants. The brain was small.

Although they resembled the elephants in the general character of the limbs, the structure of wrist and ankle bones precludes any near relationship; moreover the characters of skull and teeth were quite peculiar. The *Amblypoda* appear to have evolved from primitive ancestors related to the *Condylarthra,* and are connected with them through a number of intermediate types of



BY COURTESY OF THE AMERICAN MUSEUM OF NATURAL HISTORY

SKELETON OF A UINTATHERIUM, OR DINOCERAS, THAT ROAMED WYOMING MILLIONS OF YEARS AGO IN THE MIDDLE EOCENE PERIOD

Palaeocene mammals. *Coryphodon* of the Lower Eocene (Europe and North America) was about the size of the larger bears. The front teeth were enlarged; the stout flaring tusks and heavy muzzle suggesting the hippopotamus; the skull broad-topped and roughened; the proportions of the body much as in the bears; the tail rather small. The premolar teeth had crescentic cusps; the true molars a combination of crescents and curving crests of unique pattern.

The *Uintatheres* or *Dinocerata* of North America were the most specialized and largest of the *Amblypoda.* In these the upper incisors were absent; the upper canines enlarged into great dagger-like tusks; the cheek teeth small with a distinctive pattern of crescents and crests; and the top of the skull bore two or three pairs of stout prominent bony bosses or "horns" analogous to the horns of the giraffe. This group first appears in the Palaeocene of North America and Central Asia with small ancestral types no larger than a pig—hornless; but already showing the characteristic pattern of tusks and cheek teeth.

Bathyopsis of the Lower Eocene was somewhat larger; still hornless; but with rudimentary bosses on the skull. *Uintatherium* (*Dinoceras*) of the Middle Eocene had two pairs of horns, one over the orbits, the other near the back of the skull. It was as large as a small rhinoceros. *Eobasileus* (*Loxolophiodon*) of the Upper Eocene had a third pair of horns above the nasals, and the size of the two other pairs increased. This animal attained the size of the largest rhinoceros. The brain remained quite undeveloped, very small in contrast to the huge massive skull.

(*See* PALAEONTOLOGY.) (W. D. M.)

AMBO, the reading-desk of the early Christian church, originally movable, but by the 6th century established as an important and stationary piece of great decorative value. From the 12th century on, and earlier than that outside Italy, the ambo was more and more superseded by the pulpit and lectern, and even in Italy it has gone out of liturgical use, except in the Ambrosian rite in Milan. The normal single ambo consisted of a raised platform in three levels, reached by steps and protected by railings. Each level was consecrated to a special part of the service: the highest, reserved for the deacon who read the gospel; the middle, for the deacon reading the epistle; the lowest, for the subordinate clergy. Later, two separate ambones were used, one on each side of the church; the one to the south was used for reading the gospel, the other for the epistle.

These ambones were usually composed as part of the choir screen, and, like it, were, in all the finer churches, made of marble, frequently decorated with mosaics and carving. A normal type is represented by those in San Clemente at Rome (*see* illustration under BASILICA) which are at least as old as the beginning of the 12th century; others of great interest, of later date, and rich with that fine-scaled geometric mosaic known as Cosmati work, are those of Sta. Maria-in-Ara-Coeli, Sta. Maria-in-Cosmedin and San Lorenzo outside the walls, all of the 12th or 13th century Outside of Rome, although Ravenna has early examples, it is in south Italy that the finest are found; notably that of Ravello (1130), and that of Salerno. In south Italy it is the rule to have the ambones supported on spiral columns; in Rome the base is usually solid.

In the Eastern Church, the ambo is slightly different. In Russian orthodox usage the term usually designates the steps leading to the platform in front of the iconostasis (*q.v.*). In the Greek Church the ambo retains its earlier form, and is placed at one side of the church; but in the Greek Catholic Church, the ambo is a table before the doors of the iconostasis.

See the liturgical and ecclesiastical dictionaries of Martigny, Migne, and Smith and Cheetham, *sub voce.*

AMBOIM: *see* ANGOLA.

AMBOINA is a Dutch Residency of the Government of the Moluccas, area 198,367 sq.km., and is the name of the capital and the island on which it is situated. Formerly a separate residency, in 1927 it was united with Ternate Residency to form the Government of the Moluccas. Amboina includes the island of that name, Saparua (with Haruku, Oma, Melano and Nusa Laut—the Uliassers); Kajeli (Buru); Masareti (Buru); Kairatu (Ceram); Wahai (North mid-Ceram); Amahai (South mid-Ceram); the Banda Isles, with East Ceram, Ceram Laut and the Goram Archipelago; the islands of Aru, Ké, and Tenimber, or Timor Laut; West and South New Guinea, and the South-Western Islands. Pop. (1925) 358,250, comprising 2,808 Europeans (including Eurasians), 350,192 natives, and 5,250 foreign Asiatics, including Chinese. The area is about 20,000sq.m. Imports (1925) 3,717,778 guilders; exports 4,152,141. Amboina lies S.W. of Ceram, N. of the Banda Sea. Two oblong peninsulas, Hitoe much larger than Leitimor, rise parallel from the sea, and are

united by a narrow alluvial isthmus not more than a mile long The total length of the island is 32m., and its area is 386sq m. It is subject to damage from earthquakes and volcanic eruptions as are the neighbouring isles to the east, the Uliassers (pop., 20,000, largely Christian). Amboina is of Tertiary (Miocene) formation, and is traversed by mountain ranges (highest peaks Salhatu, 4,929ft, and Wawani) of fine-grained granite, with serpentine, magnesite, etc. The chalk cliffs round Amboina Bay have stalactite caves; the rivers are small and unnavigable, there are hot springs and solfaturas, but no active volcanoes. The climate is comparatively healthy and not unpleasant, the mean maximum temperature being 84·6° and the mean minimum 73·4°, whilst a minimum of 66·6° has been registered. The hottest time is in February, the wettest in June–July (during the east monsoon with very strong winds) and the average yearly rainfall is 135·63 in. The mammalian fauna of Amboina is very poor, but birds include a fine racquet-tailed kingfisher, *Tanysiptera nais*, described by A. R. Wallace as "the largest and handsomest" of this family. It has also a crimson lory, *Eos rubra*, and a brush-tongued parrot, of vivid crimson colour, and it is rich in insects, particularly Lepidoptera, and in shells. There are 700 varieties of fish in the Bay of Amboina, under which, at the eastern end, are very fine marine gardens. The profuse vegetation varies on different sides of the island. Spice trees are grown, principally clove and nutmeg, fruit trees, and coconut palms, maize, sugar-cane, rice, also coffee and cocoa. Cloves and copra are the chief exports. The natives live largely on fruit and vegetables and sago —the sago being imported from Ceram. Amboina wood, very hard and knotty, and of great value for ornamental wood-work, is obtained from Ceram, and exported. Goats and sheep are kept, and pigs in the Christian villages, fishing provides a living for a numerous class, and shells and turtle-shells are collected. Pop. 114,297 (Europeans and Eurasians 2,290), almost entirely Christian in the south and Mohammedan in the north. The Amboinese are a strong and thick-set race, with dark skin, curly or wavy hair, flat nose and thick lips. The women are slender in build, but not good-looking. The men wear a cotton jacket and trousers; the women a *sarong* and *kabayah*.

Amboina, the town, and residence of the Resident and Commander of the forces in the Moluccas, is a clean and well-built place, with wide, straight streets, often tree-lined, and many houses and business premises of stone; Ft. Victoria, built in the early 17th century and restored later; a church dating from the earliest settlement, a hospital, barracks (within the fort), and many Government buildings, a commodious club, and two good parks. In Amboina G E. Rumph (Rumphius) the well-known naturalist, lived and died, and a monument commemorates the fact. The town is at the head of the bay, which, at its entrance, is 5½m. in width and continues so for 10m, when it contracts and forms a narrow passage leading into an inner harbour 3m. long by 1¼ broad. The town and port is on the eastern side of the bay, a mile short of the entrance to the inner harbour and about 8m from the outer entrance. The depths in the outer bay are very great and anchorages are few, but safe. The port is well equipped with wharves and warehouses, has a regular connection with Java, Sumatra, Borneo and Celebes, as well as with the rest of the archipelago, and is the chief centre for the shipment of Moluccan produce and for the distribution of imports from Europe and America. Pop. 11,726—1,453 Europeans (and Eurasians), 8,804 natives, and 1,469 foreign Asiatics, including Chinese, engaged in agriculture, fisheries and trade. There are roads sufficient for local needs, a government wireless station and a telephone system.

The clove trade of Amboina led the Portuguese to the island, Antonio d'Abreu arriving there and departing with a cargo of cloves in the same year (1510) as that in which Albuquerque captured Malacca. The Portuguese gave the place its name and founded a settlement (1521), but their policy of ruthless repression made it easy for the Dutch to arrange with the Sultan of Ternate, recognizing him as suzerain over Amboina and other Moluccan islands, and, in 1600, with the chiefs of Amboina. This enabled them first to dispossess the Portuguese and then to bring the Amboinese within their power. In 1615 a British settlement was formed on the other side of the island at Cambello (the Dutch were on the Amboina town site) and it remained there until 1623, when the Dutch, who aimed at establishing a clove monopoly, claimed to have discovered British participation in a native revolt in Ceram, and in the Bandanese island of Run, and massacred the settlers. The massacre was unnoticed by James I., but in 1654 Cromwell compelled the Dutch government to give the sum of £300,000, and the island of Run, as compensation to the descendants of those who had suffered. Dryden (1673) wrote a tragedy, *Amboyna, or the Cruelties of the Dutch to the English Merchants*. In 1683 the Dutch declared all contracts with the Sultan of Ternate void, and took over his suzerainty of Moluccan islands, Amboina included. In 1796 the British, under Admiral Rainier captured the island, but it was restored in 1802, re-taken in 1810, during the Napoleonic War, and once again restored to the Dutch in 1814. (E. E. L)

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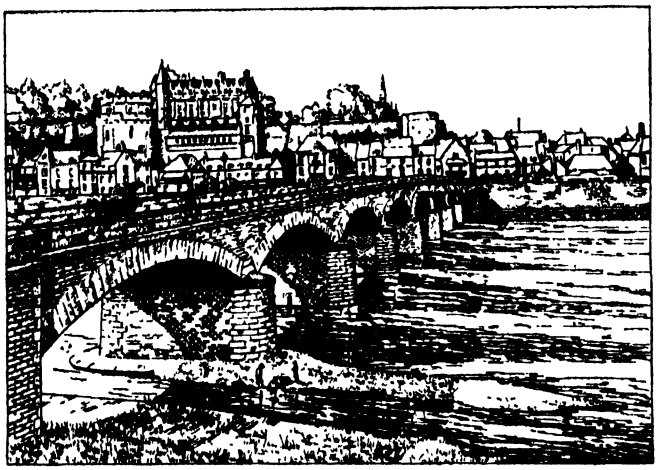
AMBOISE, GEORGES D' (1460–1510), French cardinal and minister of State, was the son of Pierre d'Amboise, seigneur de Chamont, chamberlain to Charles VII. and Louis XI. Georges d'Amboise was bishop of Montauban, then archbishop of Narbonne, and then (1493) of Rouen. On the accession of Louis XII., to whose party he had belonged before Louis was king, D'Amboise became a cardinal and first minister of the crown. His domestic policy was wise and prudent. In foreign affairs he was animated by two aims—to increase the French power in Italy and to seat himself on the papal throne; and these aims he sought to achieve by diplomacy, not by force. He, however, sympathized with, and took part in, the campaign which was begun in 1499 for the conquest of Milan. In 1500 he was named lieutenant-general in Italy and charged with the organization of the conquest. On the death of Alexander VI. he aspired to the papacy. He had French troops at the gates of Rome, by means of which he could easily have frightened the conclave and induced them to elect him; but he was persuaded to trust to his influence; the troops were dismissed, and an Italian was appointed as Pius III; and again, on the death of Pius within the month, another Italian, Julius II., was chosen (1503). D'Amboise received in compensation the title of legate for life in France and in the Comtat Venaissin He was one of the negotiators of the disastrous treaties of Blois (1504), and in 1508 of the League of Cambrai against Venice. In 1509 he again accompanied Louis XII. into Italy, but on his way home he died at Lyons on May 25, 1510. His body was removed to Rouen, and a magnificent tomb, on which he is represented kneeling in the attitude of prayer, was erected to his memory in the cathedral

See *Lettres du roi Louis XII. et du cardinal d'Amboise* (1712); L. Legendre, *Vie du cardinal d'Amboise* (Rouen, 1726); J. A. Deville, *Tombeaux de la cathédrale de Rouen* (3rd ed., 1881); E. Lavisse, *Histoire de France* (vol. v. by H. Lemonnier, 1903). For a bibliography of the printed sources, *see* H. Hauser, *Les Sources de l'histoire de France, XVIe siècle*, vol. i. (1906).

AMBOISE, a town of France, dept. of Indre-et-Loire, on the left bank of the Loire, 12m. E. of Tours by the Orléans railway. Pop. (1926) 4,284. Its famous château overlooks the Loire from the rocky plateau above the town. In the 11th century Amboise was a lordship under the counts of Anjou, who rebuilt the ancient castle. Its territory was united to the domain of the crown of France by Charles VII. about the middle of the 15th century, and thenceforth the château became a favourite residence of the French kings. The discovery in 1560 of the "conspiracy of Amboise," a plot of the Huguenots to remove Francis II. from the influence of the house of Guise, was avenged by the death of 1,200 members of that party. In 1563 Amboise gave its name to a royal edict allowing freedom of worship to the Huguenot nobility and gentry. The château was frequently used as a state prison. In 1872 it was restored by the National Assembly to the house of Orléans. The Logis du Roi, the most important portion, was the work of Charles VIII.; the other wing was built under Louis XII. and Francis I. The ramparts are strengthened by two massive towers containing an

inclined plane on which horses and carriages may ascend. The chapel of St. Hubert, said to contain the remains of Leonardo da Vinci, who was summoned to Amboise by Francis I., king of France, and died there in 1519, is late Gothic; a delicately carved relief over the doorway represents the conversion of St. Hubert. The town has a 15th-century gateway surmounted by a belfry. Iron-founding, wool-weaving and the manufacture of boots and



AMBOISE, FRANCE, SCENE OF MANY STIRRING HISTORIC EVENTS, WITH THE CHATEAU, FAMOUS AS A RESIDENCE OF THE FRENCH KINGS, IN THE LEFT BACKGROUND

shoes, sabots, and farm and fishing implements are among the industries.

AMBRACIA (more correctly Ampracia), an ancient Corinthian colony in Epirus about 7m. from the Ambracian gulf, on the navigable river Aracthus, in a fertile wooded plain. It was founded between 650 and 625 B.C. by Gorgus, son of the Corinthian tyrant Cypselus. After expulsion of Gorgus's son Periander its Government developed into a strong democracy. Early features were loyalty to Corinth, consequent aversion to Corcyra, and frontier disputes with Amphilochians and Acarnanians. Hence it took a prominent part in the Peloponnesian War until the defeat at Idomene (426). In 338 it surrendered to Philip of Macedon. After forty-three years of autonomy under Macedonian suzerainty it became the capital of Pyrrhus, king of Epirus, who adorned it with a palace, temples and theatres. In the wars of Philip V. of Macedon and the Epirotes against the Aetolian league (220–205), Ambracia ultimately joined the Aetolians, and during their struggle against Rome it stood a stubborn siege. After its capture in 189, it fell into insignificance. The foundation by Augustus of Nicopolis (*q.v.*), into which the remaining inhabitants were drafted, left the site desolate. In Byzantine times a new settlement took its place under the name of Arta (*q.v.*).

BIBLIOGRAPHY.—Thucydides ii. 68–iii. 114; Aristotle, *Politics*, 1,303a *sqq.*; Strabo p. 325; Polybius xxii. 9–13; Livy xxxviii. 3–9; G. Wolfe, *Journal of Geographical Society*, iii. (1833) pp. 77–94; E. Oberhummer, *Akarnanien, Ambrakien*, etc., *im Altertum* (Munich, 1887).

AMBRIDGE, a borough of Beaver county, Pa., U.S.A., on the Ohio river and the Pennsylvania railroad, 16 m. N.W. of Pittsburgh, opposite to the borough of Woodlawn. It lies on a wide plain, 755ft. above sea-level, and 70ft. above the river. The population in 1920 was 12,730, of whom 4,545 were foreign-born whites, and was estimated at 16,993 in 1925. Its factories in 1925 produced 575,798 tons of finished products, valued at $58,536,511, including such commodities as structural steel for bridges, buildings and barges; bare and insulated wire and cable; flexible steel conduit, carburettor tubing, asbestos-protected metal, electric conduit and fittings, pig-casting machines, cold finished steel, mining and coal-handling machinery, skylights and ventilators.

Within the boundaries of Ambridge is the former village of Economy, founded in 1824 by the Harmony Society, under its leader, George Rapp, the German Communist. Under Rapp and his successor, R. L. Baker, the community built up substantial agricultural and manufacturing industries; but after 40 or 50 years the rule of celibacy and the lack of fresh converts resulted in dwindling numbers, and in 1906 the society was disbanded. Many of the original buildings are still standing, including the Great House, which is now owned by the State of Pennsylvania and maintained as an historical museum.

Ambridge was incorporated as a borough from part of Harmony township in 1905. It has a city-manager form of government.

AMBRIZ: *see* ANGOLA.

AMBRIZETE: *see* ANGOLA.

AMBROS, AUGUST WILHELM (1816–1876), distinguished musical historian, was born at Vysoké Myto, Bohemia. From 1850 onwards he became well known as a critic and essay-writer, and in 1860 he began working on his *magnum opus*, his *History of Music*, which was published at intervals from 1864 in five volumes, and reissued in a revised and enlarged edition in 1909. Ambros became professor of the history of music at Prague in 1869, and later occupied a similar position at Vienna, where he died.

AMBROSE, SAINT (340?–397), bishop of Milan, one of the greatest Fathers of the Church, was born a Roman citizen about 337–340 in Trèves, where his father was prefect of Gallia Narbonensis. His mother was a woman of intellect and piety. Ambrose was intended to follow his father's career and accordingly educated in Rome. He became consular prefect of Liguria and Emilia, with headquarters at Milan, where he made an excellent administrator. In 374 Auxentius, bishop of Milan, died, and the orthodox and Arian parties contended for the succession. An address delivered to them at this crisis by Ambrose led to his nomination to the see; though only a catechumen, he was baptized and duly installed as bishop of Milan. Having apportioned his money among the poor, he settled his lands upon the Church, but leaving his sister Marcellina tenant for life and committing the care of his family to his brother, he entered upon a course of study under Simplician, a presbyter of Rome, and devoted himself to the labours of the episcopate. An invasion of Goths compelled Ambrose and other churchmen to retire to Illyricum for a time. His eloquence soon found ample scope against the Arians. Gratian, the son of the elder Valentinian, took the same side; but the younger Valentinian, now a colleague in the empire, adhered to the Arians, and Ambrose failed to win him to orthodoxy. The Arian leaders Palladius and Secundianus, confident of numbers, persuaded Gratian to call a general council from all parts of the empire; but Ambrose in the end prevailed upon the emperor to remit the matter to a council of the Western bishops alone. A synod, composed of 32 bishops, was held at Aquileia in the year 381. Ambrose was elected president; and Palladius, being called upon to defend his opinions, declined, insisting that the meeting was a partial one, and that, since not all the bishops of the empire were there, the sense of the whole Christian Church could not be manifest. A vote was then taken, and resulted in Palladius and Secundianus being deposed.

Ambrose was zealous in combating the pagan reaction. Quintus Aurelius Symmachus, consul in 391, besought Valentinian II. to set up again the altar of Victory in the hall of the senate, to provide for the support of seven vestal virgins and to revive the pagan ceremonies. Ambrose, in a letter to Valentinian, countered this petition: both documents are extant.

Although the court rejected the religious tenets of Ambrose, it respected his statesmanship. When Maximus usurped supreme power in Gaul and meditated a descent upon Italy, Valentinian sent Ambrose to dissuade him: Ambrose was successful. On a second attempt of the same kind Ambrose was unsuccessful; the enemy entered Italy; Milan was taken. Justina and her son fled; Ambrose remained, and for the relief of the suffering populace he did not hesitate to cause the consecrated vessels used in the most sacred rites of the Church to be melted down: a memorable precedent often to be cited in Church history. Theodosius, the emperor of the East, espoused the cause of Justina, and regained the kingdom.

In 392, after the assassination of Valentinian and the usurpation of Eugenius, Ambrose fled; but when Theodosius proved victorious, the saint became a suppliant to the emperor for the pardon

of those who had followed Eugenius. Theodosius died at Milan in 395, and two years later (April 4, 397) Ambrose also passed away.

A man of pure character, vigorous mind, unwearying zeal and uncommon generosity, Ambrose ranks among the Fathers of the ancient Church, with Augustine, Jerome, and Gregory the Great; as one of the Latin "doctors," he is fitly compared with Hilary, whom he surpasses in statesmanship, if he falls below him in theology. Even in theology, however, his achievements are of no mean order, especially when we remember his juridical training and his comparatively late handling of Biblical and doctrinal subjects. In matters of exegesis he is, like Hilary, an Alexandrian; his chief productions are homiletic commentaries on the early Old Testament narratives, *e.g.*, of the Hexaëmeron and of Abraham, some of the Psalms, and the Gospel according to Luke. In dogmatic he follows Basil of Caesarea and other Greek authors, but nevertheless gives a distinctly Western cast to the speculations of which he treats. This is particularly manifest in the emphasis which he lays upon human sin and divine grace, and in the place which he assigns to faith in the individual Christian life. His chief works in this field are *De fide ad Gratianum Augustum, De Spiritu Sancto, De incarnationis Dominicae sacramento, De mysteriis.* His great spiritual successor, Augustine, whose conversion was helped by Ambrose's sermons, owes more to him than to any writer except Paul. Ambrose's intense realization of the dignity of the episcopal office furthered the growing doctrine of the church and the *sacerdotium,* while the prevalent asceticism of the day, continuing the Stoic and Ciceronian training of his youth, enabled him to promulgate a lofty standard of Christian ethics. Thus we have the *De officiis ministrorum, De viduis, De virginitate* and *De paenitentia.*

Ambrose has also left several funeral orations and 91 letters. Catching the impulse from Hilary and confirmed in it by the success of Arian psalmody, Ambrose composed several hymns, marked by dignified simplicity, which served as a fruitful model for later times. We cannot certainly assign to him more than four or five (*Deus Creator Omnium, Aeterne rerum conditor, Jam surgit hora tertia,* and the Christmas hymn *Veni redemptor gentium*) of those that have come down to us Each of these hymns has eight four-line stanzas and is written in strict iambic tetrameter. The attribution of the *Te Deum* to him, either as sole author or in collaboration with St. Augustine, has long since been discredited by all competent scholars.

On the Ambrosian ritual *see* LITURGY; on the Ambrosian library *see* LIBRARIES; on the church founded by him at Milan in 387 *see* MILAN. EDITIONS: The Benedictine (4 vols., Venice, 1748 ff) Migne, *Patrol. Lat.* xiv.-xvii.; P. A. Ballerini (6 vols., Milan, 1875 ff.). LITERATURE: Th. Forster, *Ambrose, B. of Mailand* (Halle, 1884) and art in Herzog-Hauck, *Realencyk.*, where the literature is cited in full; A. Ebert, *Gesch. der christlichlatein. Litt.* (2nd ed., 1889). O. Bardenhewer, *Patrologie* (2nd ed., 1891); A. Harnack, *Hist. of Dogma,* esp. vol. v.; W. Bright, *Age of the Fathers.*

AMBROSE (*c.* 1190), Norman poet, chronicler of the third crusade and author of a work called *L'Estoire de la guerre sainte,* which describes in rhyming French verse the adventures of Richard Coeur de Lion as a crusader. The poem is known to us only through one Vatican ms., and the credit for detecting its value belongs to Gaston Paris, although his edition (1897) was partially anticipated by the editors of the *Monumenta Germaniae Historica,* who published some selections in the 27th volume of their *Scriptores* (1885).

Ambrose followed Richard I. as a non-combatant, and not improbably as a court minstrel. He is surprisingly accurate in his chronology; though he did not complete his work before 1195, it is evidently founded upon notes which he had taken in the course of his pilgrimage. He is rather to be treated as a biographer than as a historian of the crusade in its broader aspects. None the less he is the chief authority for the events of the years 1190–92, so far as these are connected with the Holy Land. The *Itinerarium Regis Ricardi* (formerly attributed to Geoffrey Vinsauf, but in reality the work of Richard, a canon of Holy Trinity, London) is little more than a free paraphrase of Ambrose. Stubbs's edition of the *Itinerarium* (Rolls series, 1864) in which it is treated as an independent work, appeared before Gaston Paris published his discovery.

See the edition of *L'Estoire de la guerre sainte* by Gaston Paris in the *Collection des documents inédits sur l'histoire de France* (1897); the editor discusses in his introduction the biography of Ambrose, the value of the poem as a historical source, and its relation to the *Itinerarium.* R. Pauli's remarks (in *Monumenta Germaniae Historica. Scriptores,* xxvii.) also deserve attention. (H. W. C. D.)

AMBROSE (ANDREY SERTIS-KAMENSKIY) (1708–1771), archbishop of Moscow from 1761 to 1771, was famous for his interest in schemes for the alleviation of poverty in Moscow and as the founder of new churches and monasteries. A terrible outbreak of plague occurred in Moscow in 1771, and the populace began to throng round an image of the Virgin to which they attributed supernatural healing power. Ambrose, seeing that the crowding together spread the contagion, had the image secretly removed. The mob, suspecting that he was responsible for its removal, attacked a monastery to which he had retired, dragged him away from the sanctuary, and, having given him time to receive the sacrament, strangled him. Ambrose's works include a liturgy and translations from the Fathers.

AMBROSE (AMBROISE), AUTPERT (d. 778), French Benedictine monk. He became abbé of St Vincent on the Volturno "in the time of Desiderius, king of the Lombards." He wrote commentaries on the Apocalypse (see *Bibl. Patrum,* xiii. 403), on the Psalms, on the Song of Solomon; *Lives of SS. Paldo, Tuto and Vaso* (according to Mabillon); *Assumption of the Virgin; Combat between the Virtues and the Vices.*

BIBLIOGRAPHY.—Mabillon, *Acta sanct. Bolland.* III. ii. 259, 266; Georg Lommel, *Der ostfrankische Reformator Ambrosius* (Giessen, 1847); Bollandist *Bibl. hag. lat.* (1898), 61.

AMBROSE, ISAAC (1604–1663–4), English Puritan divine, vicar of Preston. Ambrose left his great church of Preston in 1654 and became minister of Garstang, whence he was ejected in 1662 with the two thousand ministers who refused to conform As a religious writer Ambrose has a vividness and freshness of imagination possessed by scarcely any of the Puritan Nonconformists. His *Looking to Jesus* long held its own in popular appreciation with the writings of John Bunyan.

AMBROSE THE CAMALDULIAN, the name by which Ambrogio Traversari (1386–1439), Italian humanist and ecclesiastic, is commonly known. Ambrogio was born at Portico, near Florence, and studied Greek under Emmanuel Chrysoloras. He entered the Camaldulian Order at 14, and became general of the order in 1431. His great work was the introduction of the Greek theologians' works to the church of the Renaissance by a series of translations to which he devoted his life. Those writings of the fathers which were available were often rendered into obscure and barbarous Latin, and many had not been translated at all. He produced a new version of the homilies of St. Chrysostom and of others of his works, and translations of Dionysius the Areopagite and other authors. Many of his mss. are preserved in the library of St. Mark's, Venice. He was a friend of Cosmo de Medici, at whose desire he reluctantly turned aside from the Greek fathers for a moment to make a Latin version of Diogenes Laertius. He died on Oct. 20 1439.

See G. Voigt, *Die Wiederbelebung des klass. Altertums,* 3rd ed. (1893); his *Epistolae* were published by Cannato (Florence, 1759) with a life by Mehus; Bollandist *Bibl. hag. lat.* (1898), 63; A Masius, *Über die Stellung des Kamaldulensers Ambrogio Traversari zum Papst Eugen IV. und zum Basler Konzil* (Döbeln, 1888); Savigny, *Geschichte rom. Rechts im Mittel.* (1850), vi. 422–424.

AMBROSIA, in ancient mythology, sometimes the food, sometimes the drink, of the immortals. The word has generally been derived from Gr *ἀ,* not, and *μ(β)ροτός,* mortal. A. W. Verrall, however, denies that there is any clear example in which the Greek word *ambrosios* necessarily means "immortal," and explains it as "fragrant," a sense which is always suitable. If so, the word may be derived from the Semitic *ambar* (ambergris), to which Eastern nations attributed miraculous properties. W. H. Roscher thinks that both nectar and ambrosia were kinds of honey. The name *Ambrosia* was also later applied by Dioscorides and Pliny to certain herbs, and has been retained in modern botany for a genus of plants from which it has been extended to the group

of dicotyledons called *Ambrosiaceae,* including *Ambrosia, Xanthium,* and *Iva,* all annual herbaceous plants represented in America. *Ambrosia maritima* and some other species occur also in the Mediterranean regions.

There is also an American beetle, the Ambrosia beetle, belonging to the family of Scolytidae, which derives its name from its cultivation of a succulent fungus, called ambrosia. Ambrosia beetles bore galleries into timber, and the wood-dust provides a bed for the fungus on which the insects and larvae feed.

AMBROSIAN CHANT, a general term applying to the particular type of liturgical music associated with the name of St. Ambrose, bishop of Milan, and introduced by him into the churches of his diocese. As to what it amounted to precisely considerable doubt exists, but it is generally agreed that St. Ambrose transplanted the singing of the Hallelujah and antiphonal singing from Greece into Italy, while he is also looked upon as the originator of the Responses. Otherwise the Ambrosian Chant seems to have had much in common with the Gregorian, which is regarded by some as having been merely a comprehensive revision of the then existing (7th century) ritual song, based on Ambrosian practice, although doubtless including much which had been added after St. Ambrose's death (397). St. Ambrose was also responsible for the introduction of hymn-singing, as distinguished from the chanting of the Psalms and the canticles, as an essential feature of the music of public worship in the Western Church, and wrote many hymns himself, though the number of genuine examples to be ascribed to him is less than has sometimes been stated. (*See* also AMBROSE, SAINT; GREGORY [Pope]; and PLAIN-SONG.)

AMBROSIANS, the name given to several religious brotherhoods which at various times since the 14th century have sprung up in and around Milan; they have about as much connection with St. Ambrose as the "Jeromites" who were found chiefly in upper Italy and Spain have with their patron saint. Only the oldest of them, the Fratres S. Ambrosii ad Nemus, had anything more than a very local significance. This order is known from a bull of Gregory XI. addressed to the monks of the church of St. Ambrose outside Milan. These monks, it would appear, though under the authority of a prior, had no rule. Their discipline became so slack that an appeal was made to Cardinal Borromeo asking him to reform their houses. By Sixtus V. the order was amalgamated with the congregation of St. Barnabas, but Innocent X. dissolved it in 1650.

The name Ambrosians is also given to a 16th century Anabaptist sect, which laid claim to immediate communication with God through the Holy Ghost. Basing their theology upon the words of the Gospel of St. John i. 9 ("There was the true light which lighteth every man coming into the world"), they denied the necessity of any priests or ministers to interpret the Bible. The doctrine of the Ambrosians may be compared with the "inner light" doctrine of the Quakers

See Herzog-Hauck's *Realencyklopädie,* i. 439.

AMBROSIASTER. A commentary on St. Paul's epistles, "brief in words but weighty in matter," and valuable for the criticism of the Latin text of the New Testament, was long attributed to St. Ambrose. Erasmus in 1527 threw doubt on the accuracy of this ascription, and the author is usually spoken of as Ambrosiaster or pseudo-Ambrose. Owing to the fact that Augustine cites some parts of the commentary on Romans as by "Sanctus Hilarius" it has been ascribed by various critics at different times to almost every known Hilary.

See Souter, *Study of Ambrosiaster* (1905), with references given there.

AMBROSIUS AURELIANUS, leader of the Britons against the Saxons in the 5th century, was, according to the legends preserved in Gildas and the *Historia Brittonum,* of Roman extraction. There are signs of the existence of two parties in the national opposition to the invaders, but as Pascent, son of Vortigern, is said by Nennius to have held his dominions in the west by leave of Ambrosius, the Roman element seems to have triumphed. It has been suggested that Amesbury in Wiltshire is connected with Emrys, the Celtic form of his name.

See Bede, *Eccl. Hist.* (Plummer) i. 16; *Nennius, Hist. Britt.* § 31; Gildas, *De excidio Brittarium,* § 25; J. Rhys, *Celtic Britain* (1884), pp. 104, 105, 107.

AMBRY. An ambry in mediaeval churches was a wall-niche or recess near the altar in which the sacred vessels were kept. Large churches and cathedrals had numerous ambries fitted with shelves and richly carved doors, where consecrated oils, vestments, holy relics, books or linen were stored. Occasionally an ambry was a chest or cupboard hung near the altar. Variant forms of the word are almery, aumbry and armaliorum.

AMBULANCE, a term applied in England and America to the wagon or other vehicle in which the wounded in battle, or those who have sustained injuries in civil life, are conveyed to hospital. More strictly it signifies a hospital establishment moving with an army in the field, to provide for the collection, treatment and care of the wounded on the battlefield, and of the sick, until they can be removed to hospitals of a more stationary character. In 1905–06 the term "field ambulance" was adopted in the British service to denote this organization. The description of the British service given below applies to the system in vogue in the army after the experience gained in the World War.

The ambulance organization which, variously modified in details, now prevails in all civilized armies, only dates from the last decade of the 18th century. Hitherto surgical assistance did not reach the battlefield till the day after the engagement, or even later. In 1792 Baron Dominique Jean Larrey (1766–1842) of the French army introduced his system of *ambulances volantes,* or flying field hospitals, like the "flying artillery" of that time. They were adapted both for giving the necessary primary surgical treatment and for removing the wounded quickly from the sphere of fighting. A corps of *brancardiers,* or stretcher-bearers, was organized about the same time.

Geneva Convention.—An important step towards the amelioration of the condition of the wounded of armies in the field was the European convention signed at Geneva in 1864, by the terms of which, subject to certain regulations, the wounded and the official staff of ambulances and their equipment were declared neutral.

The American Civil War marked the beginning of the modern ambulance system. The main feature of the hospital organization throughout that war was the railway hospital service. Hospital trains and ships equipped with medical staff, nurses, stores and appliances, for the transport of cases from the front to the base, were rapidly introduced into other armies.

In the Japanese army a special feature is the sanitary corps, whose duty is the prevention of disease among the troops; it has been brought to a great pitch of perfection, with the result that in the Russo-Japanese War (1904–05) the immunity of the troops from all forms of preventable disease surpassed all previous experience. Not only was the army accompanied by sanitary experts who advised on all questions of camping grounds, water supply, etc., but before the war began the Intelligence Department collected information as to the diseases of the country likely to be the scene of operations, unhealthy places to be avoided, etc.

British Army System.—Coming now to the ambulance system of the British army, we shall trace the progress of a wounded man from the field of battle to his home.

When a soldier is wounded the regimental surgeon and stretcher-bearers apply the "first field dressing"—a packet of antiseptic material which every officer and man on active service carries stitched to his tunic. From the field he walks or is carried on a stretcher by bearers of the Royal Army Medical Corps to the collecting station, where he is placed on an ambulance wagon and taken to the dressing station. Here his wound is examined if necessary, but as on the field the first medical officer who examined him has already attached a "specification tally" to the patient, giving particulars of the wound, it will probably not be disturbed. Any urgent operation, however, will be here performed, nourishment, stimulants and opiates administered if required, and the patient moved to the field hospital in an ambulance wagon. From the field hospital he is transferred as soon as possible by ambulance train to the general hospital at the advanced base of operations,

and from there, by one or more stages, he is ultimately either returned to duty or sent home in a hospital ship. In warfare in hilly or uncivilized countries special arrangements for transport of the wounded are adopted. The Indian Medical Service is self-contained, and by reason of caste restrictions special modifications have been introduced, but the general arrangements resemble those of the Home army.

Different regulations are made by various powers as to the work of the Red Cross societies under the Geneva flag (*see* RED CROSS). Whereas in Germany and France such aid is officially recognized and placed under direct military control, the English Red Cross societies have acted side by side with, but independently of, the military ambulance organization.

St. John Ambulance Association.—Great attention has been paid to civil ambulance organization in England. In 1878 the British ambulance association of St. John of Jerusalem was founded. Its object was to render first aid to persons injured in accidents on the road, railway or in any of the occupations of civil life. As the result of the initiative taken by this association, ambulance corps have been formed in most large towns of Great Britain; and police, railway servants and workmen have been instructed how to render first aid pending the arrival of a doctor. The Association, whose headquarters are in Clerkenwell, London, has branches in most parts of the British empire.

Ambulance Wagons.—British ambulance wagons are built to convey four patients lying down, one seated, and the driver, or fourteen persons all seated. The Indian ambulances are small two-wheeled carts drawn by two bullocks or mules; very strongly made, they are capable of holding two men lying down or four sitting up, besides the native driver.

AMBULATORY, the covered passage round a cloister, or the aisle or procession way around the east end of a church choir behind the altar.

AMBUSCADE, an alternative form of ambush (*q.v.*).

AMBUSH (older form, "embush," O Fr. *embusche*, from the Ital. *imboscata, in* and *bosco,* a wood), the hiding of troops, primarily in a wood, and so any concealment for the purpose of a sudden surprise attack.

AMEBIASIS or **AMOEBIASIS:** *see* PARASITIC DISEASES.

AMEDEO FERDINANDO MARIA DI SAVOIA, DUKE OF AOSTA (1845–90), third son of Victor Emmanuel II., king of Italy, and of Adelaide, archduchess of Austria, was born at Turin May 30 1845. In 1868 he was created vice-admiral of the Italian Navy, but two years later left Italy to ascend the Spanish throne, his reluctance to accept the invitation of the Cortes having been overridden by the Italian cabinet. On Nov. 16 1870 he was proclaimed king of Spain by the Cortes; but before he could arrive at Madrid Marshal Prim, chief promoter of his candidature, was assassinated.

Though warned of a plot against his life (Aug. 18 1872) he refused to take precautions, and while returning from Buen Retiro to Madrid in company with the queen was repeatedly shot at in the Via Avenal, but escaped unhurt. A period of calm followed the outrage. On Feb. 11 1873, however, Amedeo, abandoned by his partisans and attacked more fiercely than ever by his opponents, signed his abdication. Upon returning to Italy he was cordially welcomed and reinstated in his former position. His wife, born Princess Maria Carlotta del Pozzo della Cisterna, died Nov. 3 1876. On Sept. 11 1888, Amedeo contracted a second marriage with his niece Princess Letitia Bonaparte. Less than two years later (Jan. 18 1890) he died at Turin, leaving four children—the duke of Aosta, the count of Turin, the duke of the Abruzzi (issue of his first marriage), and the count of Salemi.

AMELIE-LES-BAINS, watering place, south-west France, in the department of Pyrénées-Orientales, at the junction of the Mondony with the Tech. 28½m. south-south-west of Perpignan by rail. Pop. (1926) 1,484. It has numerous warm sulphurous springs and both a winter and summer season. There are two bathing establishments, one of which preserves remains of Roman baths. The town was known successively as Arles-les-Bains, Bains-sur-Tech and Fort-les-Bains, and received its present name in 1840 in honour of the wife of Louis-Philippe.

AMELOT DE LA HOUSSAYE, ABRAHAM NICOLAS (1634–1706), French historian and publicist, was born at Orleans in Feb. 1634 and died in Paris on Dec. 8, 1706. His most important work is *Histoire du gouvernement de Venise* (1676), which called forth a violent protest from the Venetian ambassador in Paris. The author spent six weeks in the Bastille, but the popularity of the book was increased by the publicity given to the affair. It went through 22 editions in three years, and was translated into English and other languages.

AMEN. This old Hebrew expression has become "perhaps the most widely known word in human speech," being used today in worship not only by Jews but by Christians and, in a minor degree, by Mohammedans. (*a*) As a religious term expressing affirmation and desire it signifies (as in the Greek translation of the O.T.) "so be it"; (*b*) but essentially it was an interjection of *assent*—"so it is," or "so it will be," even of secular application (1 Ki. i., 36; Jer. xi, 4, xxviii., 6) in the sense of "yes." The Hebrew verb means *to be firm,* or *sure;* also *to be trusted.* (1) The term is employed by the user to adopt as his own, words spoken by another; so in Tobit viii, 8; *cf.* Judith xiii, 20. As a response of the people at the close of a doxology or prayer uttered by the priest, it is found in Neh. viii., 6; 1 Chron. xvi., 36; *cf.* Ps. cvi., 48. This use, which became especially common in the Jewish synagogue, was developed by the Christian church. In 1 Cor. xiv., 16, St. Paul refers to "the Amen." Justin *c.* 150 A.D. writes: "The president likewise offers up prayers and thanksgivings, and the people answer the Amen" (*Apol.* I. 67; *cf.* 65). (2) Developed out of this use Amen is employed also by the *offerer* of thanksgivings and prayers, public and private, in order to sum up and thus to confirm what he himself has said. Signs of this use even in the O T. are to be seen in the detached doxology placed as *vv.* 18 and 19 of Ps. lxxii, and in the short doxologies with which the 3rd and 4th books of Maccabees end. It is found in Rom. i., 25; Gal. vi, 18, etc., and it has become exceedingly common with Christians. Like (1), as an aid in focusing the concentration of the worshipper, its value is obvious. With the growing popularity of hymns the use of Amen has been extended. (3) Unique, but in harmony with the meaning "so it will be," was the usage of Jesus Christ to *introduce* a statement of his own by "Amen" (translated "Verily"), "I say unto you" (or "thee"). In the Fourth Gospel uniformly, and only in that gospel, is the *double* and more emphatic "Verily, verily" (*e.g.,* iii. 3); *cf* the double Amen in Ps. xli, 13, etc. In Rev. iii, 14, the word Amen is applied, probably under the influence of Isa. lxv., 16, to Christ Himself; *i.e*, He in whom things become true—"the faithful and true witness"; *cf.* 2 Cor. i, 20. The nearest parallel to the Amen introducing a sentence is in Rev. i, 7, where the writer *closes* an affirmation thus: "Behold he cometh . . . Even so, Amen."

See Hogg, *Jew. Qrly. Rev*, Oct, 1896; Nestle, *Exp. Times*, 1897 pp, 190ff.; Dalman, *Worte Jesu* pp. 185–187 (Eng. trans pp. 226–229). (R. S. C.)

AMENDMENT, an improvement, correction or alteration (nominally at least) for the better. The word is used either of moral character or, more especially, in connection with "amending" a bill or motion in parliament or resolution at a meeting; and in law it signifies the correction of any defect in the record of a civil action or on a criminal indictment.

(*See* also AMERICAN LAW.)

AMENDOLA, GIOVANNI (1882–1926), Italian politician and journalist, was born at Naples, April 15 1882. He entered journalism at the age of 18, and eventually became Rome correspondent of the Milan *Corriere della Sera,* which he left in 1921 to found a paper of his own, *Il Mondo.* In 1919 he was elected deputy for Sarno in the province of Salerno and re-elected in 1921 and 1924. After the World War he devoted himself entirely to politics as a Democratic Liberal and a supporter of Nitti. On Nitti's fall, June 9 1920, he joined the opposition to Giolitti, and became minister for the colonies, first under Bonomi, then under Facta. He opposed Fascism from the first, and after Mussolini's advent to power he became in some sense the leader of the heterogeneous opposition groups. After the Matteotti crime he was the leader of those who withdrew from the Chamber to the Aventine

(*see* ITALY). His devotion to constitutional principles led him during the election campaign of 1924 to declare the electoral law enacted by the Fascist Government to be unconstitutional and therefore null and void. His two publications *Una battaglia liberale* (1924) and *La Democrazia dopo il 16 Aprile 1924* (1924) made known his political faith. His death in hospital at Cannes, April 6 1926, was thought to be the result of the two attacks on his life on Dec. 26 1923, in Rome, and in Aug. 1925, while on holiday at Montecatini.

AMENEMHET I., the ruler of Egypt who began the 12th Dynasty (*c.* 2212 B.C.?). His personal name was Sehetepibre, which shows that he was especially devoted to Amon (*q.v.*), the god of Epet. (See *Cambridge Ancient History,* vol. i. 2nd ed., 1924.)

AMEN HOTEP, I.–IV.: *see* EGYPT, *The New Empire.*

AMENORRHOEA is the absence of menstruation between the age of puberty and the menopause. In those who have never menstruated the cause of amenorrhoea is usually poor general health or anaemia. Occasionally it is found to be an abnormality in the development of the genital tract, and it has also been ascribed to glandular unbalance. Often no cause can be found. After the onset of menstruation by far the most common cause of missing a period is pregnancy. During acute diseases the period may be delayed or missed, and in the course of chronic debilitating diseases menstruation is often suppressed. Operative removal of uterus and ovaries, and certain diseases of the ovaries, also cause amenorrhoea. Strong emotions, especially the dread of pregnancy, may likewise account for it. Amenorrhoea in itself is not serious, but the condition causing it may require investigation and treatment.

AMEN-RE: *see* AMMON.

AMENTACEAE or **AMENTIFERAE.** This name was formerly used to include the families of plants which bear their flowers in catkins (*amenta*). It comprised the families *Salicaceae,* willows and poplars, *Juglandaceae,* walnut and hickory, *Betulaceae,* birch and alder, *Fagaceae,* oak, beech and chestnut. It is not used in the most modern systems of botanical classification.

AMERCEMENT or **AMERCIAMENT,** in English law, an arbitrary pecuniary penalty, inflicted in old days on an offender by the peers or equals of the party amerced. The word has in modern times become practically a poetical synonym for fine or deprivation. But an amercement differed from a fixed fine, prescribed by statute, by reason of its arbitrary nature; it represented a commutation of a sentence of forfeiture of goods, while a fine was originally a composition agreed upon between the judge and the prisoner to avoid imprisonment. The assessment of an amercement was termed an *affeerment.* In the lower courts the amercement was offered by a jury of the offender's neighbours (*affeerors*); in the superior courts by the coroner, except in the case of officers of the court, when the amount was affeered by the judges themselves. All judgments were entered on the court roll as "in mercy" (*sit in misericordia*). Articles 20 to 22 of Magna Charta regulated the assessment of amercements.

See Stephen, *Hist. Crim Law;* Pollock and Maitland, *Hist. Eng. Law;* McKechnie, *Magna Carta.*

AMERIA (mod AMELIA), Umbria, about 65m. N. of Rome on the Via Amerina (which diverged from the Via Cassia, passing through Castellum Amerinum, probably mod. Orte, where it crossed the Tiber) It has a fine position, 1,332ft. above sea-level, and still retains considerable remains of the city wall with jointed polygonal blocks of limestone. Roman remains include a large ten-chambered water reservoir. The lofty campanile of the cathedral was erected in 1050. Ameria is alluded to as a flourishing place, with a fertile territory extending to the Tiber, by Cicero in his speech in defence of Sextus Roscius Amerinus.

AMERICA, the general name by which the huge continent called the western hemisphere is now known. It is commonly agreed that the name is derived from that of the navigator, Amerigo Vespucci (*q.v.*). America is divided geographically and ethnologically into three parts: North America (Canada and the United States of America); Central America and South America. These three divisions will be found treated separately under their own names.

Physical Geography.—The accidental use of a single name, America, for the pair of continents that together have a greater north-south extension than any other continuous land area of the earth, gives some support to the theory of its tetrahedral deformation; for America, broadening in the north toward its neighbours on the east and west, and tapering far to the south toward the Antarctic continent, roughly presents the triangular outline that is to be expected from tetrahedral warping. There is, however, not a unity but a duality, in its plan; North and South America resemble each other roughly in geological evolution as well as in outline, their chief correspondences being: (1) the area of ancient fundamental rocks in the north-east (Laurentian highlands, Guiana), without great deformation since early geological times; (2) the area of south-eastern highlands (Appalachians, Brazil), with a crystalline belt near the ocean and more or less deformed Palaeozoic strata farther inland, both owing their present altitude to broad and modern geological uplifts; (3) the complex of younger mountains along the western coasts (Cordilleran highlands of both continents) of comparatively modern deformation and upheaval, associated with much volcanic activity; (4) confluent lower lands between the several highlands, with rivers flowing to the north (Mackenzie, Orinoco), east (St. Lawrence, Amazon), and south (Mississippi, La Plata). Differences are numerous, but they do not suffice to conceal the resemblance in general plan. Indeed, the chief differences between the two continents arise from their unlike position with respect to the equator. North America is bathed in frigid waters around its broad northern shores, its mountains in the north-west bear huge glaciers, the outlying north-eastern area of Greenland is shrouded with ice, and in geologically recent times a vast ice-sheet spread over its north-eastern third; while a warm and moist climate in its southern part gives it a torrid flora and fauna, and warm waters bring coral reefs to parts of its southern shores. South America has a torrid flora and fauna over its northern half and coral reefs on parts of its northern shores, while cold waters and glaciers characterize its narrowing southern end, where geologically recent glaciation has taken place.

The similarity of outline between the western margin of the Old World and the eastern margin of the Americas, long ago noticed, has in recent years been taken to support a daring theory of continental fragmentation, according to which the Atlantic is thought to occupy the space left vacant when America floated away westward from its original moorings.

The relation of the Americas to the rest of the world as the home of plants and animals is greatly affected by the breadth of the adjacent oceans. Between the parallels of 60° and 70°N., the east-and-west widening of North America forms more than a third of the almost continuous land ring around a zone of sub-Arctic climate; as a result there is a remarkable resemblance of plant and animal life in the high latitudes of North America and Eurasia. In strong contrast with this is the exceptional isolation of far southern South America, which but slightly interrupts a sub-Antarctic ocean ring; as a result, the land flora and fauna of South America to-day are strongly unlike those of the other south-ending continents.

For further treatment of the physical geography of the American continents, *see* NORTH AMERICA and SOUTH AMERICA. (W. M. D.)

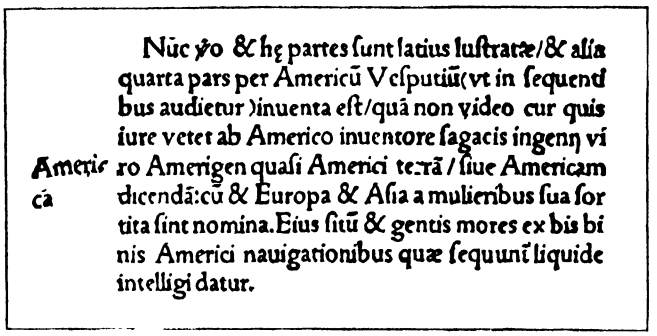
GENERAL HISTORICAL SKETCH

The name America was derived from that of Amerigo Vespucci (*q.v.*). In Waldseemueller's map of 1507 the name is given to a body of land roughly corresponding to the continent of South America. As discovery revealed the existence of another vast domain to the north, the name spread to the whole of the pair of continents, in spite of the protests of the Spaniards, by whom it was not officially used of North America till the 18th century.

Barring any trips which the Norse sea-rovers made, or may have made, to the Western continent, the discovery of America is justly dated, Oct. 12 (N.S.21) 1492, when Christopher Columbus (*q.v.*), the Genoese, made his landfall on the island of Guanahani, now identified with Watling island in the Bahamas. After many disappointments Columbus persuaded the catholic sovereigns, Ferdi-

nand and Isabella of Spain, to furnish him with a squadron of three small vessels. With it he sailed from Palos in Andalusia on Aug. 3, 1492, reached Guanahani on Oct. 12, touched on the coast of Cuba and on Hispaniola, established a small post, and returned to Lisbon on March 4, 1493, and thence to Spain.

It was the belief of Columbus and his contemporaries that he had reached the islands described by Marco Polo as forming the


Nūc ẏo & hę partes ſunt latius luſtratæ/& alia quarta pars per Americū Veſputiū(vt in ſequentibus audietur)inuenta eſt/quā non video cur quis iure vetet ab Americo inuentore ſagacis ingenij viro Amerigen quaſi Americi terrā / ſiue Americam dicendā:cū & Europa & Aſia a mulieribus ſua ſortita ſint nomina.Eius ſitū & gentis mores ex bis binis Americi nauigationibus quæ ſequunt liquide intelligi datur.

Americ
cā

FROM WALDSEEMULLER, "COSMOGRAPHIAE INTRODUCTIO," ST. DIE, MAY 1507

THE EARLIEST MENTION OF AMERICA

In his essay, "Cosmographiae Introductio," published in 1507, a geographer, Martin Waldseemüller, termed the western lands "America" after Amerigo Vespucolo who had referred to them for the first time as the New World in 1499

eastern extremity of Asia. Hence he spoke of the "Indies," and "las Indias" continued to be the official name given to their American possessions by the Spaniards for many generations His feat produced a diplomatic controversy with Portugal which was destined to have important political consequences. In 1454 Pope Nicholas V. had given the Portuguese the exclusive right of exploration and conquest on the road to the Indies. His bull contemplated only the use of the route by the coast of Africa to the south and east. After the return of Columbus and his supposed demonstration that the Indies could be reached by sailing west, disputes might obviously arise. The catholic sovereigns applied to Pope Alexander VI., a Spaniard, for a confirmation of their rights. The pope drew a line from north to south 100 leagues west of the Azores and Cape Verde islands, and gave the Spaniards the claim to all to the west (May 4, 1493). The Portuguese thought the division unfair to them, and protested. A conference was held between the two powers at Tordesillas in 1494, and by common consent the line was shifted to 370 leagues west of the Cape Verde islands. The boundary line is generally considered as the 50th degree of longitude west of Greenwich, which strikes the mainland of South America about the mouth of the Amazon. Thenceforward the Spaniards claimed the right to exclude all other peoples from trade or settlement "beyond the line."

Between Sept. 1493 and the time of his last voyage (May 1502 to Nov. 1504), Columbus explored the West Indies, reached the mainland of South America at the mouth of the Orinoco and sailed along the coast of Central America from Cape Honduras to Nombre de Dios (near Colon). Henry VII. of England allowed the Bristol merchants to fit out a western voyage under the command of another Genoese, John Cabot (*q.v.*), in 1497. The history of the venture is very obscure, but Cabot is thought to have reached Newfoundland and the mainland. Between 1500 and 1503 a Portuguese family of the name of Cortereal carried out voyages of exploration on the eastern coast of North America. In 1500 the Portuguese, Pedro Alvàrez Cabral, while on his way to the East Indies, sighted the coast of Brazil at Monte Pascoal in the Aimores, and took formal possession. The belief that the eastern extremity of Asia had been reached died slowly, and the great object of exploration in America continued to be the discovery of a passage through to the Spice islands, in order to compete with the Portuguese, who had reached them by the Cape route. The first Spanish settlement in Hispaniola spread to the mainland by the adventure of Alonso de Ojeda and Diego de Nicuesa in Darien in 1509. Cuba was occupied by Diego de Velasquez in 1511. In 1512 (or 1513) Juan Ponce de Leon made the first recorded exploration of the coast of Florida and the Bahama channel. In 1513 Vasco Nuñez de Balboa crossed the isthmus of Darien and saw the South Sea (Pacific). The hope that a passage through to the Spice Islands would be found near existing Spanish settlements was now given up. One was sought farther south, and in Nov. 1520 Ferdinand Magellan (*q.v.*) passed through the strait which bears his name and sailed across the Pacific. At last the existence of a continent divided by a vast stretch of ocean from Asia, and mostly lying within the sphere of influence assigned to Spain by the pope, was revealed to the world.

The first aim of the Spaniards had been trade with the Indies The *Casa de Contratacion,* a committee for the regulation of trade, was established at Seville in 1503. European plants and animals were introduced into Hispaniola and Cuba, and sugar plantations were set up. But the main object of the Spaniards was always gold, to be won by slave labour. As the surface gold of the islands was exhausted, and the feeble island races perished before the invaders, the Spaniards were driven farther afield. In 1519 Pedrarius Davila transferred the Darien settlement to Panama. In that and the following year the coasts of Yucatan and of the Gulf of Mexico were explored successively by Francisco Hernandez Córdova and Juan de Grijalva, who both sailed from Cuba. From Cuba it was that Hernan Cortes (*q.v.*) sailed on Feb. 10 or 18, 1519, for the conquest of Mexico. Hitherto the Spaniards had met only the weak islanders, or the more robust cannibal Caribs, both alike pure savages. In Mexico they found "pueblo" or town Indians who possessed an organized government and had made progress in civilization. The hegemony of the Aztecs, who dominated the other tribes from the central valley of Mexico, was oppressive. Cortes, the most accomplished and statesmanlike of the Spanish conquerors, raised the subject peoples against them. His conquest was effected by 1521. His example stimulated the settlers at Panama, who had heard of a great people owning vast quantities of gold to the south. Between 1524 and 1535 Francisco Pizarro (*q.v.*) and Diego de Almagro had completed the conquest of Peru, which was followed, however, by a long period of strife among the Spaniards, and of rebellions. From Peru the Spaniards advanced southwards to Chile, which was first unsuccessfully invaded (1535–37) by Diego de Almagro. Their advance to the south was checked by the indomitable opposition of the Araucanians, but from the southern Andes the Spaniards overflowed on to the great plains which now form the interior of the Argentine republic. The first permanent settlement at the mouth of the river Plate at Buenos Aires dates from 1580. In its main lines the Spanish conquest was complete by 1550. What the Spaniards had then overrun from Mexico to Chile is still Spanish America. Brazil, after a period of exploration which began in 1510, was gradually settled by the Portuguese. The vast territories acquired by Spain in this brief period were held to be, by virtue of the pope's bull, the peculiar property of the sovereign. In 1509 the Council of the Indies was established, but it did not take its final form till 1524. It consisted of a president, with a board of advisers, who possessed legislative and administrative powers, and who varied in number at different times. The *Casa de Contratacion,* another board regulated the trade. In America the Crown was represented by governors. After the preliminary period of conquest the whole of the Spanish possessions were divided into the two "kingdoms" of New Spain—consisting of Venezuela and the Spanish possessions north of the isthmus—and of New Castile, a title soon changed to Peru, which included the Central American isthmus and all of South America except Venezuela and Brazil. Each was ruled by a viceroy. As the Spanish dominions became more settled, the viceroyalty of Peru was found to be unwieldy. New Granada (which included the present republics of Venezuela, Colombia and Ecuador) was created a viceroyalty in 1718 (soon abolished, but re-created in 1740). A fourth viceroyalty for the river Plate was formed in 1778. Other governments known as captain-generalships were cut out of the viceroyalties at different periods.

The government of Spain administered its dominions from the beginning in the strictest spirit of the "colonial system." The Indies were expected to supply precious metals and raw mate-

rials, and to take all manufactures from the mother country. In order to facilitate the regulation of the trade by the *Casa de Contratacion,* it was concentrated first in Seville, and when the Guadalquivir was found to be becoming too shallow for the growing tonnage of ships, at Cadiz. Merchant vessels were required for their protection to sail in convoy. The convoys or *flotas* sailed in October first to Cartagena in South America, and thence to Nombre de Dios or, in later times, Porto Bello. The yearly fairs at these places received the imports from Europe and the colonial trade of the Pacific coast, first collected at Panama and then carried over the isthmus. From Nombre de Dios or Porto Bello the convoys went to La Vera Cruz for the trade of New Spain, and returned home in July by the Florida straits. One-fifth of the produce of the mines belonged to the Crown. The collection of this bullion was at all times a main object with the Spanish government, and more especially so after the discovery of the great silver deposits of Potosi in Bolivia. Forced labour was required to work them and the natives were driven to the toil.

The Portuguese settlement in Brazil was more purely colonial than the Spanish possessions. Until 1534 little was done to regulate the activity of private adventures. In that year the coast was divided into captaincies, which were united under a single governor-general in 1549. Between 1572 and 1576 there were in Brazil the two governments of Rio de Janeiro and Bahia; but its history is of little importance till the occupation of Portugal by Philip II. drew the country into the wars of the Spanish monarchy.

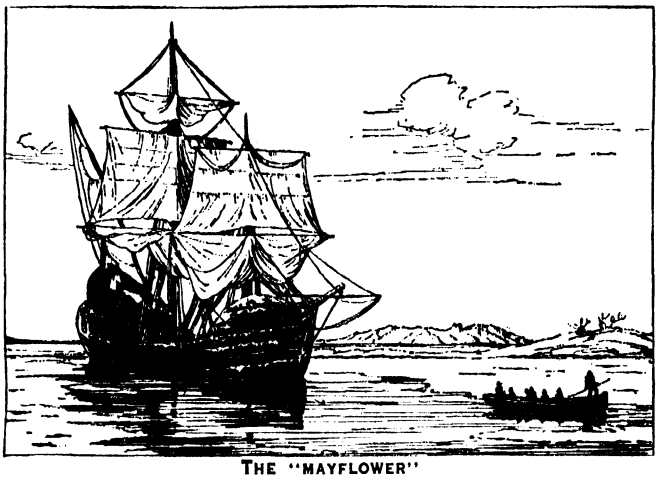
The claim of the peninsula powers to divide the American continent between them, based as it was on an award given in entire ignorance of the facts, would in no case have been respected. As England was in general alliance with the sovereigns of Spain during the early 16th century, Englishmen turned their attention at first towards the discovery of a route to the Spice islands round the north of Asia. But the rivalry of Francis I. and Charles V. gave France a strong motive for assailing the Spaniards in the New World. King Francis encouraged the ill-recorded and disputed voyages of the Florentine Giovanni da Verrazano in 1524, and the undoubted explorations of Jacques Cartier. Between 1534 and 1542 this seaman, a native of St. Malo, explored the Strait of Belle Isle and the Gulf of St. Lawrence, and visited the Indian village of Hochelaga, now Montreal. The claims of France to the possession of a great part of the northern half of America were based on the voyages of Verrazano and Cartier. The death of King Francis, and the beginning of the wars of religion, suspended colonial enterprise under royal direction. But the Huguenots, under the inspiration of Coligny, made three attempts to found colonies to the south—at Rio de Janeiro (1555–67), near the present Beaufort, South Carolina (1562), and in Florida (1565). These ventures were ruined partly by the hostility of the Spaniards and Portuguese, partly by the dissensions of the colonists. Meanwhile, French corsairs from St. Malo and Dieppe had been active in infesting the West Indies and the trade route followed by the Spanish convoys. After the accession of Queen Elizabeth, and the beginning of the breach between England and Spain, they were joined by English sea-rovers. The English claimed the right to trade with all Spanish possessions in or out of Europe by virtue of their treaty of trade and amity made in the reign of Charles V. The Spaniards maintained that there was "no peace beyond the line," *i.e.,* Pope Alexander's line as finally fixed by the conference at Tordesillas. The English retaliated by armed smuggling voyages.



FROM A MURAL PAINTING BY CHARLES Y. TURNER IN THE HOTEL RALEIGH, WASHINGTON, D.C.

THE DEPARTURE OF RALEIGH'S COLONISTS FROM ENGLAND IN 1585

In 1585 Sir Walter Raleigh sent a group of colonists to Virginia in the hope of establishing a permanent settlement. But the new land offered so many hardships that the colonists sailed home with Sir Francis Drake the following year, just before a relief ship arrived at Roanoke Island in search of them



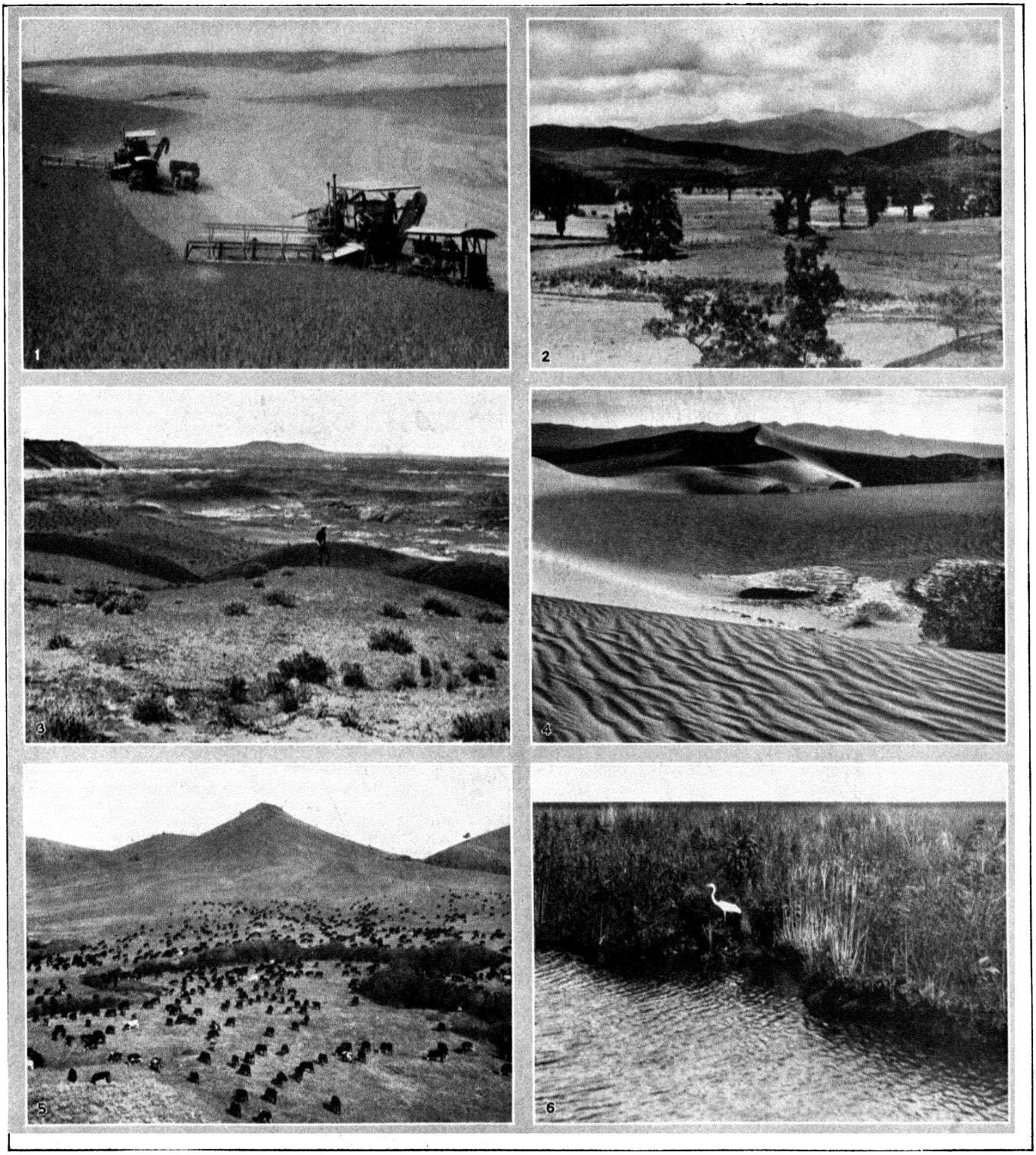
THE "MAYFLOWER"

In 1620, 35 years after the Raleigh expeditions, and 118 years after Columbus landed at San Salvador, a party of pilgrims sailed from Southampton on the "Mayflower" for the New World. A voyage of 65 days brought them to the shores of North America, and after exploring the coast they settled at Plymouth

It was, however, not till late that they attempted to found permanent settlements. In 1578 Sir Humphrey Gilbert obtained a patent for discovery and settlement. In 1583 he perished in an effort to establish a colony in Newfoundland. His work was taken up by his half-brother, Sir Walter Raleigh, in 1584. Between 1586 and 1603 Sir Walter made successive efforts to settle a colony in the extensive territory called Virginia, in honour of Queen Elizabeth. His colony at Roanoke, in what is now North Carolina, was unsuccessful, and after his fall his patent reverted to the Crown, but the new Virginia company carried on his schemes. In 1607 the first lasting settlement was made in Virginia, and after a struggle began to flourish by the cultivation of tobacco.

In 1620 another settlement was made. A small body of religious dissentients, 101 men, women, and children, secured leave from the Virginia company to plant themselves within its bounds. They sailed in a single ship, the "Mayflower," and landed near Cape Cod, where they founded the colony of Plymouth, afterwards (1621) obtaining a patent from the council for New England. From these two centres, and from later settlements, arose the "plantations" of the English, which gradually increased to the number of 13 and were destined to become the United States of America.

The English colonies, though divided by interest or character, were all alike jealous to defend, and eager to extend, their freedom of self-government, based on charters granted by the Crown. The settlers by degrees threw off the control of the proprietors who had received grants from the Crown and had promoted the first settlements. It was a marked characteristic of the English colonists, and a strong element in their prosperity, that they were hospitable in welcoming men of other races—Germans from the Palatinate, and French Huguenots driven out by persecution who brought with them some capital, more intelligence, and enduring hatred of Roman Catholic France. Though the British Government gave, more or less unwillingly, a large measure of self-government to the plantations, it was no less intent than the Spanish Crown on retaining the whole colonial trade in British hands, and on excluding foreigners. Two foreign settlements within the English sphere—the Dutch colony

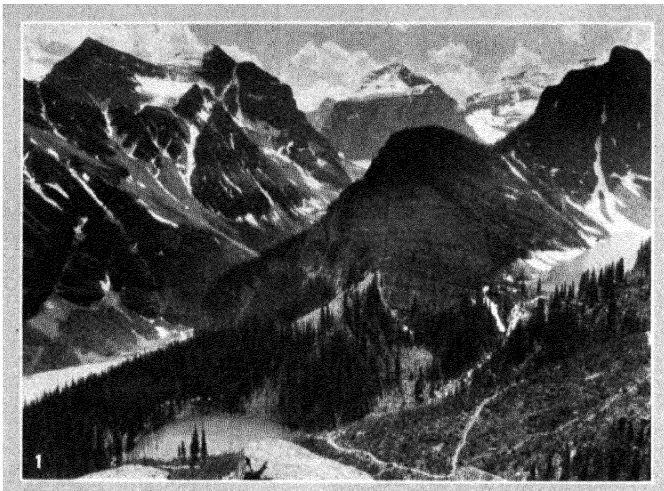


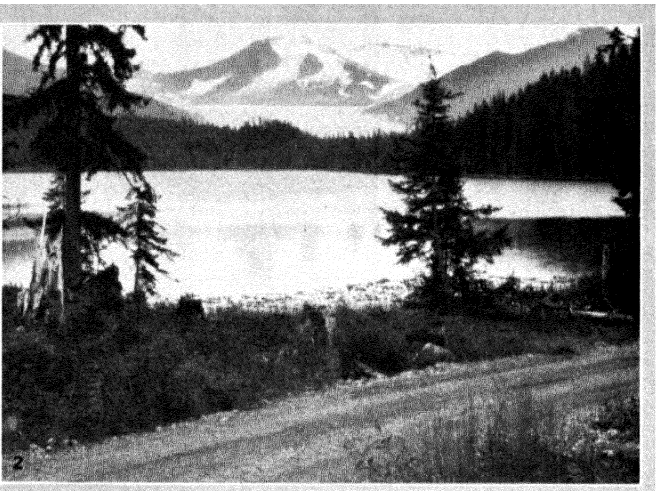
BY COURTESY OF (1) THE CATERPILLAR TRACTOR COMPANY, (2, 3, 4, 6) EWING GALLOWAY, (5) BY SCHLECHTEN

TYPICAL SCENERY OF THE EASTERN AND WESTERN STATES IN THE UNITED STATES

1. Two "caterpillar" 30's pulling 16-foot cut combines in a 1,400 acre wheat field near Walla Walla, Washington, U.S.A.
2. Mt. Washington, the highest peak in the White Mountains (6,293 ft.), photographed from Intervale, New Hampshire
3. The Old Trail Highway, winding over the Painted Desert of Arizona, so named because of the richness of its coloring
4. Shifting sand dunes of Death Valley, California, surrounded by the Panamint Mountains. The lowest part of this valley is 210 feet below sea level and the temperature ranges from 30° F below zero in winter to 130° F above in summer
5. A large herd of cattle grazing on a ranch near Bozeman, Montana, U.S.A.
6. An everglades scene along the canal in West Palm Beach, Florida, showing an American egret, which is a native of that part of America

AMERICA









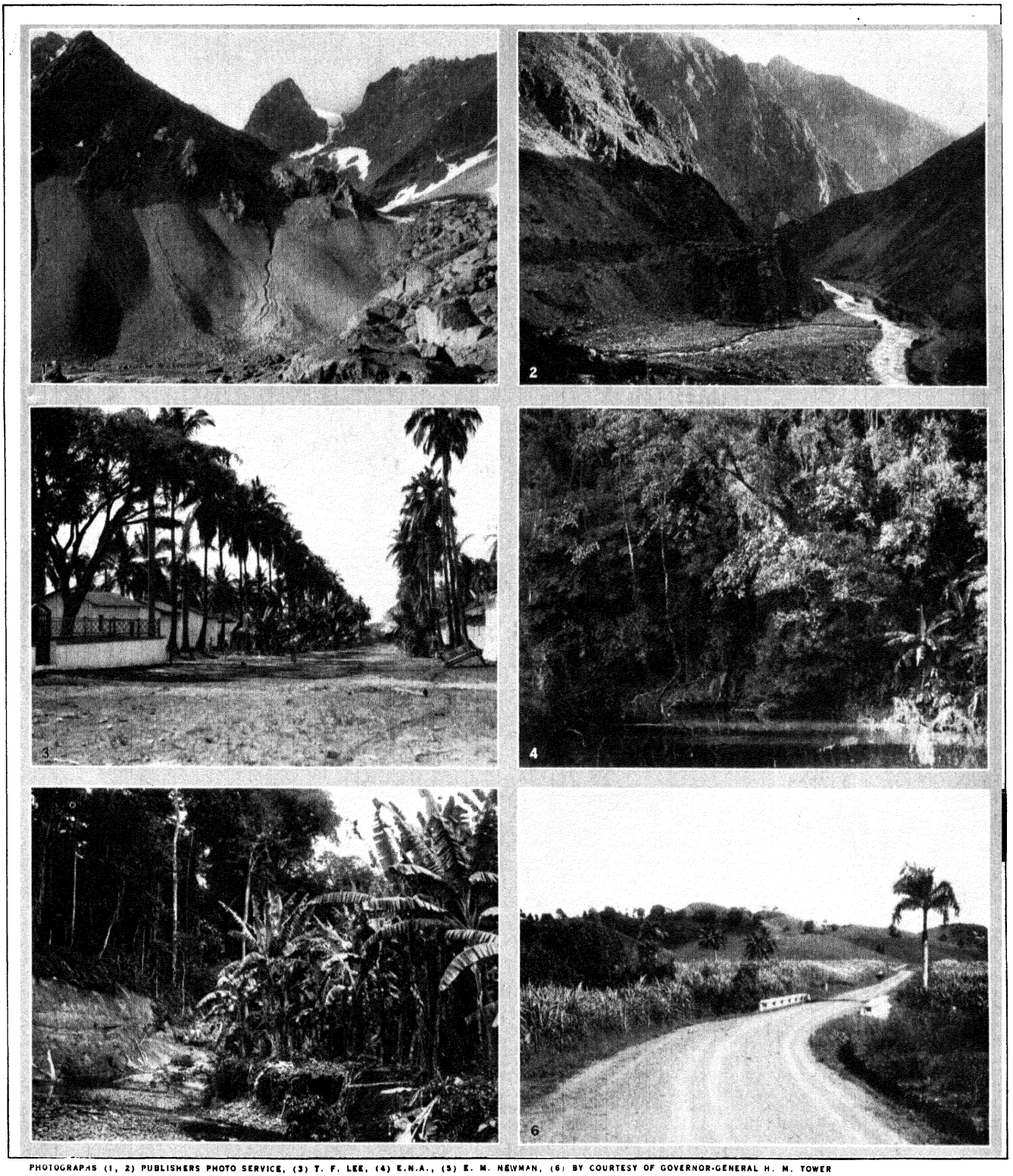




PHOTOGRAPHS (1, 6) EWING GALLOWAY, (2, 4, 5) PUBLISHERS PHOTO SERVICE, (3) VISUAL EDUCATION SERVICE

LAKE, BEACH AND RIVER SCENES IN NORTH AMERICA

1. Rocky Mountain scene in Canada showing Lake Louise, Mirror Lake and Lake Agnes from left to right taken from a point near the trail from Château Lake Louise. Big Bee Hive is the tree-covered peak near the centre of the picture
2. View of Auk Lake, near Juneau, Alaska
3. A large sand dune on the shore of Lake Michigan
4. Scene along the Indian River boulevard in Florida, U.S.A.
5. Looking down the Crescent river, Florida, U.S.A.
6. Mother Ann Profile in the rocks at Gloucester lighthouse, Gloucester, Mass.



PHOTOGRAPHS (1, 2) PUBLISHERS PHOTO SERVICE, (3) T. F. LEE, (4) E.N.A., (5) E. M. NEWMAN, (6) BY COURTESY OF GOVERNOR-GENERAL H. M. TOWER

SCENES IN CENTRAL AND SOUTH AMERICA

1. The highest Trans-Andean station on the Argentine side of the mountains
2. A canyon near Oroya on the Mantaro river in Peru
3. Quarters for workmen on a plantation in Honduras
4. A mangrove swamp and forest on a backwater of the Amazon in Brazil
5. A corner of a banana plantation in Colombia, South America
6. Cane and coffee plants bordering a road in Porto Rico



BY COURTESY OF CANADIAN NATIONAL RAILWAYS

MENDENHALL GLACIER, A RIVER OF ICE, OVER A MILE IN WIDTH AND 100 FEET IN HEIGHT

Because of its accessibility by motor from Juneau, Alaska, Mendenhall glacier has many visitors each year

of New Netherland, now New York, and the Swedish settlement on the Delaware—were absorbed by the growing English element.

While the English plantations were striking root along the coast, by somewhat prosaic but fruitful industry, and were growing in population with rapid strides, two other movements were in progress. To the south, the English, French, and Dutch, though often in rivalry with one another, combined to break in on the monopoly of the Spaniards. They turned the maxim that "there is no peace beyond the line" against its inventors. They invaded the West Indies, seized one island after another, and formed the freebooting communities known as the brethren of the coast and the buccaneers. After the renewal of the war between Spain and Holland in 1621, the Dutch invaded the Portuguese colony of Brazil and seized Bahia. A long period of struggle followed, but, after the declaration of Portuguese independence in 1640, local opposition, and the support given to the Portuguese by the French, led to the retreat of the Dutch.

To the north, to the west, and to the south of the English settlements on the mainland, a most characteristic French colonial policy was being carried out. No sooner were the wars of religion over than the French again set about making good their claim to Canada, and to whatever they could represent as arising naturally out of Canada. In 1599, under the encouragement of Henry IV., speculators began to frequent the St. Lawrence in pursuit of the fur trade. Their settlements were mainly trading posts. Their colonists were not farmers but trappers, wood-rangers, *coureurs du bois,* who married Indian women, and formed a mixed race known as the *bois brulés.* Not a few of the leaders, notably Samuel de Champlain (*q.v.*), who founded Quebec in 1608, were brave, ingenious men, but the population provided no basis for a lasting colony. It was adventurous, small, scattered, and unstable. The religious impulse which was so strong both in the Spanish and the English colonies was prominent in the French, but in the most fatal form. Pious people were eager to bring about the conversion of the Indians, and were zealously served by missionaries. The Jesuits, whose first appearance in New France dates from 1611, were active and devoted. Their aim was to reduce the fierce Red men to a state of childlike docility to priests. It was true that the most active French colonial element, the trappers, were barbarized by the natives, and that the pursuit of the fur trade and other causes had brought the French into sharp collision with the most formidable of the native races, the confederation known as the Five (later Six) Nations. During the reign of Louis XIV., after 1660, the French government paid great attention to Canada, but not in a way capable of leading to the formation of a colony. The king was as intent as the rulers of Spain had been to keep the American possessions free from all taint of heresy. Therefore he carried on the policy of excluding the Huguenots—the only colonizing element among his subjects—and drove them into the English plantations. A small handful of obedient peasants formed the basis of the colony. On this narrow foundation was raised a vast superstructure, ecclesiastical, administrative, and military. His priests, and his officials civil and military, gave the French king many daring explorers. While the English colonies were slowly digging their way, taking firm hold of the soil, and growing in numbers, from the sea to the Alleghanies, French missionaries and explorers had ranged far and wide. In 1682 Robert Cavelier, Sieur de la Salle, who had already explored the Ohio, sailed down the Mississippi and took possession of the region at the mouth by the name of Louisiana.

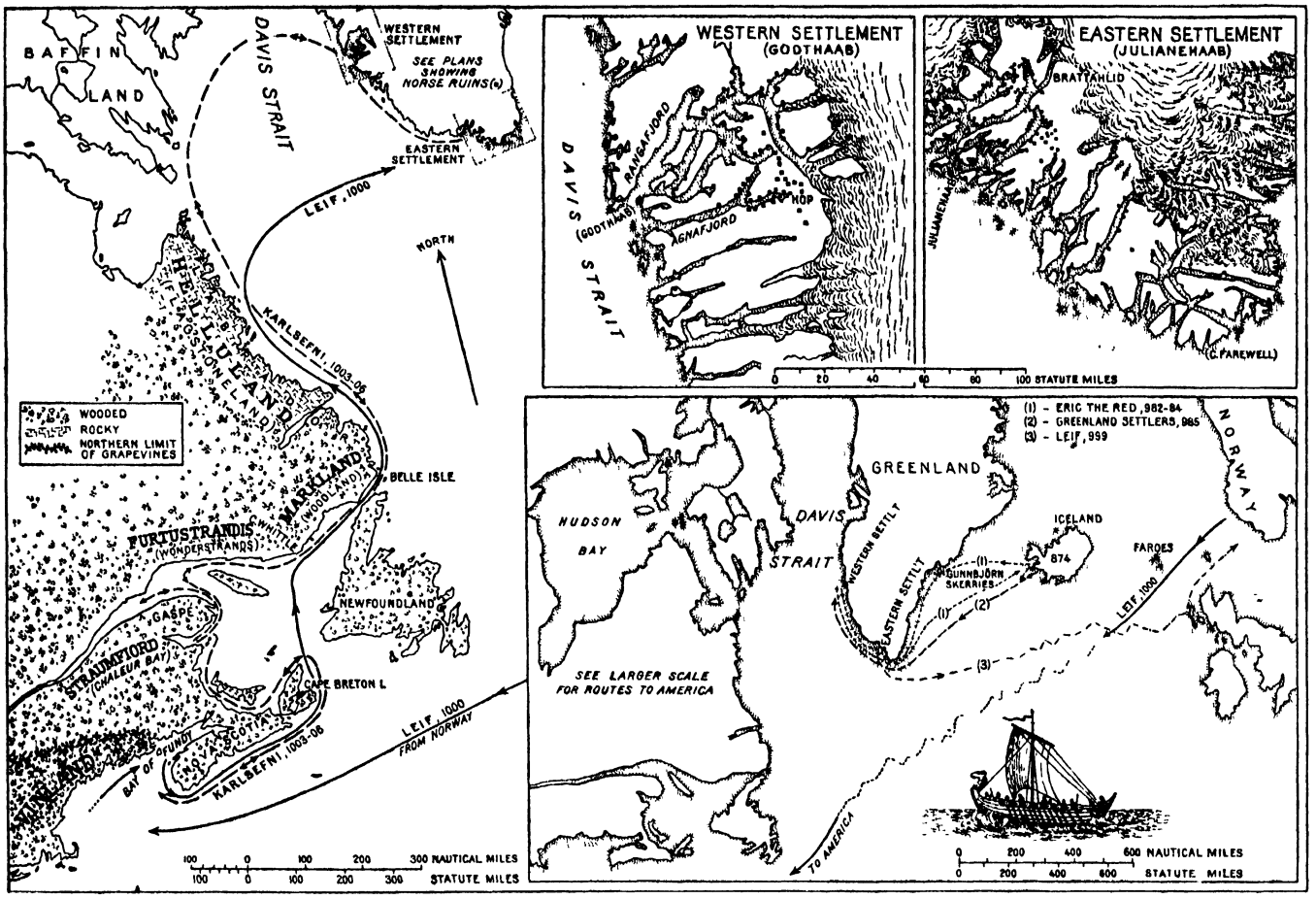
The problem which was to be settled by a century of strife was now posed. On the one hand were the English plantations, populated, cultivated, profitable, stretching along the east coast of North America; on the other were the Canadian settlements, poverty-stricken, empty, over-officialled, a cause of constant expense to the home government, and, at a vast distance, those of Louisiana, struggling and bankrupt. The French remedy for an unsuccessful colony had always been to annex more territory, and forestall a possible rival. Therefore the French government strove to unite the beggarly settlements in Canada and Louisiana by setting up posts all along the Ohio and the Mississippi, in order to confine the English between the Alleghanies and the sea.

The political history of North America till 1763 is mainly the story of the pressure of the English colonies on this paper barrier. As regards Spanish America, England was content to profit by the *Asiento* treaty, which gave her the monopoly of slave-hunting for the Spanish colonies and an opening for contraband trade. In the River Plate region, where the dissensions of Spaniards and Portuguese afforded another opening, English traders smuggled. The Spaniards, with monstrous fatuity, refused to make use of the superb waterways provided by the Paraná and Paraguay, and endeavoured to stifle all trade. England's main struggle was with France. It was prolonged by her entanglement in European disputes and by political causes, by the want of co-operation among the English colonies, and their jealousy of control by the home government. The organization of the French colonies, though industrially ruinous, gave them the command of more available military forces than were at the disposal of the English. Thus the fight dragged on. At last, when under the leadership of the elder Pitt (*see* CHATHAM, EARL OF) England set to work resolutely to force a final settlement, the end came. The British navy cut off the French from all help from home, and after a gallant struggle, their dominion in Canada was conquered. They surrendered Louisiana to Spain, which had suffered much in an attempt to help them, and their possessions in America were reduced to their islands in the West Indies and French Guiana.

The fall of the French dominion on the continent of North America was practically the beginning of the existence of independent nations of European origin in the New World. The causes which led to the revolt of the colonies, the political and military history of the war of independence, are dealt with under the heading of UNITED STATES (*History*) and AMERICAN REVOLUTION. The significance of these epoch-making events in the general history of America is that from 1783 onwards there was, in the New World, an autonomous community in entire separation from European control. Such a polity, surrounded as it was by territory dependent on European sovereigns, could not be without a profound influence on its neighbours. Of deliberate direct action there was not much, nor was it needed. The peoples of the 13 States which had secured emancipation from British sovereignty were wisely intent on framing their own Federal Union, and in taking effective possession of the vast territories in the Ohio region and beyond the Mississippi. But their example worked. Their independence tempted, their prosperity stimulated. From the freedom of the United States came the revolt of Spanish America, and the grant by Great Britain to Canada of the amplest rights of self-government.

The effect which the establishment of the great northern republic was bound to have on their own colonies was not unknown to the wiser among the rulers of Spain. They took, however, few and weak steps to counteract the visible peril. The wars of the French Revolution and of Napoleon, in which Spain was entangled, interrupted her communications with her colonies, and weakened her hold on them. The defeat, in 1806 and 1807, of two British expeditions to Buenos Aires and Montevideo, resulting in the capitulation of the English force, gave a great impulse to the self-reliance of the colonists, to whom the credit of the victory entirely belonged. When the intervention of Napoleon in Spain plunged the mother country into anarchy, the colonists began to act for themselves. They were still loyal, but they were no longer passive. The brutality of some Spanish governors on the spot provoked anger. The cortes assembled in Cadiz, being under the influence of the merchants and mob, could make no concessions, and all Spanish America flamed into revolt. For the details of the struggle the reader must refer to the articles ARGENTINA, BOLIVIA, CHILE, COLOMBIA, ECUADOR, PANAMA, PERU, PARAGUAY, URUGUAY, VENEZUELA. Brazil followed the same course in a milder way and a little later. The struggle of Spanish America for independence lasted from 1810 to 1826.

Meanwhile the United States had taken decisive action. President Monroe, in his message to Congress on Dec. 2, 1823, laid



THE CONJECTURAL ROUTES OF THE NORSEMEN TO AMERICA DURING THE VIKING PERIOD, A D 800–1000

From the 7th to the 11th century the spirit of expansion that characterized the Norsemen for several hundred years appeared at its height. They settled in France, England, Scotland and Ireland and journeyed as far east as Russia. In the western hemisphere they colonized Iceland and, late in the 10th century, Greenland. It was from this latter place that expeditions were made by Eric the Red and others to the north-east shores of America

down the rule that no part of America was any longer *res nullius*, or open to colonial settlement. Though the vast ultimate consequences of this sudden appearance of the great western republic in the arena of international politics were not realized even by those in sympathy with Monroe's action, the weight of the United States made any effective protest by the continental powers of Europe impossible. From President Monroe's declaration has grown up what is now known as the Monroe Doctrine (*q.v.*) which, in substance, insists that America forms a separate system apart from Europe, wherein still existing European possessions may be tolerated, but on the understanding that no extension of them, and no establishment of European control over a nominally independent American state, will be allowed.

The Monroe Doctrine is indeed the recognition, rather than the cause, of undeniable fact. Europe is still possessed of some measure of sovereign power in the New World, in Canada, in Guiana, and in the West Indian islands. But Canada is bound only by a voluntary allegiance, Guiana is unimportant, and in the West Indian islands, where the independence of Haiti and the loss of Cuba and Porto Rico by Spain have diminished the European sphere, European dominion is only a survival of the colonial epoch. America, North and South, does form a separate system. Within that system power is divided as it has not been in Europe since the fall of the Roman empire. On the one hand are the United States and Canada. On the other are all the States formed out of the colonial empires of Spain and Portugal. The states of the American Union, as also Canada, are non-tropical, adapted to the development of European races, not mixed with Indian blood, and possessed by long inheritance of the machinery needed for the successful conduct of self-government. They grew during the 19th century in population and wealth at a rate that placed them far ahead of the Spanish and Portuguese states, which in the beginning were the richer and the more populous. The Spanish and Portuguese states of America are largely tropical, and therefore less adapted to the health of a white race. Their population is divided between a white, an Indian and a coloured portion, the latter two sometimes docile and industrious, sometimes almost savage. They inherited no machinery of self-government. Townships governed by close corporations, and all embedded in the despotic power of the Crown, presented few of the elements out of which a stable commonwealth could be formed. It was inevitable that in the early stages of their history, the so-called Latin communities should fall under the control of "the single person," and no less inevitable that he should be a soldier. The sword and military discipline long supplied the only effective instruments of government. It would have been a miracle if the first generation of Mexican and South American history had not been anarchical. It was not until the last quarter of the 19th century that the greater portion of Spanish and Portuguese America settled down and established permanent and peaceful governments.

In the first quarter of the 20th century this tendency toward political stability was increasingly pronounced. The Spanish-American War, which swept away the last vestiges of Spanish rule in the New World, resulted in certain changes of importance. Following the defeat of Spain, Porto Rico, and later by purchase the Virgin islands, became dependencies of the United States, and Cuba, Haiti, and Santo Domingo came under the influence of the United States. This influence was further strengthened by the acquirement of the Panama Canal Zone and the construction and control of the interoceanic canal, which facilitated American trade and gave the United States overwhelming preponderance in the Caribbean. Moreover, the relations of the United States in co-operation with South American countries in the World War

further established the prestige of the North American republic. Increasing commercial interpenetration fostered economic development and with it a better social and political order. Pan-American conferences, such as that held at Havana in 1928, have in some degree contributed to this result. In this latest period there have been serious lapses on the part of some of the Latin nations. In Mexico the overthrow in 1911 of the efficient government long maintained by Diaz was followed by more than a decade of revolutionary turbulence with repeated usurpations by military leaders. In Brazil the formidable revolt of 1924 seriously disrupted trade in the chief exporting district of the country. Between Chile and Peru the long unsettled Tacna-Arica controversy was revived in 1921 and, despite all efforts to secure arbitration, unsettled for several years the relations of the two countries.

On the whole, however, the Latin nations of America reached during the early decades of the 20th century the highest general level of economic and political stability that they had as yet attained. In this connection it is significant that the strictly Latin peoples in these lands, now that all fear of Spanish political domination has been removed, look to the Latin nations of Europe—to France, Spain, and Italy—for their social, artistic and political ideals and for the basic inspirations of their culture.

BIBLIOGRAPHY.—Separate bibliographies will be found under the headings of the separate States. Amid the plethora of books, the reader cannot do better than consult the *Narrative and Critical History of America*, Justin Winsor (1886–89), in eight large octavo volumes, in which all the chapters are supplied with copious and carefully compiled bibliographies (X.)

PRE-COLUMBIAN DISCOVERIES

Alleged discoveries of the continent or islands of America by Europeans before Columbus lack foundation, with the exception of those made by the Norsemen. Because of the geographical conditions it was natural that they should be the first to discover territory in the western hemisphere. They advanced step by step towards west and north-west. First they accidentally discovered the Faroes, then Iceland, and finally, early in the 10th century, Gunnbjörn Ulfsson probably sighted the snow-clad mountains of Greenland, when he landed on some desert islands which afterwards were called Gunnbjörn Skerries, and which presumably were identical with some of the islands off Angmagsalik on the east coast. This discovery was not followed up until Eric the Red, who had first been exiled from Norway and thereafter from Iceland, decided to seek those islands in 982 and to ascertain if they were habitable. Thus he discovered the mainland of Greenland, the south-western part of which he explored during the next three years; he thereafter returned to Iceland and succeeded in persuading a number of people to go with him to Greenland, and to establish there a colony on the model of the Icelandic commonwealth.

From this colony further discoveries were made not only along the west coast of Greenland but also on the American continent. These were in the beginning accidental, and a fairly full account of them has been preserved in Icelandic tradition, which has two somewhat different versions of them. The older of the two, the *Saga of Eric the Red*, ascribes the discovery of the continent to Leif Ericson (*q.v.*); the younger, called the *Tale of the Greenlanders* (found in the *Flatey Book*) makes Bjarni Herjólfsson the first discoverer. The *Saga* is doubtless much more reliable although the *Tale* probably preserved a few touches which the *Saga* left out. The accidental discovery of Leif in the year 1000 was followed up the next year by his brother, Thorstein Ericson, who, however, failed to reach the new lands. Two years later the Icelander, Thorfinn Karlsefni (*q.v.*), went with three ships from Greenland in search of Vinland with the intention of settling there. His expedition lasted three years (1003–06), at the end of which time he returned to Greenland, realizing that a colony could not be maintained there because of the hostile aborigines.

Probably in 1007, Karlsefni returned to Iceland, where the story of his exploits was finally written down. The various place-names mentioned in this are impossible of definite identification with localities on the American continent, since no genuine Scandinavian remains of those times have been found there. There seems, however, little doubt that Helluland (Flagstoneland) is Labrador; while Markland (Woodland), the next land south of this, has often been looked upon as identical with Nova Scotia or Newfoundland, but it might as well be sought on the south coast of Labrador, where almost certainly Furdustrandir (Wonderstrands) are to be found. As Prof. Steensby has pointed out, no place on the east coast of America tallies so well with the description of those desolate strands as the low coast west of Cape Whittle. In such case Straumfiord, where Karlsefni wintered twice, has probably to be looked for within the Gulf of St. Lawrence, and Chaleur bay is possibly identical with it. Vinland (*q.v.*) must, however, be sought somewhere on the coast of New England.

After Karlsefni's expedition Icelandic sources mention only two sailings towards those lands from Greenland; the first of these was in 1121, when Bishop Eric of Greenland left for Vinland, probably as a missionary, but he was never heard of again. In 1347 there arrived in Iceland a ship of Greenland which had been to Markland for timber, but had been driven out of its course. This may indicate that such trips were made now and then from Greenland, although only this one is on record. The Greenland colony probably existed until the 15th century, but at that time its connections with those lands discovered in the west as well as with the mother country had ceased. Although Columbus doubtless visited Iceland some years before his discovery of America, there is no reason to believe that he heard of these early Norse discoveries, or that they in any way influenced him.

Recently an attempt has been made by Dr. Sophus Larsen to show that a combined Danish-Portuguese expedition under Didrik Pining and Pothorst reached the coast of Labrador or Newfoundland shortly after 1472, thus substantiating the alleged discoveries in those regions by the elder Corte Real. The evidence presented in support of this is partly indirect and hence dubious, and partly drawn from late sources which are not authoritative.

For the bibliography of this subject *see* H. Hermannsson, *Northmen in America 982–c. 1500* (Ithaca, N.Y., 1909). In addition to the titles given under LEIF ERICSON the following may be mentioned: F. Nansen, *In Northern Mists* (1911); W H Babcock, *Early Norse Visits to America* (1913); W. Hovgaard, *The Voyages of the Norsemen to America* (1914); H P. Steensby, *The Norsemen's Route from Greenland to Wineland* (Copenhagen, 1918); H. Hermannsson in *Geograph. Review*, 1927, p. 107 *et seq*; G. M Gathorne-Hardy, *The Norse Discovery of America* (1921); S. Larsen, *The Discovery of North America Twenty Years before Columbus* (Copenhagen, 1924). (H. HE)

AMERICA ISLANDS, a name said to have been given to Christmas, Fanning, Palmyra and attendant islets; they have also been called the LINE ISLANDS.

AMERICAN ACADEMY IN ROME, THE, situated on the Janiculum, in Rome, Italy, comprises a School of fine arts and a School of classical studies. It was founded in 1894 under the leadership of Charles F. McKim It is administered by a director and staff in Rome, and a president and board of trustees in New York city. The School of fine arts includes departments of architecture, painting, sculpture, landscape architecture and musical composition. Seventeen students of advanced attainment are chosen, through annual competitions, as Fellows. The term of the Fellowship in fine arts is three years; in classical studies, one or two years, with residence in the academy and stipend to cover cost of living and travel. There is no formal instruction, but work of certain kinds and travel in classic lands are prescribed. Results of research and reproductions of the work of the artists are published in the *Memoirs* or *Papers and Monographs* of the Academy By giving its selected artists and scholars opportunities for intimate association through study and travel in an atmosphere of art and amid the inspiration of masterpieces, the Academy aims to contribute toward the elevation of American art and letters.

AMERICAN AGRICULTURAL CHEMICAL COMPANY, THE, was organized in 1899 under the laws of Connecticut for the purpose of consolidating about 20 companies engaged in the manufacture of fertilizers, in the Northern, Eastern and Middle Western States. The original capital stock of $20,000,000 preferred, and $20,000,000 common, has subsequently been increased to a present amount of $28,455,200 preferred, and

$33,322,126 common, to provide for the increase in the business. The bonded debt has been reduced from $36,112,500 in Feb. 1921 to $12,548,500 on June 1, 1928, and $2,500,000 additional bonds were called for redemption on Aug. 1, 1928. The company's business has expanded to include the cotton States of the South and the island of Cuba. It early acquired extensive phosphate rock properties and now owns reserves sufficient to supply its needs of this basic material for many decades to come.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, founded in 1848 and incorporated in 1874, is an organization which "aims to advance science in the New World in every feasible way." Its membership was approximately 15,000 in 1927, the majority of the members residing in the United States and Canada. It has two divisions, which are autonomous: the Pacific division and South-western division. In addition to individual membership there are connected with the association 115 wholly autonomous and independent associated organizations, 62 societies and 22 State academies. The association has 15 sections, representing the main current subdivisions of science, each designated by a letter, as follows: A (Mathematics), B (Physics), C (Chemistry), D (Astronomy), E (Geology and Geography), F (Zoological Sciences), G (Botanical Sciences), H (Anthropology), I (Psychology), K (Social and Economic Sciences), L (Historical and Philological Sciences), M (Engineering), N (Medical Sciences), O (Agriculture), Q (Education). Funds are received and administered for the advancement of science and education. The permanent endowment in 1928 amounted to over $140,000, the income being devoted mainly to grants for scientific research. A volume of summarized proceedings is published at intervals of about four years, including a directory of members. Current expenses are cared for by membership dues. Each member in good standing receives *Science*, the official journal, or the *Scientific Monthly* may be taken instead The annual meeting occurs during the Christmas holidays, at which time a number of the associated and affiliated societies meet with it for the reading of papers. Its headquarters are at Washington, D.C.

AMERICAN ASSOCIATION OF ADVERTISING AGENCIES, an organization comprised of approximately 140 of the leading advertising agencies in the United States and Canada. For convenience the association is divided into five councils, one for each active business section of the country. The purposes of the association centre around the improvement of advertising and advertising procedure. It has promulgated a standard of ethics for the advertising business which is widely quoted and followed. Correction of such unethical practices as rebating, making false claims in advertising and unfair methods of soliciting business in its field has been one of the important activities of this association. The association maintains a research department which has made a survey of the national field in the study of duplication of periodical circulation. It maintains an export department which operates a rate and data file covering the entire world, primarily in the interests of the manufacturer or advertising agency which advertises in several countries. The association maintains a personnel bureau in which are registered a majority of those actively engaged in national advertising. This is probably the most extensive bureau of its kind in existence. This association also acts as a clearing house for advertising information. While this service is maintained primarily in the interests of the members, it is practically free and open to all who have a legitimate use for the data it has on file. (H. E. A.)

AMERICAN BANK NOTE COMPANY, THE, an organization in the field of "security" engraving and printing, specializing in quality of workmanship and effective safeguarding during manufacture. In addition to an extensive business in the United States, more than 40 other countries are its customers for bank-notes, postage stamps, revenue stamps, bonds and similar work requiring the protection against counterfeiting given by fine engraving. The business of engraving and printing securities in the United States was founded during the American Revolution by Paul Revere of Boston. His first work of importance was the making of some paper money for the colony of Massachusetts bay, now the State of Massachusetts. The business was subsequently carried on by various partnerships until 1858 when it was incorporated as the American Bank Note company. In 1879 the National Bank Note company and the Continental Bank Note company were consolidated with it. At various times since the American Bank Note company has acquired the capital stock and property of other concerns. Among these were the Franklin-Lee Bank Note company, Western Bank Note and Engraving company and International Bank Note company. In 1906 the United Bank Note corporation was organized to acquire the stock of the Consolidated American Bank Note company. In 1911 the United Bank Note corporation merged with it and assumed the name American Bank Note company.

At the beginning of 1928 the company's surplus was $6,299,919; net working capital, $6,470,266; current assets, $8,176,784; and total assets, $19,498,006. The company's principal printing plant is in New York city, with an important branch in Chicago. It has an English subsidiary, Bradbury, Wilkinson and company, Ltd., with a plant at New Malden, Surrey, England, and a Canadian subsidiary, the Canadian Bank Note company, Ltd., with a plant at Ottawa, Canada. Inclusive of its subsidiaries, the company employs a total of some 3,500 persons. (D. E. W.)

AMERICAN BAR ASSOCIATION, THE, a voluntary association of lawyers and jurists organized at Saratoga, N.Y., in 1878. Its object, as defined by its constitution, is "to advance the science of jurisprudence, promote the administration of justice and uniformity of legislation and of judicial decision throughout the nation, uphold the honour of the profession of the law and encourage cordial intercourse among the members of the American Bar." The association in 1928 had about 28,000 members, residing throughout all of the United States proper and in Hawaii, China, Porto Rico and the Philippine islands. The work of the association is supervised by its president and executive committee. There were in 1928, 15 regular and 10 special committees appointed by the president. In addition to the committees, there were 9 self-perpetuating sections which elected their own officers, while remaining intimately affiliated with the work of the association Thus, the association, through its committees and the affiliated sections, covers the whole field of the law, including among its activities the adoption of canons of the professional and judicial ethics and advancing the standards of legal education; the introduction and support of measures in Congress for the improvement of the administration of justice; organized opposition to the recall of judges; defence of the power and jurisdiction of the Federal courts; the recommendation of proposed uniform State laws to the legislatures; and the defence of the rights of the poor. The American Bar Association publishes a *Year Book* and an official organ monthly called the *American Bar Association Journal.* Its list of presidents includes the names of lawyers of international reputation, among them being Elihu Root, ex-President Taft, Joseph H. Choate, John W. Davis, Charles E. Hughes, Frank B. Kellogg and other leaders of the bar.

(S. H. S.)

AMERICAN CAN COMPANY, THE, was incorporated in 1901. It was a consolidation of 65 manufacturers of metal containers for foods, chemicals, tobacco, paints and many other products, and is the leading producer in its field. Its manufacturing plants are situated in 45 cities of the United States (18 States), Canada and Hawaii. The company's products include, besides both tin and fibre cans, packages and metal receptacles of many kinds, metal-ware, sheet-metal and other metal manufactures, as well as machinery and tools for all of its activities; also, products and materials originating from such manufactures or found useful in connection with them.

From 1903 to 1927 the plant and real estate account increased from $77,000,000 to $116,000,000; the corporate surplus increased $41,188,772, reaching a total of $43,851,369 in 1926. Important improvements in buildings and equipment have been made, and new factories have been built as business has increased. In 1927 the company's total current assets were $50,041,168; total assets, $167,977,164; net working capital aggregated $39,118,544; and the capital stock was $41,233,000, 7% cumulative Preferred (par

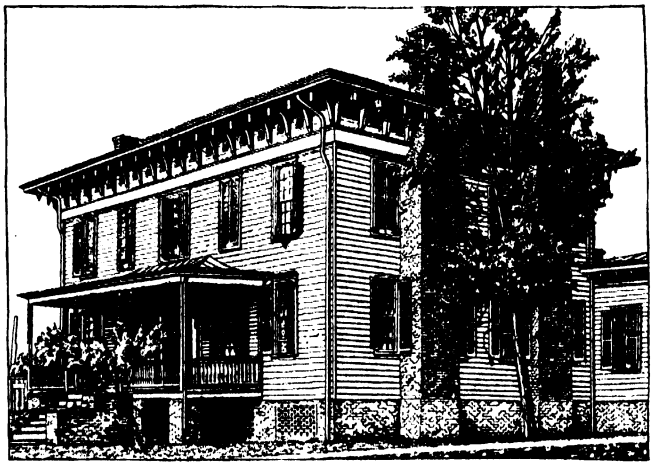
$100), and $61,849,000, Common (par $25). Headquarters are in New York city. (H. W. P.)

AMERICAN CAR AND FOUNDRY COMPANY, a leading manufacturer in the United States of railway equipment and various allied products. Its incorporation in 1899 effected the union of 13 important manufacturing concerns, situated in eight different States from New York to Missouri, with the avowed purpose of engaging in the manufacture of railway cars and supplies, cast iron pipe and other foundry products. During the period 1899–1928 eight other similar companies, with various subsidiaries, were acquired. When the company was organized, the standard equipment on American railways comprised only wooden passenger coaches, of slight protection to passengers in case of collision, and wooden freight cars limited to a capacity of only 60,000lb. and, owing to the type of construction, to a very short period of service. To the great revolution that has since taken place in the character of railway carriers and equipment, the company has made substantial contributions. Old plants have been modernized and new plants have been built. In 1928 the physical property of the American Car and Foundry Company included 4 passenger car plants, 14 freight car plants, 7 wheel foundries, 8 grey iron foundries, 2 rolling mills and forges, a malleable iron and a brass foundry, an architectural wood-working mill, and a plant for building car floats and small commercial and pleasure boats. Moreover, it controlled subsidiaries equipped for making motor-buses and trucks, electric railway cars, steel dining wagons, gasolene engines, carburetors, and also for welding, steel fabricating and repairing tank cars. The large working capital has been provided from earnings. (W. H. W.)

AMERICAN CIVIL WAR, a conflict lasting four years in the United States of America between eleven States of the South, which asserted their right to leave the Union, and the States and Territories of the North, which were determined to maintain the Union. The Southern States contained slightly over half the population of the Northern States which remained in the Union. At the opening of the conflict, an independent government, the Confederate States of America (*q.v.*) was set up. The Civil War began when the guns of the South fired on the Federal Fort Sumter on April 12, 1861, and ended with the surrender of General Lee at Appomattox on April 9, and of General Johnston at Greensboro on April 26, 1865. Approximately 4,000,000 troops took part in the war, which resulted in the preservation of the Union, the abolition of slavery, and many important social and economic changes.

For the sake of clearness, the names of Confederate statesmen, soldiers and ships are in italics.

Charleston Harbour, 1860–61.—During the last months of Buchanan's presidency a succession of events occurred, which brought the United States to the verge of armed conflict between the rival sections. South Carolina seceded from the Union (Dec. 20, 1860), and Governor *Pickens* sent commissioners to Washington to claim possession of the forts in Charleston harbour and all other U.S. property in his State. Anderson, commanding the Federal garrison, secretly transferred his two weak companies from Ft. Moultrie, which was untenable against a land attack, to Ft. Sumter in the mouth of the harbour (Dec. 26). *Pickens* seized the arsenal and other forts and began throwing up batteries against Sumter, whilst his commissioners at Washington demanded the recall of the Federal troops from Charleston. This demand Buchanan refused. He had already (Dec. 3) in his message to Congress denied the right of secession, though he qualified this denial by expressing the opinion that the Constitution gave him no right to attempt coercion. An unarmed steamer with supplies and reinforcements was sent to the relief of Sumter, but it turned back when fired on as it was entering the harbour (Jan. 9). *Pickens* sent a fresh envoy to demand the surrender of Sumter. Between Jan. 9 and Feb. 1 six other States followed South Carolina's example. Their governors without attempting negotiation seized all the forts and arsenals in their respective States except Ft. Pickens in Pensacola harbour. Delegates from the seceding States met at Montgomery, Ala., organized the Confederate States of America, and set up a provisional Government with *Jefferson Davis* as President. His inauguration took place on Feb. 18. The Confederate Government now assumed control of the negotiations about Sumter. Neither Buchanan nor *Davis* was anxious to precipitate a crisis. The former's fervent desire was to leave the solution of the whole problem to his successor; *Davis* was chiefly concerned to get his administration in working order, whilst Buchanan with a "no



THE DAVIS HOME, FIRST "WHITE HOUSE" OF THE CONFEDERATE STATES
In Dec. 1860, South Carolina seceded from the Union. By Feb. 1861 six other States had followed her example. Their delegates assembled at Montgomery and organized the Confederate States of America, with Jefferson Davis as president

coercion" policy was in office, and present the latter's successor with a *fait accompli.* In spite of the remonstrances of *Pickens,* who urged the importance of securing Sumter before Buchanan quitted office, the question was temporarily shelved, though *Beauregard,* an engineer officer of distinction, was sent to Charleston to complete the preparations for attacking Sumter. The day after *Beauregard* reached Charleston, Lincoln was inaugurated at Washington (March 4, 1861).

It was a difficult problem which confronted him. Seven slave States had seceded, but eight still remained in the Union. Any attempt at coercion would throw all these States, except Delaware (which practically counted as a northern State), into the arms of the Confederacy. With these siding with the seceders or even maintaining neutrality as between the two combatants, it seemed impossible to restore the Union by force of arms. At this stage neither side wanted war; certainly not the North, where a strong feeling was growing in favour of letting "the wayward sisters depart in peace"; the South was less reluctant to face the risk, because its leaders were confident that the other slave States would rally to their help, but they were no less confident that, if peace could be maintained, these States would soon seek admission to the Confederacy. Lincoln's inaugural speech was really addressed to the slave States still in the Union; to the Confederate States it sounded like a declaration of war. But they sought to avoid the responsibility of striking the first blow. Theirs was a defensive rôle, that of a newborn nation only asking to be left alone. They hoped to force Lincoln's hand over Sumter. Anderson's position there was daily growing more difficult. The late administration had imposed a policy of inaction. He would himself have gladly evacuated the fort to avert a civil war. But his duty as a soldier compelled him to sit there with folded hands, whilst the enemy were completing their preparations. His provisions would be exhausted by mid-April. The Confederate batteries had made such progress that he doubted whether it was still possible to relieve the fort, unless possession of the whole harbour were secured, and for that purpose he estimated that 20,000 men would be required. The whole U.S. army only numbered 17,000 men, most of whom were scattered in small posts on the Indian frontier, whence they could not be hastily withdrawn. Only on March 5 did Lincoln learn that Anderson might be starved into surrender. Gen. Scott, his chief military adviser, urged evacuation on military grounds. But Lin-

coln had pledged himself "to hold, occupy and possess the property and places belonging to the Government." It would be fatal to the prestige of his administration to start by going back on his word. Evacuation might seem a virtual recognition of the Confederacy. He determined to send food supplies only to Sumter. If the Federal flag was fired on, that would constitute a *casus belli*. The responsibility of beginning the war would be thrust upon the Confederates. To prevent them from pleading a misunderstanding, he gave *Pickens* precise information of his intention. Lincoln must have foreseen the actual event. But only by war could the Union be restored, and the sooner war came, the better; the longer the Confederate Government was allowed to function unchallenged, the more difficult it would become to unite the North in resistance to its "declaration of independence." Lincoln's despatch was delivered to *Pickens* (April 8), who promptly informed his President. From Montgomery orders were sent to *Beauregard* to reduce Sumter. On Anderson's refusal to evacuate, the batteries opened fire at 4:30 A.M. on the 12th. The bombardment continued without intermission till the afternoon of the next day, when Anderson agreed to surrender. At noon of the 14th Anderson evacuated the fort and the Federal flag was lowered. The ready acceptance of Lincoln's challenge by the South was probably due to the desire of its leaders, who now realized his steadfast purpose, to provoke a collision for fear lest the ardour of their people, a considerable minority of whom were originally opposed to secession, might abate. At that date Fts. Sumter and Pickens were the only places where they could strike a blow, and they selected the more vulnerable.

The Call to Arms.—The fall of Sumter "set the heather on fire" in the North. Democrats were at one with Republicans in denouncing this crowning insult to the national flag. Lincoln called for 75,000 militia for three months' service (April 15). Not that he underrated his task, but he intended to start by treating secession as an act of insurrection. To suppress insurrection was a constitutional function of the militia, but this force could only be held for three months' service outside its own State. The free States enthusiastically responded to the call, but the governors of the seven slave States still in the Union, except Hicks of Maryland, refused to raise their contingents. The Virginia convention passed an ordinance of secession (April 17). Governor *Letcher* immediately seized the Harper's Ferry arsenal and Norfolk navy yard, and without waiting for popular confirmation of the convention's action entered into a military alliance with the Confederacy. North Carolina, Arkansas and Tennessee took the same course. If they had to choose between fighting for and against the Confederacy, they unhesitatingly threw in their lot with their sister States of the South. But Western Virginia beyond the Alleghanies, which had its own personal grievances against the eastern section of the State and belonged geographically to the Ohio valley, repudiated the ordinance of secession and prepared to join the North. In Maryland there was a considerable secessionist minority, chiefly concentrated in Baltimore, where a riot occurred (April 19), as a Massachusetts regiment was passing through to Washington. For three weeks Baltimore was in the hands of the secessionists and the movement threatened to spread through the State. Washington was cut off from direct railway communication with the North. But troops were brought round by water to Annapolis, whence they were railed to the capital. No help came to Baltimore from Virginia, and Governor Hicks outmanoeuvred the local leaders of insurrection by pretending to yield to their demands, until Butler with a small force made a sudden dash at the city and occupied it unopposed (May 13).

In Kentucky parties were fairly equally divided. There was general sympathy for the South, of which the State regarded itself as a part, but also a genuine devotion to the Union. If the governor favoured secession, a small majority in the legislature was opposed to it. His refusal to supply Lincoln with troops met with no protest from the Unionists, who at first concentrated upon keeping the State neutral. But neutrality could not be a permanent attitude. It gave too great an advantage to the Confederates, who drew food supplies from Kentucky and were sheltered from invasion along their western front from the Alleghanies to the Mississippi. Sooner or later the Federal armies must occupy Kentucky as a base for an offensive campaign. But a premature movement would drive Kentucky into secession and to lose Kentucky would be "nearly the same as to lose the whole game," in Lincoln's judgment. Understanding the feelings of his fellow Kentuckians better than any of his counsellors at Washington, he handled the critical situation with consummate tact. It was worth suffering some temporary disadvantage to win Kentucky in the end. The legislature steadily refused to summon a convention, which might declare for secession. The governor was too good a Kentuckian to overstep the constitutional limits of his office. In August a new legislature was elected with an overwhelming Unionist majority. The inevitable decision was hastened by the tactless policy of the Confederacy. Kentucky declared for the North (Sept. 20).

In Missouri, Governor *Jackson* was a violent secessionist, eager to go all lengths to take his State out of the Union, and the legislature seemed ready to support him. But the convention, which was summoned, was overwhelmingly Unionist. An extreme section of Unionists, led by F. P. Blair, whose brother was in Lincoln's cabinet, and largely recruited from the Germans in St. Louis, was ready to meet violence with violence. The St. Louis arsenal, the best equipped in all the slave States, was too rich a prize to be allowed to fall into *Jackson's* hands. But in February Scott had placed in it a sufficient Federal force to secure it against sudden surprise, and in March the convention had adjourned without even discussing secession. A large majority of the people favoured neutrality, and a policy of conciliation would probably have preserved peace within the State, as in Kentucky. But Lincoln allowed himself to be guided by the Blairs. Their agent was the fanatical Capt. Lyon, who broke up (May 10) a militia camp close to St. Louis on the ground that Jackson was planning an attack on the arsenal, and his return to the city with his prisoners caused a riot with considerable loss of life. This premature appeal to force and the use of Federal troops caused a revulsion of feeling. Civil war became inevitable, when Lyon was appointed temporary commander of the department. He promptly ascended the Missouri with a small force, occupied the State capital, Jefferson City (June 15) and routed a body of secessionist militia at Booneville (June 17). After this defeat *Jackson* fled to the Arkansas border.

Lincoln by undertaking definitely a policy of coercion had lost four more of the slave States, but secured three, and West Virginia was soon to make a fourth.

The Military Outlook.—Twenty-two States (including Kentucky and Missouri) were now arrayed against eleven, and the white population of the former was four times that of the latter. But the 3½ million slaves in the South, so far from being a danger, proved of great assistance, supplying the labour required for the production of food and construction of fortifications. Over two-thirds of the officers and all the men of the U.S. army were on the side of the North; so too was the navy. In material resources and business capacity the North was overwhelmingly superior. All the manufacturing centres were within its borders, all the shipping in its hands. The South was dependent upon it for practically everything except food. But in spite of these advantages the North was likely to find its strength taxed to the uttermost. To restore the Union the South would have to be conquered piecemeal and resistance crushed throughout the whole region, which was "30,000sq m. larger than the combined areas of Austro-Hungary, Germany, France and Italy, with Belgium, Holland and Denmark thrown in." Neither a few victories in the field nor the capture of the Confederate capital would end the struggle, but only the permanent occupation of great stretches of Southern territory. The country in which the invading armies must operate was sparsely inhabited, with few cities, poor railways and worse roads. Except in a few favoured districts an army could not find subsistence but would have to carry its supplies with it. Consequently it would be tied to its lines of communication; viz., single track railways and rivers. East of the Alleghanies the rivers ran down to the Atlantic across the line of the invader's

advance and constituted formidable obstacles, but to the west the Mississippi, the Tennessee and Cumberland rivers opened a way into the heart of the Confederacy. Their superiority in mechanical resources enabled the Federals to gain command of these rivers with squadrons of gunboats, to which the Confederates could only oppose a few untrustworthy craft. The possession of the navy similarly secured to the North command of the sea. In a war of attrition the blockade would prove a potent weapon. The rôle of the North seeking to reconquer the South was necessarily offensive; that of the South fighting to win its independence mainly defensive. Against such heavy odds the Confederates could not hope to conquer the North, but they expected to make the task of reconquest so costly in life and money that public opinion in the North would demand its abandonment, and in this they nearly succeeded. But at the outset they made a miscalculation. They cherished the delusion that "cotton was king" and that a stoppage of their cotton supply would compel the intervention of Great Britain and France. But in 1861 there happened to be in England, at least, abundant supplies on hand owing to the previous year's record crop, and a glut of manufactured cotton goods. The manufacturers disposing of their accumulated stocks at rising prices had no wish to see the blockade raised In 1862 and 1863 cotton was exported from Liverpool to New York. The pressure of the "cotton-screw" was not felt till the time for intervention had passed. Yet it was this groundless belief in foreign intervention which dictated *Davis's* military policy in the first stage of the war He believed that within 12 months at longest, Britain and France would come to his aid, unless he intensified the prejudice felt against the Confederacy as a slave power by wantonly invading the North.

Both sides had to create their armies before they could fight. Here the South had a distinct advantage. The officers who resigned their commissions contained a disproportionately large number of the ablest men in the old army; the two *Johnstons* and *Lee* had been pre-eminent in their profession. *Davis* was a graduate of West Point, had served seven years in the regular army, later as a volunteer won distinction in the Mexican War, had been secretary of war and was chairman of the military committee in the Senate till just before the outbreak of the Civil War. He could be trusted to appoint the best officers to command his armies and to see that the first steps in military organization were wisely taken Lincoln was void of military experience, had no knowledge of the professional merits of his officers and personal acquaintance with but a few, including McClellan, and no business training. His appointments were too often made for political reasons. Banks, Butler and Frémont were flagrant instances. Again, the Southerners could be more quickly trained as soldiers. There was an aristocracy accustomed to rule, and another class of whites who recognized its claim to their obedience. Under the patriarchal conditions of Southern civilization its men were more robust, accustomed to an open-air life, of pugnacious disposition, trained to the use of gun and horse. The democratic North except in the west, did not provide such good fighting material. The Federal armies were uniformly more successful in the West, where the troops on both sides were much of the same class and the North's superior resources turned the scale, whereas in the East townsmen and European immigrants were fighting against country-bred men. But, given time, the quality of the Northern armies would improve and throughout the advantage of superior numbers would be theirs. But this advantage would be least felt in the first months of the war. The initial problem of both governments was not how to raise men, but how to equip them. There were more volunteers than could be armed. The stocks in the arsenals were quickly exhausted. The South had at least its fair share of them, and *Davis* was purchasing arms in England. But the meagreness of his order (10,000 rifles) indicates that he did not anticipate a lengthy war.

The Opening Moves, April–Aug. 1861.—In the first days Washington, shut in between Virginia and Maryland, had been in danger, but by the end of April was secure against a raid, and a fortnight later railway communication with the North through Baltimore was re-established. *Lee,* commanding the Virginia State forces, was loath to become the aggressor and refrained from attacking Washington or helping Baltimore Lincoln had proclaimed a blockade of the Confederate ports (April 19), and called for 42,000 three-year volunteers and 40,000 more men for the regular army and navy (May 3). He was awaiting the result of the referendum to be taken in Virginia on May 23 and scrupulously avoided any violation of Virginian territory. Federal troops crossed the Potomac (May 24) and without opposition occupied the south bank for the protection of the capital.

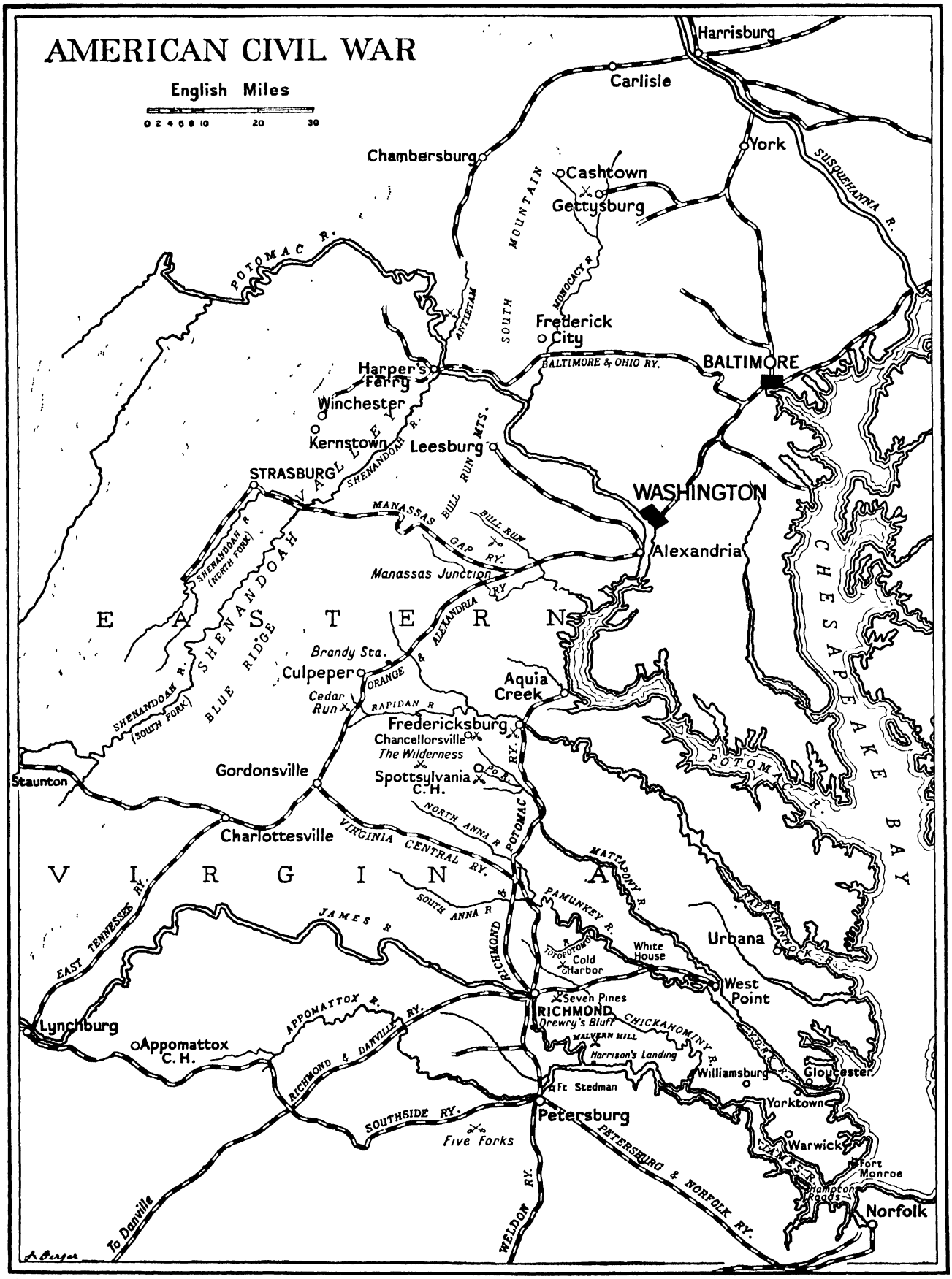
Scott had little faith in the militia. He proposed to use them to defend Washington and recover Harper's Ferry, whilst he trained the volunteers for an autumn campaign. Washington was served by two railways, the Orange and Alexandria (O. and A) running southward to Lynchburg and the Baltimore and Ohio (B. and O) passing through Harper's Ferry. The former was joined at Manassas Junction, 30m from Washington, by the Manassas Gap railway from Strasbourg in the Shenandoah valley. The Valley (as it was commonly called) between the Blue Ridge and the Alleghanies was of great strategical importance, providing the Confederates with a covered line of advance into Maryland and giving them control of a considerable section of the B and O. railway. To the Federals it was of less offensive value, as its direction led away from Richmond, but its possession would enable them to strike at Richmond's direct line of railway communication with the West.

Lee, now acting as *Davis's* military adviser, was gathering two armies, one under *Beauregard* at Manassas Junction, the other at Harper's Ferry under *J. E. Johnston.* The latter evacuated his post (June 15) when Patterson with a larger force threatened attack, and fell back covering the Manassas Gap railway.

The Richmond authorities had vainly attempted to retain their hold on the western section of the State Having failed to raise recruits from the district itself for its defence, they sent a small force to hold the crests of the Alleghanies. But McClellan crossed the Ohio and overwhelmed it (July 11–13) at Rich Mountain and Carrick's Ford. Meanwhile a convention at Wheeling had repudiated secession and set up "a Restored Government of Virginia " West Virginia's defection was a serious blow to the Confederates, losing them the Ohio, which they intended to make their line of defence, and the western portion of the B. and O. railway.

At Washington there was a demand that *Beauregard* should be attacked before the term of the militia's service expired. "On to Richmond," the new capital of the Confederacy, was the popular cry. On political grounds a plausible case could be made out for overruling Scott's advice. McDowell, whom Scott, too old and infirm for service in the field, had appointed commander of the forces south of the Potomac, submitted a plan of operations (June 24). With 30,000 men he proposed to drive *Beauregard's* 20,000 back behind the Rappahannock, provided that Patterson prevented *Johnston* from joining him. The Manassas Gap railway gave the Confederates the advantage of "interior lines." McDowell advanced from Alexandria (July 16). The two armies met (July 21) at Bull Run (*q v.*), where after several hours' fighting the Federals left the field. Their retreat became a panic-stricken flight, which carried them back to the Potomac. The Confederates were too disorganized to conduct an immediate pursuit. Presently they advanced to Centreville, where they established their main position and waited for the Federals to make the next move. Washington quickly recovered from its alarm. McClellan was summoned from West Virginia and started to organize a fresh army The first pitched battle of the war was barren of decisive results.

In the west a neutral Kentucky interposed a barrier between the combatants, but there was some fierce fighting in south-west Missouri. Lyon pursued *Jackson* as far as Springfield, where he halted to await reinforcements Ex-Governor *Price,* commanding the State militia, raised a fresh force and being joined by *McCulloch's* troops from Arkansas advanced against Lyon, who being left unsupported was defeated and killed at Wilson's Creek (Aug 10). This battle too lacked decisive results. *McCulloch,* having entered Missouri without orders from the Government, retired after his victory into Arkansas, leaving *Price* to continue the struggle with his own resources.



EASTERN VIRGINIA ON THE OUTBREAK OF THE CIVIL WAR BECAME THE MAIN SCENE OF CONFLICT AND THROUGHOUT THE FOUR YEARS, 1861–65, CONTINUED TO BE THE MOST STUBBORNLY CONTESTED GROUND. HERE WAS THE BACKBONE OF THE CONFEDERACY WITH THE CONFEDERATE CAPITAL, RICHMOND. THE MAJOR CAMPAIGNS CONDUCTED IN VIRGINIA BY THE ARMIES OF THE UNION, BEGINNING WITH BULL RUN, LED TO MANY SANGUINARY CONFLICTS, THE MOST IMPORTANT OF WHICH ARE SHOWN ABOVE, AND CULMINATED IN THE SURRENDER AT APPOMATTOX

McClellan in Supreme Command.—The defeat at Bull Run was followed by "the second uprising of the North." Congress authorized the enlistment of 500,000 three-year volunteers, and again recruits poured in. McClellan excelled as an organizer and within three months added 100,000 men to the Army of the Potomac, whose discipline and training rapidly improved under his command. But in October public confidence in him began to abate. Confederate batteries on the lower Potomac, which closed its navigation, were left undisturbed, and the discreditable affair of Ball's Bluff occurred (Oct. 21) where four Federal regiments were ferried over the Potomac to make a reconnaissance towards Leesburg, but were driven back into the river with the loss of over half their numbers. Nevertheless on Scott's resignation he was appointed general-in-chief (Nov. 1). He was expected to open an offensive campaign while the "mud" roads in Virginia were still hard and dry. But though his forces were twice as strong as *Johnston's* at Centreville, he accepted the report of his secret service, which doubled *Johnston's* actual numbers. Moreover, in his new post he was engaged, as will be seen, in organizing the military resources in all theatres of war and despatching expeditions against the Confederate coast. Appreciating the value of sea power he was already contemplating the transfer of his army by water next spring to some point where he would be nearer to Richmond than *Johnston*. But he treated Lincoln with great want of consideration in keeping his plans a secret from him In December he contracted typhoid fever and was absent from duty for some weeks.

The Confederate generals at Centreville had been vainly pressing *Davis* for reinforcements that they might enter Maryland. They realized the danger of prolonged inaction, while McClellan's army was daily growing stronger. If *Davis* could reinforce them with 20,000 trained men, they proposed to cross the Potomac and by threatening the communications of Washington force McClellan to risk a pitched battle, before he had time to train his raw levies. *Davis* in conference with his generals (Oct. 1) said that he had no reinforcements to spare; he could not withdraw troops from the coast, which was itself threatened with attack. Though the Confederate coastline extended 3,000 m. the Federals could make the blockade practically effective by sealing up the few important harbours and getting possession of the North Carolina "sounds." The forts guarding Hatteras Inlet had been captured (Aug 29); those protecting the entrance to Port Royal, S C., fell to another and larger force (Nov. 7); and a third expedition on a still larger scale under Burnside was being equipped against Roanoke island, whose capture would complete the conquest of North Carolina's "inland waters."

What, however, chiefly decided *Davis* to refuse his generals' request was his determination to stand strictly on the defensive in the belief that the war had been won at Bull Run, and that before the spring campaign could open, European intervention would end hostilities. Even in West Virginia, where Rosecrans, McClellan's successor, was pushing forward into the Kanawha valley, no real counter-offensive was attempted. *Lee* after Bull Run was sent to co-ordinate the operations of four separate detachments acting independently of each other. But he failed to produce an effective combination, and after his return to Richmond in October the loss of West Virginia was regarded as inevitable.

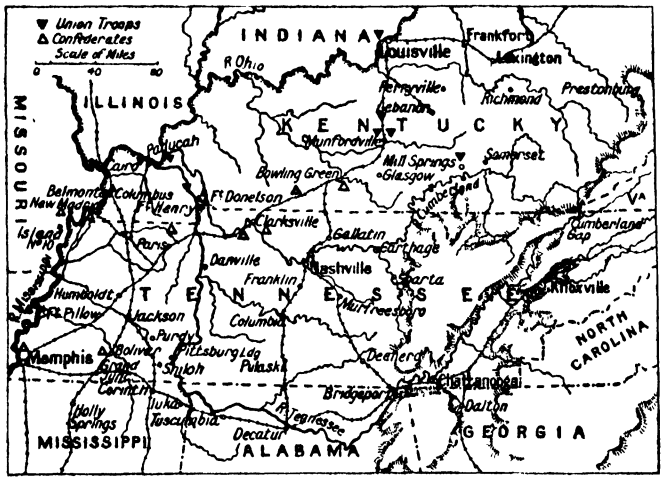
In the west, Confederate encroachments upon Kentucky's territory forced it into the war. Frémont, commanding in Missouri, was threatening an expedition down the Mississippi, which would involve the occupation of the Kentuckian shore. Therefore *Polk*, general and bishop, early in September seized Hickman and Columbus, which afforded strong defensive positions on the river, whilst Grant, one of Frémont's brigadiers, promptly replied by occupying Paducah and Smithland at the mouths of the Tennessee and Cumberland. *Polk's* refusal to withdraw his troops, unless Grant set the example, ended Kentucky's neutrality. A new theatre of war was opened up, the great extent of which offered immense possibilities to either side. McClellan on becoming general-in-chief set up in the west two military departments, that of the Missouri embracing all Kentucky west of the Cumberland under Halleck, and that of the Ohio including the rest of Kentucky under Buell. *Davis* appointed *A. S. Johnston*, one of his ablest generals, to supreme command in the west. *Johnston* advanced into Kentucky and took up a defensive position with his left at Columbus and his right at the important railway junction of Bowling Green, whilst Forts Henry and Donelson in the centre guarded the approaches up the Tennessee and Cumberland. At the outset the Federals were ill prepared to take the offensive. In Missouri, Frémont had left everything in confusion. Kentucky appeared unable or unwilling to defend itself. The troops from the free States north of the Ohio had been largely diverted to West Virginia or Missouri. Lincoln and McClellan were at one in pressing Buell to advance into East Tennessee, Lincoln wishing to send relief to the distressed Unionists there and make of it a second West Virginia, whilst McClellan considered that the success of his campaign in Virginia depended upon the capture of the East Tennessee railway, Richmond's direct line of communication with the west But the proposed movement presented great difficulties, especially so late in the year, when the roads were almost impassable. There was no railway or navigable river to serve as a line of communication for an invading force, whilst the enemy could bring up troops from east or west over their railway. Buell proposed a different plan. An offensive against *Johnston* should precede any movement into East Tennessee. Halleck with two "flotilla columns" should ascend the Tennessee and Cumberland and break through the Confederate line at its most vulnerable point. Buell would himself advance overland on Nashville, Tennessee's capital. This was the plan of campaign, which when carried out two months later met with brilliant success, but it found no favour with Lincoln, McClellan or Halleck. A small Confederate force advancing through Cumberland Gap into Kentucky was defeated by Thomas at Mill Springs (Jan. 19, 1862). This victory cleared the way for an advance into East Tennessee, but before Buell could follow it up, his attention was called to another quarter by an unexpected move on Halleck's part.

Beyond the Mississippi *Price* had marched north towards the Missouri, gathering up recruits as he went. All over the State, except in St. Louis, Southern sympathizers took up arms to avenge the violation of their "State rights." *Price*, not strong enough to attack St. Louis, aimed at crossing the Missouri to join the secessionists in the north of the State. He captured Lexington (Sept. 20). But Frémont's advance with 40,000 men forced him to retreat to the southwest border. Frémont followed in pursuit to Springfield, where he was relieved of his command (Nov. 2). He had won fame as an explorer in the Rockies, and in California during the Mexican War, and had been a candidate for the Presidency in 1856, but he now proved incompetent both as an administrator and in the field and was held responsible for Lyon's defeat. When *Polk* from Columbus established a post at Belmont on the Missouri bank, Grant descended the river and attacked Belmont (Nov. 7). He was eventually driven back to his boats and forced to re-embark. During the winter Halleck restored order out of chaos and made all preparations for driving *Price* finally out of the State.

On his return to duty in mid-January 1862 McClellan found two changes, both destined to affect his fortunes adversely. Congress had appointed a joint committee of the two houses on the conduct of the war, and Stanton had become secretary of war. McClellan now revealed his new plan of campaign to Lincoln, who first rejected it, but three days later reopened the discussion. McClellan offered a choice of three oversea routes, stating his own preference for a movement to be made with great secrecy to Urbana on the lower Rappahannock, where he would be within 50 m. of Richmond. He expected by a rapid advance from that base to cut off a Confederate force in the Yorktown peninsula and capture Richmond, before *Johnston* could intervene. Lincoln did not see how the preparations could be kept secret, and was sure that McClellan would still find *Johnston* between himself and Richmond. He objected to any movement which uncovered Washington and withdrew McClellan from interposing between the capital and *Johnston*. He gave, however (Feb. 27), a grudging assent to an oversea movement without specifying the actual point of disembarkation. Finally he forbade the Urbana plan and left

McClellan his choice between landing at Fortress Monroe at the end of the Yorktown peninsula, the route which McClellan considered the worst of the three, and making an overland campaign. McClellan chose the first alternative. Probably the withdrawal (March 9) of *Johnston* behind the Rappahannock reconciled him to the sacrifice of his Urbana plan. Throughout these discussions Lincoln demanded adequate protection for Washington, and McClellan undertook to leave ample forces for the purpose.

The Federal Offensive in the West, Feb.–May 1862.—The weak point in *A. S. Johnston's* line was at the centre, where the



BARTHOLOMEW, EDIN

THEATRE OF THE FEDERAL OPERATIONS IN THE WEST. FEB.–MAY 1862

Memphis and Ohio railway, which formed the link between his two wings, crossed the Cumberland and Tennessee so close to Fts. Donelson and Henry that the capture of these forts would sever his line of communication with the Mississippi. The Tennessee was navigable as far as Tuscumbia in North Alabama, and the Cumberland up to Nashville. The Confederates had no gunboats on these rivers, and if these forts fell there was nothing to oppose the Federal advance to the Memphis and Charleston (M. and C.) railway, the direct line of communication between east and west. Halleck without orders from McClellan or arrangement for co-operation with Buell ordered Grant (Feb. 1) with 15,000 men and Foote's gunboats to ascend the Tennessee, capture Ft. Henry and destroy the railway bridge. Ft. Henry surrendered to the gunboats (Feb. 6), the garrison escaping to Ft. Donelson. *Johnston* evacuated Bowling Green, sending half his army to Ft. Donelson and retiring with the other half to Nashville. This division of forces proved fatal. The concentration of 18,000 men at Ft. Donelson did not prevent its surrender with the bulk of its garrison to Grant (Feb. 16). *Johnston* abandoned Nashville, which was occupied by Buell (Feb. 24), and took up his position at Murfreesboro, and *Beauregard,* sent from the east to command on the Mississippi under *Johnston,* evacuated Columbus (Mar. 2) after removing its armament to New Madrid and Island No. 10, where he intended to make the next stand against a Federal descent of the river. *Johnston* was thus thrown back to his second line of defence along the M. and C. railway with his wings at Memphis and Chattanooga and his centre at Corinth. Halleck's unauthorized movement had proved a brilliant success, but he was in no hurry to follow it up. Buell proposed that they should unite their forces as far up the Tennessee as possible on the east bank, cross the river and seize the M. and C. railway. The occupation of Corinth would secure control of the Mississippi down to Vicksburg. Halleck preferred to act independently, sending a strong force up the Tennessee to raid the Confederate communications on the west bank. Lincoln gave Halleck the supreme command in the west (Mar. 11) placing Buell under his orders.

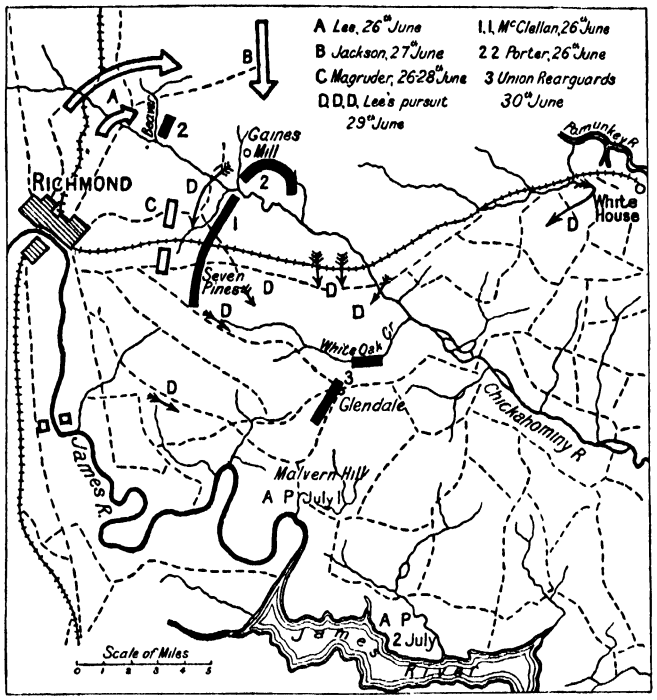
Halleck now sent Pope with 20,000 men down the Missouri bank to capture New Madrid and Island No. 10, and summoned Buell from Nashville to Savannah on the Tennessee to join Grant encamped on the opposite bank at Pittsburgh landing. He assumed that the recent campaign had thrown the Confederates permanently on the defensive and that the concentration of his own forces would be effected without interruption. But *Johnston* and *Beauregard,* well served with information by local sympathizers, seized their opportunity. By calling up *Bragg* from Pensacola with 10,000 men they concentrated an army of nearly 40,000 at Corinth before the end of March. *Van Dorn* was bringing 15,000 men from Arkansas, but they could not wait for his arrival. The battle of Shiloh (*q.v.*) (April 6–7) was one of the most fiercely contested in the war. *Johnston* was killed the first day and *Beauregard* retreated to Corinth. Halleck joined his armies (April 11) and having been reinforced by Pope (April 21), who had captured with the help of the gunboats the garrison (7,000) of Island No. 10 with all its guns and stores, commenced a slow and cautious advance on Corinth. *Beauregard* held on to Corinth till May 30th, when he retreated to Tupelo. The evacuation of Corinth was followed by that of Ft. Pillow below Island No. 10 and Memphis (June 3). The Federal squadron fought and destroyed a Confederate flotilla at Memphis (June 6). With the capture of Corinth and Memphis the Federal offensive virtually ended. They had cleared Kentucky and West Tennessee of the enemy, established themselves on the M. and C. railway, and opened the Mississippi to Vicksburg But the Confederate army of the west had escaped and would presently take the offensive.

West of the Mississippi Halleck had scored another success. *Price* had been driven out of south-west Missouri by Curtis, who followed him into Arkansas. *Van Dorn,* commanding in the newly formed Trans-Mississippi department, reinforced *Price,* and their combined forces attacked Curtis at Pea ridge (or Elk Horn) but suffered a severe defeat (March 7–8). Still farther west the Confederates had suffered another reverse. A small expedition under *Sibley* had been sent up the Rio Grande to secure Arizona and New Mexico with a view to bringing California into the Confederacy. *Sibley* occupied Santa Fe in March, but was forced by Canby in April to make a disastrous retreat to Texas, and the whole of the territory, which he had overrun, was secured permanently by the Federals. But of all the disasters suffered in the west by the Confederates in the spring of 1862 the greatest, because irreparable, was the loss of New Orleans. Farragut with the Gulf squadron ran past the forts guarding the lower Mississippi and appeared next day before the city (April 24–25), which, abandoned by its garrison, surrendered to the fleet, and was formally occupied by Gen. Butler's troops (May 1).

McClellan's Peninsular Campaign, March–July 1862.—The sensational appearance of the iron-clad "Merrimac" in Hampton Roads, at the mouth of the James river (March 8), had threatened the collapse of McClellan's oversea campaign, but next day the "Monitor" proved more than her match, and the naval authorities gave a doubtful assurance that they could cover the landing. The embarkation began (March 17); McClellan himself reached Fortress Monroe (April 2). On taking command in the field of the Army of the Potomac he had been relieved of his duties as general-in-chief. For the next four months Lincoln and Stanton were responsible for the "higher strategy." McClellan commenced his advance (April 4), expecting to move rapidly up the peninsula to the neighbourhood of Richmond, where he would fight and win the decisive battle, and capture the Confederate capital. He knew that Yorktown and Gloucester on opposite banks of the York river were fortified, but he counted on the co-operation of the navy to capture Yorktown and intended to land McDowell's corps, which had not yet arrived, on the left bank for the reduction of Gloucester. But the navy could give no help as long as the "Merrimac" was afloat; Lincoln detained McDowell for the protection of Washington on the ground that McClellan had not kept his promise of leaving it absolutely secure. McClellan was held up before Yorktown for a month (April 5–May 3).

J. E. Johnston, who had brought his army to the peninsula and assumed command at Yorktown (Apr. 17), slipped away just as McClellan was about to open fire with his siege batteries. A sharp rearguard action took place at Williamsburg (May 5), and an attempt to intercept *Johnston's* retreat by sending a force up the York failed. McClellan established his headquarters at White House on the Pamunkey (May 16). He had succeeded in bring-

ing over 100,000 men (organized into five corps) within striking distance of Richmond, and only 60m. away on the Rappahannock opposite Fredericksburg lay McDowell's corps, now under orders to advance on Richmond on May 26. McClellan would have transferred his base from the York to the James, now open to the Federal war vessels as far as Drewry's Bluff, as the Confederates after the evacuation of Yorktown had abandoned Norfolk and



DISPOSITION OF OPPOSING FORCES JUST PRIOR TO THE RETREAT OF THE FEDERAL ARMIES FROM BEFORE RICHMOND, 1862

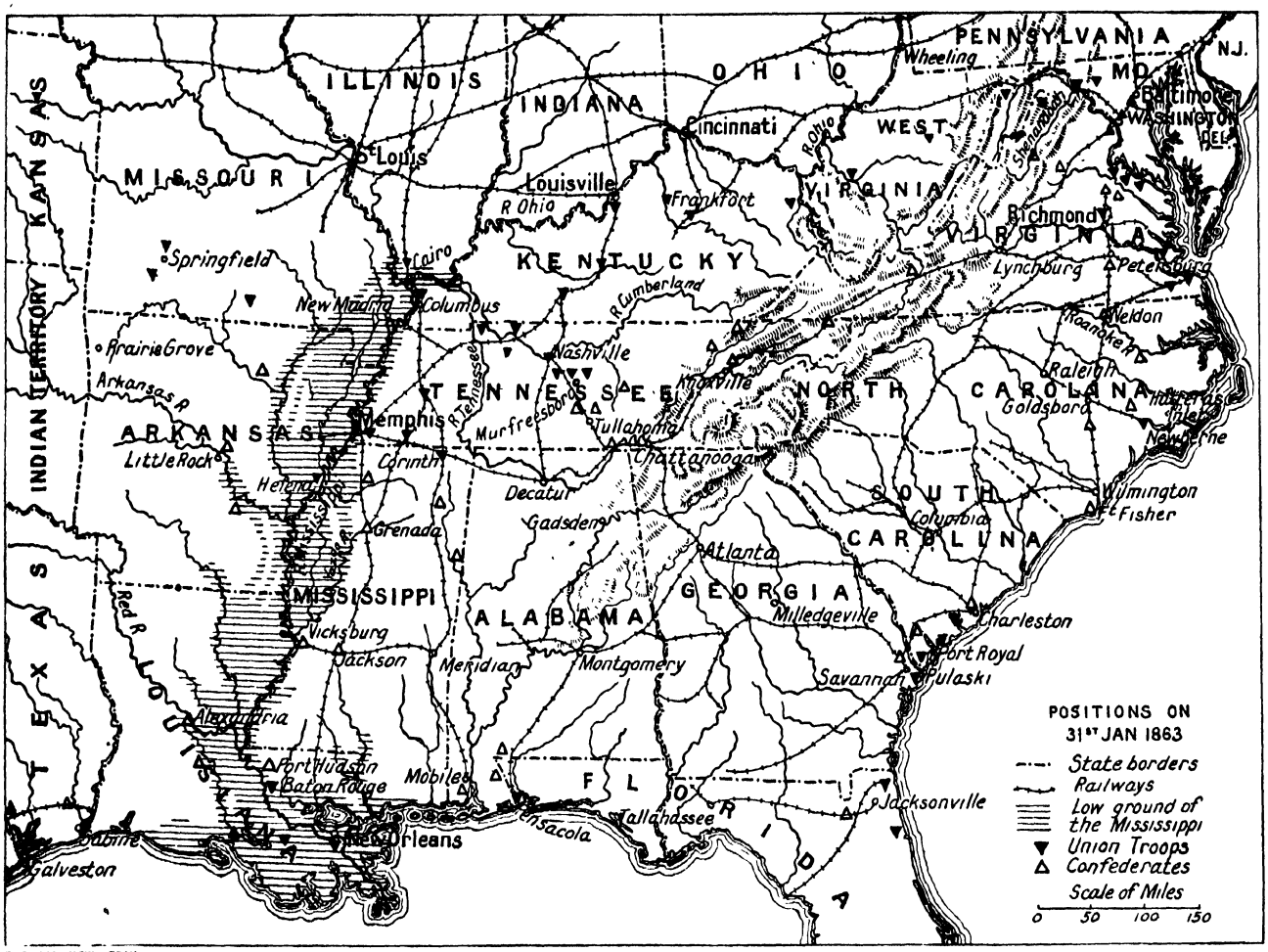
destroyed the *Merrimac*, which was unable to ascend the river But, informed by Stanton that he was to be reinforced, he advanced to the Chickahominy (May 20) and sent two corps across in preparation for the advance on Richmond, keeping three on the left bank to join hands with McDowell. He retained this position with his wings divided by the Chickahominy, although he learnt (May 24) that McDowell's advance was suspended owing to *"Stonewall" Jackson's* operations in the Valley, hoping that McDowell's movement would shortly be resumed. *Johnston* concentrated against the two corps on the right bank and brought on the battle of Seven Pines (*q.v.*) (May 31–June 1). He was beaten off, and himself severely wounded the first day. *Lee* on assuming command withdrew the troops. McClellan moved two more corps to the right bank, leaving one to cover his communications with White House and still hoping for McDowell's coming. *Lee's* plan was to continue using *Jackson* in the Valley to prevent McDowell moving south, and at the right moment to bring him to Richmond to take part in the decisive battle. *Jackson's* successes (June 8–9) served to hold McDowell fast, and *Lee* learning (June 15) that McClellan's right was "in the air," next day ordered *Jackson* from the Valley. McClellan had been waiting for the ground to dry, that he might move his siege batteries to the front. On the 25th his outposts were only 4 m. from Richmond, and he telegraphed to Washington that the final advance was about to begin. He was too late. Next day *Lee* struck and the Seven Days' Battle began (*q.v.*) (June 26–July 2.)

After the defeat of his one corps on the left bank of the Chickahominy (June 27), McClellan decided to "change his base" by a flank march through the White Oak swamp to the James. To cover the passage of his trains he was forced to stand and give battle to *Lee*, who sought to destroy the Federal army by a combined attack upon its rear and right flank. But, as at Seven Pines, the Confederate commander and his staff failed to co-ordinate the movements of their troops. June 30 was the critical day of the retreat, when the Confederates almost broke through the Federal centre, but failed through lack of support to reach the road on which McClellan's trains were moving. After repulsing a final assault at Malvern hill (July 1), McClellan reached the James and entrenched a position at Harrison's Landing. *Lee* finding that his opponent designed no immediate movement withdrew nearer Richmond (July 8).

McClellan's "change of base" placed him in a position to renew the offensive with good chance of success. He was farther away from Richmond, but his communications were absolutely secure. He could advance on either side of the river. Petersburg lay practically defenceless within his reach and its occupation would enable him to cut Richmond's communications with the south, as Grant did in 1864–65. His army was still numerically stronger than *Lee's* which had suffered the heavier losses in the week's fighting. It was at first assumed at Washington that he would resume the advance on Richmond, when he received reinforcements. But McClellan demanded 100,000 fresh troops, and Lincoln could not find more than 20,000. Political pressure was being put upon him to replace McClellan. To solve the problem, Halleck was appointed general-in-chief (July 11). A retired engineer officer, who had taken up legal practice, he was an acknowledged authority on the art of war. His recent success seemed to mark him out as McClellan's natural successor, but he proved but little help to Lincoln as a military adviser. He visited McClellan's army (July 25) and committed his first blunder by ordering the withdrawal of the Army of the Potomac to Aquia creek, where it could unite with Pope's Army of Virginia on the Rappahannock for an overland advance on Richmond (Aug. 3).

Jackson's "Valley campaign" is described elsewhere. Here it may be noted that on three separate occasions *Jackson* caused McDowell's corps to be withdrawn from McClellan. For his attack at Kernstown (March 23) alarmed Lincoln and was partly the cause of his detaining McDowell in the first instance at Washington. Throughout the campaign *Lee* worked upon Lincoln's anxiety for the safety of Washington to break up the threatened combination against Richmond.

The Confederate Offensive in the East, Aug.–Sept. 1862.—Pope was summoned (June 26) from the west to command an army composed of the forces on the Rappahannock and in the Valley. *Jackson's* campaign had taught Lincoln that one general is better than three. Pope's immediate task was to lighten the pressure upon McClellan by threatening the Virginia Central railway. *Lee* despatched (July 13) *Jackson* in time to save Gordonsville from Pope's cavalry. *Jackson* advancing towards Culpeper to prevent the concentration of Pope's scattered forces defeated Banks at Cedar Run (Aug. 9), but fell back when Banks was reinforced. *Lee* joining *Jackson* with *Longstreet's* command (Aug. 15) sought to crush Pope, before he could be reinforced from McClellan's army now definitely leaving the peninsula. Pope narrowly escaped being cut off on the Rapidan and retreated behind the Rappahannock. *Lee*, learning that portions of McClellan's army had disembarked at Aquia creek and were marching to Pope, detached *Jackson* to make a wide detour through the Bull Run mountains and strike Pope's line of communications at Manassas Junction (Aug. 25–27). Pope, mystified by this movement, made a succession of mistakes and *Lee*, reuniting his army on the battlefield, drove Pope across Bull Run (*q.v.*) (Aug. 29–30). Pope retired within the fortifications of Washington (Sept. 3). *Lee* would not allow the second Bull Run to be as barren of results as the first. Having received reinforcements from Richmond, which more than made good his losses, he crossed the Potomac at Leesburg and occupied Frederick (Sept. 7). He entered Maryland partly to "shift the burden of military occupation from Confederate to Federal soil." But his objective was mainly political, to influence the approaching elections in the North, impress Europe with a sense of Southern power and detach Maryland from the Union. Finding his line of communications up the Valley threatened by a strong garrison at Harper's Ferry, he divided his forces (Sept. 10), sending *Jackson* with the larger half to capture that post, whilst he withdrew the rest behind South Mountain. After the fall of Harper's Ferry he proposed to reunite his army and invade Pennsylvania.



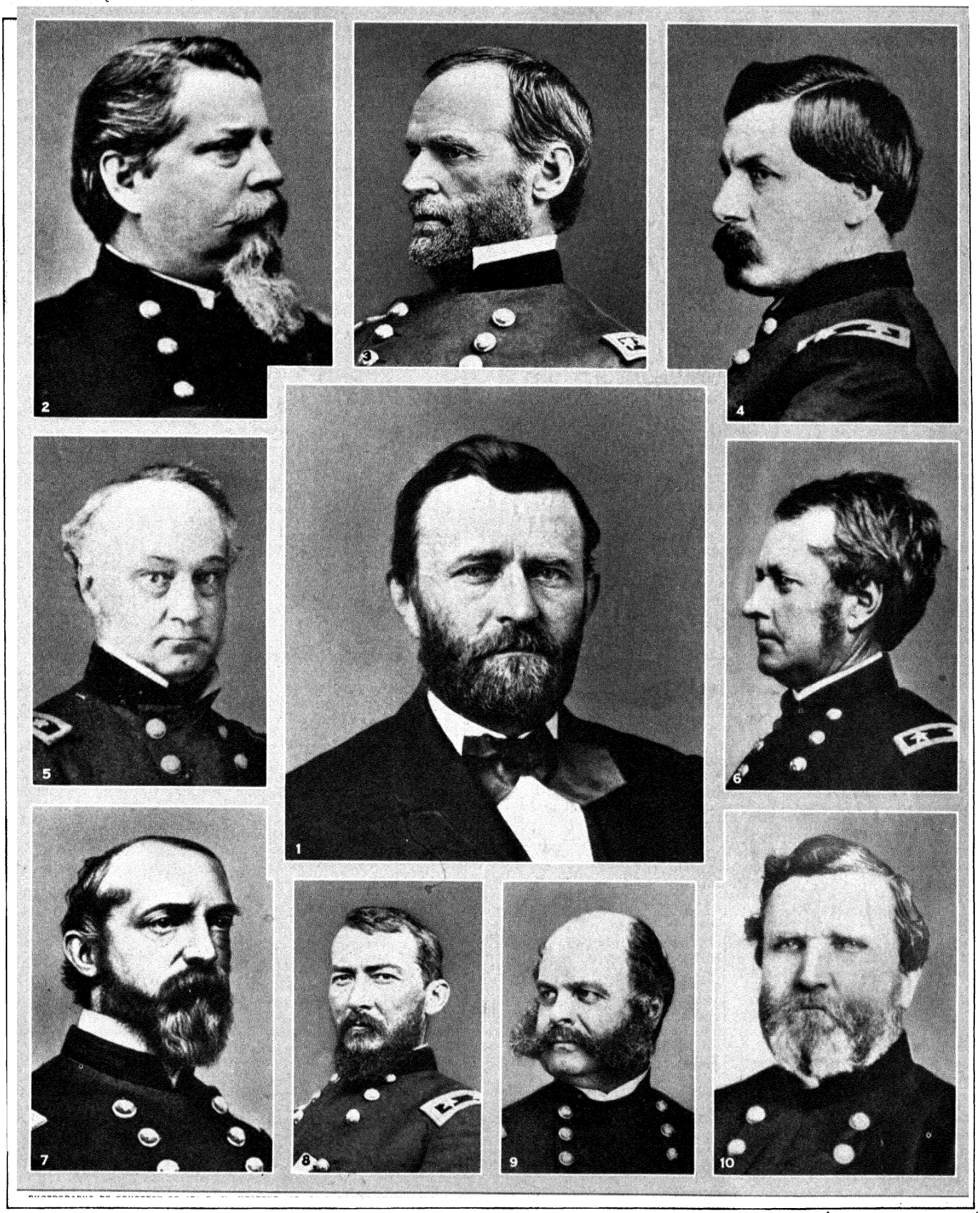
BARTHOLOMEW, EDIN.

McClellan, placed by Lincoln in command of all the forces in Washington, again took the field (Sept 7). Not knowing what *Lee's* next move might be, he advanced slowly, until a copy of *Lee's* order for the division of his army fell into his hands at Frederick (Sept. 13). He forced the South mountain passes (Sept. 14). *Lee* fell back behind the Antietam, covering a ford over the Potomac.

Jackson with three divisions had crossed the Potomac at Williamsport and appeared before Harper's Ferry from the west (Sept. 13). Other divisions occupied the heights north and east of Harper's Ferry on the opposite banks of the Potomac and the Shenandoah. The garrison (12,500), being completely surrounded, capitulated early on the 15th. Leaving A. P. Hill's division to complete the arrangements for the surrender, *Jackson* started for Sharpsburg and after a night-march rejoined *Lee* on the morning of the 16th with two divisions, and a third arrived later in the day. McClellan reached the Antietam on the 15th, devoted the next day to reconnaissance and fought the battle of Sharpsburg or the Antietam (*q.v.*) (Sept. 17). At the close of the day *Lee* still held his ground, but on the night of the 18th he recrossed the Potomac. His stay in Maryland was too short to produce any effect upon the political attitude of the State and the inhabitants had shown scant signs of sympathy.

The Confederate Offensive in the West, Aug.–Oct. 1862.—Halleck after the fall of Corinth could either follow up *Beauregard's* retreat or strike at Vicksburg or Chattanooga. Pursuit should have ended in the annihilation of the sole Confederate army in the west; the capture of Vicksburg would open the Mississippi to its mouth and cut the Confederacy in two; the occupation of Chattanooga would further Lincoln's policy of sending relief to the Unionists in East Tennessee. Halleck limited his offensive to sending Buell's army alone towards Chattanooga, and wasted three weeks by forcing him to use as his line of supply the M. and C. railway, which was exposed to cavalry raids. At the end of June Buell gained permission to transfer his base to Nashville. As no movement was made towards Tupelo, *Bragg*, who had succeeded *Beauregard* (June 27), left *Van Dorn* and *Price* to check Grant, who on Halleck's appointment as general-in-chief at Washington was left in command of the department of the Tennessee, Buell resuming command of his original department, and moved the bulk of his army to Chattanooga. He sought the co-operation of *Kirby Smith*, commanding in East Tennessee, in an advance on Nashville, but yielded to the other's confidence in the political results of an invasion of Kentucky and agreed to march to the Ohio. Buell, whose advance from Nashville on Chattanooga was twice suspended in consequence of cavalry raids upon his communications, took up a defensive position at Murfreesboro covering Nashville.

Kirby Smith "turned" Cumberland Gap, swept aside an extemporized force, which faced him at Richmond, Ky. (Aug. 30), and occupied Lexington (Sept. 2), threatening Louisville and Cincinnati. *Bragg*, concentrating behind the Cumberland mountains, appeared on Buell's front (Sept. 5). Then ensued a race to Louisville, in which Buell got the worse of the start, as he dared not uncover Nashville, and reached Bowling Green (Sept. 14) to find *Bragg* planted squarely across the railway between him and Louisville. Buell could not risk an offensive battle with so much at stake; *Bragg* would only fight on the defensive. He moved out of Buell's path owing to lack of supplies (Sept. 21) to make connection with *Kirby Smith*, who had collected a large depot of stores at Lexington. Buell entered Louisville (Sept. 25) and having reorganized his army marched out (Oct. 1) to find and fight the invaders. Their generals were more occupied with the inauguration of a provisional governor at Frankfort (Oct. 4) than with the need for concentrating their forces. An accidental encounter with indecisive results occurred at Perryville (Oct. 8) between Buell's and *Bragg's* left wings. *Bragg* and *Kirby Smith* now united their armies, but only to retreat through Cumberland



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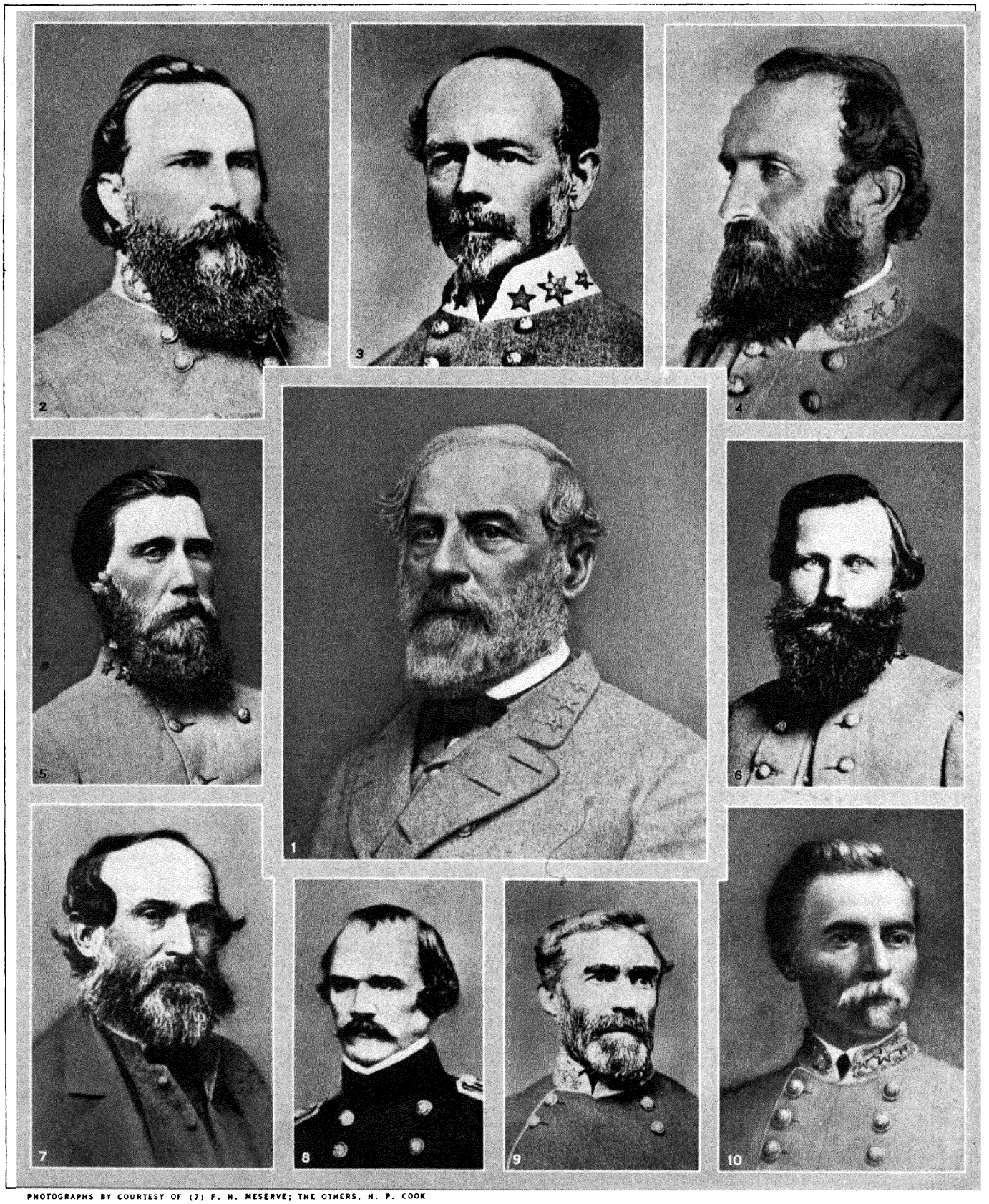
GENERALS OF THE UNION ARMY

1. Ulysses S. Grant (1822–85), created general-in-chief in March, 1864. 2. W. S. Hancock (1824–86), commanded a brigade in the Army of the Potomac. 3. W. T. Sherman (1820–91), who made the march through Georgia to the sea. 4. G. B. McClellan (1826–85), organizer of the Army of the Potomac. 5. H. W. Halleck (1815–72), general-in-chief of Union Armies, July 1862–64. 6. "Fighting Joe" Hooker (1814–79), won the "battle above the clouds." 7. G. G. Meade (1815–72), defeated Lee's Army at battle of Gettysburg. 8. P. H. Sheridan (1831–88), in command of the Army of the Shenandoah. 9. A. E. Burnside (1824–81), in command of the Department of the Ohio, 1863. 10. G. H. Thomas (1816–70), known as the "rock of Chickamauga"

AMERICAN CIVIL WAR



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GENERALS OF THE CONFEDERATE ARMY

1. R. E. Lee (1807–70), commander-in-chief of Confederate armies, February, 1865. 2. James Longstreet (1821–1904), "General Lee's war horse." 3. J. E. Johnston (1807–91), as commander of army of the Tennessee, conducted the campaign against Sherman in Georgia until July, 1864. 4. T. J. Jackson (1824–63) "Stonewall Jackson," Lee's chief subordinate. 5. J. B. Hood (1831–79), given command of army of the Tennessee, July, 1864. 6. J. E. B. Stuart (1833–64), held a command in army of Northern Virginia. 7. J. A. Early (1816–94), in command in the Shenandoah valley, 1864–65. 8. A. S. Johnston (1803–94). (Photograph taken during his service in the United States army previous to the outbreak of the Civil War). 9. B. Bragg (1817–76), the commander of the Western Department, 1862–63. 10. P. G. Beauregard (1818–93), opened the war by bombardment of Fort Sumter

Gap into East Tennessee. The Confederate invasion of Kentucky was barren of political results. The provisional governor was chased out of his capital immediately after his inauguration.

The Federals Resume the Offensive, Nov.-Dec. 1862.—Lincoln celebrated *Lee's* retreat with the Emancipation Proclamation. This alienated the Democrats, and if the Administration was to win the autumn elections it must raise its credit by some signal success. McClellan was urged to cross the Potomac and force another battle. He demanded time to reorganize his army. Five weeks passed before he began his advance along the east side of the Blue Ridge. But *Lee,* bringing *Longstreet* to Culpeper, again interposed McClellan was relieved of his command (Nov. 7) and his successor, Burnside, adopted a new plan of campaign, to transfer his base to Aquia creek, cross the Rappahannock at or below Fredericksburg, and march straight on Richmond. But delay in forwarding a pontoon-train from Washington prevented him crossing till *Lee* had taken up a position on the Fredericksburg heights (*q.v.*). Though the element of surprise was lost, Burnside persisted in crossing the river and, attacking *Lee,* was repulsed with terrible slaughter (Dec. 13).

In the west, Buell was replaced (Oct. 30) by Rosecrans, who as Pope's successor under Grant had gained the credit of defeating *Price* at Iuka (Sept. 19) and *Van Dorn* at Corinth (Oct. 3–4). Before renewing the advance upon Chattanooga he determined to make himself temporarily independent of the railway by accumulating a reserve of 2,000,000 rations at Nashville. For this purpose he had first to repair the Louisville railway, as the Cumberland, like the Tennessee, only became navigable in the latter part of the winter. The Government chafed at the delay. Rosecrans refused to be hurried. He commenced his advance against *Bragg* (Dec. 26), who since returning from Kentucky had established himself at Murfreesboro, where he expected to pass the winter. The battle of Stones river or Murfreesboro (Dec 31–Jan. 2) ended with *Bragg* abandoning the battlefield, evacuating Murfreesboro and falling back to Tullahoma. Rosecrans occupied Murfreesboro, and settled down for the winter.

After *Van Dorn's* defeat Grant moved against Vicksburg. Sherman starting down the river from Memphis was to land his troops at the mouth of the Yazoo, seize the bluffs north of Vicksburg, and attack the city from the rear, whilst Grant, who was already advancing along the Mississippi Central railway towards Jackson (Mississippi) would hold *Pemberton, Van Dorn's* successor, fast and prevent him sending help to Vicksburg But Grant had to retire when his supply depot was destroyed by a cavalry raid (Dec. 20), and Sherman was forestalled by *Pemberton,* who was kept informed by spies of the Federal movement, and defeated at Chickasaw Bluffs (6 m. north of Vicksburg) (Dec. 29). In northwest Arkansas *Hindman* was organizing a fresh invasion of Missouri but was anticipated by Blunt and Herron, who crossed the frontier and defeated him at Prairie Grove (Dec. 7).

Operations in the East, 1863: Chancellorsville and Gettysburg.—After "the horror of Fredericksburg" the two armies passed the winter facing each other across the Rappahannock. Hooker replaced Burnside (Jan. 26) and quickly restored the shaken *moral* of his army. *Lee* found great difficulty in feeding his troops, and by direction of the war department *Longstreet* with two divisions was sent to the south bank of the James to collect provisions in the vicinity of Suffolk, which was in Federal occupation. *Longstreet* invested Suffolk and at the moment, when his divisions were urgently needed on the Rappahannock, was engaged in a futile siege 120 m. away.

Both *Lee* and Hooker were eager to take the offensive. *Lee* had been considering with *Jackson* an invasion of Pennsylvania, but in the absence of *Longstreet's* divisions had to resign the initiative to Hooker. The latter aimed at forcing *Lee* out of his entrenchments by a wide turning movement over the upper fords of the Rappahannock above its junction with the Rapidan, and sent his newly organized cavalry corps to destroy the railways in *Lee's* rear and intercept his retreat. He thus deprived himself of "the eyes of his army," and to the absence of his cavalry (except one brigade) was largely due the failure of the Chancellorsville campaign (*q.v.*).

Hooker, who outnumbered *Lee* by fully two to one, concentrated the larger half of his army about Chancellorsville (April 30), whilst Sedgwick crossed the Rappahannock below Fredericksburg. *Lee,* leaving 10,000 men to check Sedgwick, threw Hooker on the defensive (May 1), outflanked and rolled up his right wing with *Jackson's* corps (May 2), drove him out of his entrenchments to a fresh defensive position (May 3), turned on Sedgwick, who had captured the Fredericksburg heights, and forced him back over the river (May 4), and then counter-marched to Chancellorsville to strike another blow at Hooker. But the latter retreated across the Rappahannock on the night of May 5. *Lee's* victory was dearly bought at the price of *Jackson's* life (May 10). He now reorganized his army into three corps under *Longstreet, Ewell* and *A P. Hill* and prepared to carry out his plan of invading Pennsylvania.

Longstreet had proposed another plan, viz , to utilize the advantage of the "interior lines" for the relief of Vicksburg now in dire straits. *Lee* should leave the army, which had fought at Chancellorsville, to "contain" Hooker on the Rappahannock, and with *Longstreet's* two divisions join *Bragg* in Tennessee. *Johnston's* troops should be brought from Mississippi and *Buckner's* from East Tennessee to the same point. The united forces under *Lee's* command could then take the offensive against Rosecrans with a good prospect of overwhelming him. If victorious, *Lee* should then invade Kentucky and threaten Louisville and Cincinnati as the most likely means of forcing Grant to raise the siege of Vicksburg. But *Lee* was unwilling to leave Virginia or divide his army.

Lee's objects were much the same as had prompted his invasion of Maryland in 1862, and in particular he hoped to levy much-needed supplies of food and clothing from a free State and at least prevent reinforcements being sent to Grant before Vicksburg He commenced his movement on June 3. His plan of campaign was to transfer his army to the Valley, cross the Potomac and march to the Susquehanna. He could count upon Lincoln's anxiety for Washington's safety keeping Hooker from attacking any of his widely separated corps before they were concentrated in Pennsylvania. He left *Hill* at Fredericksburg till Hooker should withdraw northwards, and *Longstreet* at Culpeper formed the link between *Hill* and *Ewell* pushing down the Valley. A cavalry battle at Brandy Station (June 9) warned Hooker that *Lee* was on the move. Being refused permission to march on Richmond, he began to fall back towards Manassas (June 13). *Hill* marched to the Valley covered by *Longstreet,* who advanced east of the Blue Ridge. *Ewell* captured Winchester (June 15) and crossed into Maryland, pushing his cavalry forward into Pennsylvania. *Longstreet* passed into the Valley in *Hill's* rear and their two corps were crossing the river on June 23–24. Hooker began crossing on June 25 and concentrated at Frederick, threatening *Lee's* line of retreat. *Hill* and *Longstreet* were at Chambersburg, *Ewell* on his way to Harrisburg with two divisions at Carlisle and one at York (June 27). But the absence of *Stuart's* cavalry, which was on a raid round the Federal army, and did not rejoin till July 2, left *Lee* in ignorance of Hooker's movements. He did not learn till the night of the 28th that Hooker had crossed into Maryland and was threatening his communications. He at once ordered a concentration of all his forces at Cashtown to keep the Federals east of South Mountain by threatening Baltimore Meade, who had replaced Hooker (June 28), was moving his army northwards to prevent *Lee* crossing the Susquehanna. A chance encounter on June 30 at Gettysburg (*q.v.*) brought on the famous battle.

Hill advancing from the west and *Ewell* coming down from the north had defeated two Federal corps and occupied Gettysburg (July 1). Neither *Lee* nor Meade expected a battle so soon, but *Lee* could complete his concentration first, and the chance of defeating his opponent in detail urged him to assume the offensive. But he could not get his corps commanders to work together as a team. No attack was delivered (July 2) till 4 P.M., and though the Confederates gained some ground on both flanks and for a moment broke through the Federal centre, at nightfall Meade still held Cemetery Ridge and had his whole army concentrated. *Lee* made his final assault (July 3) with two divisions against the enemy centre, but again concert of action was lacking, and

Pickett's charge, being unsupported, was a costly failure. *Lee* commenced his retreat (July 4) through the South Mountain passes. He was held up at Williamsport for a week waiting for the river to run down, but on the night of the 13th withdrew his army and trains into the Valley before Meade, who had only appeared on his front the day before, could make up his mind to attack.

Lee gradually fell back behind the Rapidan and Meade followed him across the Rappahannock as far as Culpeper. Both armies were weakened in September by sending heavy detachments to Tennessee. In October and November the two generals engaged in a campaign of manoeuvre, which had no decisive result and left them in their original positions on the Rapidan and Rappahannock respectively.

Operations in the West, 1863: Vicksburg and Chattanooga.—In 1863, as in 1862, it was in the west that decisive results were obtained. By the capture of Vicksburg and Port Hudson the Federals gained complete control of the Mississippi, and in East Tennessee they captured Chattanooga and Knoxville. Grant's Vicksburg campaign (*q.v.*) was one of the most brilliant operations of the war, though he owed much to his opponent's mistakes.

The problem was to transport his army from the right bank of the Mississippi to the high ground in the rear of Vicksburg After four unsuccessful attempts (Feb.–March) to open up a water-route, by which the enemy's flanks might be turned, Grant in April, when the winter-floods had begun to subside, moved two corps by land to a point below Grand Gulf, the extreme left of the Confederate defences. Part of the Federal fleet had run past the Vicksburg batteries by night (April 16), bringing with them two transports, and five more transports got past six nights later. Grant began crossing the river (April 30). *Pemberton,* who as commander of the Department of Mississippi and East Louisiana was responsible for both Vicksburg and Port Hudson, had been so mystified by Grant's demonstrations on the north side of Vicksburg that he had only four brigades available to meet his advance south of the Big Black river. Grant defeated these (May 1) and established a temporary base at Grand Gulf. Having been joined by Sherman with further supplies, he advanced (May 7) against the Vicksburg–Jackson railway, on which *Pemberton* depended for supplies and reinforcements. But suspecting after the engagement at Raymond (May 12) that a considerable force was collecting at Jackson, Grant cut loose from his base and marched with his whole army on Jackson, living off the country till he could work round to the north of Vicksburg and establish a new base on the Yazoo *J. E. Johnston,* commander-in-chief in the west, had been ordered (May 9) to go and assume personal command of the troops in Mississippi. He reached Jackson from Tullahoma (May 13) but found only two brigades there. Next day, after fighting a delaying action at Jackson, he retreated up the Mississippi Central railway to Canton. Grant then fell upon *Pemberton's* field-force at Champion's Hill (May 16) and drove it into the fortifications of Vicksburg, occupying Haynes's Bluff two days later. The fate of Vicksburg was now sealed. For *Johnston* was unable to collect a force strong enough to create a diversion, and *Pemberton* capitulated (July 4).

Butler's successor at New Orleans was equally successful in reducing Port Hudson, 200 m. below Vicksburg (July 9) Farragut with two warships had run past the Port Hudson batteries (Mar. 14), and by closing the mouth of the Red River deprived the garrison of its main source of supplies. Banks commenced siege operations (May 24), and the Confederates were on the verge of starvation when they surrendered.

For several months Rosecrans and *Bragg* remained watching each other in Middle Tennessee, confining themselves to cavalry raids against each other's lines of communication. Rosecrans was urged by the Government to take the offensive against *Bragg* to prevent him sending reinforcements to Mississippi. But Rosecrans maintained that, while he remained on *Bragg's* front, the latter would not risk the loss of Middle Tennessee by detaching troops elsewhere. *Bragg* did in fact send some reinforcements to *Johnston.* Rosecrans was really afraid that Grant might be defeated and was unwilling to commit himself to a fresh movement while the issue at Vicksburg remained unsettled. At last he advanced (June 23) and in nine days of incessant rain manoeuvred *Bragg* out of two strong positions in succession and forced him to retreat behind the Tennessee. He resumed his advance (Aug. 16) in co-operation with Burnside, who advancing from Kentucky occupied Knoxville (Sept. 2). Rosecrans feinting at *Bragg's* right, as if he intended to cross the Tennessee above Chattanooga and join Burnside, moved the bulk of his army across well below Chattanooga (Sept. 4) and advanced over the mountain ranges south of the river against *Bragg's* line of retreat. This manoeuvre forced *Bragg* to evacuate Chattanooga (Sept. 8), but he retreated only 25m. to Lafayette, where he covered the railway, waiting for a chance of defeating Rosecrans's army in detail. Rosecrans, imagining *Bragg* to be in full retreat, fell into the trap and pressed forward with three columns so widely separated that no two were within supporting distance of each other. But *Bragg* failed to close the trap. Two chances of overwhelming isolated portions of the Federal army were lost by his lieutenants. Rosecrans reconcentrated his army (Sept. 18), and *Bragg,* having received considerable reinforcements, including five brigades under *Longstreet,* from Virginia, attacked and defeated him (Sept 19–20) in Chickamauga valley (*q.v.*) and drove him back into Chattanooga, where the Federal army was practically besieged and in danger of starvation. Grant was now appointed to the supreme command in the west and reached Chattanooga (Oct. 23), where Hooker with reinforcements from the Army of the Potomac had already arrived. Grant substituted Thomas for Rosecrans in command of the Army of the Cumberland and averted all fear of starvation by opening a short line of communication with Bridgeport by way of two ferries over the Tennessee. *Bragg* now weakened himself by sending *Longstreet* with a large detachment against Burnside (Nov. 3) Grant on the arrival of four divisions of the Army of the Tennessee under Sherman took the offensive and stormed *Bragg's* position on Missionary ridge, which overlooked Chattanooga (*q.v.*) (Nov. 25).

In his anxiety for Burnside's safety Grant ceased his pursuit of *Bragg's* retreating army (Nov 28) and despatched Sherman to Knoxville, where *Longstreet* was besieging Burnside After failing in an assault upon the Federal works (Nov. 29), *Longstreet* raised the siege (Dec 4) on Sherman's approach and retreated up the Holston valley. The greater part of East Tennessee was now in Federal hands.

Grant in the East, 1864.—Halleck having failed during 18 months to co-ordinate from Washington the movements of the Federal armies, Grant was commissioned (March 9) lieutenant-general, a grade revived by Congress, and appointed general-in-chief to command in the field. Deeming his presence more urgently needed in the east, he attached himself to the Army of the Potomac, retaining Meade in actual command Sherman succeeded him in the west. The presidential election was due in November. The North was war-weary, and Lincoln's chance of re-election would be small unless speedy victory were in sight. Grant's was a policy of attrition, aiming at the exhaustion of the only two enemy armies of considerable size still in the field, viz., *Lee's* in Virginia and *Johnston's* in Georgia, by concentrating against them all the force available. For Meade's army not Richmond, but *Lee's* army was the objective. Grant designed to flank *Lee* out of his entrenchments behind the Rapidan and wear him down by "continuous hammering." He could afford to lose two men to *Lee's* one, because Southern man-power was nearly exhausted. But he also sought to create a diversion by threatening Richmond and its railway communications on both flanks. Columns were ordered to march on Staunton and Lynchburg, and then unite for a movement against Richmond; the Army of the James was to advance up the south bank of the James River. But in allowing Butler to command this army, Grant made a grievous mistake. B. F. Butler, a criminal lawyer and influential politician, had shown no military capacity in his various commands, but he was a dangerous man to alienate in a presidential year.

Grant crossed the Rapidan (May 4). After two days' battle in the Wilderness (*q.v.*) he moved by the left flank to Spottsyl-

vania and continued this "side stepping" manoeuvre till close to Richmond. But in these forty days he never got *Lee* into the open. On the Po, North Anna, Totopotomoy and at Cold Harbor he found *Lee* entrenched across his path. No diversion came from Butler, who missed the opportunity of capturing Petersburg in the first week and was "bottled up" by *Beauregard* (May 16). The other subsidiary movement was nearly as unsuccessful.

After Grant's defeat at Cold Harbor (June 3) *Lee* detached *Early's* corps to save Lynchburg from Hunter, who had already captured Staunton. Hunter retreated into West Virginia, leaving the Valley open to *Early*, who marched down it, crossed the Potomac, defeated a scratch force on the Monocacy (July 9) and appeared before Washington (July 11) Grant sent back one corps for the protection of the capital. But *Early* withdrew (July 12) and retired into the Valley, having given Washington and Baltimore a sudden fright, but without seriously deranging Grant's plans. Grant's casualties had reached 55,000, and though probably he inflicted as heavy losses on *Lee* in proportion, he had to part with 36 time-expired regiments, and the reinforcements, which kept up his numbers, could not replace the veterans of the old army.

Grant's finest achievement was the transfer of his army across the Chickahominy and the James unopposed under *Lee's* nose (June 12–15), but he lost the chance of capturing Petersburg (June 15–18), which *Lee* was slow to reinforce (*q v.*). The ensuing siege of Petersburg was "trench warfare" and a siege only in name, as *Lee's* army was never invested. Grant's aim was to extend his lines to his left so as to get possession of the railways from the south and south-west to Petersburg and Richmond, whilst making demonstrations on the north bank of the James and "feeling" the Richmond defences. The fiasco of the "Burnside mine" (July 30)—when a mine was successfully exploded under a salient in the Confederate lines, but the assaulting troops owing to the mismanagement of Burnside, the corps-commander on whose front the attempt was made, were repulsed with heavy loss—warned him against frontal attacks on *Lee's* lines round Petersburg. He secured a considerable section of the Weldon railway, but at the end of the year *Lee* still held the Southside and Danville lines.

The only Federal successes in the east this year were won by Sheridan in the Valley (*q.v.*). Sent by Grant to drive out *Early*, he won three victories in a month (Sept. 19–Oct 19) and completely devastated the Valley, which had become the granary of Richmond. These victories, coupled with Sherman's capture of Atlanta (Sept. 2), secured Lincoln his overwhelming triumph over the Democratic candidate, Gen. McClellan

Sherman in the West, 1864.—Sherman with three armies under Thomas, McPherson and Schofield confronted *Johnston*, who had taken command of *Bragg's* beaten army.

The Richmond Government had wished *Johnston* to effect a junction with *Longstreet* and invade Middle Tennessee, but *Johnston* finding his army in no condition to take the offensive remained at Dalton, where he occupied a strong defensive position. Grant's instructions to Sherman were "to move against *Johnston's* army, to break it up and to get into the interior of the enemy's country as far as you can." To Grant the destruction of the enemy army was the primary objective, but Sherman thought more of occupying strategic points in Confederate territory. Atlanta, *Johnston's* base, was at the junction of four important railways and "full of foundries, arsenals and machine-shops. Its capture would be the death-knell of the Confederacy" (Sherman). Eventually Sherman captured Atlanta but let the Confederate army escape. He had about the same superiority of numbers as Grant had, roughly 100,000 against 60,000, and was as far from Atlanta as Grant was from Richmond. But as compared with Grant he had one great disadvantage. He was practically tied to the railway and could not be continually shifting his base. Grant had intended that Banks should effect a diversion in Sherman's favour by a movement on Mobile in co-operation with Farragut's fleet. But Banks was not available, having been previously sent by Halleck up the Red River to establish at Shreveport a base for the military occupation of northern Texas, the Government fearing that the French in Mexico were planning to establish an independent republic in Texas.

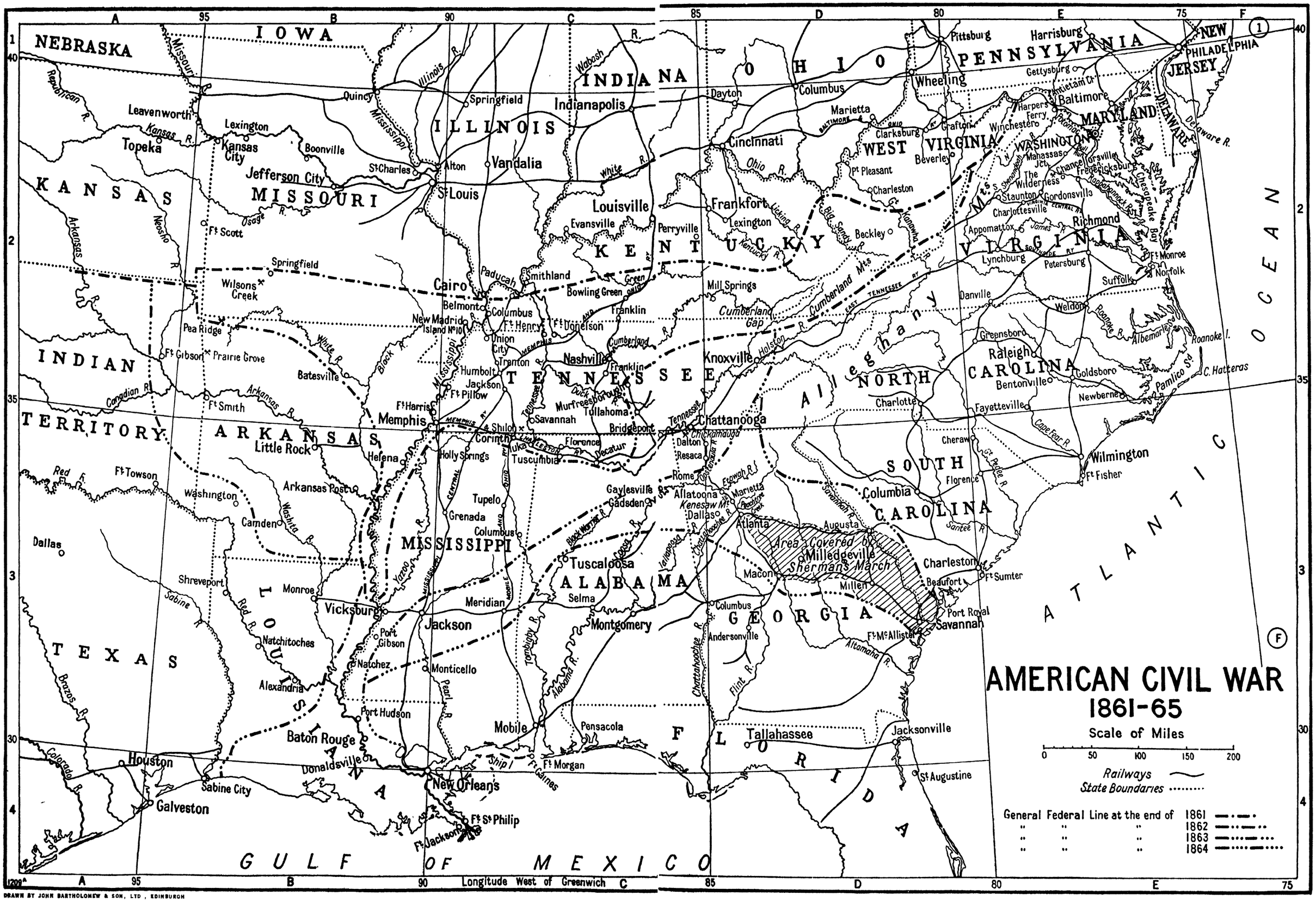
The campaign opened (May 4) Between Dalton and Atlanta the railway crossed three rivers, the Oostanaula at Resaca, the Etowah and the Chattahoochee.

Johnston's policy was to delay Sherman's advance as much as possible, withdrawing from his successive positions before he could be drawn into a pitched battle except upon his own terms. He was prepared to fall back as far as Atlanta, which he regarded as impregnable, "too strong to be taken by assault and too extensive to be invested." Sherman's general plan of campaign was to keep Thomas's army in the centre to "contain" *Johnston's* army, for which it was in itself a match, and use the other two to turn his flanks With McPherson's army he outflanked *Johnston's* left and forced him to evacuate Dalton (May 13) and Resaca (May 15). In the comparatively open and rolling country between the Oostanaula and the Etowah *Johnston* expected to be able to make a stand and give battle, but his corps commanders dissuaded him, and retreating across the Etowah (May 20) he took up a strong position in the mountain pass at Allatoona.

By temporarily cutting loose from the railway and marching on Dallas Sherman turned the Allatoona pass and by shifting McPherson over to the left flank gradually forced *Johnston* to contract his lines round Marietta (*q v.*). Wishing to save his troops the fatigue of yet another flank movement over roads rendered almost impassable by continuous rain, Sherman attacked *Johnston's* lines on Kenesaw mountain (June 27), but was repulsed with heavy loss Resuming the outflanking movement round *Johnston's* left he manoeuvred him out of the Marietta position (July 2), and a week later *Johnston* withdrew his whole army behind the Chattahoochee, after Schofield had crossed above his right flank. Though in this protracted duel only the engagement at Kenesaw mountain ranks as a battle, skirmishing never ceased, often developing into hard fighting, especially during the operations round Dallas. During May and June Sherman's casualties amounted to about 17,000, and *Johnston's* were relatively, if not actually, greater. *Johnston* was preparing to fall upon Sherman's columns, as they crossed the Peach Tree creek, the only natural obstacle between the Chattahoochee and Atlanta's northern defences, when he was superseded by *Hood* (July 17). *Davis* was tired of *Johnston's* Fabian tactics and believing that he would abandon Atlanta without a battle, put a fighting general in his place. *Hood* promptly fought three battles before the end of July, but was defeated in them all, and evacuated Atlanta (*q v*) (Sept 2). Sherman waited for *Hood's* next move. *Hood* crossed the Chattahoochee (Sept. 29) and striking first at Sherman's communications marched to Gadsden (Alabama) drawing Sherman in pursuit more than 100m from Atlanta as far as Gaylesville (Oct. 20) When *Hood* moved still farther west to cross the Tennessee, Sherman started back to Atlanta to execute his long-cherished plan of marching through Georgia to the coast. He left Thomas to deal with *Hood*. But the force assigned to Thomas was barely sufficient for the purpose.

In actual numbers superior to *Hood's* army, it was made up of widely separated commands; one corps was still in Missouri, and until its arrival at Nashville (Nov. 30) Thomas can hardly be said to have had an army at all. Sherman could easily have spared another 12,000 men, and this addition to his strength would have made Thomas's position absolutely safe

Hood's plan was to destroy Thomas's forces before they could concentrate, capture Nashville, invade Kentucky, threaten Cincinnati and then march through East Tennessee to join *Lee*. But a three weeks' delay at Florence to collect supplies proved fatal. Schofield with 23,000 men had time to take position at Pulaski and delay his advance, whilst Thomas was concentrating his other forces at Nashville. Having failed to envelop Schofield on the Duck river, *Hood* attacked him furiously but unsuccessfully at Franklin (Nov. 30) and appeared before Nashville (Dec. 2). In spite of the severity of his losses and the fact that he was confronted by an army superior to his own, *Hood* was still bent on retaining the offensive and detached his cavalry


NEBRASKA
IOWA
INDIANA
OHIO
PENNSYLVANIA
NEW JERSEY
ILLINOIS
KANSAS
MISSOURI
KENTUCKY
WEST VIRGINIA
MARYLAND
DELAWARE
VIRGINIA
INDIAN TERRITORY
ARKANSAS
TENNESSEE
NORTH CAROLINA
SOUTH CAROLINA
MISSISSIPPI
ALABAMA
GEORGIA
LOUISIANA
TEXAS
FLORIDA
Area Covered by Sherman's March
ATLANTIC OCEAN
GULF OF MEXICO
Leavenworth
Lexington
Topeka
Kansas City
Boonville
Quincy
Springfield
Indianapolis
Jefferson City
St Charles
Alton
Vandalia
St Louis
Louisville
Evansville
Ft Scott
Springfield
Wilsons Creek
Cairo
Paducah
Smithland
Bowling Green
Belmont
Columbus
New Madrid
Island No 10
Ft Henry
Ft Donelson
Franklin
Pea Ridge
Ft Gibson
Prairie Grove
Batesville
Union City
Humbolt
Nashville
Jackson
Ft Pillow
Ft Harris
Memphis
Savannah
Murfreesboro
Tullahoma
Bridgeport
Chattanooga
Ft Smith
Little Rock
Helena
Holly Springs
Corinth
Florence
Tuscumbia
Decatur
Dalton
Resaca
Rome
Gaylesville
Gadsden
Allatoona
Kenesaw Mt
Marietta
Atlanta
Dallas
Ft Towson
Washington
Arkansas Post
Camden
Tupelo
Grenada
Columbus
Tuscaloosa
Selma
Montgomery
Meridian
Vicksburg
Jackson
Port Gibson
Natchez
Monticello
Shreveport
Monroe
Natchitoches
Alexandria
Port Hudson
Baton Rouge
Mobile
Pensacola
Tallahassee
Jacksonville
St Augustine
Houston
Galveston
Sabine City
Donaldsville
New Orleans
Ft St Philip
Ft Jackson
Ft Morgan
Ft Gaines
Dallas
Pittsburg
Harrisburg
Philadelphia
Gettysburg
Wheeling
Dayton
Columbus
Cincinnati
Marietta
Clarksburg
Grafton
Baltimore
Harpers Ferry
Winchester
Pt Pleasant
Beverley
Charleston
Frankfort
Lexington
Perryville
Beckley
Mill Springs
Cumberland Gap
Knoxville
Danville
Lynchburg
Petersburg
Richmond
Appomattox
Staunton
Gordonsville
Charlottesville
Manassas Jct
Chancellorsville
Fredericksburg
The Wilderness
Suffolk
Norfolk
Ft Monroe
Weldon
Greensboro
Raleigh
Goldsboro
Bentonville
Newberne
Fayetteville
Charlotte
Cheraw
Florence
Wilmington
Ft Fisher
Columbia
Augusta
Charleston
Ft Sumter
Beaufort
Port Royal
Savannah
Macon
Milledgeville
Millen
Andersonville
Ft McAllister
Albemarle Sd
Pamlico Sd
C. Hatteras
Roanoke I.
Cape Fear R.
Santee R.
Savannah R.
Altamaha R.
Flint R.
Chattahoochee R.
Tombigby R.
Alabama R.
Pearl R.
Black Warrior R.
Coosa R.
Tallapoosa R.
Etowah R.
Oostanaula R.
Chickamauga
Tuckahoe R.
Roanoke R.
James R.
Potomac R.
Rappahannock R.
Chesapeake Bay
Delaware R.
Big Sandy R.
Kanawha R.
Holston R.
Cumberland R.
Green R.
Licking R.
Kentucky R.
Ohio R.
Wabash R.
Illinois R.
Missouri R.
Mississippi R.
White R.
Arkansas R.
Red R.
Canadian R.
Neosho R.
Osage R.
Republican R.
Black R.
Yazoo R.
Washita R.
Sabine R.
Brazos R.
Colorado R.
Red R.
Tennessee R.
Duck R.
Shiloh
Ft Harris
Memphis & Charleston R.R.
Orange & Alexandria R.R.
Mobile & Ohio R.R.
Central R.R.
Baltimore & Ohio R.R.
Virginia Central R.R.
Manassas Gap R.R.
Orange Court House
Manassas Jct
Gordonsville
Charlottesville
Staunton
Appomattox
Lynchburg
Petersburg
Richmond

against the Federal lines of communication. He remained before Nashville in the vain hope of receiving reinforcements promised from Texas, until Thomas marched out and defeated him in the most decisive battle of the war (*q.v.*) (Dec. 15–16). *Hood* escaped over the Tennessee, but his army as a fighting force practically ceased to exist.

Sherman started from Atlanta (Nov. 15) on his 300m. march with 60,000 men and without encountering any organized resistance reached the outskirts of Savannah (Dec. 10), feeding his army off the country. His purpose was to demonstrate "the hollowness" of the Confederacy and by ruining the railway system of Georgia, now the granary of the South, prevent food reaching Richmond Georgia was left undefended except by *Wheeler's* cavalry and the State militia, *Hood's* invasion of Tennessee being counted upon to bring Sherman back in pursuit. Sherman, having destroyed 160m. of the Georgia Central railway, by storming Ft. McAllister established communication with the fleet in Ossabaw sound. Savannah was evacuated (Dec. 20). Sherman was now free to join Grant by sea or land.

Though the Confederates still held Mobile, its value as a port was gone. Farragut had forced an entrance into the bay (Aug. 5) and captured the forts guarding the harbour mouth. Only in the Trans-Mississippi had the Confederates gained any success. Banks's Red River expedition proved a complete failure and he retreated to New Orleans. But the Federals retained their hold upon northern Arkansas, including Little Rock, the State capital. *Price* made a last raid into Missouri in September and October.

Collapse of the Confederacy, Jan.–May 1865.—Richmond's fall was near at hand. Grant's next advance would plant him on the Southside railway. *Lee* had not sufficient troops to hold a further extension of his lines. Desertion was thinning his ranks; conscription had broken down. Wilmington, the last Confederate port, was closed by the capture of Ft Fisher (Jan. 15). A peace conference held in Hampton Roads failed (Feb. 3) because *Davis* still insisted on the recognition of Southern independence. Congress forced *Davis* to appoint *Lee* (Feb 9) commander-in-chief of all the Confederate forces. But this step came too late; *Lee* could only appoint *Johnston* to command such troops as could be mustered to meet Sherman For Grant, having decided that to the Army of the Potomac should fall the honour of capturing Richmond, ordered Sherman to march up through the Carolinas, and to provide him with a base on the coast, brought Schofield round from Nashville to North Carolina to capture Wilmington Sheridan with 10,000 cavalry moved from the Valley to White House (March 19) in time for Grant's next advance *Lee* had determined to withdraw his army to Danville and effect a junction with *Johnston* against Sherman But his artillery horses and transport animals were in no condition for hard work, until the roads improved. To prevent Grant extending to the left, *Lee* attempted a diversion by attacking Ft. Stedman (March 25) on the right of the Federal lines After the repulse of this sortie Grant ordered a general advance by the left flank. Sheridan's victory at Five Forks (April 1), beyond the extreme right of *Lee's* lines, where with his cavalry and Warren's corps he defeated *Pickett's* division and *Fitzhugh Lee's* cavalry, gave the Federals possession of the Southside railway Next morning Grant broke through *Lee's* lines on a broad front, driving him back into the suburbs of Petersburg. That night *Lee* commenced his retreat. Richmond surrendered (April 3). *Lee* having been forced by Sheridan from the Danville road to the north bank of the Appomattox surrendered (April 9).

Sherman advanced (Feb 1) and occupied Columbia (Feb. 17), which was accidentally burnt. Charleston was evacuated (Feb. 18). Although the march over swollen rivers and swamps was most arduous, Fayetteville, N.C., was occupied (March 11), where communication was established with Wilmington, which had been captured (Feb. 22). Sherman now aimed at Goldsboro to effect a junction with Schofield, who had left Wilmington for New Berne. To prevent this junction *Johnston* attacked Sherman's left wing at Bentonville (March 19), but withdrew his forces and retreated to cover Raleigh (March 21). Sherman joined Schofield at Goldsboro (March 23). From Goldsboro Sherman moved out against *Johnston* (April 10) and occupied Raleigh (April 13). Next day *Johnston* asked for an armistice. The assassination of Lincoln (April 14) caused a delay, but *Johnston* finally surrendered at Greensboro (April 26). In the lower South, Wilson conducted a brilliant cavalry campaign in Alabama, defeating *Forrest* and capturing Selma (April 2), the last Confederate arsenal, and Canby, Banks's successor, captured Mobile (April 12). *Taylor* surrendered the Confederate forces in Alabama and Mississippi to him (May 4), and *Kirby Smith* surrendered the Trans-Mississippi forces (May 26). *Davis* was captured by some of Wilson's cavalry (May 10).

The Navies and the Blockade.—The United States navy was quite unprepared for war. Half of the 34 steamships available for service were on foreign stations and the home squadron comprised only seven steamers and five sailing ships. The navy department was slow to recognize the value of armour plate for warships and let the Confederates get the start with the *"Merrimac." Mallory,* secretary of the navy, aimed at providing three types of warships: armoured rams for coast defence, sea-going ironclads to destroy the blockading squadrons and commerce-destroyers. The last two classes he hoped to build or purchase in Europe. The *"Merrimac"* and the "Monitor" represented the types of ironclad constructed by the two combatants respectively. The former, a U S. frigate, which had been fired and scuttled at Norfolk, was raised and cut down to a ram with a wooden casemate, protected by armour and carrying ten heavy guns, erected upon her hull. At her first appearance in Hampton Roads she sank two wooden sailing vessels, the *"Cumberland"* and *"Congress,"* but next day, after a drawn battle with the "Monitor," retired to Norfolk. Altogether 12 of these ironclads were constructed, but the weakness of their engines rendered them less formidable than was expected The Confederates, unable to build engines in their workshops, had to use for their ironclads either the old ones or those which they took out of other steamers. The main features of the "Monitor," designed by Ericsson to counter the *"Merrimac,"* were the revolving turret, the low freeboard and the projecting overhang. She drew less water and was more easily handled. The Federals built a large number of monitors, which, though more than a match for the rams, were comparatively ineffective against forts, as was proved by the failure of the naval attack on the Charleston forts (April 7, 1863). The river "ironclads," which fought in the waters of the west, were gunboats constructed by Eads with a partially armoured casemate. To the original nine, five more were added in 1863, more heavily armoured and powerfully armed. Three single-turret ironclads of light draught were specially constructed for the Red River expedition.

Two powerful ironclads were built in England for the Confederates, but the British Government prevented them sailing. One ironclad built in France passed into Southern hands, but reached Havana too late to take part in the war. Three commerce-destroyers built or purchased in England drove the Federal mercantile marine from the seas. Having auxiliary sail power they could economize coal. The *"Alabama"* during her 22 months' cruise never put into a Confederate port. She captured 68 prizes in the Atlantic, Indian ocean and China sea, sank the Hatteras gunboat off Galveston but was herself sunk off Cherbourg by the sloop-of-war "Kearsarge" (June 11, 1864). The *"Shenandoah's"* objective was the whaling fleet in the North Pacific, which she destroyed (June 1865), having no official news that the war was over. The Geneva Arbitration (1872) found Great Britain responsible for the losses inflicted by these three cruisers to the amount of $15,500,000.

The Federal navy concentrated upon blockading the seven principal southern ports. Lincoln had proclaimed a blockade of the Southern coast (April 19, 1861). But for many months it was little more than nominal for lack of ships which could enforce it. An attempt to close Charleston harbour by sinking stone-laden hulks in the entrance proved a failure. Not till the middle of 1862 could the blockade be regarded as even moderately effective. Then with the export of cotton at last unrestricted

and an increasing demand in the English market, vessels specially adapted for blockade-running were built in the English shipyards, and in spite of the Federal navy blockade-running only ceased to be a profitable speculation when the ports were actually in Federal occupation. Savannah had been practically closed since the capture of Ft. Pulaski (April 1862). The loss of Charleston and Wilmington left the Confederacy without an Atlantic port, and reduced the armies of *Lee* and *Johnston* to a state of destitution.

Conclusion.—The collapse of the Confederacy was so sudden and complete that it took Europe by surprise. Sherman's "march to the sea" first opened foreign eyes to the probability of Southern defeat. But by the end of 1863, when *Lee* had suffered defeat at Gettysburg and *Bragg* had finally lost Chattanooga, and the Federals had recovered the Mississippi between Vicksburg and Port Hudson, thus completely isolating the Trans-Mississippi department, ultimate defeat stared the Confederacy in the face. The sole remaining hope was that the North through sheer war-weariness might throw away the victory already won. When Grant seemed fought to a standstill by *Lee* round Richmond in the summer of 1864, and between Sherman and Atlanta *Johnston's* army interposed still unbeaten, the North very nearly reached the limit of its endurance. The Democrats put forward a programme, the first article of which pronounced the war a failure. Lincoln despaired of re-election. But the fall of Atlanta and Sheridan's triple victory over *Early* in the Valley came in time to turn the scale in favour of the Government. Gradually too the significance of Grant's position in front of Petersburg began to be realized. *Lee* had lost the power to manoeuvre, when he was shut up in Richmond and Petersburg, and could not force Grant to relax his hold. Yet once more the North was filled with alarm when *Hood* crossed the Tennessee and, with Sherman far away in Georgia, threatened an invasion of Kentucky. Grant himself was on his way to take command at Nashville, when he heard the news of Thomas's crowning victory. Sherman could now present Lincoln with Savannah as a Christmas gift, and the one organized army of the Confederacy in the west was definitely broken up.

The South made a great mistake during the first winter of the war, when the North was organizing its military strength and the Confederates took no counter-measures. Their Government, counting on European recognition to be followed by peace, left *A. S. Johnston* in the west with an entirely inadequate force to hold Kentucky and Tennessee. At the first onset the Federals broke through his line of defence; his counterstroke failed; Kentucky and a great part of Tennessee were permanently lost, New Orleans fell, and the Federals gained control of great stretches of the Mississippi. Then the Confederate Government awoke from its dream. The first Conscription Act (April 1862) retained in service the 148 regiments of one-year volunteers and by encouraging voluntary enlistment enabled *Lee* to save Richmond, but the ground lost in the west was never recovered.

The Confederacy had one inherent weakness. It was composed of "sovereign" States, which would temporarily sacrifice their "State rights" for the success of their revolution, but demanded that the Central Government should provide for their protection, and if it failed in that duty, would take their own measures for self-defence. The State governors were always a thorn in *Davis's* side. From the first they required delicate handling and, when things began to go wrong, became refractory. This State patriotism combined with geographical conditions to isolate the different sections of the country and prevented the Confederates from taking proper advantage of the "interior lines." Only once did troops from the Trans-Mississippi come to the help of their countrymen on the other side of the river. *Van Dorn* moved from Arkansas to *Beauregard's* aid at Corinth, but his men were very reluctant to cross the river, and it is significant that no attempt was made to bring reinforcements to Vicksburg in 1863 from that department. Only once were considerable reinforcements sent from the east to the west, when *Longstreet* with two divisions was sent to *Bragg's* aid, and the victory of Chickamauga (*q.v.*) was the result.

The west was the really decisive theatre of war. In the east *Lee's* victories did not alter the strategical position. The end of each campaign found the Army of the Potomac on the Rappahannock, still menacing Richmond. But the fall of Vicksburg cut the Confederacy in two; the loss of the food supplies, especially cattle, from the Trans-Mississippi was sorely felt, and the capture of Chattanooga and Knoxville not only cut off another section of territory, but opened the way to Georgia, the granary of the South. That *Lee's* and *Johnston's* armies were reduced to starvation was due to the loss of Georgia's supplies. Grant indeed captured Richmond and *Lee's* army, but had he chosen he might have brought Sherman's army by sea from Savannah to the James, and it could have been there two months before he began his final move.

In final analysis the North's naval superiority must be reckoned a decisive factor. It made possible the conquest of the Mississippi and Sherman's march through Georgia The capture of New Berne by the Burnside expedition (Mar. 1862) provided the Federal land forces with a base, from which they could threaten an advance on Richmond, and caused the permanent retention in North Carolina of a considerable Confederate force, which might have been profitably employed elsewhere, notably at the time of *Lee's* invasion of Pennsylvania. The blockade threw the South upon its own resources, which proved inadequate, especially in the matter of munitions of war and medical stores. It was not lack of food, but the difficulty of transport, which reduced the Confederate armies to the verge of starvation The Southern railways were not equal to the strain of a four years' war. The rolling stock could not be replaced when worn out or the permanent way kept in working order owing to the lack of iron rails.

(W. B. Wo)

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AMERICAN COLLEGE OF PHYSICIANS, an association of physicians engaged in the study and practice of internal medicine in its various branches. It was legally chartered on May 11, 1915, under the laws of the State of Delaware as a corporation "not for profit." The objects of the college as stated in the constitution are: "to uphold and maintain high standards in medical education and practice; to encourage research especially in clinical medicine; to foster measures for the prevention of disease and for improving public health; to perpetuate the history and best traditions of medicine and to maintain high standards of medical ethics; and to maintain the dignity of the profession in its relationship with patients" Its membership is made up of outstanding internists (including pediatrists, psychiatrists, neurologists, bacteriologists, pathologists, dermatologists, röntgenologists, medical teachers and investigators, tuberculosis and public health specialists) of the United States, its possessions, and Canada Fellowship, with the degree, the designation, or the certificate of "F A.C P." (Fellow of the American College of Physicians), is conferred on applicants or nominees who present evidence of suitable professional qualifications and character, as specifically set forth in the constitution and by-laws of the organization.

AMERICAN COLLEGE OF SURGEONS, an American college or guild (not a teaching institution), whose fellowship embraced in 1928 approximately 8,000 qualified surgeons of North and South America. The college was organized in 1913 by some 500 surgeons of North America, leaders in every branch of surgery and representatives of all sections of the country. The object of the college is "to elevate the standard of surgery, to establish a standard of competency and of character for practitioners of surgery, to provide a method of granting fellowships in the organization, and to educate the public and the profession to

understand that the practice of surgery calls for special training, and that the surgeon elected to fellowship in this college has had such training and is properly qualified to practise surgery." The college opposes the paying of commissions for surgical work. At the annual congress and in the sectional meetings of the college, conferences are held on all matters pertaining to hospital standardization of interest to the profession, hospital personnel and the public. The "Minimum Standard" of the college sets forth definite professional requirements, essential for every hospital which aims to give the highest degree of efficiency in the professional care of its patients. Regular and special bulletins are published by the college containing information dealing with hospital standardization and the hospitals attaining to its "Minimum Standard"; and a hospital information and service bureau is maintained for the answering of questions and sending out of special data in the hospital field. *Surgery, Gynaecology and Obstetrics* is the official journal of the college. The library and department of literary research of the college were organized to further the standardization of literature on surgery and closely allied subjects and to encourage the wider reading and study of scientific material. A department of clinical research includes the committee on treatment of malignant diseases with radium and X-Ray, the committee on the treatment of fractures, the registry of bone sarcoma, the board on traumatic surgery and the committee on standardization of clinical laboratories. The most recent responsibility assumed by the college is the very extensive programme for medical motion picture films which the American College of Surgeons is fostering in co-operation with the Motion Picture Producers and Distributors of America, Inc., and the Eastman Kodak Company. A preliminary survey of films already produced is being made. For the production of additional films advisory committees have been appointed in the various branches of medicine and surgery. The headquarters of the college are in Chicago, Illinois.

AMERICAN EXCHANGE IRVING TRUST COMPANY adopted this name in 1926 when the American Exchange-Pacific Bank merged into the Irving Bank and Trust Company, at which time the capital was increased from $22,000,000 to $32,000,000. The Irving Bank, New York, originated in 1851 as a New York State bank under the name "New York Exchange Bank"; was chartered in 1864 as a national bank; took the name Irving National Exchange Bank of New York in 1907; changed its name to Irving National Bank, New York, in 1912; and was again converted into a New York State bank on Jan. 6, 1923, under the name Irving Bank, New York. In 1923 the Irving Bank merged into the Columbia Trust Company (formed in 1871) which then increased its capital from $5,000,000 to $17,500,000 and changed its name to Irving Bank-Columbia Trust Company. Three years later (1926) the National Butchers' and Drovers' Bank of the City of New York merged into the Irving Bank-Columbia Trust Company, which thereupon increased its capital to $22,000,000 and adopted a new name, Irving Bank and Trust Company. The American Exchange-Pacific Bank had its origin in 1838 as a New York State bank, under the name American Exchange Bank. It was chartered as a national bank in 1865, under the name American Exchange National Bank, and changed its name to American Exchange-Pacific National Bank in 1925, when the Pacific Bank, a New York State institution, was converted into a national bank and merged with it. It was again converted into a New York State bank in 1928, under the name American Exchange-Pacific Bank

At the close of 1927 the total assets of the American Exchange Irving Trust Company were $734,821,545. It is a member of the Federal Reserve System.

AMERICAN FARM BUREAU FEDERATION, an agricultural organization founded in 1919 as an outgrowth of the county farm bureau movement. County bureaux, voluntary societies of farmers, had for some years co-operated with county agricultural agents (advisers), often paying part of the agent's salary. The bureaux had gradually undertaken other activities, such as co-operative buying and selling. State farm bureau federations, with the county bureaux as units, had been formed in a number of States. Delegates from 31 States joined in organizing the national federation, with the aim of developing an organization that should act as spokesman for American farming as a whole. The federation early established a legal department, which presented the agricultural viewpoint in railway rate cases. The federation also opened an office in Washington in the interest of agrarian legislation. The membership of the American Farm Bureau Federation is widespread, but its greatest strength is in the Middle West.

See O. M. Kile, *The Farm Bureau Movement* (1921).

AMERICAN FEDERATION OF LABOR. The American Federation of Labor was organized in Pittsburgh, Pa., Nov. 15 1881. The 107 delegates participating represented international unions, national unions, local unions and city central bodies with a membership of 262,000.

Previous to the meeting in Pittsburgh, a number of representative labour officials met in Terre Haute, Ind., and declared that the time had arrived for a more perfect combination of labour, one that would "propagate trade union principles and impress the necessity of protective trade and labour organizations." The object was to "elevate trade unionism and obtain for the wage earners respect for their rights and that reward for their services to which they were justly entitled." Three principles were adopted by the Pittsburgh convention as a basis upon which to carry on the work of the trade union movement. These were:

"1. A shorter workday.

"2. To recognize neither creed, colour nor nationality

"3. All workmen whether mechanics or labourers are eligible to membership"

Another declaration was: "We believe the gaining of higher wages and the shorter workday to be the preliminary steps toward great and accompanying improvements in the condition of the working people."

Non-Partisan Policy.—In order to insure the safety of the organization and to avoid repeating the folly of previous national labour organizations, the convention positively "forbade any member of the legislative committee from publicly advocating the claims of any of the political parties" This was the foundation for the non-partisan political policy religiously followed from 1881.

The first convention advocated the eight-hour day; the protection of children from exploitation in industry; compulsory education; declared the script system of payment of wages instead of in lawful currency a gross imposition and downright swindle; favoured legislation giving wage earners the first lien upon property upon which they had been employed; demanded the repeal of all laws regulating wages and the number of hours in a day's work; urged that a bureau of labour statistics be created in the several States and by the Federal Government, and laws be enacted forbidding the importation of foreign labourers under contract.

All these were gained. It was through agitation by the American Federation of Labor that every State in the United States has compulsory education laws and laws protecting children. Some of the laws protecting children are far below the necessary standards, and therefore organized labour obtained the submission of an amendment to the Constitution of the United States giving Congress the power to limit, regulate and prohibit the labour of children under 18 years. It secured legislation to compensate the victims of accidents in industry; for the health, safety and comfort of workers in all industries; for sanitation; and for the elimination of convict labour competition in several of the States, a principle for whose establishment it continued vigorously agitating in all the States.

Through organized labour's influence a Federal department of labour was created. The secretary of labour is a member of the President's Cabinet, and only union men have been appointed to that position. Nearly all the States have created labour departments and free employment bureaux.

Influence on Immigration.—Through its efforts immigration has been restricted. From 1898 to 1907 more than 7,000,000 immigrants came into the United States. After the War at least

10,000,000 were anxious to enter. But restrictive laws were enacted in 1924 which limited the yearly number to 164,667 and forbade immigration of persons ineligible for citizenship.

When the American Federation of Labor was organized the length of the workday ranged from ten to 18 hours. In 1884 an appeal was made "to union men and those not under the banner of organized labour in the name of justice and humanity to concentrate their energies upon the single issue of reduction in the hours of labour." The struggle for the shorter workday was carried on until practically every union man and great numbers of the unorganized gained the eight-hour day. The American Federation of Labor always opposed the fixing of hours of labour and wages by legislation except for Federal, State, county and municipal employés. One principle has been maintained—not to ask for legislation for any purpose that can be gained through organized labour's own economic power. It reserved the right to increase wages and shorten the workday through collective bargaining between chosen representatives of the unions and the employers.

Protective laws for women were sought and obtained because of the latter's inability to organize permanently In many States, as well as the Federal Congress, laws limiting the hours of women in gainful occupations to eight were enacted

Hours of Labour.—The increased use of machinery, which began in the early '70s, made imperative a reduction in the hours of labour. There was no opposition to the introduction of machinery, but labour demanded that it should share in the benefits accruing from its use An outstanding feature of the reduction in hours of labour was that as the hours were reduced wages were increased. It was declared: "Social inequality, industrial instability and injustice must increase unless the workers' real wages, the purchasing power of their wages, coupled with a continuing reduction in the number of hours making up the working day are progressed in proportion to man's increasing power of production." To accomplish this the five-day week was advocated

The American Federation of Labor has no power not delegated to it by conventions composed of delegates from national and international unions, State federations of labour, city central bodies and local unions directly affiliated. It has 106 national and international unions, four departments, composed of trades in allied industries, 49 State federations of labour (which includes Porto Rico), 794 central bodies, 742 local department councils, 365 directly affiliated local trade and federal labour unions There are 30,000 local unions affiliated to the national and international unions. The membership is approximately 4,000,000.

Fraternal Relations.—Since 1884 the British Trades Union Congress and the American Federation of Labor have sent fraternal delegates to each other's conventions. In later years fraternal delegates from labour movements of other nations have attended the conventions of the American Federation of Labor.

In 1915 the necessity for co-operation between the labour movements of the various countries in the western hemisphere was considered. In 1918 a meeting was held at Laredo, Texas, which permanently organized the Pan-American Federation of Labor. Other conventions of the Pan-American Federation of Labor were held in New York city in 1919, in Mexico City in 1923 and in Washington in 1927.

The American Federation of Labor publishes the *American Federationist* and *Weekly News Service*. The former is a monthly magazine with nearly 100,000 circulation and is devoted to policies of the labour movement. The *Weekly News Service* furnishes news to the publications of the national and international unions and to 300 weekly labour papers published by central bodies or individuals.

The legislative committee looks after legislation in Congress. Hostile legislation is opposed and remedial legislation is supported by the committee, which works under the direction of the president.

Labor Day, which was first suggested in 1882 by the New York City Central Labor Union, has been made a legal holiday by the Federal Government and 48 States. Other holidays celebrated by labour are: Labour Sunday, Labour Memorial Sunday and Mother's Day. It has also favoured legislation declaring May 1 Child Health Day.

Through the efforts of the American Federation of Labor, Congress freed the seamen, granting them the right to go ashore in safe harbour.

When war threatened, the United States representatives of the various national and international unions met in Washington April 6 1917, and offered their services "to our country in every field of activity, to defend, safeguard and preserve the Republic of the United States of America against its enemies whomsoever they may be, and we call upon our fellow workers and fellow citizens in the holy name of labour, justice, freedom and humanity to devotedly and patriotically give like service." This declaration was unanimously approved by the American Federation of Labor. It later declared there should be "no peace without victory."

Other activities of the American Federation of Labor were: opposition to compulsory arbitration; demanding and securing jury trials in contempt cases; crusade against the white plague; introduction of the union label; agitation against sweating shops and abolition of tenement house labour

The view of the federation is that strikes are growing fewer in number because collective bargaining is becoming more and more recognized. General strikes are emphatically opposed

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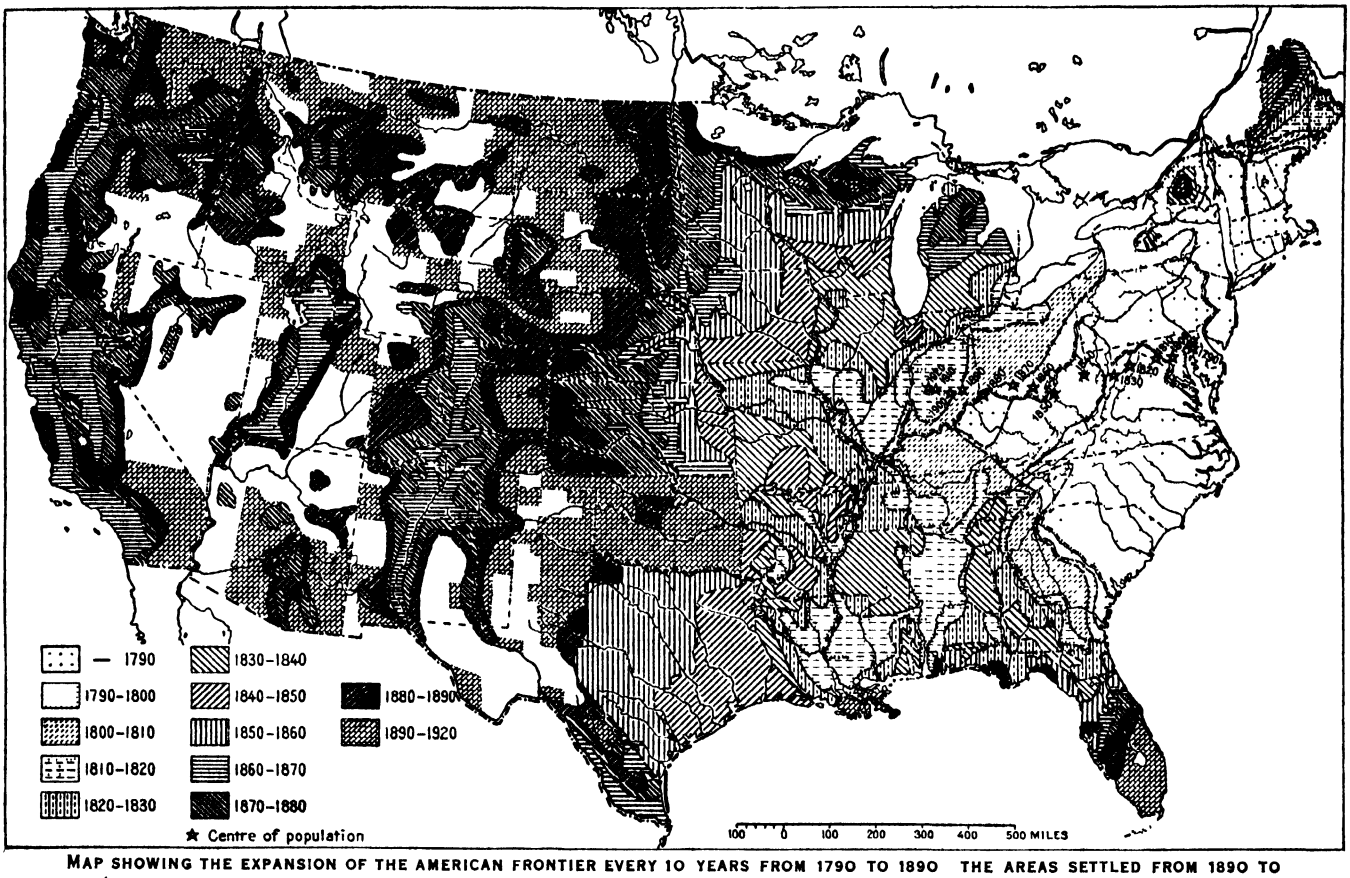
AMERICAN FRONTIER, THE. The American frontier, from an early period in the history of the continent, has affected the imagination of the pioneer who desired to exploit it, and of the visitor from afar who viewed it. Long before its existence and its significance attracted the attention of indigenous historians, it had drawn comment from the alien observer as an environment in which unusual processes were at work, and in which new human values were being born and old values were attaining new proportions. The various definitions that have been accorded it have depended largely upon the momentary use to which the frontier was being put by white men, or upon the functional relationship of the frontier as it has stood with settled society on one hand and with primitive virgin soil upon the other.



BY COURTESY OF THE UNIVERSAL PICTURES CORPORATION

A TRAPPER AND GUIDE, WEARING A COON CAP, A FAMILIAR FIGURE DURING AMERICA'S EARLY EXPANSION

The cultural values of the frontier have come piecemeal. First, there was the explorer's frontier, as the European invader brought one geographic region after another within the field of recorded human knowledge. Next came the frontiers of the missionary, the soldier and the trapper, upon which each of these scouts of society lived his life. The first of these worked upon the souls of the native inhabitants, who were destined to recede as the world became aware of their existence; the second was staking in a new world, for one great Power or another, the claims that it was hoped one day to exploit; the third, the trapper, differed from his priestly or his military fore-runner in that he, first among white men, lived on the land he found and derived from its products a basis for existence. None of these changed the face of nature. All gave way, eventually, when the frontier of the farmer made its appearance and dotted the land with cabins and cleared fields. There is a long succession of later frontiers that may be traced in American history, as alongside the farmer's frontier emerged also the frontiers of the miner, the lumberman and the railroad; and out of them came the frontiers of established local government, of locally created capital, of industrial society and of the various aspects of culture or religion. In each of these several fields the frontier provides a means for studying institutions while they are in the formative stage, and before they have become



MAP SHOWING THE EXPANSION OF THE AMERICAN FRONTIER EVERY 10 YEARS FROM 1790 TO 1890 THE AREAS SETTLED FROM 1890 TO 1920 ARE SHOWN COMBINED THE MAP IS BASED ON A POPULATION OF NOT LESS THAN TWO INHABITANTS PER SQUARE MILE

inextricably involved in the complex of a progressive and sophisticated society.

From a different point of view the frontier may be described as a region, a process or a fixed line. As a region, it may be considered as a place in which the new forces of western civilized life are being applied for the first time, and in which a new social group is finding itself and is creating its internal bonds As a process, it concerns itself with the ways and means whereby the institutions of older society are being worked over and selected according to their survival values, within the territorial limits of the frontier region. As a geographic line, it may be shown upon a map for any period at which statistical evidence is available; and in this connection it is always the line that may be drawn separating territory possessing an arbitrarily selected average of residents per square mile, from territory of less than that average number. The decennial census of the U S. Government, since 1790, has provided the basis for this cartographic identification of the frontier. In most of the recent census reports maps are shown for each decennial period, with shadings indicating the distribution of populations of under two inhabitants per square mile, of 2 to 6, of 6 to 18, of 18 to 45, of 45 to 90 and of over 90. The steps in this scale that American historians have commonly accepted for their study of frontier lines are the first and the second. Most frontier lines are drawn at under two, or over six; and in either case the line thus drawn shows, for the period of the census concerned, the region near which the frontier process was most typically at work. A series of frontier line maps, made ten years apart, from 1790 until 1890, shows that invariably the zone of contact between settled America and the wilderness ran irregularly from north to south; and that at each decennial census it had made a perceptible advance along most of its front towards the west. At the date of the first census the line ran not far from the watershed of the Appalachians; after 1890 it had passed beyond the Great Plains, and the whole of the United States was so nearly occupied that no sharp frontier line can be indicated. The duration of the period in American history in which a frontier line can always be shown runs, therefore, from the moment of the initial settlements in the 17th century until the close of the 19th century. To-day, there is no frontier in the true sense, and the frontier episode is closed.

The history of the frontier in America falls easily into three major divisions, that may be separated roughly by the treaties that closed the Seven Years' War (1763), and by the panic of 1837. Each of these periods has characteristics that warrant its treatment as a logical unit.

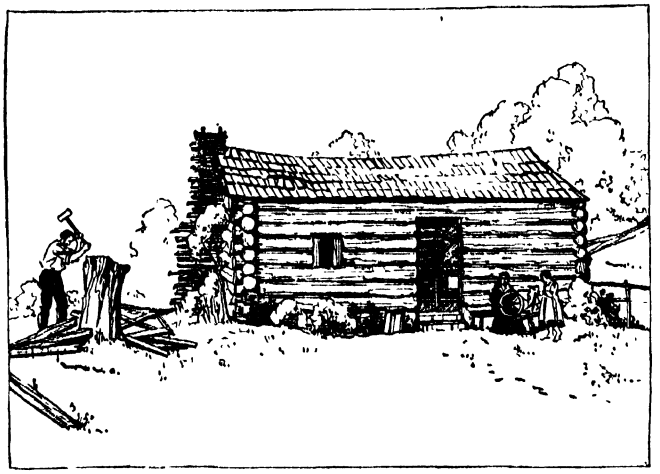
The first period is dominated by the planting and extension of the English colonies in North America. No serious damage is done by ruling out both the French and the Spanish. The French, confined mostly to the valley of the St. Lawrence, failed to develop a pioneering population; and their settlements existed chiefly as a residence for the missionaries, the military men and the trappers who were uncovering the interior of the continent without changing its aspect. The Spanish settlements in the southern portions of the United States were even less aggressive in the spreading of civilization than the French. And both French and Spanish proved themselves unable to stand up against the competition of the invaders from the British settlements.

Nature of Early Frontier.—Throughout most of the period that ran from the planting of Virginia and Massachusetts until the middle of the 18th century, the frontier in America was really a frontier of Europe, along which the institutions of the western European countries, and particularly of England, were being tested in the wilderness. This is a part of European quite as much as of American history; and every European court felt that to some extent the basis of survival among themselves was to be found among the American plantations. The period does not come to an end until, at the close of the Seven Years' War, the superior weight of the English possessions asserted itself, and it was possible for the English diplomats to claim and secure compensation by ejecting France from North America, and by pushing Spain west of the Mississippi. During the century and a half from Jamestown to the Treaty of Paris, the settlements had spread

from the beach where the earliest English colonies were planted. Up the river valleys and the bays they advanced. By 1700 they had reached and were passing the "falls line" (a line that may be shown on a map by connecting the lowest rapids or waterfalls of the successive Atlantic rivers). Beyond the "falls line" they entered the *piedmont* of the Appalachians; and by 1763 scattered areas along the upper reaches of the Mohawk, the Connecticut, the Delaware, the Susquehanna, the Potomac, the Shenandoah and the James, were alive with the activities of the pioneers. But the period preserves its unity because of the omnipresence of the European connection, because of the dependence of the settlements upon rivers flowing into the Atlantic ocean, and because the future of the continent in its relation to European suzerainty was not certain until after the expulsion of the French.

The Second Period.—The second period of the frontier in America extends from the expulsion of the French until the occupation of the Mississippi valley (that was to ripen in modern times into the Middle West); its zone stretches from the valleys of western Pennsylvania to the bend of the Missouri river, where the Kansas enters from the west. It has a striking difference from the first period for it is now an American frontier, since the new life is an offshoot from the older American establishments. In this period indeed the United States prided itself upon its aloofness from Europe and from European interests, and gave birth not only to a new breed of democracy that was identified with Andrew Jackson, but to the American system of Henry Clay, and to the international doctrine of James Monroe. The European flavour has largely disappeared, and no considerable body of new European settlers takes a part during this second period in the movement towards the West.

The Third Period.—There is a common quality in the first and second periods of frontier extension that is lacking in the third which covers the years between the panic of 1837 and the panic of 1893. This is primitive transportation. The routes of the pioneers of the earlier periods, as they sought new homes, were those of the natural roads and trails, and the river valleys that lay in the course of the movement. Until the second period was nearly at an end there were no improvements in these natural means of transport, except here and there a fragment of stone road like the Lancaster pike or the Cumberland road (each of which, however, ran close to an improved beaten way), and once



BY COURTESY OF FIRST NATIONAL PICTURES

A MODERN RECONSTRUCTION OF A PIONEER'S LOG CABIN IN THE BACK SETTLEMENTS

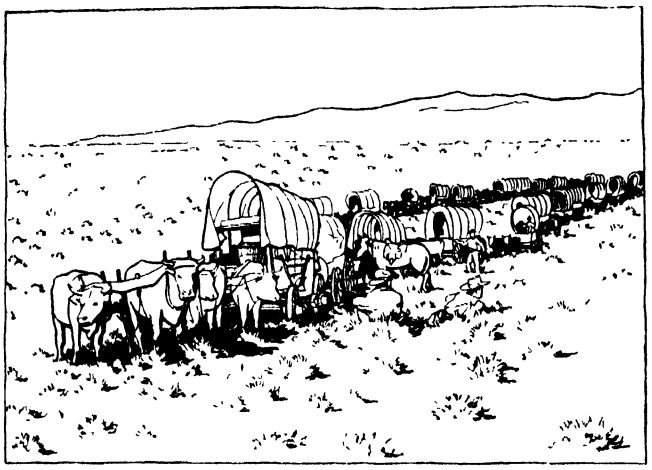
in a while a steamboat on some of the western rivers. The successful development of the steamboat for up-river traffic, the construction of numerous canals, of which the Erie canal was first and greatest, and the building of the railroads served to introduce new tendencies in migration. The routes were materially changed, speed was quickened, and the carrying capacity of the highways grew as freights declined. The zone of occupation in the third period was west of the Mississippi bend. Across the plains and mountains to the Pacific, the overland trails guided most of the migrants in the early part of the third period. A little later the completed continental railroads put an end to pioneer traffic of the older sort, and speedily brought a conclusion to the era of the frontier. The frontiersman himself was vastly changed by these improvements in his methods of travel; while the introduction of elaborate machinery on the farm, like the reapers that spread in use on the prairies, brought capital to his aid and changed the technique of his work.

Characteristics.—In each of these three periods of frontier expansion, there are vital problems which have as yet received little treatment from the historian or the economist. First and fundamental was the relation of the settler to his piece of land; for this was generally an agrarian advance The land economics of each region had much to do with the course of development as the frontiersmen came in; and after a region had been taken up, no set of problems was more searching than that which had to do with the escape of the frontier from the burden of land encumbrance. Second was the financial problem; varying according to region and period, but pressing in every aspect. The personnel of the advance included a low proportion of persons with enough money to be free. The others had to borrow, not only to buy their land, but to pay the costs of outfit and transportation to the new homes, and for maintenance until the new farm became self-supporting. The most rapid advance of the frontier occurred after the introduction of banking brought formal credit to the aid of the frontiersman. But interest was high and his collateral was sketchy, and it nearly always happened that the debts incurred during the hopeful period of speculative development became a burden and a curse in moments of economic depression. Third, and indispensable, was the problem of marketing the surplus that has lasted over from the frontier period into modern western agriculture. The farming communities had no means of meeting land payments or absolving debts other than that of marketing a surplus of agricultural goods. In a community wholly agricultural there was no market; and long distances and high freight rates separated every good market from the source of supply The search for a market is thus a third of the frontiersman's fundamentals, and one that has never been permanently solved except in narrow regions where agricultural diversification could enter, or where local industrial societies grew up to consume the surplus.

As the frontiersmen met their problems certain conditions were emphasized that were not unique or new, but that were not so clearly visible in older and more complicated societies Striking among these conditions was a trend towards equalitarianism, with its resulting consequence in social and political democracy. For the bulk of any frontier group, and during a period of years that averaged perhaps 20 in a single frontier community, nearly the whole attention of society was devoted to the primary physical tasks of reclaiming the land and erecting the dwellings. The period begins when the earliest pioneer makes his appearance; it ends, normally, when the first of the native-born children leave the home cabin to move on to a new frontier. The uniformity of activity necessary for survival placed a high premium on physical and moral virtues, and threw into the discard matters of social standing, cultivation of taste, birth and even financial status. There were few things on a frontier that could be bought; least of all personal service With all at work each resented the occasional individual who escaped work. There was a tendency to dislike those not in step with the community. Men equal in actual status found it easy to generalize upon equality, and to resent artificial prominence. A rough and ready democracy grew up, that gave tone and character to all the frontiers that appeared and passed.

Another condition of frontier life was an unusual openness of mind in certain directions. In most settled societies of the world, personal status was so nearly fixed at birth that it was safe to assume a future without change But to the frontiersman change was the orderly expectation of life Within two decades the successful pioneer saw his virgin claim develop and improve, his acreage increase, his cleared fields spread, his herds multiply. He saw grow around him the roads, schools, churches, county towns and institutions of government. He saw the transition

from Indian country to sparse farming, the progress from arbitrary territorial government to full participation by the autonomous State, the spread of the available country towards the west as the Government bought land from the Indian or took it over from Spain or Mexico. And in his mind grew an idea of progress that time has scarcely dimmed in the American mind. His community was less than usually bound to rigid classifications



BY COURTESY OF PARAMOUNT PICTURES

AN OXWAGON TRAIN, SHOWING THE COVERED WAGONS IN WHICH THE FRONTIERSMAN TRANSPORTED HIS FAMILY AND GOODS

and was abnormally ready to look upon and accept a change. He was always a romanticist as he brooded over his future; and in public affairs this state of mind turned easily into a spirit of expansion.

A more precise consequence of his economic status was his normal tendency towards the acceptance of inflationist theories of finance. Every frontier was improved, largely, by borrowed money. Although the capitalist with ready money to use or lend was not unknown, the average pioneer citizen was obliged to borrow in order to develop his farm He borrowed amid the enthusiastic conditions of a boom period By a kind of auto-intoxication the frontier community magnified its hope of profits, elevated the value of its land and multiplied its probable crop. Loans were made on inflated valuations; rates of interest were promised that could never be earned Debt was spread over the whole farm, yet it was always a matter of years before more than a small fraction of the total acreage could be made to yield. The community borrowed to build its roads and public buildings; when railroads came, the community and its people bonded themselves to subsidize the railroad From the mixture of blind enthusiasm, lack of skill and actual fraud that accompanied frontier promotion came a situation of heavy debt at a high interest rate that reduced the community to bankruptcy when the boom was over or hard times came. On such occasions, without fail, the local response to hard times and unpayable debts was the appearance of inflationist schemes and the suggestion of stay laws to prevent the forcible collection of debts. The land banks of New England, the paper money revolt of Shay, the banking restrictions of the Jackson period, the stay laws of Kentucky, the repudiation of State debts, the demand for greenbacks and the cry for free silver in turn indicated the frontier tendency to accept inflation as a remedy. And the tendency was given profound political meaning because of the uniformity of the frontier group and the lack of capitalistic dissenters among the debtor farmers. And the directness of the American representative system gave an easy route for the translation of this discontent into party action.

Repeatedly, in every region of the United States, the frontier set-up was prepared, and the resulting community fitted into the matrix and developed towards a balanced and normal life. The process was repeated so often, and under such nearly uniform conditions, that the American frontier affords one of the few places in which it is practicable to study human affairs as in a laboratory. The experiments were staged not by premeditation but by standard conditions that repeated themselves for many generations. Raw nature and stark human power were again and again brought together; and from their contact emerged human self-governing groups. The effect of the process, as group after group selected for its use the institutions it valued, and abandoned the customs, restrictions and institutions that seemed to have lost their meaning, was to launch American society as a whole, and to transmute the person, of whatever race, into a new type that was already known as American when Benjamin Franklin made his appearance at the courts of Europe. Its constant tendency was towards direct popular government on a representative system, towards a broadening opportunity for all in affairs political, economic or social, and towards a new status for women Enough has already been established by the historians of the frontier to indicate that herein is the most distinctive factor in the making of the United States

In Political Life.—The political tendency of the American frontier has been unmistakable and fairly uniform. Before the American Revolution nearly every one of the English colonies was conscious of unrest among its newer settlements; and in Pennsylvania, Virginia and North Carolina this unrest had already drifted rapidly towards open conflict. In the colonies as a group, as within the several colonies, the frontier tendency created a distrust of absenteeism in finance and government. The most convincing of the explanations of the American Revolution is that it was a frontier revolt against the long-range control that emanated from Westminster, and that it was embittered because the width of the ocean had prevented the participants on either side from realizing that frontier life had created a new race across the Atlantic. The revolution was not built upon a passion to alter the scheme of life, but on the human determination to control it. The revolutionaries stopped their work when the power of England was broken and independence was attained. The new governments erected in America were direct descendants of the old colonial establishments, only sifted and modified by the normal tendencies of the frontier

Twenty-five years after the separation from England there came a second wave of frontier discontent with the trend of affairs, and it was Thomas Jefferson who organized and led the democratic revolt His political followers were scattered over every State, among the young and the little; but on the frontier his name aroused enthusiasm in the average mind. His democ-



"LAST CHANCE GULCH" AT HELENA, MONTANA, A SETTLEMENT WHICH SPRANG INTO EXISTENCE AS A RESULT OF THE MIGRATION DUE TO THE DISCOVERY OF GOLD

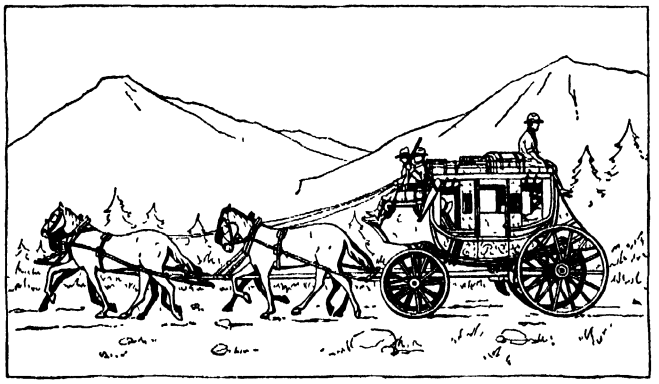
racy, more than a little derived from the French revolutionary philosophers, was instantly acceptable in a community where equality in fact was the common condition. He and his lieutenants governed the United States until their enthusiasm cooled, their youthful ideals settled into middle-aged conservatism, and until a new democracy of the Mississippi valley ranged itself behind the personality of Andrew Jackson.

In 1828 Andrew Jackson was elected president of the United States, and for a third time a frontier party took charge of American destiny. A minor revolt, but one with many re-

semblances to that of Jackson, took the government away from the Jacksonians in 1840, and placed the Whig Party in power. And 20 years later, the new Republican Party, whose enthusiasms ran highest among the newer communities of the north-western States, gained control of the government and entered upon the struggle to prevent the extension of slavery and for the maintenance of the Union, with a typical child of the frontier, Abraham Lincoln, at its head.

A generation after Lincoln, the new States of the western plains, where railway activity had promoted immigration faster than the country was able to support it, festered with discontent. And again there was the element of absenteeism, of inflation finance, of the protest of the common man against the power of the great, of the desire for a re-making of the institutions of administration and government. In this, as in the earlier revolts, there was lacking any great desire to change the basis of affairs, or to alter the philosophies of life. There was little of socialism or revolution but much of a desire to capture the organs of government and to operate them in the interest of the common people. The issue was fought in 1896, over the slogan of free silver and behind the crusading leadership of William Jennings Bryan For once the western sequence of party creations was stopped An embattled East resisted and prevented victory for free silver and Populism. But it was because the country had changed and the frontier had become a reminiscence rather than a living fact. No comprehension of American politics is possible without an understanding of the ways and means by which, for a century after independence, this democratic wave sequence kept alive the ideals of western democrats in protest against the rigid classifications of older and industrialized society.

The Frontier Disappears.—During the final decade of the 19th century the open frontier disappeared from the American map. During the boom years of the '80s the spread of settlements went farther and faster than was economically wise; and after 1890 there was an actual recession of the settled areas, so that there are now hundreds of counties in the western States that have fewer farming inhabitants than they had in 1890 With the completion of the continental railroads, no large area was left without easy means of contact and communication with the rest of the nation Only three tracts remained that had not reached



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THE STAGE COACH, THE CHIEF MEANS OF TRANSPORTATION IN THE EARLY WEST, AFTER THE COVERED WAGONS WENT AND BEFORE THE RAILROADS CAME

the full dignity of Statehood; and these, Oklahoma, Arizona and New Mexico were admitted to the Union early in the present century.

The significance of the frontier in American life was never clearly expressed until in 1893 Frederick Jackson Turner, a professor in the University of Wisconsin and himself a child of the north-western frontier, published a monograph, "The Significance of the Frontier in American History." Thereafter, by its sheer convincing quality, Turner's idea gave a new reasonableness to American history that young historians absorbed without knowing it; and that older historians, almost without exception or protest, adopted. It forced a general restatement of American history, now that the organizing principle was recognized. And this restatement is still under way, making progress as new studies develop the meaning of local affairs, or as new syntheses attempt to bring together the whole of the American story.

BIBLIOGRAPHY.—A brilliant synthesis giving the frontier full recognition, but with more economic determinism in it than most frontier specialists would approve, is that of Charles and Mary Beard, *The Rise of American Civilization* (1927). There is also a comprehensive survey, with its attention generally focused upon the frontier line as it swept across the country, in F. L. Paxson, *History of the American Frontier* (1924). The initial essay of Prof. Turner is most accessible in his *Frontier in American History* (1920). C. W. Alvord, *The Mississippi Valley in British Politics* (1917), and A. P. Whitaker, *The Spanish-American Frontier* (1927), are distinguished studies of the West as a stake in European diplomacy. S. J. Buck, *The Agrarian Crusade* (1919), traces the farmer movements that are an integral part of post-frontier reactions; and there is much useful detail in C. Goodwin, *The Trans-Mississippi West* (1922).

(F. L. P.)

AMERICAN GEOGRAPHICAL SOCIETY OF NEW YORK, founded in 1852, is the oldest geographical society in the United States. Its principal activity is the publication of books, maps and a quarterly journal, the *Geographical Review,* which present the result of original research in all branches of geographical science and record work carried out in the field of exploration The society also maintains one of the outstanding collections of maps and geographical books in America. A programme of lectures is arranged annually under the auspices of the society, which also recognizes distinguished contributions to geography by the award of medals. A special department of the society's research staff is devoting itself to the compilation and publication of maps and monographs relating to Hispanic America. The society also maintains a school for the training of explorers in survey methods

AMERICAN INSTITUTE OF CO-OPERATION, an educational institution incorporated in 1925 in the District of Columbia and holding a session for a month each summer. The idea originated in 1923 in the National Co-operative Milk Producers' Federation and readily gained the support of other agricultural organizations The purpose of the institute is to collect and disseminate accurate information on the economic, sociological and legal phases of co-operation. So far its attention has been restricted to agricultural co-operation, but it expects in the future to broaden its field. Representatives of the important agricultural co-operative associations and other farm organizations, and economists from universities and research institutions participate in the annual sessions. These are held at various universities. The proceedings, published annually under the title *American Co-operation,* constitute a valuable compendium of principles, practices and ideals maintained in the co-operative movement in the United States

AMERICANISM, a term first used by John Witherspoon, president of Princeton university, in 1781, designates (a) any word or combination of words which, taken into the English language in the United States, has not gained acceptance in England, or, if accepted, has retained its sense of foreignness; and (*b*) any word or combination of words which, becoming archaic in England, has continued in good usage in the United States. The first class is the larger and has the longer history. The earliest settlers in Virginia and New England, confronted by plants and animals that were unfamiliar to them, either borrowed the Indian names or invented names of their own.

Examples are afforded by *raccoon* (1608), *chinkapin* (1608), *opossum* (1610) and *squash* (1642) among Indian words, and by *bull-frog, canvasback, cat-bird* and *live-oak* among inventions The former tended to take anglicized forms. Thus the Indian *isquontersquash* (at least, that is how the early chroniclers recorded it) became *squantersquash* and was then reduced to *squash,* and *otchock* became *woodchuck.* Many other words came in as the pioneers gained familiarity with the Indian life. Such words as *hominy, moccasin, pone, tapioca* and *succotash* remain everyday Americanisms.

The archaisms, of course, showed themselves more slowly. They had to go out of use in England before their survival in America was noticeable. But by the beginning of the 18th century there was already a considerable body of them, and all

through that century they increased. The English language in Great Britain, chiefly under the influence of pedantry in the age of Anne, was changing rapidly, but in America it was holding to its old forms. There was very little fresh emigration to the Colonies, and their own people seldom visited England. Thus by the end of the century *"I guess"* was already an Americanism, though it had been in almost universal use in England in Shakespeare's day. So, too, with many other verbs: *to wilt, to whittle, to fellowship* and *to approbate;* and with not a few adjectives: *burly, catty-cornered, likely* and *clever* (in the sense of amiable); and with multitudes of nouns: *cesspool, greenhorn, cordwood, jeans, flap-jack, bay-window, swingle-tree, muss* (in the sense of a row), *stock* (for cattle) and *fall* (for autumn). A few of these archaisms, in late years, have been taken back into English usage by the force of American example.

Meanwhile, American English had begun to borrow words, chiefly nouns, from the non-English settlers, and to develop many new words of its own. To the former class the Dutch contributed *cruller, cold-slaw, cookie, scow, boss, smearcase* and *Santa Claus,* and the French contributed *gopher, prairie, chowder, carry-all* and *bureau* (a chest of drawers). Other contributions came from the Germans of Pennsylvania, the Spaniards of the south-west and negro slaves. The native coinages were large in number, and full of boldness and novelty. To this period belong, for example, *backwoods, hoe-cake, pop-corn, land-slide, shell-road, half-breed, hired-girl, spelling-bee, moss-back, crazy-quilt, stamping-ground* and *cat-boat.* These words were all made of the common materials of English, but there was something in them that was redolent of a pioneer people and a new world. In their coinage the elegances were disdained; the thing aimed at was simply vividness. At the same time, verbs were made out of nouns, nouns out of verbs and adjectives out of both.

In 1789 Benjamin Franklin, who had lived in England, denounced *to advocate, to progress* and *to oppose* as barbarisms, but all of them are good American to-day, and even good English. Noah Webster, the lexicographer, gave his imprimatur to *to appreciate* (in value); *to eventuate* was popularized by Gouverneur Morris; and no less a hero than Washington is said to have launched *to derange.* Many inventions of that daring era have succumbed to pedagogical criticism, *e.g., to happify, to compromit* and *to homologize.* But others equally harsh have gradually gained acceptance, *e g., to placate* and *to deputize.* And with them have come in a vast number of characteristic American nouns, *e.g., breadstuffs, mileage, balance* (in the sense of remainder) and *elevator* (a place for storing grain).

Divergent Meanings of Words.—It was during the same period that a number of important words, in daily use, began to show different meanings in England and America. Some familiar examples are *store, rock, lumber* and *corn.* What Englishmen call a *shop* was called a *store* by Americans as early as 1770, and long before that time *corn,* in American, had come to signify, not grains in general, but only maize. The use of *rock* to designate any stone, however small, goes back still farther, and so does the use of *lumber* for *timber.* Many of these differences were produced by changes in English usage. Thus *cracker,* in England, once meant precisely what it now means in the United States. When the English abandoned it for *biscuit* the Americans stuck to *cracker,* and used *biscuit* to designate something else. How *shoe* came to be substituted in America for the English *boot* has yet to be determined. There is indeed much that remains obscure in the early history of such Americanisms. Until very lately, American philologians kept aloof from the subject, which they apparently regarded as low. Until George P. Krapp of Columbia university took it up, there was not even any serious investigation of the history of American pronunciation

Thus the American dialect of English was firmly established by the time the Republic was well started, and in the half-century following it departed more and more from standard English. The settlement of the West, by taking large numbers of young men beyond the pale of urbane society, made for grotesque looseness in speech. Neologisms of the most extravagant sorts arose by the thousand, and many of them worked their way back to the East. During the two decades before the Civil War everyday American became almost unintelligible to an Englishman; every English visitor marked and denounced its vagaries. It was bold and lawless in its vocabulary, careless of grammatical niceties, and further disfigured by a drawling manner of speech. The congressional debates of the time were full of its phrases; soon they were to show themselves in the national literature.

Policing the Language.—After the Civil War there was an increase of national self-consciousness, and efforts were made to police the language. Free schools multiplied in the land, and the schoolmarm revealed all her immemorial preciosity. A clan of professional grammarians arose, led by Richard Grant White; it got help from certain of the literati, including Lowell. The campaign went to great lengths. *"It is me"* was banned as barbarous, though it is perfectly sound historically; *eye-ther* was substituted in polite usage for *ee-ther,* though *ee-ther* is correct and *eye-ther* is on the part of an American an absurd affectation.

But the spirit of the language, and of the American people no less, was against such reforms. They were attacked on philological grounds by such iconoclasts as Thomas R. Lounsbury; they were reduced to vanity by the unconquerable speech habits of the folk. Under the very noses of the purists a new and vigorous American slang came into being, and simultaneously the common speech began to run amuck. That common speech is to-day almost lawless. As Ring Lardner reports it—and he reports it very accurately—it seems destined in a few generations to dispose altogether of the few inflexions that remain in English. "Me and her woulda went" will never, perhaps, force its way into the grammar-books, but it is used daily, or something like it, by a large part of the people of the United States, and the rest know precisely what it means.

On higher levels the language of the Americans is more decorous, but even there it is a genuinely living speech, taking in loan-words with vast hospitality and incessantly manufacturing neologisms of its own. The argot of sport enriches it almost daily. It runs to brilliantly vivid tropes. It is disdainful of grammatical pruderies. In the face of a new situation the American shows a far greater linguistic resourcefulness and daring than the Englishman. *Movie* is obviously better than *cinema,* just as *cow-catcher* is better than *plough* and *job-holder* is better than *public servant.* The English seldom devise any thing as pungent as *rubber-neck, ticket-scalper, lame-duck, pork-barrel, boot-legger* or *steam-roller* (in its political sense). Such exhilarating novelties are produced in the United States every day, and large numbers of them come into universal use, and gradually take on literary dignity. They are opposed violently, but they prevail. The visiting Englishman finds them very difficult. They puzzle him even more than do American peculiarities of pronunciation.

The common vocabularies in England and the United States show important differences in the meaning of words. Here are a few examples:

American	*English*
ash-can	dust-bin
ash-cart	dust-cart
ashman	dustman
backyard	garden
baggage	luggage
baggage-car	luggage-van
ballast (railroad)	metal
bath-robe	dressing-gown
beet	beet-root
bid (on a contract)	tender
bill-board	hoarding
brakeman	brakesman
bumper (car)	buffer
calendar (court)	cause-list
campaign (political)	canvass
can (noun)	tin
candy	sweets
car (railroad)	carriage, van or wagon
carom (billiards)	cannon
catalog (university)	calendar

American	*English*
checkers (game)	draughts
cheese-cloth	butter-muslin
chicken-yard	fowl-run
chief of police	chief constable
city editor (newspaper)	chief reporter
city ordinance	by-law
clipping (newspaper)	cutting
coal	coals
coal-oil	paraffin
collar-button	stud
commutation ticket	season ticket
corn	maize or Indian corn
counterfeiter	coiner
cow-catcher	plough
cracker	biscuit
crazy-bone	funny-bone
cross-tie	sleeper
crystal (watch)	watch-glass
daylight time	summer time
derby (hat)	bowler
dime novel	penny dreadful
district (political)	division
druggist	chemist
drug-store	chemist's shop
drummer	traveller
dry goods store	draper's shop
editorial (noun)	leader
elevator	lift
elevator boy	liftman
enlisted man	private soldier
express train (subway)	non-stop train
fire department	fire brigade
fish-dealer	fishmonger
floorwalker	shopwalker
fraternal order	friendly society
freight	goods
freight car	goods wagon
frog (railway)	crossing-plate
garters (men's)	sock-suspenders
gasoline	petrol
grade (railway)	gradient
grain	corn
grain broker	corn factor
groceries	stores
hardware dealer	ironmonger
headliner (vaudeville)	topliner
hodcarrier	hodman
hog-pen	piggery
hood (automobile)	bonnet
hospital (private)	nursing-home
huckster	coster (monger)
hunting	shooting
Indian	Red Indian
instalment business	credit trade
instalment plan	hire-purchase plan
internal revenue	inland revenue
janitor	caretaker
laborer	navvy
legal holiday	bank holiday
letter-box	pillar-box
letter-carrier	postman
locomotive engineer	engine driver
long-distance call	trunk call
lumber	deals
lumber-yard	timber-yard
mad	angry
molasses	treacle
notions	small wares
office-holder	public servant
orchestra (seats)	stalls
outbuildings (farm)	offices
parcels room	left-luggage room
patrolman (police)	constable
peanut	monkey-nut
pen point	nib
pitcher	jug
poorhouse	workhouse
postpaid	post-free
potpie	pie
prepaid	carriage-paid
press (printing)	machine
pressroom	machine-room
program (of a meeting)	agenda
public school	board-school
railroad man	railway servant
Rhine wine	hock
roadbed (railroad)	permanent way
roast (of meat)	joint
roll call	division
rooster	cock
round-trip ticket	return ticket
saloon	public-house
shirtwaist	blouse
shoe shine	boot polish
shoestring	boot-lace
sick	ill
sidewalk	footpath or pavement
sight-seeing bus	charabanc
silver (collectively)	plate
sled	sledge
soft drinks	minerals
spigot	tap
sponge (surgical)	wipe
stem-winder	keyless watch
stockholder	shareholder
stocks	shares
store fixtures	shop-fittings
street railway	tramway
street car	tramcar
suspenders (men's)	braces
switch (noun, railway)	points
switch (verb)	shunt
taxes (municipal)	rates
taxpayer (local)	ratepayer
tenderloin (beef)	under-cut or fillet
ten-pins	ninepins
thumb-tack	drawing-pin
ticket-office	booking-office
trained nurse	hospital nurse or nursing sister
transom (door)	fanlight
trolley car	tram-car
truck (vehicle)	lorry
undershirt	vest
warden (of a prison)	governor
wash-rag	face-cloth
washstand	washhand-stand
wastebasket	wastepaper-basket
witness stand	witness box

Of late the increase of travel and other intercommunication between England and America has tended to halt the differentiation of the two dialects. It was more marked, perhaps, before the World War than since. But if it ever vanishes altogether the fact will mark a victory for American.

The American "movie" floods England (and the rest of the English-speaking world) with American neologisms, but there is very little movement in the other direction. Thus the tail begins to wag the dog. How far the change has gone may be observed in Australia. There a cockneyfied pronunciation holds out, but the American vocabulary is increasingly triumphant. In Canada it long ago overcame the last vestiges of opposition.

BIBLIOGRAPHY.—There is no satisfactory dictionary of Americanisms.

The best is Richard H. Thornton's *American Glossary* (1912), but it is based wholly on written records and is thus incomplete. George Philip Krapp's *The English Language in America* (1925) is valuable to the student of American pronunciation, and contains much miscellaneous matter of interest, but there are gaps in it, and the author opposes his own evidence by arguing that English and American show few important differences. In *A Comprehensive Guide to Good English* (1927), by the same author, many Americanisms are listed, but the collection is by no means exhaustive. Many are also listed in the American edition of *The Pocket Oxford Dictionary of Current English* (1927), the American editor of which is George van Santvoord. Some valuable observations upon American pronunciation are in *The Pronunciation of Standard English in America*, by Krapp (1919), and in *A Dictionary of English Pronunciation with American Variants*, by H. E. Palmer, J. Victor Martin and F. G. Blandford (1926). An extensive bibliography is in H. L. Mencken's *The American Language*, 3rd ed. (1923). In 1925 Dr. Louise Pound, of the University of Nebraska, began the publication of a monthly, *American Speech* (Baltimore). It became a quarterly in 1927. (H. L. M.)

AMERICANIZATION. The popular use of the word Americanization, and the general acceptance in the United States of the idea it stands for, date from the early months of the World War. Long before the United States became an actual belligerent, American reactions to European hostilities had revealed the fact, long familiar to close students of the immigration problem, that the population of the United States contained vast sections of foreigners who, in spite of long residence in America, were still completely alien in sympathy, loyalty and general social and emotional affiliations These persons were clearly thinking and feeling as Germans, Irish, English or Italians, not as Americans. Most disturbing of all was the inescapable realization that these foreign-minded elements included many naturalized American citizens, sometimes of long standing It was perhaps a premonition that the United States must eventually become involved in the great conflict that made these facts produce such widespread consternation. The Americanization movement, therefore, as a distinct sociological phenomenon, may justly be considered a product of war conditions, though it is quite probable that in this, as in so many other cases of social movement, the war merely accelerated a change that was destined to come eventually in any case.

The objective of Americanization is nothing new It is merely assimilation, the harmonization of alien with native elements into a homogeneous socio-political unit. The novelty lies in the method Before the revelations of the war it had been generally assumed that assimilation took place in the United States spontaneously, without the exertion or necessity of any conscious effort on the part of anybody. The metaphor of the "melting pot" had been introduced and enthusiastically accepted to symbolize the mystical potency of the great democracy whereby peoples from every corner of the earth were fused into a harmonious and presumably admirable blend. Once this illusion was shattered it was inevitable that the American people should determine to do something about it. The Americanization movement represents a determination to accomplish by deliberate, purposeful means the indispensable assimilation which it was clear could no longer be trusted to natural, spontaneous forces. It was also characteristic of the American people that the means chosen should be organization, particularly through committees, and education. The two foremost committees, which promoted and stimulated the movement in its early phases, were the Committee for Immigrants in America and the closely related National Americanization committee. These worked in close co-operation with the Federal Bureau of Education which, through its Americanization division, published a special periodical, *Americanization*, promoted conferences and fostered the movement in various ways. The idea won immediate popularity. It became a favourite form of patriotic service, particularly after the entry of the United States into the war, for countless individuals whose available time was not engrossed by other war activities. Americanization agencies and activities in almost unlimited variety sprang up throughout the country. The unifying principle was the general educational conception of the problem. The logic was simple. These unassimilated foreign individuals lacked some of the important characteristics of genuine Americans. This was dangerous for America. Therefore they must be *taught* the missing qualities. The basic theory of Americanization at this stage of its development was that assimilation can be accomplished through an educational programme.

The deficiencies selected for correction were naturally the most conspicuous, specifically lack of mastery of the English language and of knowledge of American civics and history. These three subjects constituted the backbone of the Americanization curriculum. To them, however, were soon added many supplementary accomplishments such as millinery, cooking, social amenities and the care of babies, all conceived in the American manner, and all to be attained by means of an educational régime. For this expansive programme all available educational agencies, with necessary modifications and adjustments, were mobilized and many special agencies were created. The public schools organized night schools and opened various kinds of special classes, State departments of education formed Americanization divisions, universities and city governments appointed Americanization directors, and many industrial concerns co-operated eagerly in the establishment of special classes for alien workers. A national conference on Americanization in industries was held in Boston in 1919.

Enthusiasm for Americanization persisted throughout the war period, and was prolonged into the reconstruction period, largely stimulated by the "Red Radical hysteria" which infected the country for two or three years. Gradually, however, interest diminished. One after another the subsidiary features were dropped, until Americanization became synonymous with teaching foreigners English, civics and history, and eventually English alone in many cases. This was due to several causes: first, the subsidence of war-time apprehensions themselves, and preoccupation with other matters; secondly, the tremendous decline in immigration due to war conditions and special restrictive legislation.

With the decline of the war-time attitude of extreme nationalism, many broad-minded Americans began to regard it as not only bigoted but also unwise to insist upon the complete transformation of the foreigner into the American type. They became convinced that the culture of the United States could be profitably enriched by the incorporation of some of the more admirable features of the various foreign nationalities. Attempts were made to supplant the metaphor of the melting-pot by other symbols, such as a "weaving-machine," which should suggest the harmonious combination of traits, not blended but preserved in their pristine quality. Americanization was presented as a two-sided process of give-and-take. Simultaneously, many students and practitioners of Americanization began to question whether, after all, it is possible to attain the objectives aimed at by means of an educational programme. The truth seemed to be that genuine assimilation is attained not by learning but by living. The process involved represents a prolonged and difficult reaction to a social environment much more vital, involved and inclusive than that of a class-room. So deeply did these convictions penetrate that within less than a decade after the armistice, many workers were reluctant to apply the word Americanization to the most well-conceived and constructive activities. As a result it has been customary to refer to those permanent and unemotional features of the program which still remain as "adult education of the foreign-born" (*see* ADULT EDUCATION), intimating that as far as the rising generation is concerned the educational phases of assimilation have been resigned to the regular public schools.

Rightly to judge these latter developments, it is necessary to comprehend clearly the process and the desirability of assimilation. On both of these points there is still considerable divergence of opinion. Some prominent thinkers, native as well as foreign, believe that assimilation in its accepted sense is not a desirable goal, but that the United States will reach its highest pinnacle by preserving many separate cultures side by side within its boundaries. Others continue to insist that assimilation is a two-way process. The outstanding trend of opinion, however, is probably toward the conclusion that assimilation is indispensable to national dignity, prosperity, and even existence, and that in a situation so complicated as that of the United States the only practicable means to that end is to accept one national culture, the American, as the norm and to insist that all foreign cultures must be sub-

merged in it. At least, one anomalous war-time development has been almost completely abandoned, viz., that of coerced naturalization, the insistence that the foreigner, whether willing or not, whether assimilated or not, must be compelled to acquire American citizenship on pain of deportation or some other penalty.

(H. P. F.)

AMERICAN LAW (private). Technically speaking there is no American law. Except within a field constitutionally restricted, there is no national supreme tribunal to unify legal doctrine. Neither is there a common law of the United States as a sovereign State. Each of the States has its own common law, unrestrained otherwise than by certain provisions of the Federal Constitution; and none of these necessarily tends to produce unity of law except the clause requiring that "full faith and credit shall be given in each State to the public acts, records and judicial proceedings of every other State"; a provision which does somewhat tend to unify doctrines respecting the conflict of laws. It is also possible that the decisions of the lower Federal courts that sit in every State and the decisions of the Supreme Court tend to regularize and nationalize judicial doctrine. This is true within the field of "general commercial law," in which the Supreme Court has held since 1842 that the Federal courts sitting within the several States are not bound to follow the judicial doctrines of the local courts; and have in fact been developing a national body of Federal commercial law, which the States have tended to follow, although not bound to do so. The importance of this was greater, however, before the spread of the various uniform acts which in recent decades have been prepared by the American Bar Association for adoption by all the States. These statutes illustrate the sense in which there does exist an American law,—there is a great body of judicial tradition, and a vast mass of legislation, embodying the rules and standards by which the American people, regardless of State lines, are content to guide their lives; and all this law presents broad features of unity. Indeed, nothing is more astonishing than the rapid spread of statutes, in a few years, into dozens or even scores of States—thus evidencing popular convictions nationally dominant; nothing more certain than the slower spread of a judicial doctrine that is felt to have adjusted justice to new conditions.

Of the civil law that once prevailed in territory subject to France and Spain little trace remains to-day except in Louisiana and in the variant marital community systems in seven other States.

In the sense just explained American law is marked by four periods of development.

(I.) To 1776.—It is a traditional judicial tenet that the colonists brought with them as a birthright, along with English political traditions and precedents, the common law; its concepts of property, liberty and justice; and such of its rules as fitted colonial conditions. They did indeed claim the general liberties of Englishmen. They did not claim or desire the common law; they had suffered too much from governmental tyranny which they deemed part and parcel of that system. All of the New England Colonies, by practice or explicitly, denied its binding character. Half a dozen of the other Colonies endeavoured to follow it from an early day. All the Colonies, however, had codes, some notably complete, that covered their essential needs, so that, at best, the common law was but a subsidiary system; and in several even this position was accorded, not to that law but to the Scriptures. Only three Colonies gave statutory recognition to the English law in the colonial period.

For these reasons, and because the colonies were isolated and imperial control slight, the 17th century, in particular, was a period of experiment and creativeness. The colonists were well aware of the proposals of reform and codification made by Lord Bacon and under the Commonwealth, and some of their codes were prepared in England by men who evidently sympathized with those proposals. Dozens of striking innovations—some of them of singularly modern semblance—were made upon the common law; some persisted into the later law—among which the most important was perhaps the recording of conveyances. For two reasons, however, the history of this period, although profoundly interesting in itself, must be regarded as apart from the general legal development of the country. In the first place, because its practices were too divergent from the tradition of the common law. There were almost no law books—original, reprinted or imported; in most of the Colonies there were extremely few trained lawyers; even the chief justices were rarely lawyers; the highest courts were legislative or executive. Laymen administered a sort of natural equity. In the second place, because most of the valuable innovations were abandoned as soon as a reception of the common law began.

In the 18th century something like an independent judiciary developed. Imperial control became a reality; colonial statutes were disallowed (400 of them) for departures from established law; judicial appeals to England became steadily more numerous. A professional bar—for which there was evidently no place in the preceding century—gradually developed. Many of its leaders studied in the Inns of Court (perhaps 50 before 1760; 115 between 1760 and 1783); and to a very remarkable degree it was composed, otherwise, of graduates of American colleges. When the Revolution came it was entirely dominant, and this preeminence it retained for a century. This period was one of absorption of the English law, marked by the disappearance of older innovations and the development of few new ones. That it is in the truest sense an integral part of American legal evolution could be illustrated in many ways. Sufficient is a reference, in the field of procedure, to its system of courts, the most characteristic feature of which—the multiplication of local tribunals that brought justice near to every man, instead of a circuit system—has persisted (for similar reasons born of frontier conditions and self-government) to the present day; and, in substantive law, the origin of the American doctrine that in libel truth (subject indeed to commentary for which there is no room) is a defence.

The whole of colonial experience was of course continuous and so the spirit of the earlier century lived on through the later. Demonstrably, various of its positive innovations, clearly adapted to colonial conditions, persisted against the English reception. As for many innovations of omission, doubtless "mere ignorance had freed the colonies of a great mass of antiquated and useless rubbish" (32 N H. 231), but what was once overlooked in ignorance must later have been excluded in wisdom.

(II.) 1776–1828.—The formal adoption of the common law, after the Revolution, as the basis of American law—but in all the States, explicitly or in judicial practice, only so far as suited to American conditions—set an ideal which the next period was reasonably well to realize. The present continued to be essentially one of reception of the English law. This was inevitable. There was still no independent body of American law; the first volume of American reports was published in 1789; less than a dozen volumes were in print in 1800. When Kent was appointed to the New York bench in 1798 there were no reports of that State. "English authority," he says, "did not stand very high in these early feverish times, and this led me a hundred times to bear down opposition or shame it by exhaustive research and overwhelming authority." Free from hampering precedents, in his 25 years as judge and chancellor he not only gave form to the entire law of that State but made an unrivalled contribution to the law of the whole country. In this, his *Commentaries* (1826–30) played a large part; by universal consent they are worthy of comparison with Blackstone's. He set himself to the task of establishing the common law, and he succeeded. That he had not a reformer's spirit is shown by his sigh over "the piles of learning," "the profound logic, skilful criticism and refined distinctions," doomed to destruction by the New York statute abolishing the Rule in Shelley's Case. He did, however, reject the doctrine of market overt, extended replevin to any wrongful taking, and lauded the establishment of the lien-theory in mortgages.

Notable statutes of the period are fairly numerous; permitting grants in fee without mention of heirs; granting powers *in rem* to courts of equity; legitimizing children by subsequent marriage of their parents; abolishing entails and the Rule in Shelley's Case; abolishing primogeniture and establishing inheritance equally by all children; modifying the law of devises in favour of after-

born children and the issue of predeceased children; conferring limited liability upon corporations; providing a general law under which corporations might freely organize. Pennsylvania—"the first of civilized countries to do so"—provided in 1776 for a penitentiary; presumably under the influence of Beccaria, whose book had already been published in America and was soon to be found on the remotest frontiers. At the same time she introduced relief for insolvent debtors, and within a generation they were "scheduling out" of jail in remote western territories. New York, in 1827, made a complete revision of her statute-book, altering fundamentally the law of realty and providing a system which exists to-day in various States. Very notable also were reforms due to popular disuse, such as the dying-out of feoffments, fines and recoveries; all of which were used in colonial times and were provided for in the statutes of this period. These illustrations sufficiently indicate the experimental spirit of the time. It was not displayed in equal degree by the judiciary. Preferable to Kent's lament was the denunciation of demurrers by a contemporary farmer judge, as "an invention of the bar to prevent justice . . . a cursed cheat!"

(III.) 1828–68.—Almost as distinctly as in political history, the triumph of frontier democracy in the elections of 1828 marks the transition to a new era in the law. It is a period great for its critical spirit. Also, though individualism was the dominant notion of the contemporary world, in politics and in economics, and though the frontier influence might have been expected to exalt its influence, it is a period remarkable for its social spirit. Both judicial and legislative improvements reveal its originality What Wigmore has said of the law of evidence could be said of other fields of law: "Partly because of the lack of treatises and reports, partly because of the tendency to question important rules and therefore to defend on grounds of principle and policy whatever could be defended, partly because of the moral obligation of the judiciary, in new communities, to vindicate by intellectual effort its right to supremacy over the bar, and partly, also, because of the advent, coincidently, of the same rationalizing spirit which led to the reformatory legislation—this very necessity of restatement led to a finely reasoned system." Very important in this period, rivalling the influence of James Kent in the preceding, was the work of Joseph Story, who in 13 years (1832–45) published nine remarkable text-books, which in rapidly succeeding editions had a profound effect in forming American law.

Thus, in the law of evidence, "the period from 1840 to 1870 saw the enactment, in the various jurisdictions in this country, of most of the reformatory legislation which had been carried or proposed in England," and the promulgation of a body of opinions "superior (on the whole) to the judgments uttered in the native home of our law." Notable innovations were the repudiation of the merger of torts in crimes and of postponement of the civil action; repudiation of the doctrine of ancient lights (impossible in a new country); introduction of apportionability of rent; the first decisions permitting suits upon a contract by the beneficiary (now the general doctrine); the first decisions treating divorce as a proceeding *in rem* and recognizing a woman's separate domicile for purpose of divorce; notable decisions—though with precedents "from the first colonization" (Chief Justice Waite)—upholding the regulation of private business "affected with a public interest"; and the first of many decisions forbidding the malicious use of a land owner's privileges.

Many changes plainly reflect the special conditions of the country. Examples of such were the substitution of navigability for the tidal test of admiralty jurisdiction, thus adapting it to the inland seas and rivers of the country; the introduction of the doctrine of "colour of title" in adverse possession, and other minor changes in that subject due to frontier conditions; fence laws reversing the common law duties respecting trespass by animals; decisions concerning grain elevators that made novel changes in the law of bailments and confusion of goods. American deeds began to assume forms suitable to the simple descriptions and titles of the country; quitclaim deeds became primary and original conveyances; disseisees acquired the right to make conveyances. Great modifications were made in equitable doctrines of laches and forfeitures in specific performance of contracts for the purchase of land on instalments—modifications due to the fact that in America land has always been a subject of commerce, as Kent pointed out a century ago. The amazing persistence of benefit of clergy down to (and indeed through) this period was certainly due to the illiteracy of even prominent citizens in frontier society. A very remarkable adoption of frontier customs in this period (though mainly by statute) was that of the mining and water laws developed in western mining camps.

Even more distinctive than the work of the courts was the legislation of this period. At this time reform by statute became, and has remained, the primary characteristic of American Government and law. "The establishment of self-government on a new soil realized the idea of the people as the source of political power as it had not been realized in historic times" (Freund); and on a scale equally unique they proceeded to illustrate the dictum that democracy relies on laws rather than on men. Religious and property qualifications for voting, office-holding and jury service were swept away by the middle of the century. To these triumphs of liberalism a third was added in the creation of a public school system before the Civil War. A prelude to the use of the police power in the following period appears in the elaborate constitutional provisions, beginning before 1850, respecting banks, railroads and canals; and in statutes requiring periodical or cash payments of wages. Income taxes of the modern sense were adopted in the 1830s and '40s in six States. A great moral movement in the political field—for prohibition, anti-slavery and women's rights—and an altruistic effort on a vast scale in favour of the poor and defective marked the entire period. Exemption laws (which came down from colonial times) became general and liberal. Very notable was the appearance of the homestead (1836) and its inclusion in the exemption statutes. Save for slight vestiges, imprisonment for debt was everywhere abolished. The narrow protection in property rights accorded married women by equity was widened by statutes which have placed them on an equality with their husbands; although not until 1913 were the disabilities of coverture abolished in the last State. Judicial liberalism supplemented this legislation, *e g*, in recognizing a wife's right in the society of her consort. It was recognition of woman's equal participation in the hazards and hardships of frontier life that wrote this entire chapter of the law. Children were protected against parental cruelty by imposing criminal responsibility; reformatories were established for minor delinquents—but their criminal liability was not much altered. In the law of property rules of inheritance were greatly changed in favour of parents, surviving spouses, the half-blood and illegitimate children. Heirs and next of kin became generally identical. Howsoever acquired, and whether from the paternal or maternal side, estates were made to descend in the same manner. All real estate became liable to execution and administration assets for payment of debts with few preferences. The fictions of ejectment disappeared. In this whole field, however, legislative reform has always been partial, casual and unsatisfactory. Variations from State to State remain to the present day innumerable. The distinctions between realty and personalty and between legal and equitable estates are still fundamental. The doctrines of tenure, and the devices to evade them that fill the law of future interests, remain in most States untouched except by fragmentary tinkerings. Entails are still theoretically possible in various States. Shelley's Case has life in about half the States. Dumpor's Case, and others of ill repute, still pervert legal doctrine.

Equity, on the other hand, was developed with relative consistency. The erratic state of the property law still extends, however, to mortgages, which are hardly the same in any two States; although everywhere the legal incidents tend toward obsolescence. The equitable doctrine of priorities has from colonial days been fundamentally modified by the recording system. For historical reasons the spread of the equity system was delayed in various States, proceeding piecemeal by statutory grant; even Massachusetts having no complete system until 1877, nor Pennsylvania one to-day. The infiltration of equity into law, in such States, was a unique detail of American legal experiment. No American

court exercises the full jurisdiction of English courts of chancery, its administrative portions having been given to separate tribunals. The development of probate courts was a noteworthy feature of the period before the Civil War. During it, also, the equitable jurisdiction was generally entrusted to courts of double jurisdiction (in five States they still remain distinct and some others maintain distinct chancery terms). Under the codes of civil procedure which have been adopted since 1848 in many States the administrative fusion has been complete; the common law actions and the distinction between law and equity being abolished, in the sense that rights and reliefs formerly "legal" or "equitable" are all enforced in one "civil action." It is certain that under both these systems the principles of equity, enforced by judges trained primarily in the common law system, have somewhat suffered; the separate equity courts are, as a group, the strongest in the country to-day. On the other hand, not only did the adoption of the codes hasten the spread of equity throughout the country, but there is a steady and beneficent infiltration of its doctrines into law cases which must ultimately result in complete fusion and the general dominance of equity.

The adoption of these codes of civil procedure is the most remarkable feature of the third period, and on the whole, the most ambitious systematic reform yet undertaken in American law. The ideals of these codes have been only imperfectly realized. For various reasons (not the least, the hostility of the courts when the codes were first created) their construction has been hardly less balefully technical (and perhaps less certain) than the old common law system. Constant legislative tinkering increased uncertainty and resulted in monstrosities of bulk and complexity. While their fundamental reforms will doubtless never be abandoned, there has been in recent years a strong agitation for the regulation of strictly procedural matters by rules of court. As yet this movement has had slight success.

In some ways popular control in this period debased the judiciary. Of particularly evil consequence was a tendency to restrict the power of the trial judge in charging the jury, forbidding more than a bare restatement of the evidence. This remains to-day general practice. Down to 1798 all the judges were appointed by the governor or elected by the legislatures; by 1840 popular election was characteristic, and since then it has become increasingly predominant. A tendency to shorten the term of tenure sprang from democratic distrust of irresponsible authority. The powers of practically any judge to declare legislation unconstitutional and to issue injunctions have kept alive such distrust. Elective terms, however, have always been long as compared with those of other officials, and no frontier State ever made judicial tenure so short and precarious as did two of the oldest States in New England. There is decidedly an increasing tendency to-day to re-elect worthy judges and to make their salaries adequate. Few leaders of the bar can be drawn from practice by any feasible salary, unless under tenure for good behaviour; but the rising level of judicial ability and the many instances of brilliant men who have already served on the bench justify the belief that judicial competence is obtainable under the elective system. The gravest charge that can be brought against the frontier democracy of the period before the Civil War is that it greatly lowered the standards of admission to the bar.

The bench was both able—in some States, notably in the South, brilliant—and liberal. The legislatures were characterized by rationalism and enlightenment. The bar, whatever its defects, dominated the legislatures and enjoyed in general a social and political prestige far beyond that which it holds to-day. On the whole, the period is the greatest in the legal history of the country.

(IV.) 1868–1928.—The ultimate protection of private rights rests to-day upon guaranties in the Federal Constitution. No State may deprive any person "of life, liberty or property without due process of law," "deny to any person within its jurisdiction the equal protection of the laws," or "impair the obligation of contracts." The 14th Amendment of 1868, containing the first two of these provisions, has profoundly altered the relation between the State and Federal courts and distinctly marks a new period in the legal development of the country. Attempts to define due process and the police power—which is not restrained by the constitutional guaranties—have made the Federal courts the battle ground of the social legislation of the last half century that has sprung from the complex economic and industrial conditions developed since the Civil War. All important cases involving corporations (which were for decades parties to approximately half of all litigation) are also thrown into the same tribunals, for they are "persons" under these clauses and their charters are contracts with the State. And as corporations carry on most of the business and own a very large percentage of all the property in the country (Mr. Justice Field of the Supreme Court estimated it as four-fifths in 1890), the matter has immense social significance.

The establishment of unbridled democracy a century ago only slightly affected the treatment of industrial property. "For at least 60 years after the adoption of universal suffrage the tendency was all in the other direction—to legislate for the property owner rather than against him; to strengthen the powers of capital rather than diminish them. . . . The small protection given to the rights of man, as compared with that which was accorded to the rights of property, is a salient feature in the early history of every American State—and sometimes of its later history also" (Hadley). The explanation of this fact lies undoubtedly in the loose economic framework of society. Cheap land created a people of freeholders without class distinctions, among whom any man who aimed high might rise high. Radicalism, in such a society, could gain no headway. That came with the development of great urban centres and an industrialized society: the rural population was nine-tenths of the total in 1800, and little less in 1850, but less than half in 1920.

Industrial regulation of modern type began about 1870 with the railroads, and its assertion "shook the foundation of State and national politics for a generation." The subsequent increase of administrative commissions, with inquisitorial powers and free from judicial procedure and review, is perhaps the most striking phenomenon in recent legislation. There is a present tendency to standardize procedure and there seems to be developing in this way a great field of administrative law. Trade regulation, though with some history for 100 years, has only very recently increased with extraordinary rapidity; for example, pure food laws, now universal, began in 1892.

The purely legal status of the American industrial worker is unique. The exemption statutes have lessened the effectiveness of the law's remedy of damages; the 13th Amendment of the Federal Constitution, prohibiting "involuntary servitude," makes specific performance impossible, even were equity minded to try it. Yet these immunities were relatively worthless so long as the worker was unprotected against unfair agreements secured through his economic needs. The tendency is strongly toward increasing restriction upon "freedom" of contract and "right" to labour, although this has only very recently begun to overcome constitutional obstacles. As late as 1905 the Supreme Court held unconstitutional a law regulating the hours of bakers, but the case is already without vitality; it was killed by a dissenting epigram of Mr. Justice Holmes—"the 14th Amendment does not enact Mr. Herbert Spencer's Social Statics." In the field of tort nothing had been done up to 1900 beyond limitations upon the rules of fellow servant, contributory negligence, and assumption of risk, sometimes through and sometimes outside of employers' liability laws; thus leaving wholly unprovided for at least half of all industrial accidents. Since 1910, however, all the States have adopted workmen's compensation acts (first, 1902), and most of them industrial insurance acts. Social insurance, otherwise, is still incipient.

The range of other social legislation has been immense. Much is purely moralistic (against gambling, racing, cigarettes, liquor, sexual sin, etc.). The treatment of women merits, perhaps, special mention. Within the family the married woman has been placed in substantial equality with her husband. In industry the attempt to give her special protection has been a storm centre of agitation.

In general women enjoy to-day such protection and to some extent a favoured position in property and domestic relations. Divorce is in one State not allowed at all; elsewhere causes run from adultery only to a score and more, including mental cruelty and incompatibility. Such causes are in many instances a cover for mutual consent. As a State need not recognize a foreign divorce improperly obtained by or against its citizens, a woman's status might possibly be that of lawful spouse, divorcee or bigamist in different jurisdictions. Suits for breach of promise to marry and for alienation of affection (both almost exclusively brought by women) are curiosities of American law. "Common-law" marriage still exists in many States. Desertion of wife or children, a very common offence, is generally a crime and a score of States have adopted a uniform act on this subject prepared by the American Bar Association. In recent years there has been considerable eugenic legislation restraining freedom of marriage.

Defects of the System.—Dissatisfaction with the legal profession has been acute during recent decades. The bar has lost its one-time leadership because it has ceased to lead, to make a social contribution commensurate with its political pre-eminence. The judges have been forced to invalidate many legislative reforms demanded by popular opinion; but, even when free, few of them have been guided by a liberal appreciation of expanding public interests. "Most of the common law has developed in that atmosphere of indifferent neutrality which has enabled courts to be impartial but also keeps them out of touch with vital needs" (Freund). Even the intelligent layman in America rarely knows anything of law except through the newspaper. There he reads only of constitutional questions—seemingly mere matter of policy of which any man may judge and which often seem irrational; of criminal cases—which blazon all the vices of criminal procedure; of labour decisions and of injunctions—often recklessly vague and sweeping—which cause excessive irritation. Hence the discontent which precipitated 20 years ago the demand for the "recall" of judges and judicial decisions by popular vote, and for limitations upon the power of divided courts to invalidate statutes; all of which demands became law in a few states. The administration of justice is to-day the paramount problem in national life. Not only in many cities are the trial dockets filled for two to four years ahead; even in rural jurisdictions the same is sometimes true. General verdicts are the basis for repeated retrials of the facts. The reports of representative States show that a few years ago appellate decisions turned on pleadings in from 5 to 25% of all cases—and the higher number was much the nearer to the mean. Reversals for all causes are still given in a large proportion of all cases appealed. Innumerable reversals are still based, even in civil cases, upon errors that could not affect substantial rights, although this is now statutorily prohibited in about two-thirds of the states. The efforts of reformers are being directed toward strengthening the authority of the trial judge; re-establishing the original practice at common law of permitting the appellate court, even on writs of error, to render final judgment on the facts without ordering a new trial, as in appeals in equity; regulating procedure in higher courts by rules of court, as in England, in place of the legislative enactments, sometimes of infinite detail, which have been the almost exclusive system of the past and have been prolific of delay and appeals; and abolishing appellate reversals for immaterial defects. As regards the last there has become evident a marked improvement in the attitude of appellate judges. A great reform, rapidly spreading, is the declaratory judgment; 12 States have adopted since 1922 the uniform act drafted by the American Bar Association. Very recently statutes of Congress and of various States have made arbitration agreements specifically enforceable. Much has also been accomplished in expediting and cheapening the petty litigation of great urban centres by reorganizing them into appropriate branches under a simplified procedure. In more than 60 cities there are legal-aid societies which dispose of a vast amount of litigation substantially without charge. Regular courts for small claims and poor litigants are being established. In some States summary judgments are now being introduced, as in England, in debt collections, vastly relieving the congestion of trial dockets. The non-inclusion of counsel fees in costs is universal American practice, but its importance as a handicap upon the poor and a weapon in the hand of the unscrupulous is at last being recognized.

All the evils of procedure present in civil suits exist in more aggravated form in criminal suits, with many others in addition. Homicides alone are estimated by many authorities at about 10,000 yearly. That many kinds of urban crime are an organized business seems to be unquestionable. That lawyers are essential to, when not part of, this business, prepared with every legal device to delay and evade justice for their criminal clients, is often manifest. Cases of worthless bail bonds, of criminals at large under several bonds at once, given in different cases, are notorious. Equally alarming is the actual inequality of men, rich or poor in money, before the law, in consequence of its delays; and of those rich or poor in influence in being brought before it. In 1909 President Taft declared the administration of the criminal law in all the States, with possibly "one or two exceptions" to be "a disgrace to our civilization." Frequently hundreds, sometimes thousands, of veniremen are examined before a jury is secured; usually days, sometimes months, are thus utilized. Delays in trial are even greater than in civil cases. Indictments are still found deficient in appellate courts, though here recent years have witnessed great improvement, for flaws of unbelievable triviality. The defendant is nowhere compelled to testify. Punishments for the same crime vary amazingly from State to State. In some States the jury has large discretion in fixing the punishment; in many it is judge of both the law and facts. The requirement of unanimous verdicts is universal in criminal cases.

Legislation is at present extremely active in remedying many of these evils. Eight States in 1926–27 adopted habitual-criminal acts which, among other things, impose life-imprisonment upon a defendant with a record of a small number (usually four) of earlier convictions. Minors have been given greater protection (since 1900) by greatly raising the age of criminal responsibility (to 16 or 18); and establishing special courts to deal with the younger delinquents, subjecting these to the State's guardianship somewhat as under the old doctrines of equity. In the field of punishment notable reforms have been introduced: suspended and indeterminate sentences, commutations for good behaviour and parole. But even these are perverted. Weak or calculating judges abuse the first with a leniency so excessive that it approaches immunity; the second appear plainly to be over-generous to hardened offenders; the most vicious of criminals are often paroled. The primary cause is probably politics; indubitably so in some States, where every step—whether or not an arrest shall be made, the defendant held to the grand jury, the case dismissed, the convict paroled—seems to be seriously entwined with political corruption.

For these evils, and equally for the evils in trial and appellate courts, in civil and criminal cases, which spring from a deep-rooted attitude toward litigation as a mere game of wit, there is no cure except in an increased power and awakened conscience of the bench, and a general betterment in the moral tone of the bar. At least as regards intellectual improvement much has been accomplished. The university law schools are of distinguished excellence and enjoy a high professional prestige. Higher standards of education are being enforced through requirements for admission to the bar—the American Bar Association now advocating a minimum pre-legal education of two years in college and a minimum professional training of three years in law-school—but less than a dozen States meet these standards. Disbarment is in the hands of the courts and has been far too sparingly resorted to. A few States have very recently incorporated their bars as self-governing bodies, with exclusive power over admission and discipline.

Codification, after the period of activity which began before the Civil War, temporarily ceased, but has recently begun again in a new form. Five codes of penal and of the substantive civil law, 30 codes of civil procedure and about thirty of criminal procedure are mainly the products of the earlier movement. The American Bar Association, acting with State commissioners, have prepared since 1892 43 uniform acts. Of these five in the commercial field (on negotiable instruments, warehouse receipts,

bills of lading, sales and stock transfers) have been adopted in from half to all jurisdictions. An American Law institute, in which teachers of law are dominant, is preparing a "restatement" of various branches of the substantive law and a model code of criminal procedure; all designed to promote uniformity in essential principles. The "Complete" or "Revised Statutes" that exist in every State of course merely "supplement" the unenacted law, but which of the two is in many States to-day of greater scope it would be hazardous to say. Legislative drafting bureaux (the earliest of 1890) exist in practically every State.

The impulse to codification has come from the unmanageable bulk of judicial law and the consequent uncertainty of legal knowledge. The number of volumes of American reports in 1917 was 17,000. The cases cited by the court in any volume run into hundreds and frequently into thousands, from many jurisdictions. In the five years 1909–13 there were passed by the National and State Governments 62,014 statutes; and there were rendered by the courts of last resort 65,379 decisions. The law is beyond the power of any layman to discover or to comprehend.

Very much has been wisely said on the necessity of guiding legislation and judicial decision by the functional test of social utility; but no efficient instrumentality has existed or now exists through which to supply objective evidence of the relative working of substantive legal rules. On the other hand it is expected that precisely this will be accomplished in the procedural field by the "judicial councils" which have been created since 1922 in nine States for the consistent study and improvement of judicial organization and procedure. Altogether, the immense significance of the new spirit manifest in the profession cannot be doubted Most important of all is the fact that the revolt against unsocial law created by the labour struggle has spread to social workers, social scientists, the law school and finally even to the bar. It may well be that this spirit will prove to have inaugurated a new epoch in the law of the country.

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PUBLIC LAW

The public law of the United States largely revolves around (1) the Federal system; (2) the written Constitution; and (3) the judicial construction of written Constitutions. These three elements are closely related, for the United States Supreme Court has from an early day been the final arbiter to determine the respective powers of the United States and of the States under the written Constitution of the nation; and the State courts (each within its own territory) are the final arbiters of State governmental power under the written Constitutions of the States.

The Federal System.—Plans of colonial federation were several times proposed before the period of the American Revolution. The movement that finally led to independence forced some degree of unity, and the first. Continental Congress assembled in Philadelphia in 1774 was the outward symbol of unity of political action. What political direction there was of the revolutionary movement came through the continuance of such an organization, without any formal written instrument of union, and this system was highly inefficient. It was replaced by the Articles of Confederation in 1781.

The Articles of Confederation established a loose union, with little in the way of a national Government, and with no power in that Government to raise revenue or to enforce its orders by action directed immediately to the citizens of the United States. The Confederation had authority to ask the States to act, but not to compel action either by the State or its citizens. It had power to make treaties but no power to enforce State observance of such treaties. Each State had power to impose restrictions upon trade with other States, and a State with the geographical advantages of New York was in a position to impose and did impose burdensome restrictions upon the commerce of the neighbouring States of New Jersey and Connecticut.

Such conditions could not long continue. They led to the assembling of the Federal Convention of 1787 and to the framing and adoption of the present Constitution of the United States, under which the present Government was instituted in 1789. The Constitution was framed with specific reference to the difficulties presenting themselves before its adoption. A governmental organization was set up independent of that in the States, and with power to enforce its commands directly up the citizens of the States Large powers were conferred, the most important of which were the powers to control interstate and foreign commerce, to levy taxes and to raise Federal revenues independently of the States, and the control of foreign relations Thus a central Government was constituted with real authority. The history of the Federal system since 1789 is to a large extent a history of the expansion of the importance and authority of the national Government under this Constitution. This expansion has been accomplished in several ways. (1) by a broadened construction of the original provisions of the Constitution of 1787; (2) by amendment of this Constitution; (3) by the development of means of transportation and communication which enormously increase the number of transactions in interstate and foreign commerce, subject to national control; (4) by the increased number of States, the larger portion of which were created out of territory belonging to the national Government.

Construction of the National Constitution.—The Constitution of the United States has been authoritatively and finally construed by the United States Supreme Court, an organ of the national Government. In substantially all matters this court determines the limits of national power on the one hand and of State power on the other. No matter how impartial such a tribunal may have sought to be, it has almost of necessity tended to favour the Government of which it is an organ. Under the chief justiceship of John Marshall (1801–35) it was an essential factor in establishing broad national authority. *McCulloch* v. *Maryland,* 4 Wheat. 316 (1819) determined that the nation had not only the powers expressly conferred upon its legislative, executive and judicial departments, but also all authority "appropriate" to carry such powers into execution. The Constitution uses the words "necessary and proper," but the court held that there was no need to show actual necessity in order to uphold national power Under the chief justiceship of Roger Brooke Taney (1836–64) there was an occasional tendency in dicta of the court to regard State power as of greater importance, but no actual reduction of national power took place. In fact two of the broadest extensions of national power were made under Taney through reversals of views taken under Marshall. In one of these cases admiralty jurisdiction was extended to all navigable waters (*Genesee Chief* v. *Fitzburgh,* 12 How. 443, 1851). In the other the Federal courts acquired an extensive jurisdiction in corporate matters (*L.C. & C.R R. Co.* v. *Letson,* 2 How. 497, 1844).

Although the powers of the national Government under the Constitution have been expanded, the Supreme Court has at the same time sought to prevent the destruction of State powers by construction. The power of the national Government to tax cannot be used as a mere cloak for regulation of child labour in the States under the guise of taxation; nor can the power to regulate

interstate commerce be used for such a purpose (*Hammer* v. *Dagenhart*, 247 U.S. 251, 1918; *Child Labor Tax Cases*, 259 U.S. 20, 1922). While the nation's powers have been extended, there remains a large sphere of State power upon which the nation may not encroach. No national power exists except as it is found in the terms of the written Constitution, and the United States Supreme Court can expand such powers only as they may be derived from the terms of the written Constitution. The terms of this document are broad and expansible, yet judicial construction of these terms has definite limits.

Amendment of the National Constitution.—But by constitutional amendment the terms of the written Constitution may be changed. Nineteen amendments to the Constitution of the United States have been adopted. The first 10 of these amendments are limitations upon the national Government, but in no material respect do they narrow the powers exercisable by that Government. The 11th amendment safeguards the States against suits; the 12th, with reference to the election of the president, does not affect governmental power. The 13th affirmed the judgment of war that slavery should be abolished. As now construed by the courts, the "due process of law" and "equal protection of the laws" clauses of the 14th amendment have transferred the protection of individual rights from the States to the national Government. The 15th and 19th amendments, and to some extent the 14th, limit the determination by the State as to who shall have the right to vote. The 17th, by providing for the popular election of senators, somewhat diminishes the importance of the States as units in the Federal system. The 18th amendment, by authorizing the establishment of Federal agencies for prohibition enforcement, has brought the nation into closer and more detailed contact with the daily life of the citizens of the United States. The 16th amendment gave to the national Government a new source of revenue, and made possible a system of subsidies or grants-in-aid, through which the national Government largely controls State policy as to matters not otherwise directly within Federal power.

Increased Contacts of a National Character.—In 1789 transactions in interstate commerce were few, and the means of conducting such commerce slow and cumbersome. As new agencies of commerce have developed, the Federal regulatory power has applied to them. With the transition from the horse and the stage-coach to the steamboat, the railroad, the telegraph, the telephone, the radio and the aeroplane, portions of the country once distant have been brought into closer relation, and the transactions controllable by the national Government have been infinitely multiplied. These changes have necessarily brought increased exercise of national power.

Federal regulation of interstate railroad rates and service came in 1887, and has rapidly expanded. The relations between interstate commerce and purely domestic commerce within a single State are necessarily close when both transactions are handled by the same agency. And so by legislation of 1920 and by judicial decision, the Federal Government has come largely to control the railroad rates for domestic transportation within the States, as an incident to the control of interstate commerce (*Railroad Commission of Wisconsin* v. *C.B. & Q.R R.*, 257 U.S. 563, 1922). In the same manner the nation has come to control safety appliances of railroads in both interstate and domestic commerce (*Southern Railway* v. *United States*, 222 U.S. 20, 1911).

Congress began in 1890 the regulation of combinations in restraint of interstate commerce, and has in this field largely replaced State action. As an incident, the regulation of labour unions has largely been transferred to national jurisdiction by a recent decision of the United States Supreme Court (*Bedford Cut Stone Co.* v. *Journeymen Stone Cutters' Association*, 274 U.S. 73, 1927). By the expansion of the national banking system and the creation of the Federal Reserve system, the Federal Government largely controls the banking business of the country. There is now an extensive national control of industry, banking, labour, railroads and of the protection of individual rights.

These expansions of national authority are natural, and were to be expected. But they make the national system differ materially from any that could have been thought of in 1787.

Increased Number of States.—The national Government was created by a small number of States. The States were the creators of the nation. States as units in a Federal system were naturally more important when their number was 13 than when their number is 48. The influence of increased numbers becomes more important when we consider that 21 of these additional States were wholly created out of territory acquired by the nation and were never a part of the original States. These new States, forming more than half of the continental area of the country, are in a very real sense creatures rather than creators of the national Government. With the increased importance of interstate relations, State boundaries have largely become artificial lines, and national consciousness, greatly strengthened by the Civil War, has become politically dominant, since State elections in all but one State (Maine) are held upon the same day as national elections.

Yet, though the States have come to be less important politically as units in a Federal system and have lost all political status in international affairs, they have come, with increased complexity of social and economic needs, to have a heavier burden of governmental tasks than ever before. For upon them fall the burdens of administering criminal and civil justice in the daily affairs of life, and the tasks of more detailed regulation of industry, as well as the conduct of schools, the administration of charities and the protection of persons and property.

The Written Constitution.—The written Constitution is an essential element of the Federal system in the United States, for there must be some authoritative statement of the respective powers of nation and States. The written Constitution is not an essential device of State Government in the United States, but each State has from its beginning had such a Constitution. Tradition has now become so strong that a State without a written Constitution is hardly to be contemplated.

The national Constitution is a relatively brief document, as are a few of the earlier State Constitutions. But the typical State Constitution has now come to be a lengthy document, that not only organizes and imposes limitations upon the State Government, but also contains a great mass of detailed legislation. This legislative detail is frequently altered by State constitutional amendments. In theory the national Government has only such powers as are granted it by the national Constitution, and a State Government has all powers not denied it by the national Constitution and the Constitution of the State. This might naturally imply a strict construction against national powers and a liberal construction in favour of State legislative authority. But with long and detailed State Constitutions, we have the opposite result. Under broad constitutional grants of national authority, the United States Supreme Court has, from the first, been liberal in the construction of national power. Under detailed State Constitutions, hedging about the powers of State legislatures, the tendency of State courts has been toward a narrow construction of such powers.

Judicial Construction of Written Constitutions.—Some device is necessary in a Federal system to preserve the barriers between Federal and State powers. The United States Supreme Court serves as this agency. In addition it serves as the final agency in other cases for the determination of the powers of Congress under the Constitution; and the highest court of each State serves as the agency to determine the powers of its State legislature under the written Constitution of that State. The courts of both State and nation decline to pass upon certain questions that they term political, but apart from this they construe the written Constitutions of State and nation. The power of the courts to determine the constitutionality of legislation was first asserted in New Jersey in 1780, and has been generally recognized since the decision of the United States Supreme Court in *Marbury* v. *Madison*, 1 Cranch, 137 (1803).

The more detailed the Constitutions and the greater the tendency to exercise governmental power to meet new industrial and social needs, the more often are the courts called upon to construe written Constitutions. With numerous restrictions imposed on legislative action by constitutional texts, practically every important Federal and State legislative enactment now comes to

the courts for the determination of its validity. This gives to judicial decisions an emphasis proportionately greater than they deserve in the constitutional system of the United States, for in most cases the courts reach results not dissimilar from those in the countries where legislative determinations are final. But in the United States the courts have the last word, and this often leads to an emphasis upon the technical issues of constitutional construction, rather than upon the actual merits of legislation. Problems of constitutional construction have become increasingly important in the fields of (1) administrative law and (2) the administration of criminal law.

New economic and social problems have necessitated the delegation of wide authority to permanent Federal and State boards for various purposes, such as sanitation, regulation of public service corporations and of banking and insurance, workmen's compensation, and the grant and revocation of licenses to practise trades and professions. National and State Constitutions organize Governments into three departments, and impliedly forbid the delegation of legislative authority. The courts must answer the questions as to what are the functions of each department, and what are legislative powers that may not be delegated. Under pressure of practical need, the courts have found it possible to sustain wide delegations of rule-making power to administrative bodies, and also wide authority in such bodies to make determinations that may appear judicial in character. These results have been obtained through the construction of broad constitutional provisions, and have been wise ones, though the logical devices employed to distinguish later from earlier cases have often been amusing.

In the administration of criminal law the result has not been so satisfactory. Many constitutions contain detailed provisions regarding the grand jury, the jury, bail and the conduct of cases, and a number designate the precise words with which indictments shall terminate. These provisions promote technicality in judicial proceedings and retard progress, and although a number of Constitutions are easy to change, others are difficult if not impossible to amend. The courts cannot ignore these constitutional provisions, but must enforce them, though something is accomplished by liberal judicial construction. For example, the Constitution of Missouri requires that indictments conclude with the words "against the peace and dignity of the State." The Missouri Supreme Court at first said that the omission of the second "the" was fatal to an indictment, but later took the opposite view (*State* v. *Campbell,* 210 Mo. 202, 1908; *State* v. *Adkins,* 284 Mo. 680, 1920). But however liberal the courts may be, simplification of criminal procedure is retarded by placing regulations as to such matters in the text of the State Constitution.

The problems faced by the courts in constitutional construction are well illustrated by the developments in administrative law and in the administration of criminal law. Constitutional provisions creating three departments of Government and providing that each shall exercise separate powers are general and vague in character. A court may and does construe these provisions to permit what the present needs require, even though earlier decisions may have taken a different view. The only harm done by such action, if it is a harm, is the occasional use of bad logic in the effort to harmonize judicial decisions that are obviously not capable of reconciliation. The specific constitutional provisions as to criminal procedure do not give a court as great a latitude of construction, though even where a Constitution requires certain precise language, the courts may permit some variation of that language.

Constitutional provisions vary from the specific to the highly indefinite, but in the construction of all, the courts have some discretion. The discretion is greatest under the 14th amendment to the Constitution of the United States, which prescribes that no State shall "deprive any person of life, liberty or property without due process of law," and under similar clauses in State Constitutions. The United States Supreme Court has declined to define "due process of law," but reserves freedom of decision in each case. A minimum wage law for women deprives of due process of law and is unconstitutional (*Adkins* v. *Children's Hospital,* 261 U.S. 525, 1923). Laws limiting the labour of women to eight hours a day or forbidding night labour by women do not deprive of due process of law (*Miller* v. *Wilson,* 236 U.S. 373, 1915; *Radice* v. *New York,* 264 U.S. 292, 1924). The regulation of charges for rental is due process of law if in the opinion of the court an emergency exists, but is not due process of law if the court feels that the emergency has ceased (*Block* v. *Hirsch,* 256 U.S. 136, 1921; *Chastleton Corporation* v. *Sinclair,* 264 U.S. 543, 1924). A similar discretion rests with the courts in the construction and application of other indefinite provisions of State and national Constitutions. And the courts exercise a broad discretion even with respect to the constitutional provisions that appear most definite.

In American constitutional law there is a tendency to decide the specific case before the court, without affording much guidance as to the law applicable to similar cases in the future. And the constitutional law of the United States is found not so much in the texts of written Constitutions as in the judicial decisions construing such Constitutions. A distinguished French publicist has called this system "government by the judges." Whatever justification this may have, Bishop Hoadly's statement that "whoever hath an absolute authority to interpret any written or spoken laws, it is he who is truly the law-giver to all intents and purposes, and not the person who first spoke or wrote them," is peculiarly applicable to the constitutional law of State and nation in the United States. And constitutional law is the basis for the whole body of public law of State and nation.

See W. W. Willoughby, *The Constitutional Law of the United States* (2 vols., 1910); C. K. Burdick, *The Law of the American Constitution* (1922); C. Warren, *The Supreme Court in United States History* (3 vols., Boston, 1922); C. E. Martin, *Introduction to the Study of the American Constitution* (Los Angeles, 1925); Walter F. Dodd, *State Government* (new ed., 1928). (W. F. D.)

AMERICAN LEGION, an organization of World War veterans who served honourably in the armed forces of the United States or who, as American citizens, entered the armed forces of a government associated with the United States in the war. Organization was effected and a national charter was granted by Congress in 1919.

The membership, which stood at 759,799 in 1921, decreased to 609,407 in 1925, but rose to 719,873 in 1927, and early in 1928 reached the largest total for that time of the year in the legion's history. The legion maintains a national headquarters at Indianapolis, Ind, and publishes *The American Legion Monthly,* its official organ. Its activities have been directed effectively toward the passage of the National Defence Act (1920), the creation of the United States Veterans' bureau (1921), the appropriation of Government funds for the care of disabled veterans and the passage of bonus bills both by the Federal and State Governments in favour of those who served in the World War. A programme for the aid of war orphans was devised in 1923; and in 1925, with the aid of the public, a fund of about $5,000,000 was raised to endow permanently the legion's child welfare and rehabilitation work. In 1927 community service was made the major objective for the year. More than 200 different kinds of activities were engaged in by the 10,000 posts. Among these activities were the erection of community centre buildings, athletic fields and airports, the fostering of educational projects, sponsoring boys' activities, giving emergency relief to flood sufferers and promoting various civic enterprises. An outstanding accomplishment was the Paris Convention of 1927, undertaken primarily to promote international friendliness. Twenty thousand legionnaires went to France, attended the meetings in Paris and visited cemeteries and battlefields. They were warmly welcomed by the Government and by the people of France, and for the first time a foreign organization was permitted to march beneath the Arc de Triomphe.

BIBLIOGRAPHY.—*See* Annual Reports to Congress; M. James, *A History of the American Legion* (1923); E. Putnam, *The American Legion—A Brief Outline of Its History and Accomplishments* (1923) and "The American Legion," in *Annual Report of the American Historical Association,* vol. ii., *ibid,* vol. i, p. 199 *seq.* *See* also Farland W. Powell, *Service for God and Country* (1924), a handbook on Americanism; and *Dictionary of Facts of the American Legion* (1925).

AMERICAN LITERATURE. The history of American literature is the history of the slow differentiation from the parent stock of a transplanted language and culture. Beginning as an offshoot from English literature it gradually differentiated in manner and matter as diverse experience thrust the two peoples apart, until it has finally come to be the expression of a culture greatly different from the culture of England. For a generation it was written by Englishmen resident in America; for upwards of 150 years it was written by colonials who looked overseas for inspiration and models; and only within comparatively recent times has it come wholly to disregard English example and express itself individually. Up to the year 1800 it was still frankly colonial in temper, reflecting the successive schools and styles of contemporary England, imitative, diffident and provincial. It imported its literary modes from London along with its wigs and smallclothes, having due regard however to the sober colonial proprieties and rarely following the extremes of London fashion.

In its beginnings American literature just missed being a child of the great age of Elizabeth. The splendour of Elizabethan times was already fading when the first English settlements were made; and the sober Puritans who constituted the bulk of the emigrants were men to whom that splendour was no other than the lure of the devil. In consequence the literary manner transported to the new world was Jacobean instead of Elizabethan—a mode involved and self-conscious, given a sobering cast by an absorbing theological interest, and wrought into grotesque shapes by the tempests that shook England during the days of Charles and Laud. It is this heavy Jacobean manner that was impressed on the first considerable body of writings in America; and Jacobean the colonial mind remained till well on into the next century. It put away its theological prepossessions with much reluctance, and it was only after long hesitation and with a certain provincial awkwardness that it accepted the brisker modes of Augustan England. The cultural soil proved none of the friendliest to the heroic couplet and the jaunty satire of Pope and Churchill; polite circles in Philadelphia and Boston laboured somewhat too consciously to acquire the air of a wit; nevertheless by the third quarter of the 18th century the Augustan mode had come pretty generally to prevail and a sprightly rationalism pushed aside the old Jacobean heaviness.

COLONIAL AMERICA: 1607–1765

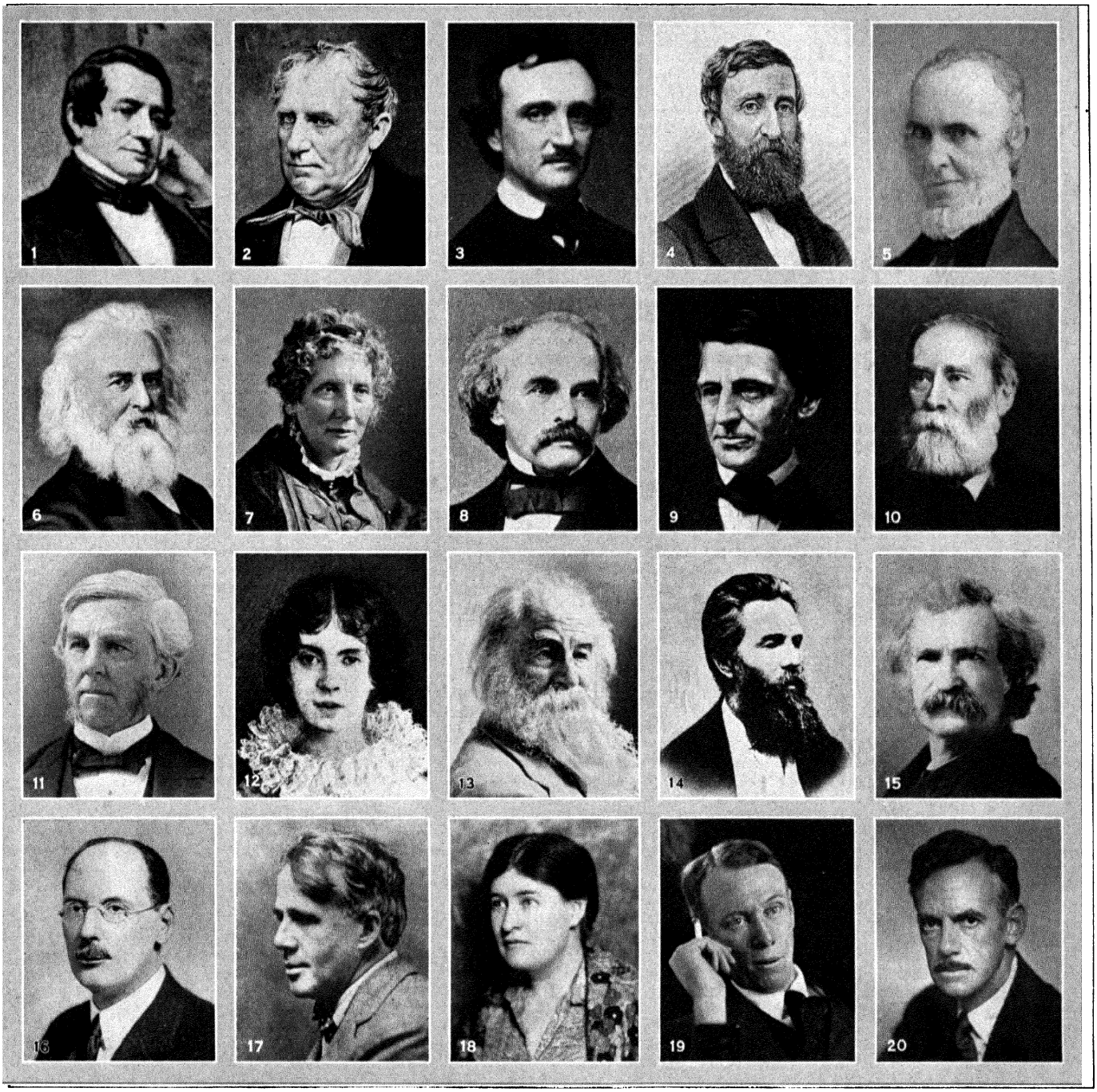
Before 1800, it must be remembered, America was still only a strip of seacoast lying between the Appalachian mountains and the ocean, rugged and infertile in the north, with abundant harbours and streams of vast potential horse-power; and widening into broad alluvial plains in the south, congenial to agriculture and adapted to the great staples of tobacco, rice, indigo and cotton. The north tended to become mercantile and seafaring; the south developed a plantation life based on slavery; and the frontier from Maine to Georgia was agricultural, based on the small freehold tilled by the owner. The tone of polite society everywhere was markedly aristocratic, dominated by a merchant aristocracy in Boston and Philadelphia, and a landed aristocracy in New York and Virginia. The democratic spirit was of late growth, the product of decentralization and frontier individualism, and not till the period of the French Revolution did it become militantly self-conscious and set about the business of democratizing society and the national government—a movement that aroused the bitter hostility of the gentry, and gave rise to a considerable body of slashing satire.

Outside of New England the writings of the 17th century were largely occasional and the total output scanty. Literature in Virginia fittingly began with Captain John Smith, the picturesque Elizabethan adventurer, who wrote a number of travel books of great interest to antiquarians. They were: *A True Relation of such occurrences and accidents of noate as hath hapned in Virginia since the first planting of that Collony* (1608); *The Generall Historie of Virginia, New-England, and the Summer Isles* (1624); and, *The True Travels, Adventures, and Observations of Captaine John Smith* (1630). A veil of romance has been thrown about the sturdy Captain Smith by later writers and especially about the figure of Pocahontas the heroine of Jamestown—somewhat quaintly called an Indian princess—who married one of the English settlers, went to England on a triumphal visit, and speedily became a romantic Virginia tradition. Another early Virginia book was *A True Reportory of the Wracke, and Redemption of Sir Thomas Gates Knight; upon and from the Ilands of the Bermudas: his Comming to Virginia, and the Estate of that Colonie then,* etc. (1610)—a picturesque account of an expedition that suffering shipwreck near the "still-vexed Bermoothes," did not reach the colony till nearly a year after it set out. It was written by William Strachey, who for three years was secretary to the colony, and its vivid description of the storm is supposed to have found reflection in Shakespeare's *The Tempest.* Another official of the colony, George Sandys, completed in Virginia his translation of Ovid's *Metamorphoses* (1626). In 1656 John Hammond published *Leah and Rachel, or, the Two Fruitfull Sisters Virginia and Mary-Land,* which like some of the works written about early New England was a song in praise of the opportunities offered by the New World to the poverty-stricken of the Old.

In those primitive early days conditions were little calculated to encourage the production of literature in Virginia, and not till the 18th century was well advanced was the output considerable. Some attempts at writing history were made, as *The History of Virginia* (1705, 1722), by Robert Beverley, an excellent account by a native Virginian; but more individual and racy were such homely works as *The Sot-Weed Factor, or a Voyage into Maryland . . . By Ebcn. Cook, Gent.* (1708)—a satire by a reputed tobacco agent on the ways and institutions of the south, and especially on the sharp dealings of Quakers, done in Hudibrastic manner; and the *Westover Manuscripts* of Colonel William Byrd (1674–1744), a wealthy planter who has been generally looked upon as embodying the early type of southern gentleman. He had travelled widely, was at home amongst the London Wits and wrote with something of Addisonian ease and grace. *The History of the Dividing Line* is an entertaining account of the slovenly southern frontier and a social document of considerable importance.

From the outset conditions in New England were more favourable than in Virginia to the writing and printing of books. The Puritans settled compactly in villages, each organized as a church-congregation under the guidance of a minister; and this commanding authority of the ministry encouraged vigorous theological disputation and the making of thorny treatises on church polity and doctrine. New England Congregationalism was a departure from English Presbyterianism that required justification to critical English Puritans, and the ways of the theocracy needed explanation and defence. Caustic criticism of the Bible-Commonwealth was frequent, both in the old home and the new, and the responsible leaders were at pains to spread good reports of their great venture. Amongst the emigrant generation were numerous men who used their pens to good effect, and before they went to their graves they had produced a small library of Puritan documents Of these much the most interesting and valuable are the journals and diaries that record informally the early history of the several plantations; amongst them are *The History of Plymouth Plantation,* by Governor William Bradford (1588–1657), begun in 1630 and continued in the form of annals for nearly a score of years; and *The History of New England,* by Governor John Winthrop (1588–1649), a journal that, beginning, as he records, on "Easter Monday, March 29, 1630. Riding at Cowes, near the Isle of Wight, in the 'Arbella', a ship of 350 tons," just at the setting out of the "Great Migration," was continued to the year of his death—a vivid abstract and brief chronicle of the controversies and happenings of the Boston settlement. Of all the writings of early New England these two—and in particular Bradford's *History*—are the most valuable historically and humanly, for in their homely pages is found much of the aspiration and adventure of those simple times.

Theology.—In comparison with the journals the abundant writings of the theologians—men like John Cotton (1585–1652), Thomas Shepard (1605–49), Thomas Hooker (1586–1647)—are so crabbed in style and so barren in present interest that few can

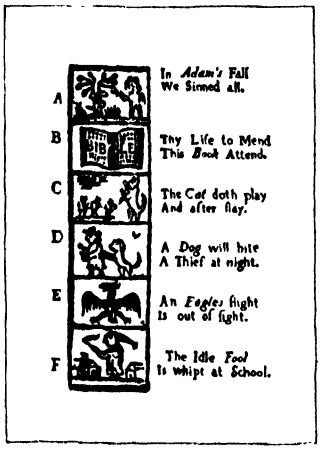


BY COURTESY OF (3) THE PLAYERS, N.Y., (12) M. D. BIANCHI, "LIFE AND LETTERS OF EMILY DICKINSON" (HOUGHTON MIFFLIN AND COMPANY), (16) MACMILLAN COMPANY; PHOTOGRAPHS, (2, 4, 6-10, 13, 15) BROWN BROTHERS, (5) SARONY, (11) PACH BROTHERS, (17) THE KEYSTONE VIEW COMPANY, (18) NICKOLAS MURAY, (19) UNDERWOOD AND UNDERWOOD, (20) BEN PINCHOT

AMERICAN AUTHORS OF THE 19TH AND 20TH CENTURIES

1. Washington Irving, 1783–1859. 2. James Fenimore Cooper, 1789–1851. 3. Edgar Allan Poe, 1809–49. 4. Henry David Thoreau, 1817–62. 5. John Greenleaf Whittier, 1807–92. 6. Henry Wadsworth Longfellow, 1807–82. 7. Harriet Beecher Stowe, 1811–96. 8. Nathaniel Hawthorne, 1804–64. 9. Ralph Waldo Emerson, 1803–82. 10. James Russell Lowell, 1819–91. 11. Oliver Wendell Holmes, 1809–94. 12. Emily Dickinson, 1830–86. 13. Walt Whitman, 1819–92. 14. Herman Melville, 1819–91. 15. Mark Twain (Samuel Langhorne Clemens), 1835–1910. 16. Edwin Arlington Robinson, 1869– . 17. Robert Frost, 1875– . 18. Willa Cather, 1876– . 19. Sinclair Lewis, 1885– . 20. Eugene O'Neill, 1888–

read them to-day with sympathy or understanding. The most dramatic figure amongst the theologians, and the one original thinker in early New England, was Roger Williams (1603–84), who, exiled from Massachusetts Bay for his inconveniently logical views, withdrew to Rhode Island where he established the first democratic commonwealth in America, and elaborated a complete democratic philosophy which marks him as one of the great political thinkers of the Commonwealth period. Unfortunately his writings are a heavy tangle of Hebraic tropes and the meaning is hard to come at. Even his most celebrated work, *The Bloudy Tenent of Persecution for Cause of Conscience* (1644), may well be taken for granted. Far more readable is a little book written by Nathaniel Ward (1578?–1652?), bearing the title *The Simple Cobbler of Aggawam in America, Willing to help 'mend his Native Country, lamentably tattered, both in the upper-Leather and sole, with all the honest stitches he can take,* etc. (1647). Ward was a caustic Jacobean lawyer-theologian and wit, who served God for a time in Massachusetts Bay and then returned to England to die. *The Simple Cobbler* was a contribution to the great debates then going forward on the settlement of England. Written in an old-fashioned style, crammed with quaint conceits and affected crotchets, and fierce in condemnation of toleration—"He that is willing to tolerate any unsound opinion, that his own may also be tolerated, will for a need hang God's Bible at the Devil's girdle"—it is the brightest bit of Renaissance English penned in America and it still amply repays reading.



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A REDUCED FACSIMILE OF THE EARLIEST EXTANT EDITION OF "THE NEW-ENGLAND PRIMER." BOSTON. 1727. BY WHICH CHILDREN WERE EDUCATED AT ONCE IN THEOLOGY AND THE ALPHABET

With the passing of the emigrant generation a deepening note of provincialism crept into the life of New England. A petty round of duties in an isolated village world laid a blight on the creative mind, and the abundant writing came to be restricted pretty much to theology and morality. The learning of the ministers became increasingly crabbed and a generous culture disappeared. In such an environment the politer forms of letters would find little sustenance. There were attempts at verse, to be sure, poems dressed in rude homespun and dealing with prosaic themes. The poet laureate of a barren world was Michael Wigglesworth (1631–1705), a pastor and physician at Malden, who offered for the delectation of all godly readers two poems, *The Day of Doom* (1662?) and *Meat out of the Eater* (1669). The former hit the taste of the generation to a nicety and achieved an immense popularity. It is a dramatization of the Last Judgment that offered a convenient excuse to versify Calvinistic theology, and its vigorous jingle is marked by a crude strength, a bald realism and an amazing *naiveté*. It marks a great fall from another work written before the provincialism of the settlement had wrought its full effect. *The Tenth Muse lately Sprung up in America* (1650), by Anne Dudley Bradstreet (1613–72), wife of Governor Simon Bradstreet and daughter of Governor Thomas Dudley, has been made much of by literary historians, and perhaps rightly, for in some of her lines are faint echoes of a great age and great poetry, before both were finally destroyed by a crabbed environment.

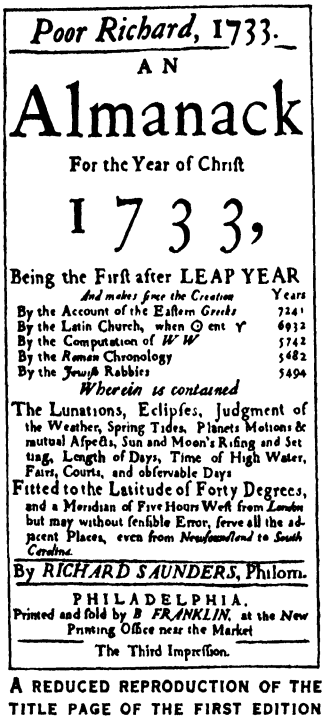
More characteristic of a world given over to theology was the work of the ministers who threshed over the old straw year after year, inditing heavy sermons, and publishing much for the glory of God and their own reputations. Of these ambitious writers, who laboured faithfully but never learned to write beautifully, the best known were Increase Mather (1639–1723), and his son Cotton (1663–1728). Stout defenders of the theocracy in the days of its decline, seeking to buttress the authority that was being undermined by a growing rationalism, they were arch-conservatives who suffered the sting of eventual defeat. Not important figures in the larger history of America, they were nevertheless of considerable significance in the prim little world of the New England clergy and they took themselves with all priestly seriousness. Of their abundant written work perhaps only the *Magnalia Christi Americana, or The Ecclesiastical History of New England* (1702), by Cotton Mather, is of any other than antiquarian interest, and even that is a curious jumble of fact and fiction. Other ministers fond of their quills were John Wise (1652–1725), a liberal who was greatly influential in determining the later form of Congregationalism; Thomas Prince (1687–1758), a painstaking historian and author of a *Chronological History of New England;* Jonathan Mayhew (1720–66), a forerunner of the later Unitarian movement and deeply immersed in Revolutionary politics; and Mather Byles (1707–88), a celebrated wit and admirer of Alexander Pope, who did much to encourage the domestication in New England of the English Augustan mode.

The most important book written in New England during the third generation was the *Diary* of Samuel Sewall (1652–1730), a Boston magistrate and money-lender who between the years 1674 and 1729 set down a plain account of what fell under his eye. Homely and often petty though the jottings are, they convey a feeling of authentic reality, and the mass of information about the daily life of Boston in the days of the transition from a theocracy to a royal colony is of very great value. Sewall is often called a New England Pepys, and despite the fact that the backgrounds of Puritan Boston were somewhat bleak and prosaic in comparison with Restoration London, there is enough likeness between the two men to justify the comparison. Very different is the *Journal* of Mme. Sarah Knight, a quaint narrative of a horseback journey from Boston to New York in 1704, with crisp vignettes of odd figures and sharp comment on strange manners that came under her shrewd eyes. William Hubbard's *Narrative of the Troubles with the Indians* (1677), written in excellent plain English, is a modest classic amongst Indian tales; as is also Mary Rowlandson's *Narrative of the Captivity* (1682?). To frontier settlers who any night might be wakened by the fierce war-whoop, such authentic narratives came home with irresistible appeal and in their pages one still feels something of the anxieties of a generation living under the common fear.

From this petty world with its daily life turning on the axle of Calvinistic theology, the figure of Jonathan Edwards (1703–58) emerges with sharp angularity. The greatest of New England thinkers, he became the chief defender of Calvinism. The cardinal dogma on which that system rested was the dogma of predestination, which in turn rested on the principle of determinism; and it was in defence of this crucial point that he wrote his celebrated *Enquiry into the Modern Prevailing Notions of that Freedom of the Will which is Supposed to be Essential to Moral Agency* (1754), seeking to establish that the will is unfree and in consequence that the dogma of predestination is logically sound. Edwards was an acute metaphysician, an idealist not unlike Bishop Berkeley, and if he had been content with philosophy he must have made a great name for himself. To modern readers his hell-fire sermons, such as *Sinners in the Hands of an Angry God* and *The Justice of God displayed in the Endless Punishment of the Wicked,* offer amusing sketches of the landscape of hell; but they are very far from an adequate measure of the intellectual powers of Edwards. He exerted a profound influence on the course of 18th-century theology, but even his great powers were inadequate to defend Calvinism against the inroads of Unitarianism. After Edwards came such theologians as the rugged Samuel Hopkins (1721–1803), author of the Hopkinsian doctrine of willing to be damned for the glory of God, and the rationalistic Ezra Stiles (1727–95), president of Yale college and a dabbler in science; and with them 18th-century theology came to an end.

Benjamin Franklin.—While New England was thus listening to sermons and patching its worn dogmas, Philadelphia was becoming a cultural centre more humane than Boston, where more books were printed, and a freer and more genial society was

patronizing the theatre and newspaper and magazine, and cultivating the graces of polite society. By the middle of the century it had reached the distinction of being the chief provincial capital to which ambitious young men like Franklin turned most hopefully. The Quaker influence was tolerantly hospitable to new ideas, and the Lutheran influence that came with the hordes of German immigrants was equally hospitable; in consequence Philadelphia was spared the harsh repressions and coercive orthodoxy that discouraged the free play of mind in Massachusetts. It was in this pleasant little city that Benjamin Franklin (1706–90) lived and worked. Born in Boston of the plainest stock, he was apprenticed to his printer brother, but the future not seeming promising he removed to Philadelphia in 1723, worked at his trade, acquired wealth and influence, became interested in experiments with electricity, entered politics, was sent to England as agent of the popular party, and eventually became the representative of America at the court of George III. Franklin was one of the great Englishmen of the 18th century, an embodiment of the practical good sense, the rationalism, the humanitarian concern that marked the age. His mind was both practical and creative. He was the first American economist, a distinguished political thinker, and a fruitful social reformer. His writings were largely incidental to the activities of a busy life, yet he wrote much in many veins and on many subjects, and his position as a master of 18th-century prose is secure. To many his fame rests chiefly on *Poor Richard's Almanack* (1733–58), with its fund of pithy proverbial sayings, and the *Autobiography* (1771–89), with its prudential account of his early years; but characteristic as such things are they reveal only a small part of Franklin's rich and many-sided nature, and that rather the utilitarian than the cultural. To know him adequately one must read largely in his works, and especially in his excellent letters.



Poor Richard, 1733.

AN

Almanack

For the Year of Chriſt

1733,

Being the Firſt after LEAP YEAR

And makes ſince the Creation Years

By the Account of the Eaſtern *Greeks* 7241

By the Latin Church, when ☉ ent ♈ 6932

By the Computation of *W W* 5742

By the *Roman* Chronology 5682

By the *Jewiſh* Rabbies 5494

Wherein is contained

The Lunations, Eclipſes, Judgment of the Weather, Spring Tides, Planets Motions & mutual Aſpects, Sun and Moon's Riſing and Setting, Length of Days, Time of High Water, Fairs, Courts, and obſervable Days

Fitted to the Latitude of Forty Degrees, and a Meridian of Five Hours Weſt from *London* but may without ſenſible Error, ſerve all the adjacent Places, even from *Newfoundland* to *South Carolina*.

By *RICHARD SAUNDERS*, Philom.

PHILADELPHIA,

Printed and ſold by *B. FRANKLIN*, at the *New* Printing Office near the Market

The Third Impreſſion.

A REDUCED REPRODUCTION OF THE TITLE PAGE OF THE FIRST EDITION OF "POOR RICHARD'S ALMANACK," ISSUED BY BENJAMIN FRANKLIN IN 1733

THE NEW NATION: 1765–1800

Into the provincial quiet of colonial life with its sober colonial psychology came the discords of the Revolutionary disputes, followed by six years of civil war and a harsh dismemberment of the dignified colonial society. With the expulsion of the Loyalists —often the wealthiest and most cultivated members of their communities—a new leadership appeared, vigorous and practical, drawn in large numbers from the younger merchants, who were impatient with the trade restrictions imposed by parliament and desired a larger measure of economic freedom. Then followed the shaping of the new fundamental law—the work of these same capable leaders—the setting up of the Federal Government, the irruption of Jacobin passions loosed by the French Revolution, and the emergence of political parties serving diverse interests. For a third of a century storm-clouds were in the sky, and during those tempestuous decades the colonial attitude of mind disintegrated and was superseded by a new Americanism. It was a period of political speculation worthy to be compared with the Commonwealth and Restoration periods 100 years before, marked by a sober and intelligent realism that was bent on exploring the reaches of a sound republicanism. Of necessity literature was largely in service to politics, and it is to the political writings of the times that the historian of letters turns most naturally.

Political Writings.—The ten acrimonious years of preliminary discussion produced a group of pamphleteers who, in exploring refined legal and constitutional questions, eventually talked the country into war. Of these were Samuel Adams (1722–1803), a Boston Radical Democrat, who laboured tirelessly to bring about disunion; John Dickinson (1732–1808) of Philadelphia, a lawyer much concerned with nice constitutional questions; Joseph Galloway (1727–1803), a moderate who later turned Loyalist; and Tom Paine (1737–1809), an English Quaker, who was the stormy petrel of two revolutions, raising a tremendous clamour wherever he passed and bringing fear to many honest bosoms. Paine may be reckoned the complete epitome of the times. One of the greatest pamphleteers the English race has produced, his influence in America was enormous. His *Common Sense,* published early in 1776 some 14 months after his arrival in America, presented vividly to the mass mind the advantages of independence and very likely hastened the formal action of the Congress a few months later. To the French period belong his celebrated *Rights of Man,* one of the greatest revolutionary forces of the time, and *The Age of Reason,* a deistic attack on the Bible that brought down on his head all the *odium theologicum* of the age.

It was during the Constitutional period (1787–1800) that the abundant political speculation of the times came to ripe fruitage. It was a richly creative period that can only be touched upon here. Amongst the leaders of American thought the most significant were John Adams (1735–1826), an embodiment of the English school of realism from James Harrington through Locke to Montesquieu; Alexander Hamilton (1757–1804), a disciple of Hobbes and Adam Smith; and Thomas Jefferson (1743–1826), a follower of Locke, modified by the French Physiocratic school. Adams was an ineffective party leader and never imposed his philosophy upon the rank and file; but Hamilton and Jefferson erected their views into party platforms and the great struggle between them runs through all later American history. Hamilton was a monarchist who desired a highly centralized and efficient Government, as like the English as possible, that should impose order at home and command prestige abroad. Accepting the new philosophy of *laissez faire* he was eager to turn America from agricultural to industrial channels. As secretary of the Treasury he united the business interests behind the administration by a skilful policy of tariffs, banks, funding and the like, with the result that he laid down the path over which America has since travelled. As a writer he is chiefly known by his contributions to *The Federalist* (1787–88), issued jointly by Hamilton, Madison and Jay, in defence of the new Constitution. The work has been much praised—perhaps over-praised—by historians of the Federalist school; it is a shrewd and skilful argument, and it has exerted a persistent influence on later judicial interpretations of the Constitution.

The leader of the opposition to Hamilton was Thomas Jefferson, a Virginia planter and intellectual, widely read in many fields, who to a sound knowledge of English political theory joined a pronounced sympathy for the social philosophy of the French Enlightenment. Like Franklin he was a physiocrat, discovering in agriculture the only productive labour, and rejecting Hamilton's industrial-capitalistic programme. A confirmed democrat, he feared power and hated an aggrandizing political State. He would keep government simple and responsive to the popular will. The most stimulating of all American political leaders, and the one whose hold on the affections of the plain people has been most persistent, Jefferson is a figure whose greatness can be appreciated only by students intimately acquainted with American history and American ideals. Although a voluminous writer, he left no single work of outstanding importance—with the exception of the *Declaration of Independence*—and like Franklin he is to be read chiefly in his letters. His *Notes on Virginia* and the *Autobiography* serve somewhat inadequately to reveal the humanitarian side of his thought, and make clear why he was the spokesman of the native agrarian America that was moving towards political democracy.

The Hartford School.—In the midst of a young society thus struggling to achieve political freedom and to organize a Govern-

ment on untried principles, polite letters must be brought into subjection to the popular interests; and in consequence poetry and the essay, during the last decades of the century, were little more than echoes of the common partisan passions. The first considerable school of poetry arose at Hartford, Conn, in the '80s and '90s, where a group of bright young men aspired to catch the spirit of current English literature. The members of the group were John Trumbull (1750–1831), Timothy Dwight (1752–1817), Joel Barlow (1754–1812), Lemuel Hopkins (1750–1831) and David Humphreys (1752–1818). All but Barlow were fierce Federalists whose pens exuded a virulent satire of democracy and the "infidel" spirit of France—a hostility that Barlow repudiated after a sojourn in Paris where he gave his heart to the philosophy of the Enlightenment. In other fields than satire the work of the Hartford Wits is marked by a certain grandiose aspiration that was always thrusting up poetic lightning-rods to catch the bolts of Jove. A similar versifier, who may be conveniently grouped with the Connecticut poetasters, was Robert Treat Paine (1773–1811), a young Harvard dilettante who divided his love between poetry and the theatre, and was one of the earliest dramatic critics of the country. More significant than these New England versifiers was Philip Freneau (1752–1832), of Huguenot stock, a Princetonian, a sea-captain in the West Indian trade, an editor and a revolutionary, who wrote much virulent satire on the ways of Loyalists and Federalists, together with some lovely romantic verse that marks him as the forerunner of the romantic movement in America. Despite his inadequacies Freneau is the most important figure in American poetry before Bryant.

During these acrid times the drama was slowly getting under way in America, aided by British officers and preceding by a few years the rise of the novel. Dependent as it was upon the development of cultural centres and the patronage of polite society, the theatre must wait upon the growth of cities. Early in the 18th century English players appeared in the colonies, and in 1752–53 Hallam's London company played in Virginia. In New England the presentation of stage plays was long prohibited by law, and it was not till 1793 that Massachusetts repealed the act, thereby eliciting from Robert Treat Paine the remark, "the Vandal spirit of puritanism is prostrate in New England." The first American play performed by professional actors was *The Contrast,* by Royall Tyler (1757–1826), given in New York in 1787. The following year *The Father of an Only Child,* by William Dunlap (1766–1839), was put on the stage, and thereafter plays increased in number and in popularity, and the theatre entered on a period of modest prosperity.

Before leaving a century that was vigorously creative in many fields—however small the output of polite literature—attention must be drawn to two isolated figures whom to know is to love. Hector St. John de Crèvecoeur (1735–1813) was a cultivated Norman gentleman who after serving with the French army under Montcalm lived for a number of years in the colonies, travelled widely, took an American wife, established himself on a pleasant farm, and in 1782 published his *Letters from an American Farmer* filled with discursive comment on the relation of manners and environment in different colonies. Crèvecoeur was deeply infused with the current French philosophy, and as a humanitarian and nature lover he observed with considerable acuteness the growth of a new type of society in the western wilderness. Unfortunately the Revolutionary war brought disaster to him. His sympathies were Loyalist and the partisanship of civil strife took heavy toll of his happiness. Returning to Normandy he wrote other letters that only recently have been published under the title *Sketches of Eighteenth Century America* (1925). A kindred spirit was William Bartram (1739–1823), son of the well-known botanist John Bartram (1699–1777), who was brought up in his father's botanical garden at Philadelphia. In April 1773 he set forth on extensive travels through the south-eastern frontier, a botanizing trip that extended to nearly five years. He roved widely through South Carolina, Georgia, Florida and Alabama, noting the soils, the flora and fauna, and in particular the manners of the Indian tribes. The result was *The Travels of William Bartram,* published at Philadelphia in 1791, and a year later in London. It was read by Coleridge who pronounced it the last book "written in the spirit of the old travellers." A gentle, kindly spirit, animated by the genial philosophy of the times, William Bartram was a man to have delighted Crèvecoeur and to have shared the enthusiasms of Jefferson.

BIBLIOGRAPHY.—For abundant bibliographical material consult *The Cambridge History of American Literature* (4 vols., 1917–21). The standard literary histories of the period are: M. C. Tyler, *A History of American Literature: 1607–1765* (2 vols., 1878), and *A Literary History of the American Revolution* (2 vols., 1897, with annotated bibliography). *See* also V. L. Parrington, *Main Currents in American Thought* (2 vols, 1927). Excellent brief accounts will be found in T. Stanton, *A Manual of American Literature* (1909), and W. B. Cairns, *A History of American Literature* (1912).

THE NINETEENTH CENTURY

The 19th century in America, disregarding formal chronology, was, so far as literature is concerned, the period from the close of the second war with England (1815) to the war with Spain (1898), a period cut sharply across by the Civil War (1861–65). In the decades preceding the latter struggle American letters were buoyantly romantic; in the years following they became increasingly realistic—a shift of temper that resulted from profound changes in American life that cannot be considered here.

Until 1815 American literature lingered in the twilight of the 18th century. The heroic couplet and the Addisonian essay possessed sturdy vitality, and when Robert Treat Paine died in 1811 a formal classicism was still in possession of the field. Nevertheless the sober culture of the earlier century was dying out. French thought was penetrating widely in America The earliest romantics, from Freneau to Channing, were children of the Enlightenment, and the rise of the romantic movement in America coincided with the spread of French romantic philosophy. The movement began in Virginia with the inception of Jeffersonian democracy, and its first expression took the form of political theory. It came into literature under the influence of the English romantic movement, first through the writings of Tom Moore, and later through Scott, Wordsworth and Byron; and in the decade of the '20s the old classicism was finally abandoned.

Of the many changes that came with romanticism perhaps the most enduring was the substitution of new literary forms that appealed to a wider and more democratic reading public. The newspaper and the magazine vastly enlarged their appeal *The Evening Post* (1802) and *The North American Review* (1815) were precursors of a notable line of periodicals that multiplied rapidly. The drama was to run an unprosperous course, but fiction was to become the commanding literary form as the century matured, engrossing much of the creative energy of American letters. The novel in America began somewhat inauspiciously with the venture in government under the new constitution. *The Power of Sympathy* (1789), by Sarah Wentworth Morton (1759–1846), was a Richardsonian study in two volumes of letters, heavily sentimental and dark with warning to incautious females who persist in flirting with a wicked world. Other lachrymose novels followed in the next decade. *Charlotte Temple* (1790), by Susannah Haswell Rowson (1762–1824), achieved a popularity so astonishing as to run to a vast number of editions, and it is still reprinted in cheap form for the curious *The Coquette* (1797), by Hannah Webster Foster (1759–1840), won a success only a little less notable. Both works were reflections of the sentimental movement of the late 18th century, and they served to popularize that movement in America.

It was at the turn of the century that the romantic novel got under headway in the work of Charles Brockden Brown (1771–1810). A Philadelphia Quaker, Brown was deeply sympathetic with the ideals of the French Revolution, and he threw into his work all the ardour of a sanguine temperament. Between 1797 and 1801 he wrote seven novels—one in a single month and three in a twelvemonth—together with a mass of occasional work. A disciple of William Godwin and Mary Wollstonecraft, he united a vigorous rationalism to a romantic enthusiasm, suffusing the religion of reason with a warm humanitarianism. Structurally the most coherent of his works is *Wieland,* a tale of the "blood and

thunder" school; but the most characteristic is *Arthur Mervyn* with its Godwinian plot of an innocent youth in the grasp of a patron turned enemy, and its embodiment of French philosophy. In *Edgar Huntly* he turned to the frontier and opened a field that later writers were to exploit. The speed at which Brown wrote was not conducive to finished technique and his tales often degenerate into absurd posturings; but he rarely fails to create a romantic atmosphere and his dramatic effects are often excellent.

THE ROMANTIC REVOLUTION: 1815–70

With the conclusion of the War of 1812 began dynamic changes in American life and modes of thought that created a native romanticism of temper. Few periods in American experience have been so revolutionary. The rise of Jacksonian democracy, the beginnings of industrialism, the enbroilment over slavery, the increasing urbanization of life, the emergence of reform movements, the two wars—these were forces more than adequate to break up the stiff soil and prepare it for the seeds of romanticism that came with every importation from Europe.



FROM THE FIRST EDITION OF IRVING'S "HISTORY"
KNICKERBOCKER, IRVING'S "SMALL, BRISK-LOOKING OLD GENTLEMAN" WHOSE HISTORY OF THE WORLD'S PROGRESS BEGINS WITH THE CREATION

The Knickerbocker Group.—The new literary movement was begun by a group of New Yorkers who in 1807 issued a series of sketches that poked fun at the ways of the little Dutch town. Of the authors of *Salmagundi* Washington Irving (1783–1859) was to win international fame and become known as the father of 19th-century American letters. With the ease of Goldsmith joined to a love of the picturesque, he was a graceful stylist who threw a glamour over the past and transmuted life into gentle emotion. His most original work, *Knickerbocker's History of New York* (1809), bubbled with the raillery of young wit. In 1815 he went to England and four years later published the *Sketch Book*, of which two sketches, "Rip Van Winkle" and "The Legend of Sleepy Hollow," speedily became American classics. For some 17 years he loitered about England and the Continent, discovering materials for other sketches, the most popular of which was the *Alhambra*. On his return in 1832 he set about exploiting the new romance of the West. *A Tour of the Prairies* (1835), and *Astoria* (1836), were the chief fruits of this new interest. Although he continued to write abundantly, Irving's creative work was done. He had outlived his audience and his later writings were less gratefully received; but the limpid prose of the *Sketch Book* and the effervescing wit of *Knickerbocker* were to survive as a permanent possession of American literature.

Associated with Irving in the writing of *Salmagundi* was a New Yorker whose literary course was to run less prosperously, but whose work is too native to be forgotten. James Kirke Paulding (1778–1860) never went abroad but chose to remain consciously provincial, a defender of America against all aliens. He was of plain stock, brought up in dire poverty entailed by the American Revolution. He joined the Irving group in New York city as a raw country boy. After a short apprenticeship he entered on the work that first brought him recognition—a series of humorous attacks on the English critics of American ways. In 1818 he published an idyllic poem, *The Backwoodsman*, and after 1823 he devoted his pen largely to writing "rational fictions," producing some 70 short stories and five novels. In the field of the short story he was a pioneer, writing some of his best tales—amongst others "Cobus Yerks"—when Hawthorne and Poe were at the beginning of their apprenticeship. Of the five novels *Königsmarke, The Long Finne* (1823) is the most amusing, and *The Dutchman's Fireside* (1831) is generally accounted his best. Paulding was not a finished craftsman, but he was an honest thinker and he wrote a homely vigorous prose.

Other members of the Knickerbocker group were Joseph Rodman Drake (1795–1820), Fitzgreene Halleck (1790–1867) and Nathaniel Parker Willis (1806–67); but they are unimportant in comparison with James Fenimore Cooper (1789–1851), a man of great creative vigour. His favourite theme was the receding wilderness, peopled with picturesque scouts and dignified Indian warriors. The "Leatherstocking Series"—five tales that trace the passage of the frontier to the western prairies and are given dramatic unity by the romantic figure of Natty Bumpo—has long been accounted his greatest achievement; but he wrote much else, in many fields. The seven years he spent in Europe opened a chasm between the 18th century gentleman and his native country that was never bridged. In a long series of studies, the best known of which are *Homeward Bound* and *Home as Found*, he gave free rein to a somewhat truculent criticism of the degeneration in manners and morals he professed to discover. In later years he showed a tendency to realism, and in such stories as *Wyandotte* and *The Littlepage Manuscripts—Satanstoe, The Chainbearer* and *The Redskins*—the older Cooper rivals his earlier work.

Controversy likewise filled many of the years of William Cullen Bryant (1794–1878), a transplanted Yankee, who after distinguishing himself as a poet, removed to New York city and entered upon a long and honourable career as editor of the *Evening Post*. He did much to dignify American journalism. He was an ardent Democrat and he combated the Whig programme with much skill; but journalistic fame is transitory, and Bryant is remembered only for his poetry, which is Wordsworthian in temper. A far greater figure was Herman Melville (1819–91), whose fierce satire was as incomprehensible as it was repugnant to his generation As a young man Melville sailed on a whaling cruise to the South Seas, and the experiences following his desertion at Nukuheva were recorded in *Typee* (1846) and *Omoo* (1847). On his return he settled down as a man of letters and in ten years published nine works, but he fell into a mood of pessimism, and at his death had long been forgotten. His greatest books are *Typee, Mardi, Moby Dick* and *Pierre. Mardi*—a confused account of wanderings about the South Sea Islands—is a fierce satire on western civilization; *Moby Dick*—a story of the pursuit of the great white whale—is one of the great books of American literature; and *Pierre*, with its bitter irony, is a tale of incest and murder that marks the lowest depths of Melville's pessimism.

The last great figure of the New York group was Walt Whitman (1819–92). Almost exactly contemporary with Melville, he was an embodiment of the great forces that reached their climax in the '50s—uncritical optimism, faith in democracy, an equalitarian and libertarian passion. He regarded himself as a prophet of the brotherhood of man in the democratic civilization of the future; and the successive editions of *Leaves of Grass*, from 1855 on, are a commentary on life as interpreted by a child of the Enlightenment, with a transcendental faith in the goodness of man, and a robust scorn of all feudal and aristocratic cultures. The frank paganism of detail scandalized a Puritan reading public, and the bold levelling offended a genteel Victorianism. To these major sins he added that of a new and strange technique. With cool audacity he put aside the accent system of versification and sought a different music based on phrase rhythms—a system repudiated by his own generation but later developed by the school of free verse. The democratic philosophy of *Leaves of Grass* was amplified in *Democratic Vistas* (1870), and in other works such as *Specimen Days* (1882). Rejected by his own generation, Whitman has come to be reckoned the chief figure in American poetry. With Melville he was a child of the mid-century, the one embodying the glowing optimism of those buoyant times, the other driven to a bitter reaction.

Southern Writers.—Literature in the south came to its first vigorous expression with the rise of romanticism in the late '20s. William Wirt (1772–1834) was a genial transition figure, but less significant than John Pendleton Kennedy (1795–1870). Kennedy is reckoned the father of the romantic plantation tradition, and in *Swallow Barn* (1832) he wrote a delightful sketch of life amongst the Virginia gentry. In *Quodlibet* (1840) he contributed to the American political library a witty satire on Jacksonian

democracy, and in *Horse Shoe Robinson* and *Rob of the Bowl* he furthered the development of the historical novel. The work of creating a plantation tradition was carried further by John Esten Cooke (1830–86), who as a very young man wrote *The Virginia Comedians* (1854), *Henry St. John* (1859) and many lesser works in a somewhat florid strain. He delighted in portraying southern chivalry; but the wit, romance and melodrama never quite fuse and the effect is less finished than in Kennedy's work.

The genius of southern literature was Edgar Allan Poe (1809–1849). Virginian by adoption and preference, he was an isolated figure, set apart from his generation by his proud temper, the originality of his work and the severity of his standards. Poe was a refined craftsman who achieved distinction in the several fields of poetry, fiction and criticism. Historically his most noteworthy influence has been in the field of the short story. With the later popularity of that literary form his fame spread widely, and with that fame has come increasing recognition of his labours in the field of criticism.

It was in Charleston, the capital of southern fashion, that southern literature found its most congenial home. The little city was the seat of magazines like *The Southern Review*—a rival of Poe's *Southern Literary Messenger*—and it prided itself on a solid and dignified culture. The outstanding literary figure of Charleston was William Gilmore Simms (1806–70). He worked in many fields—poetry, fiction, biography, local history, politics—but his greatest love was for historical romance. The series of revolutionary tales, of which *The Partisan* (1835), *Katherine Walton* (1851) and *The Sword and the Distaff* (1853)—later entitled *Woodcraft*—are representative, is marked by a pronounced picaresque strain that lends vigour to pages otherwise inclined to be stilted and florid. Simms's best-known character is Lieutenant Porgy, who reappears in successive tales, a fat hero equally valiant as warrior and trencherman, whose pranks in *Woodcraft* make it the author's most amusing story.

New England Writers.—In New England the romantic movement followed a special course determined by the theological heritage of the Puritan. Before it could make headway the cardinal dogmas of Calvinism must lose their authority and the provincial New England mind become hospitable to new conceptions It was the great schism in the church that prepared the way. The Unitarian movement brought to New England two fresh influences—the rationalism of England and the romanticism of Revolutionary France—to undermine the authority of the dogmas of total depravity, reprobation and election. The two characteristic phases of the theology thus revivified were represented by William Ellery Channing (1780–1842) and Theodore Parker (1810–60), the former retaining a supernatural explanation of the origin and rôle of Christianity, and the latter abandoning all supernaturalism In both, however, the creative conception was the conception of the excellence of human nature and the perfectibility of man—a conception that struck at the very foundation of Calvinism.

It was this invasion of French thought, with its humanitarian emphasis, that opened the New England mind to the appeal of social reform, with the result that the decades following 1830 were the golden age of New England humanitarianism. Under the leadership of William Lloyd Garrison (1805–79) the Abolition movement drew to its following many of the finest spirits of Massachusetts. John Greenleaf Whittier (1807–92) was the chief poet of the movement, but the young Lowell contributed some excellent verse. Other distinguished Abolitionists were Wendell Phillips (1811–84), Theodore Parker, Harriet Beecher Stowe (1812–1896), and Henry Ward Beecher (1813–87). From the same humanitarian root came the diverse experiments in communal living, as Alcott's "Fruitlands" and the better known "Brook Farm." Founded by George Ripley (1802–80), the latter is commonly reckoned an offshoot of the Transcendental movement. It was a picturesque and stimulating experiment that attracted a notable group of young men, amongst others Hawthorne, George William Curtis and Charles A. Dana. Emerson, Parker and Margaret Fuller were frequent visitors, but they never joined the group.

Out of Unitarianism came likewise the Transcendental movement, essentially philosophical in temper, that rejected the sensationalism of Locke and adopted the intuitionalism of the German idealistic school. The most distinguished members of a very considerable group were Ralph Waldo Emerson (1803–82) and Henry David Thoreau (1817–62), around whom must be set A. Bronson Alcott (1799–1888), Margaret Fuller (1810–50), Theodore Parker, George Ripley, Orestes Brownson (1803–76) and many others less known. The organ of the movement was the *Dial* (1840–44), edited by Margaret Fuller and later by Emerson. Transcendentalism represented the highwater mark of the New England romantic movement, the extreme reaction from the dogmatic Calvinism of earlier times.

The movement may be studied conveniently in the journals and works of Emerson and Thoreau. Lecturer, essayist and poet, Emerson embodied all the diverse idealisms of the times. In his thought the disintegrating forces released by the Enlightenment came to expression in a self-sufficing individualism that transmuted the Calvinist children of Adam into potential children of God who were called to live in harmony with their divine nature. The individual is superior to society and the State, and when he has realized his Godhood the State will cease to function. The major ideas of Emerson were elaborated in three essays that still retain their importance as prime documents for the student: *Nature* (1836), *The American Scholar* (1837) and the *Divinity School Address* (1838). In 1841 he published his first series of *Essays,* which with the *Journals* embody his most characteristic doctrines. Other collections of essays followed and in 1847 his first collection of poems.

Thoreau came more tardily to recognition. During his lifetime he was commonly regarded as no more than an echo of Emerson; but in recent years he has come to be placed on a parity with the better-known man An extreme individualist he carried to their ultimate conclusions the premises of the Enlightenment, and in his rejection of all external compulsions he marked the farthest reach of the spiritual anarchism that derived from Godwin. The essay on *The Duty of Civil Disobedience* was a radical utterance even for those radical times. *A Week on the Concord and Merrimack Rivers* (1849) is an essay on life in New England, with discursive chat on books and philosophies; and *Walden* (1854) is a study in Transcendental economics—how life may be saved from enslavement to the daily routine.

In comparison with the Concord group the Cambridge and Boston writers have suffered in reputation with the passing years. Cultivated humanists, these latter derived largely from Europe and were less original and native. In his lifetime Henry Wadsworth Longfellow (1807–82) was reckoned the most distinguished American poet, and from *Voices of the Night* (1839) to *Evangeline* (1847), *The Courtship of Miles Standish* (1858) and *Hiawatha* (1855), he was without a rival in popularity. But after the Civil War his influence declined, and his later work, although frequently marked by a fine craftsmanship and a sober beauty, was far removed from the interests of the age. With his quiet sentiment, gentle morality and humane view of life, Longfellow was a New England Victorian with a large infusion of German romanticism.

Somewhat younger than his neighbour, James Russell Lowell (1819–91) was a man with liberal instincts in whom a certain vacillation prevented the adequate expression of a rich and generous nature. Poet, critic, essayist, scholar, editor, diplomat, he was often bewildered by the changing ideals of his age As a young man he threw himself into the Abolition movement and contributed some excellent verse to the cause. Later he turned bookman and immersed himself in mediaeval and Renaissance literatures, pausing in his studies to write an occasional poem or essay, and to edit the *Atlantic Monthly.* From this quiet life he was drawn away on diplomatic missions, first to Madrid and later to London, and in his last years he was a distinguished figure if not an important creative writer. With Lowell may be grouped Oliver Wendell Holmes (1809–94), a brilliant talker and a genial writer of occasional poems. His most significant work is found in such chatty comment on things in general as *The Autocrat of the Breakfast Table* (1857), and in certain

poems, often satirical, like "The One-Hoss Shay" and "The Last Leaf." Here also may be grouped a notable company of Boston historians. George Bancroft (1800–91), William H. Prescott (1796–1859) and John Lothrop Motley (1814–77) contributed substantial works; but the most distinguished member of the group was Francis Parkman (1823–93).

The novelist of the New England renaissance was Nathaniel Hawthorne (1804–64). Of Salem stock, his literary career was



FROM DARLEY "COMPOSITIONS IN OUTLINE FOR HAWTHORNE'S 'SCARLET LETTER,'" 1879

HESTER PRYNNE CONFRONTING PURITANS IN "THE SCARLET LETTER"

The publication of "The Scarlet Letter" in 1850 marked a definite step in New England's growing tendency toward Romanticism. Its compelling spiritual tone and perfect prose won immediate fame for its author and placed it among American classics

dominated by the ghosts of the Salem past. A Puritan sceptic he joined in none of the great movements of his generation, beyond a casual year at Brook Farm that left him unchanged. His intellectual contacts were few and his interests were persistently introspective and analytical. He began as a writer of symbolical tales and only late turned to the longer romance. *Twice Told Tales* (1837) and *Mosses from an Old Manse* (1846) were a preparation for his greater works: *The Scarlet Letter* (1850), *The House of the Seven Gables* (1851) and *The Blithedale Romance* (1852)—a story of Brook Farm. Receiving appointment as American consul at Liverpool he passed seven years in England and Italy, the fruit of which was his longest romance, published in England as *Transformation* and in America as *The Marble Faun* (1860). After his return in 1860 he accomplished little, but his position as the greatest artist that Puritanism has given to America was secure.

THE CHANGE TO REALISM: 1870–1900

In the two decades following the Civil War, which have come to be called the Gilded Age, the intellectual outlook was greatly changed. The traditional cosmos of the theologians was disintegrating and a new scientific and sceptical attitude was spreading. Of the current scepticisms perhaps Henry Adams (1838–1918) was the completest embodiment, and the story of the disillusion of the post-war generation is set down in *The Education* (1906), to which must be added his *Mont Saint-Michel and Chartres* (1904)—an account of a strange Puritan quest for the Golden Age and one of the loveliest and most penetrating studies done by his generation of Americans.

In those turbid years polite literature, following the New England school, turned away from life to seek beauty; and from this alienation came what has been called the "genteel tradition" of letters, that forbade any serious grappling with reality. With a few notable exceptions such as Whitman and Joaquin Miller, the poets shut themselves up in their ivory towers to practise their craft on odes and sonnets and ballads. Of this somewhat ineffective school were George Henry Boker (1823–90), Bayard Taylor (1825–78), Richard Henry Stoddard (1825–1903), Edmund Clarence Stedman (1833–1908) and Thomas Bailey Aldrich (1836–1907). The most distinguished poet of the time was a Georgian, Sidney Lanier (1842–81), one of a group of southern poets that included Henry B. Timrod (1829–67), Paul Hamilton Hayne (1830–86) and John Bannister Tabb (1845–1909). A brilliant musician, Lanier applied to the technique of verse a conception of quantitative values that he elaborated in *The Science of English Verse* (1880), and illustrated in the fresh rhythms of such poems as "The Marshes of Glynn."

But the new literature of the Gilded Age began with the appearance of the local colour school and the rise of the short story. The irruption of the frontier upon the aristocratic domain of letters was a death blow to the genteel tradition and bitterly resented by its votaries. Yet nothing could stay its advance. Beginning with Bret Harte (1839–1902) it was to spread during the next score of years till it dominated nearly all American literature. Harte was a New Yorker who went to California soon after the "gold rush" of 1849. He delighted in the romance of the mining camp and after some experimentation he wrote *The Luck of Roaring Camp, The Outcasts of Poker Flat, Tennessee's Partner* and *The Heathen Chinee*—the latter a humorous poem. They were published in 1868–69 and received with tremendous acclaim as the expression of an authentic America. The new vogue was established and the vagabond tale speedily developed into a conscious exploitation of local dialect, characters and setting—romantic at first but becoming increasingly realistic and drawing heavily on the tradition of frontier humour. It was the period of the final conquest of the West, of the slaughter of the vast buffalo herds, of the pony-express, of the last Indian fights—the final flaring up of the romance of the frontier before the frontier was to pass forever.

Against this background appeared Mark Twain (Samuel Langhorne Clemens, 1835–1910), the most original of the frontier school and the most representative writer of the Gilded Age. His audience had been prepared for him by a considerable group of whimsical humorists, including amongst others Artemus Ward (Charles Farrar Browne, 1834–67) and Petroleum V. Nasby (David Ross Locke, 1833–88). He came from a slovenly Missouri village on the banks of the great river that ran down to New Orleans, and after a few years as a Mississippi pilot he turned westward and joined the boisterous society of the Golden Gate. From such experiences he drew his materials for *Roughing It, Life on the Mississippi, Tom Sawyer, Huckleberry Finn,* with their rough humour, quizzical comment and flashes of imagination. Early in the '70s he settled at Hartford, Conn., underwent an unfortunate process of conventionalization, was caught in the maelstrom of the Gilded Age, turned pessimistic, and divided his latest years between the romantic hero-worship of *Joan of Arc,* and the cynicism of *The Mysterious Stranger.*

The cult of the local may perhaps be reckoned an unconscious protest against the spread of an encompassing nationalism. The later decades of the 19th century were marked by bitter struggle between two Americas, an older agrarian order with sharp sectional differentiations, and a rising capitalistic order that was subduing all America to a drab industrial pattern. The crisis in the century-long struggle came in the bitter campaign of 1896, the outcome of which was the overthrow of the agrarian hosts and the removal of the last obstacle to a consolidating nationality and a common national literature. To gather up and preserve quaint local idiosyncrasies of manners and character and dialect before they were finally submerged, became therefore the business of the local colour school. The immense popularity of the short story provided a convenient literary form, and in the last quarter of the century the local dialect story carried everything before it. In New England Sarah Orne Jewett (1849–1909) portrayed with delicate and loving touch the decayed gentility of the old towns, and Mary Wilkins Freeman (1862–) described with sombre realism humble village types and the struggle of the older New England order with a masterful industrialism. In the South Thomas Nelson Page (1853–1922), of Virginia, heightened the romantic colour of the plantation tradition; Joel Chandler Harris (1848–1908), of Georgia, in his "Uncle Remus" tales put into delightful form the folk-lore of the negro; George Washington Cable (1844–1925) portrayed the romantic Creole life of New Orleans;

Charles Egbert Craddock (Mary Noailles Murfree, 1850–1922) drew the gaunt, primitive figures of Tennessee mountaineers; Octave Thanet (Alice French, 1850–) took for her field village life in Arkansas; and Constance Fenimore Woolson (1848–94), one of the pioneers of the group, dealt with the materials of several frontiers—the West of the lake region, Florida and the Appalachian mountain recesses of Virginia, North Carolina, South Carolina and Georgia.

In the new West of the Middle Border where the prairies begin, the studies in local colour inclined less to the picturesque and more to the drab realistic. The work was begun by Edward Eggleston (1837–1902), whose *Hoosier Schoolmaster* (1871) and *The Circuit Rider* (1874) aspired to be faithful chronicles of life on the Indiana frontier. The scene thus depicted with a crude veracity was re-drawn in romantic colours in the next generation by James Whitcomb Riley (1852–1916), the poet laureate of the middle West in the days just preceding the invasion of industrialism, whose folk verse was recited at every parlour gathering for a generation. A mood of the Middle Border more akin to that of Eggleston than of Riley is revealed in the early stories of Hamlin Garland (1860–). A product of the prairie frontier from Wisconsin to North Dakota, he was caught by the spirit of rebellion that surged up in the great Populistic movement of the '80s and '90s, and in *Main Travelled Roads* (1891) and later tales, including *Rose of Dutcher's Coolly* (1895), he painted grim, realistic sketches of farm life. Garland was the first farm-bred writer to deal honestly with his materials. In his view the prairie farmer suffered from unjust exploitation at the hands of the city, and he threw himself ardently into the cause of agrarianism. After the defeat of 1896 he turned to other fields, and eventually in *The Son of the Middle Border* (1918) he wrote a lovely idyll of farm life in which the harsh colours of the earlier stories are subdued to softer tones, without losing their veracity.

While the short story was drifting uncertainly from romance to realism the novel was following the same course. Two tendencies were at work in American life during those years of transition that determined the content and form of fiction—the rise of sociology and the attitude of scientific detachment; and from these tendencies came a new type of sociological-realistic novel that dealt in a critical spirit with the political and social phenomena of the times. The new attitude was revealed in a long series of novels that, beginning with *The Gilded Age* (1873) by Mark Twain and Charles Dudley Warner (1829–1900), rose eventually to a flood that involved almost all fiction between 1903 and 1917 The conquest of American life by industrialism brought forth abundant protests, and the history of the times is written fairly adequately in those sociological studies. Albion W. Tourgee (1838–1905) dealt with reconstruction in the South in a series of novels the best known of which is *A Fool's Errand* (1879), and later portrayed socialism sympathetically in *Murvale Eastman* (1890). As a result of the political corruption of the '70s Henry Adams in *Democracy* (1880) drew pessimistic conclusions from the American experiment in government, and as an aftermath of the great strikes of the same years John Hay (1838–1905) directed a somewhat ill-natured attack on the rising labour movement in *The Bread-Winners* (1883). In 1888 Edward Bellamy (1850–98) made a wide appeal with his Marxian Utopia, *Looking Backward*, and nine years later supplemented it with *Equality*, an excellent Marxian tract in story form. In the '90s the sociological novel multiplied rapidly, preparing the way for the later "muck-raking movement" that went hand in hand with the Progressive movement in politics. To this group belonged Hjalmar Hjorth Boyesen, a transplanted Norwegian scholar, who combined in his novels keen social analysis and suggestions of the realistic technique of Zola.

The most popular novelist of the period was F. Marion Crawford (1854–1909), who lived mostly in Italy and whose influence was thrown strongly on the side of romanticism; but certainly the greatest figures were William Dean Howells (1837–1920) and Henry James (1843–1916), who were the first deliberate and conscious American realists to achieve a finished technique. Neither of them was a follower or imitator of European realism, but each created a method that suited his individual temperament. Howells was an Ohio boy who during the Civil War immersed himself in Italian culture, and soon after his return settled in Cambridge, Mass., where his art was given shape by the "genteel tradition" of letters still regnant there. His technique developed in the late '70s and bore many of the marks of his Brahman environment—a refined craftsmanship, a lambent humour, a genial optimism, and a nice care for the truthful portrayal of externals. In his minute studies of New England manners, such as *A Modern Instance* (1882), *The Rise of Silas Lapham* (1885) and *April Hopes* (1887), the talk skims gracefully over the surface of life without revealing the deeper emotions. In the late '80s he came under the influence of Tolstoi, and this with his removal to New York brought a subtle change in mood with no corresponding change in technique. An awakening interest in social problems darkened his skies, and in *A Hazard of New Fortunes* (1889) he wrote what is probably his greatest novel. During these years he was tireless in advocacy of realism, and *Criticism and Fiction* (1891) sums up his later theory. Though he had become concerned over social problems he never adopted the current forms of sociological fiction, but chose to embody his protests against industrialism in charming Utopian romances *A Traveller from Altruria* (1894) and *Through the Eye of the Needle* (1907) are marked by an urbanity that almost draws the sting of his criticism. Howells wrote abundantly in many forms—the travel sketch and critical comment in particular—and his total work amounts almost to a library.

The writings of Henry James touched American life only slightly, and then the world of polite manners rather than of daily actuality. An intellectual cosmopolitan, he spent much of his life in Europe, slowly drifting back to that rich civilization which his emigrant ancestors had left behind. For years he suffered from a certain cultural nostalgia, a "relish for the element of accumulation in the human picture and for the infinite superpositions of history." Always the American backgrounds seemed to him thin and unsatisfying. In his earlier years he dwelt between two worlds, but when after years of London life he found himself at last at home in the scene, his art arrived at a rich maturity in such work as *The Ambassadors* (1903). A long alienation limited his understanding of his native land, and when he essayed, as in *The Bostonians* (1886), to depict the American scene, the effect was somewhat thin and skeleton-like, worlds removed from the actual.

Meanwhile fresh movements in fiction were getting under way —movements that belong rather to the new century. At the age of 20 Stephen Crane (1871–1900) wrote *Maggie: A Girl of the Streets*, a brilliant sketch of slum life, and soon afterwards *The Red Badge of Courage*, a forerunner of later impressionistic work. In the middle '90s Frank Norris (1870–1902), under the influence of Zola, wrote two searching studies of character degeneration, *McTeague* and *Vandover and the Brute*, before turning to sociological fiction in *The Octopus* (1901). During these years the more classical forms of literature still lingered in the familiar fields. In poetry Madison Cawein (1865–1914) continued the Victorian nature tradition, and Richard Hovey (1864–1900) poured out vigorous Swinburnian verse. In drama Clyde Fitch (1865–1909) produced a number of clever society plays, and in the essay Agnes Repplier (1858–), more French than American in spirit, created a distinguished form of criticism. On the whole American literature was waiting for the coming of new forces to free it from dependence on Old-World models and make it native and adequate.

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THE TWENTIETH CENTURY

A survey of American literature from 1900 to 1928 must deal chiefly with movements and tendencies rather than with masterpieces, schools and types. There are two reasons for this. We are still too close to our contemporaries to discriminate with even that reasonable probability of rightness which may be expected where time and taste have sifted the long-lived from the short. But an even stronger deterrent to dogmatic judgments is the nature of the period itself. In economical structure, in education, in social evolution, in politics, as well as in literature and the arts, the last three decades have abounded with change, in the United States even more than in other parts of the world. They witnessed the break-up of American self-sufficiency after the Spanish-American War; they saw the transformation of a country mainly agricultural into one predominantly industrial; they developed in their course a new capitalistic democracy, and a revival of nationalistic spirit, and they conclude with a sophistication of urban life different from any earlier culture in the history of the United States. In short, these three decades have been years of rapid transition toward a new social, moral, intellectual and economic order. But they are more than transitional. We have definitely entered upon a new epoch. An outline of American literature in this period must therefore be first of all a sketch of change and transition.

It is clear that the '90s of the last century in America as in England were not the beginnings, as was fondly supposed, of a new literary period, but rather the final efflorescence of an old trunk. The brilliant, mannered writing of the short story, the new-art magazines, such as *The Chap-Book*, the widespread imitation of the romantic elegance of Robert Louis Stevenson and the romantic virility of Rudyard Kipling, were of little significance for the immediate future of American literature. Only Jack London, with his stories of primitive, instinctive characters pursuing violent lives, expresses ideals of strenuosity with less subtlety than Kipling but with vigour in books like *The Call of the Wild* (1903) and *The Sea Wolf* (1904).

The late '90s and early 1900s were years of almost feverish writing. The American short story had reached a high pitch of technical skill and was finding a ready market in the new magazines which, like *McClure's*, were spreading to new classes of readers. The cult of local colour was being exploited for popular interest in narratives rich in dialect and local custom, but, if romantic, overcharged with sentiment, and, if realistic, specializing, like the stories of Mary Wilkins Freeman, in regional peculiarities Satire was beginning in journalism with Peter Finley Dunne's dialogues of Mr. Dooley and the fables of George Ade, but was absent from formal literature and the stage Poetry was limited to the ambitious, but rather academic, work of scholars like William Vaughan Moody, or to "magazine verse"—highly finished but conventional lyrics, brief and usually empty. Only one form of literary endeavour reached the magnitude of a school—historical romance.

The vast circulation, the great praise, the supposed significance of the historical romance in the America of the '90s and early 1900s are proofs that we are dealing with the end, not the beginning, of a period. Winston Churchill's *Richard Carvel,* Booth Tarkington's *Monsieur Beaucaire,* Paul Leicester Ford's *Janice Meredith*—these names echo but faintly now. They were stories in the direct tradition of Scott, Bulwer-Lytton, Dumas and the contemporary Stevenson. They were literary, with that slightly archaic style which is so offensive when its date is out; they were imbued with a thin romantic idealism, and while the hero made his own way in American fashion, there was little else American, or indeed contemporary, about them, except the frequent use of romantic scenes from early American history, which was a sign of the nationalism that accompanied the successes of the Spanish-American War. This vast literature of "best sellers" was read by most of the educated population of the country. It was the feeble conclusion of the great romantic movement of the 19th century.

There were forerunners of change before the end of the first decade. The vigorous cycle of Frank Norris, *The Octopus* (1901), *The Pit* (1903), which dealt especially with the struggles between the producers and the new power of concentrated money, had wheat as its main theme, and these books, in spite of a tincture of romantic melodrama, were contemporary literature in a sense that the historical romance was not. Theodore Dreiser also had begun with *Sister Carrie* (1900) the attack upon American reticence which was later to result in the freeing of sex as a permissible dominant theme in literature. But his books, in spite of their subjects drawn from an unromantic democracy, were infected with a romantic megalomania, so that his would-be epics, *The Financier* (1912) and *The Titan* (1917) were akin in spirit, if not in mood, to the more elegant, but scarcely less unreal romances of colonial life which had been loved by the populace. The influence of his more realistic books, such as *Jennie Gerhardt* (1911), was thrown powerfully upon the side of naturalism in fiction. Stephen Crane, another experimenter in realism, was more noticed for the vividness with which his trenchant style endowed themes that had been merely romantic before than for the honest realism of his mood. His *Red Badge of Courage* (1895) was a *tour de force* that dates with the early brilliant stories of Kipling, and survives as a masterpiece of achievement in anti-romance rather than as a turning point in American literature.

Indeed, the causes for the great change in literary taste, which began in America about 1910 and was established by 1912, must be sought outside American literature. Among the intellectuals, where it began, it was due to a wide and earnest reading of the great anti-romantics of Europe—Bernard Shaw, whose attack upon the conventions of 19th century manners and morals and thinking made iconoclasm fashionable; the Russian novelists (fittingly introduced to American readers by William Dean Howells, last survivor of the first realistic period), who gave examples of a powerful fiction treating of people, like ourselves, unheroic, unpicturesque; and Ibsen, whose iconoclasm preceded Shaw's and was far more dogmatic. It was Europe that gave the literary stimulus to the new literature of 20th century America; but the stimulus was not simply literary.

In the first decade of the 20th century, the term "social conscience" first came into general use. A rapid increase in concentrated wealth, the creation of trusts, the closing of the American frontier, began to put an economic pressure that was not temporary upon the American, and brought him into a closer economic sympathy with Europe Money as a power, the workers as a class, democracy as an economic factor, entered into the American consciousness. Roosevelt and Bryan made these ideas articulate; Upton Sinclair in his story of the meat industry, *The Jungle* (1906), gave concrete evidence; later the new English writers, H. G. Wells and John Galsworthy, especially, who dealt with the modern world as a complex in which the fate of men and women was determined by their environment, began to be widely read. Socialism, which had been dismissed in American universities of the '90s as played out, began to be discussed actively and a sturdy individualist, like William Graham Sumner, found that he had lived beyond his time and was unheard.

The immediate effect of all this social unrest was literary unrest. Romanticism seemed out of date. The new interest in classes created a new interest in individuals from those classes. The ordinary man in a commonplace environment entered American literature, not as a minor, but as a major character.

All this was intensified by the scientific education which since the last decades of the 19th century had been permeating all American schools and colleges. Experimental science, upon which the industrial advance of the period was based, produced in literature a realist attitude and a willingness to seek interest in the humble, the mean and the vicious. This partial realization of the scientific attitude through general education was the great factor in the change of literary taste.

TRANSITION

Poetry.—The change in literary values was, in America, sharpest in poetry. The so-called renaissance in American poetry might better be called a revolution. It was a result of new interests, new ideas acting upon the sensitive minds of the poets, and

resulting both in a new technique and in a clamorous insistence that poetry should once again become a literature of importance

The makers of the new poetry in no real sense constituted a school. They included such diverse personalities as Ezra Pound with his cult of intellectualism; Amy Lowell who drew her first inspiration from France and was as much concerned with criticism as with creation (*Sword Blades and Poppy Seeds,* 1915; *Legends,* 1921); Edgar Lee Masters, a mid-Western lawyer, self-made in style and careless in choice of theme, whose *Spoon River Anthology* (1915) depended upon a bitter realism for its success; Robert Frost, a sensitive humorist who planed down the conventions of poetical rhetoric to the levels of unromantic New England (*North of Boston,* 1914; *New Hampshire,* 1923); also Edwin Arlington Robinson, who at first poured his shrewd observation of American character into racy, difficult verse, obscure, philosophic and pungent (*The Man Against the Sky,* 1916; *Tristram,* 1927); and Vachel Lindsay, a balladist and chanter of the Mississippi valley, who took up the native themes of the most American America—the frontier, the negro, revivalism (*General Booth Enters Heaven,* 1913; *The Congo,* 1914).

Two bonds only united these adventurers, around whom many others were soon grouped—an intense desire to make poetry once again vital in its expression, and a willingness to extend its province to include every new theme, however unlovely, which stirred the emotional mood With Amy Lowell were ranked the advocates of free verse; with Masters those poets who, like Carl Sandburg (*Chicago Poems,* 1916; *Cornhuskers,* 1918; *Smoke and Steel,* 1923), found democracy and all its works, including industrialism, more truly poetical than the old themes. With Frost were less rebellious writers who, like William Rose Benét (*Merchants from Cathay,* 1913), Edna St. Vincent Millay (*Renascence,* 1912; *A Few Figs from Thistles,* 1920), Louis Untermeyer (*Challenge,* 1914), sought to put the American mood as they felt it into poetry that was original not so much in form as in its impress of a living spirit.

But in all these poets, when at their best, realistic spirit (although by no means always realism), a willingness to experiment and a passionate interest in the new developing America were evident. Poetical criticism awoke with them and grew vociferous. Long poems appeared again, and new publications which, like Harriet Munro's *Poetry* (1912), were given entirely to verse. Poetry societies were formed and poetry began again to be heard as well as read. Cultivated Americans added poetry to their reading lists, but their rhythmic sense was blunted by disuse or stiffened by convention, and it was the novelty, not raucousness of free verse which called forth criticism, a fact responsible in part for the subsidence of the most promising movement in American poetry since the New Englanders of the 19th century.

Fiction.—The full effect of the transformations of the early 19th century did not show itself until after the World War. Just before this period Henry James had been writing the last and most complex of his novels (*The Golden Bowl,* 1904), and while he was to be reckoned as more cosmopolitan than American, his example was indicative of what was to happen in America. The American novel had a good tradition behind it, and in every period there were sound examples where imagination and the reality which must always accompany a novel were happily blended. The chief effect of the awakening of a new artistic consciousness in America and the breaking of the shackles of convention was to be seen in the fine series of novels of contemporary life in which Booth Tarkington (converted from pure romance), Edith Wharton, Joseph Hergesheimer and Willa Cather were beginning a more thorough-going study of the American scene than had been attempted before. This includes Booth Tarkington's *Penrod* (1914), which though a collection of short stories has continuity, *The Magnificent Ambersons* (1918), *Alice Adams* (1921) and *The Plutocrat* (1927); Edith Wharton's *The House of Mirth* (1905), *The Custom of the Country* (1913) and *The Age of Innocence* (1920); Willa Cather's *O Pioneers!* (1913), *The Song of the Lark* (1915), *My Antonia* (1918), *A Lost Lady* (1923) and *Death Comes for the Archbishop* (1927); Joseph Hergesheimer's *The Three Black Pennys* (1917) and *Java Head* (1919).

These novels (if we include Henry James's) are more competent in their craftsmanship than any of the past half century with the exception of the best of Howells, and are richer emotionally than his. Their kind was to grow in power and variety for another two decades, and in them is to be seen the fruition of that careful workmanship and loving interest in the character types of American civilization which had been bred in the local-colour short stories of the generation before.

The short story was differently affected by the new currents of American life. It had begun as a filler for the magazines, had risen quickly into literature, and now began to descend toward journalism again. The standardizing of American life was accompanied and accelerated by the vast growth in circulation of the magazine, and a resultant demand for short fiction. To this the short story responded in two ways. First, the craftsmanship which could make an interesting story out of 3,000 words was stereotyped, and soon began to be taught in college courses, so that anyone with a tale to tell could learn to put it in acceptable form. A flood of good stories flowed over the land, which, when reprinted in book form, proved to be not so good. Only occasional masterpieces, like Edith Wharton's *Ethan Frome* (1911), which is really a belated phenomenon of the '90s, stand out from the mass. Secondly, the most successful new writers wrote in strict conformity with the needs of journalism. O. Henry (William Sydney Porter), in *The Four Million* (1906), borrowed the method which Aldrich and Bunner had used in the 19th century, and made stories of a popularity only to be compared with the romantic best sellers that preceded him His influence was great upon short-story journalism, but has small relation to the changes in American life which were reflected in the contemporary novel

Parallel Developments.—The swing from romance toward a harder intellectualism and a more realist study of contemporary life as it was manifested in this transition literature was, indeed, a phase of the general change in the American mind. In journalism the democratizing and vulgarizing of the newspaper, which had begun some years before, was an effect of better economic conditions for the classes that had hitherto not read at all, and influenced literature only by breeding innumerable writers alert to catch and follow the taste of the broadest American public. But new intellectual tendencies were evident even in the newspapers. The humorous column now began, with B L T. (Bert Leston Taylor) of the Chicago *Tribune* and Franklin P. Adams and Don Marquis of New York, to take that edge of harder satire which was to characterize the new age. At about the same time, the illustrated literary magazine, which had been America's chief contribution to periodical literature, began to lose its vitality and give way to the new weeklies for men and women, like *The Saturday Evening Post* and *The Ladies Home Journal,* which, with more journalism and less literature, became the staple reading of the American *bourgeoisie.* Beside the older magazines came into existence new vehicles of thought, some of them, like *The New Republic,* created to express the intellectual unrest of an American generation quickly outgrowing provincialism, others, like the revived *Nation,* organs of new social ideas, still others, like *The Yale Review,* expressive of a new spirit in the American universities, which were now ready to leave their specialization and take part in a reconstruction of American thinking. On the stage the change was even more marked, but as yet American talent took only a minor part, though it was in these transitional years that New York began to rival London and Paris as a market for dramatic ideas

The Essay and Criticism.—The essay, in which American literature, with Emerson and Thoreau, had shown great originality, was in the hands of conservatives. The graceful humour of Samuel McChord Crothers (*Humanly Speaking,* 1912), the caustic criticism of Agnes Repplier (*Counter Currents,* 1916), were such as might emanate from highly civilized writers in any age. In criticism there was little revival until after the war, although from this period date the first efforts to supply new grounds for judgment of contemporary writers, the work of Van Wyck Brooks (*America's Coming of Age,* 1915), Joel Elias Spingarn (*The New Criticism,* 1911) and Randolph Bourne (*Youth and Life,* 1913).

Academic criticism was still concerned almost exclusively with literary history, and was notably uncritical of anything but facts. It ignored American literature, which, from the time of Poe and the great New Englanders until the post-war period, went without serious scrutiny. A few accomplished scholars of humanistic trend, such as W. C. Brownell (*American Prose Masters,* 1909) and Paul Elmer More (*Shelburne Essays,* 1904–), made distinguished contributions in traditional fields, but there was little vitality in the criticism of contemporary literature. Note should be made of the brilliant criticism of life, half literary, half philosophical, of George Santayana (*Winds of Doctrine,* 1913, *Character and Opinions in the United States,* 1920.)

A vigorous exception was James Huneker, whose highly coloured observations on native and foreign writing in the New York newspapers had the virility and immediate interest which general criticism lacked (*Promenades of an Impressionist,* 1910; *Ivory, Apes and Peacocks,* 1915).

WAR AND POST-WAR

The World War had a dominant effect upon American ideas, but much less upon American imagination. In the first three years of the conflict, when the United States was a noncombatant, a flood of European writing was discharged upon the country, and this was met by an equal outpouring of American writing upon European topics. Europe was analysed, explained, inspected, as never before in American history. Some of this writing was mere propaganda, but much of it, whatever its purpose, was a sincere attempt to understand the French, the British and the German mind. It is difficult to over-estimate the effect of this cosmopolitan reading upon the American public. The interest in foreign literatures, already spreading rapidly in the transition period, was strengthened. Authors who had been national, like Rolland or Ibañez, became international.

The period of the war itself saw no more than a steady development of the tendencies already mentioned, although the change in American perspective put an end to the lingering reputations of the old romantic school. Kipling and Stevenson disappeared as foreign influences. The atmosphere of war discussion was unfavourable to poetic themes, whether realistic or idealistic.

But the years immediately succeeding the war brought new developments, whose importance is only now becoming evident. There was, as after most wars, a sharp revival of nationalism. This nationalism, however, was of a special character, in that it reflected the inevitable contrast and comparison which resulted from a vast migration of Americans abroad and an almost equally great inroad of European ideas at home.

The new nationalism took several forms. In the remarkable series of works by Sinclair Lewis, *Main Street* (1920), *Babbitt* (1922), *Arrowsmith* (1925), *Elmer Gantry* (1927), the provincial self-satisfaction of the prosperous, half-educated American, his decayed idealism, his aimless strenuosity, his perfunctory morality were more bitterly attacked than was deserved. Implied contrast with the proper attributes of a citizen of the world was the characteristic basis of these novels, in which respect they closely resemble the parallel work of H. G. Wells. Lewis's *Babbitt* is perhaps the most important work in fiction of the whole period

The scene of Lewis's novels is prevailingly the Middle West, and it is the emergence of the Mississippi valley (and later of the Old South) as a social *milieu* stimulative of serious fiction that is a second characteristic of this post-war nationalism. The distinguishing feature in the novels, whether historical, like Herbert Quick's *Vandermark's Folly* (1922), or psychological, like Elizabeth Roberts', *Time of Man* (1926), or expressionistic, like Glenway Westcott's *The Grandmothers* (1927), or objective, like O. A. Rölvaag's *Giants in the Earth* (1927) is the self-consciousness of the authors as regards this middle America. They feel that it is the real America, as the New Englanders before them had felt of New England, and their novels of farm life are intended to be, and are, studies in typical American problems.

A third aspect of the contemporary nationalism is the increased interest in the American past. American history as a study for the general reader revived after a long eclipse with such books as were included in the "Chronicles of America" series. But in the decade since the war this interest has been greatly extended and has resulted in a rewriting of the biographies of most of America's famous men, and many fresh contributions to the truth about the American past. The social history of America is now being written for the first time by such scholars as Allen Nevins, James Truslow Adams, Lewis Mumford, Charles Beard and Vernon Louis Parrington. (*See* particularly *Main Currents in American Thought* [1927], by Parrington; *The Golden Day* [1926], by Mumford; *The Rise of American Civilization* by Charles and Mary Beard.) Many important studies of America's past, like the *Education of Henry Adams* (1918) by the historian of that name, *A Son of the Middle Border* (1917) by Hamlin Garland, and *The Mauve Decade* (1926) by Thomas Beer, are so close to the field of psychological fiction as to be almost indistinguishable from it.

Naturalism.—Yet the chief change in American literature since the war has had little to do with either the war or nationalism. It is a logical development of the revolt against Victorian conventions which began before 1910 and was international in its scope. One manifestation is the escape of sex. It is a mistake to suppose, as the first critics of the tendency thought, that sex was suppressed in 19th century literature. It was inhibited, but not so much by convention as by a lack of interest in its problems. The scientific training of several generations has had much to do with this change in attitude, but there is also the determination of the realists to get at new truths in human relationships, and the stimulus to all such desires resulting from the disillusions of war. Sex is not the dominant theme of important American literature in this period, but it is far more important and far more freely handled than ever before. The success of such books as Gertrude Atherton's *Black Oxen* (1923), Dreiser's *American Tragedy* (1925), Sherwood Anderson's *Winesburg, Ohio* (1919), Scott Fitzgerald's *This Side of Paradise,* must be set down in part to their treatment of sex problems.

A truer conception of the change, however, is attained if such books are regarded as an offshoot of the interest which has created the new psychology in which American scientists have taken a prominent part. The problem has been to throw off all conventions and inhibitions so as to uncover the springs of the human machine. This, of course, is a substitute for the earlier desire to find the nobler motives of mankind, and is by no means necessarily an artistic advance. Yet the frank realism, and the minute study of normal, subnormal and abnormal phenomena which has resulted, have given rise to the halting but deeply moving sketches of Sherwood Anderson as surely as to the achievements of science. Inevitably this literature is thoroughly American for it is a study of actual Americans, whether apparently ordinary, as in the books just named, or extraordinary, as in the sonnet sequence, *Two Lives* (1925), of William Ellery Leonard. In the drama the same impulse has blended with an imaginative phantasy that gives it less conviction perhaps but more beauty, as in the impressive series of plays by Eugene O'Neill, particularly *The Emperor Jones* (1921), *Anna Christie* (1922) and *Strange Interlude* (1928).

These interests are responsible for the appearance in American fiction of what the French in Zola's day called naturalism. The farm novels of the Middle West are prevailingly naturalistic in method. The desire to make a complete social, psychological and physical document is predominant in Theodore Dreiser. It is visible in such different writers as the story-tellers Fannie Hurst and Edna Ferber, in the carefully wrought backgrounds of Joseph Hergesheimer and in the studies of human appearance in Sherwood Anderson. It is visible also in the meticulous backgrounds of the sentimental and standardized cinema pictures of the time.

A last major phenomenon is the sophistication of America and particularly of the literature coming from New York and Chicago. This is a natural concomitant of America's share in world wealth and world leadership, and of its recent hospitality to foreign ideas. Sophistication is a rhetorical rather than a literary term, but in this instance it is used to describe a taste for wit, for pointed satire, for cynicism, for the subtleties of social contact when given the ease and lightness of literary form.

On the stage it has led to fantastic satires and the admirable setting of the otherwise banal musical comedy; in the novel it is responsible for the witty brilliance of Thornton Wilder (*The Bridge of San Luis Rey*, 1927), the philosophic dialogues of John Erskine, the most noteworthy of which was *The Private Life of Helen of Troy* (1925), and the exquisite artificiality of Elinor Wylie's *Jennifer Lorn* (1923); in poetry it can be seen in the intellectualism of Amy Lowell and T. S. Eliot (*The Wasteland*, 1922), although other stronger influences enter here, and in the sharp-cut lyrics by Elinor Wylie (*Black Armor*, 1923); in the essay in the trenchant iconoclasm of H. L. Mencken, an ardent conservative appealing to realists weary of *naiveté*, progress and sentiment through his *Prejudices* (1919 *seq.*) and his organ, *The American Mercury*.

Most striking of all is the welcome which a sophisticated America has given to experimental literature, as Christopher Morley's *Thunder on the Left* (1925) or John dos Passos' *Manhattan Transfer* (1925). Even such poetry of experimental technique as Edward Estlin Cumming's *Tulips and Chimneys* (1923) and such plays as John Howard Lawson's *Processional* (1925) have been widely discussed.

These new currents in literature, and particularly the increasing interest in everyday life as a theme and in new forms of literary expression, have naturally brought with them a new vigour of criticism, signalized by the appearance of a new generation of critics who, like Van Wyck Brooks, apply scientific theories to American literature, or like H. L. Mencken, clear away the rubbish of old conventions for the benefit of a new realist middle class, or like Stuart P. Sherman, come out from the universities to apply their knowledge of the continuous stream of literature to the interpretation of new things. The founding of the new *Dial* in 1920, of *The Literary Review* of *The New York Evening Post* in 1920, afterwards carried on as *The Saturday Review of Literature* from 1924, and the appearance in 1925 of *Books*, the literary supplement of *The New York Tribune*, are indicative of the new interest in critical opinion.

Various literary manifestations of the period do not readily fit into the categories and tendencies described above, although doubtless in 20 years they will easily indicate their relationship.

The work of James Branch Cabell, beginning as pure romance, and becoming with *Jurgen* (1919) and its successors more and more ironical, philosophic and symbolic, is an instance. In general, Cabell clearly belongs to the generation of the 1910s that wearied of moral conventions sugared over with sentiment and attacked the *mores* of the 19th century. His almost fantastic playing with eroticism is in part at least mere rebellion against the censorship that had been imposed upon 19th century popular literature. But his elaborate mediaevalism is quite as clearly a survival from the period of romance, and his elaborate literary backgrounds represent a devotion to style for its own sake quite distinct from the tendencies of the time, and not to be confused with the sophisticated elegance of the young writers of the late 1920s. His cult is due in part to his sometimes witty eroticism, in part to his position as an authentic man of letters in a journalistic era, who writes only for the instructed. He is perhaps best understood as a survival from the '90s. Interesting comparisons can be made between Cabell and those earlier philosopher-phantasists of America, Hawthorne, Melville and Poe.

The Short Story.—It is not so difficult to relate the course of the short story, America's own invention, in the third decade of the century. While individuals, like Ruth Suckow (*Iowa Interiors*, 1926), Sherwood Anderson (*The Triumph of the Egg*, 1921), Ernest Hemingway (*Men Without Women*, 1927) and Ring Lardner (*How to Write Short Stories*, 1924) (who, like so many American humorists is fundamentally a satirist) wrote short stories that broke away from the technical convention of suspense and climax, the main stream of American short stories increased in volume without contributing much to the knowledge of American life or anything new to the art of fiction. Indeed the best writers, like Wilbur Daniel Steele (*The Man Who Saw Through Heaven*, 1927), were clearly hampered by a technique of quick and vivid telling that made their most authentic work seem artificial. Even the careless reading public began to rebel against these pyrotechnics, and the vogue of "confessions" in magazines that purported to give true stories may be assigned as much to a distaste for the obviously worked-up story as to an innate love of scandal

The worldwide success of the American cinema picture is a literary phenomenon, even though the scenarios are seldom literature. In substance, the stories belong almost exclusively to the type made popular 30 years earlier in the heroic romance, or to even more primitive forms of realistic melodrama. This is merely to say that the millions are a generation at least behind the thousands in their literary tastes, and crave certain fundamental emotional reactions without reference to time or taste. In other respects, however, cinema pictures are strictly contemporary. Like the short story, they have developed a technique so skilful and so stereotyped that there is no escape for a story once it enters the machine. Like the modern automobile, they represent great efficiency of appeal at small cost to the intellect, gained by careful standardization of emotional reactions

Finally, the reading habits of the American public were in this period definitely altered. They read more magazines and more magazine material in their newspapers. The wide public of semi-literate readers became more critical of their fare, and while it cannot be said that they demanded better substance, they did require a more competent form. The general level of American writing, whether in books, periodicals or the press, was decidedly raised. "Fine writing," diffuseness, mere rhetoric, crudity of expression, became rarer in publications of general circulation Only vulgarity increased.

As for the more literate public who read books, their tastes and interests notably broadened. They were capable of buying nearly 200,000 copies of Will Durant's *Story of Philosophy* (1926), which was really a story of philosophers. They read more and more foreign books in translation, were intensely interested in problems of psychology and social development raised by such books as James Harvey Robinson's *The Mind in the Making* (1921), demanded biography, in which they liked the new satirical note, and in general proved that the craving for self-education, always strong in America, was manifesting itself more widely than ever before. Magazines like *The American Mercury* and the reinvigorated *Harper's* of 1925 were devoted to this new intellectualization of the American reader. Publishers' lists were notably broader, and sales of non-fiction books increased.

Conclusion.—It is clear that the history of American literature in the period 1900–28 is meaningless without reference to the great social and intellectual changes which went on in the America of those decades. It is not an "age" in the literary sense, in which a group of characteristic works can be selected to represent a characteristic genius. Rather, the most interesting, though not necessarily the most permanent, books, are those which most illustrate revolt, change and discovery. If it is to be named at all it must be called an age of fiction, for the quick response to social and intellectual change is best represented in the fiction of the epoch.

From another point of view it was a period of anti-idealism in literature. The efforts of critics like H L. Mencken, the tone of the realistic and satiric novel and play, the course of historical and scientific writing, even the poetry of the epoch, were all as predominantly set toward a realist's view of the universe as 19th century American literature was turned toward idealism.

In any case it is probable that the two latter decades of the period represent the real beginning of America's coming of age in arts and letters. Like the New England renaissance of the 1840s, they follow upon a period of rapid economic progress, and although the industrial reorganization of the United States has probably postponed the period of complete literary expression, we may expect some interesting sequels to the vitality now manifested in every department of American literature except poetry.

(H S C)

BIBLIOGRAPHY.—The materials are as yet scanty. See *The Modern American Writer's Series*, Carl Van Doren's *Contemporary American Novelists* (1922), H. L. Mencken's *Prejudices* (1919–24), Henry Seidel Canby's *Definitions, First and Second Series* (1922–24), Stuart P. Sherman's *Points of View* (1924), *The Main Stream* (1927), *Critical Wood Cuts* (1926), F. L. Pattee's *A History of American Literature Since*

1870 (1915), Percy Boynton's *Some Contemporary Americans* (1924), and *More Contemporary Americans* (1927); *see* also *The Cambridge History of American Literature* (1917–21); *These Eventful Years* (1924).

AMERICAN LOCOMOTIVE COMPANY, a large manufacturer in the United States of locomotives and locomotive accessories. Its output in 1928 included steam, electric and oil locomotives, and also springs, tires and wheels for locomotives and railway cars. Upon its incorporation in 1901, the company acquired the plants and business of eight important manufacturing concerns, all of which had been in operation for many years, seven having been organized prior to 1870, including the Schenectady Locomotive Works dating from 1848. In 1904 the American Locomotive Company acquired the Locomotive and Machine Company of Montreal, Ltd, now the Montreal Locomotive Works, Ltd.; in 1905 it acquired the Rogers Locomotive Works of Paterson, N.J. (organized in 1831); and in 1917, the Chester, Pa., Foundry of the Penn Seaboard Castings Company. It also owns the American Locomotive Sales Corporation which holds membership in the Locomotive Export Association formed to manage the foreign business of both the American Locomotive and the Baldwin Locomotive Works. In 1926 the company acquired the Railway Steel-Spring Company, incorporated in New Jersey, then the largest manufacturer of railway springs and tires in the United States.

Following its policy of concentrating the manufacture of locomotives at its largest and most modern plants, the company has sold a number of its smaller establishments. In 1928 the plants operated were locomotive works at Schenectady, N.Y., Dunkirk, N.Y., Richmond, Va., and Montreal, Canada; there were in addition a steel foundry at Chester, Pa.; a locomotive accessories plant at Richmond, Va.; and spring, tire and wheel plants at Latrobe, Pa., Chicago Heights, Ill., East St. Louis, Ill., and Montreal, Canada. The company has introduced and sponsored in America many standard features of steam locomotives, including the fire-tube superheater, and has developed the Mallet locomotive and the three-cylinder locomotive for American use. During the earlier years of the World War the company devoted nearly the full capacity of its plants to the manufacture of munitions for the British and Canadian Governments, but at the beginning of 1918 restored its plants to the building of locomotives for the use of the American forces in France and for the railways of the United States. When incorporated in 1901 the company had a capital stock of $50,000,000, consisting of 250,000 shares of 7% cumulative preferred stock and 250,000 shares of common stock. In 1926 the capital stock had been increased to 385,000 shares of 7% cumulative preferred stock (with par value $100), and 770,000 shares of common stock without par value. At the close of 1927 the company possessed property, less depreciation reserves, amounting to $58,500,000; current assets, $50,500,000, including $37,000,000 in cash and marketable securities; total assets, $111,000,000; and surplus, $28,000,000. The executive offices are in New York city. (W. H. W.)

AMERICAN MEDICAL ASSOCIATION, a federacy of 54 constituent state and territorial medical associations. It was organized in 1847, and had 94,000 members in 1928. The objects of the association are to promote the science and art of medicine and the betterment of public health. It is divided into the following departments: editorial, council on scientific assembly, council on medical education and hospitals, council on pharmacy and chemistry, judicial council, council on physical therapy, bureau of health and public instruction, bureau of legal medicine and legislation, bureau of investigation, clinical laboratory and library. The association publishes the *Journal of the American Medical Association* (weekly), Spanish edition of the *Journal of the American Medical Association* (semi-monthly), *Archives of Internal Medicine, American Journal of Diseases of Children, Archives of Neurology and Psychiatry, Archives of Dermatology and Syphilology, Archives of Surgery, Archives of Otolaryngology, Archives of Pathology and Laboratory Medicine, Quarterly Cumulative Index Medicus,* and *Hygeia, The Health Magazine* (for the general public). The headquarters are at Chicago, Illinois.

AMERICAN NEWSPAPER PUBLISHERS' ASSOCIATION, an organization of newspaper publishers of the United States and Canada. It comprises about 500 of the leading newspapers. The purpose of the organization is to standardize and stabilize the newspaper publishing business. Its activities are divided into three different divisions: (*a*) traffic; (*b*) labour; and (*c*) mechanical. (*a*) The traffic department deals with matters connected with the handling of freight. It employs an expert in transport who checks freight charges for the various members and assists in securing rebates where over-charges have been made. He also acts as a representative of the members in securing satisfactory service and proper adjustment of rates from various carriers. (*b*) The labour department acts as the official representative with the labour unions in making contracts and adjusting differences. It also operates what is called the open shop department which may be called upon for help in acute labour troubles but the association claims that this "is by no means a strike-breaking organization." (*c*) The mechanical department acts in an advisory capacity for the mechanical problems that arise in printing.

The association also maintains a collection department and an information department. These are for the exclusive service of members. In addition to these, there are a considerable number of miscellaneous activities such as those of the postal committee which represents the association in matters dealing with the postal authorities concerning rates and regulations. There is also a committee which extends aid and encouragement to printing trade schools. The association holds an annual convention at which the various publishers meet to discuss topics of mutual interest.

(H. E. A.)

AMERICAN PSYCHOLOGICAL ASSOCIATION, INCORPORATED, THE, was founded on July 8, 1892, at a meeting held at Clark university, Worcester, Mass., attended by G. Stanley Hall, George S. Fullerton, Joseph Jastrow, William James, George T. Ladd, James McK. Cattell and J. Mark Baldwin as the original members. The first meeting was held at Philadelphia in December of the same year, under the presidency of G. Stanley Hall, at which time 24 more members were elected. The object, as stated in the original constitution, was "to advance psychology as a science," and the association has never deviated from this guiding principle. Since the founding, annual meetings for the presentation of scientific papers have been held at the different psychological laboratories in December of every year. The association was incorporated in the District of Columbia in 1925. Throughout its history the standard of membership has been maintained at a high level. To be admitted to membership, the degree of doctor of philosophy in psychology is necessary together with publication of an important contribution in the scientific journals. In 1924 the association introduced the grade of associate membership.

The association publishes annually a year book and proceedings of the annual meeting and owns and publishes six psychological journals. The association in 1928 had 534 members and 165 associate members.

AMERICAN RADIATOR COMPANY, THE, an Illinois corporation, was formed in 1892 by the union of the Pierce Steam Heating company, Michigan Radiator and Iron company and Detroit Radiator company, with headquarters in Chicago, Ill.

At its inception the company manufactured radiators only, but a few years later engaged also in manufacture of cast iron boilers. The radiators manufactured by the company were of the cast iron sectional type, the use of which had not yet become general. Much of the early success of the company was due to the dominance attained by this type of radiator. Another of the major policies which contributed largely to its success was that of selling only to heating plants. Prior to that time manufacturers had retarded the development of the heating profession by making plans, supervising installations and maintaining sole agencies. The founders of the company visualized that the development of heating as a science was essential if the scope of radiator heat was to extend beyond the larger buildings.

In 1899 there was organized the present company, a New Jer-

sey corporation of the same name, as successor to the Illinois corporation, and four other concerns in the industry joined in the new merger. From its inception the growth and progress of the company has been continuous. Much of its success in the popularization or radiator heat has been due to technical and manufacturing experimentation and the development of new products which have resulted in a large production and popular prices. Radiator heat, once a luxury, is now the standard of heating comfort and is available at a cost not out of proportion for moderate sized residences and buildings of all types. In 1928 the company was operating 62 branches and sales offices, with warehouses in all of the larger centres. It operates 30 plants in the United States and Canada in the manufacture of boilers, radiators, hot water heaters and various heating accessories; the company also owns and operates coal mines, coke ovens and pig iron furnaces. In Europe 11 manufacturing plants are engaged in the manufacture of like products, with sales offices and showrooms in the leading cities. (C. M. W.)

AMERICAN RAILS, a term used on the London Stock Exchange to describe the stock and bonds of the United States railways, which are dealt in by a distinct market. The shares and bonds of American railroads are issued in a way which almost constitutes them bearer securities, for they bear a transfer form on their backs. (*See* STOCK EXCHANGE.)

AMERICAN RAILWAY EXPRESS, THE, was incorporated in 1918 to engage in the general transportation business. The company immediately took over from the American, Adams, Southern and Wells Fargo express companies all their properties used in domestic express transportation. From July 1, 1918, the American Railway Express has carried on the domestic express business of these concerns, which retained, however, their properties and business not connected with the express activities. In 1920 it bought the real property and the equipment used in the express business of the Western, the Northern and the Great Northern express companies. Since Sept. 1, 1920, the company has operated as a common carrier under the jurisdiction of the interstate railway commission. It carries all the railway express business of the United States except that of the Southern railway system and a few minor roads. It functions also through steamship lines, electric railways and ferries, its business extending to Canada and the possessions of the United States. Air service was begun on Sept. 1, 1927, through contracts with air-transport companies. The first air-express routes were between Chicago and four other cities—New York, Dallas, San Francisco and Los Angeles.

At the end of 1926 the total mileage operated by the American Railway Express in the United States and adjacent countries was 249,863, classified as follows: steam railways, 221,979; coastwise steamship lines, 11,539; transoceanic steamship lines, 6,620; inland steamship lines, 6,250; electric railways, 2,890; stage routes, 574; ferries, 11. The company maintains 25,597 offices—22,107 of these with the railways—and has approximately 90,000 employes, including those employed jointly with the roads. In 1926 the company paid to carriers for express privileges alone, $147,812,159. In that year there was an outstanding capitalization of $34,642,000, and the ownership of the company was vested as follows: American Express Company, $13,062,400; Adams Express Company, $10,914,300; Southern Express Company, $1,000,000; and the public, $9,665,300. The company's current assets were $34,463,909; total assets, $72,380,644; net income, $2,318,347. Its headquarters are in New York city. (R. E. M. C.)

AMERICAN REVOLUTION, THE (1775–1781), known also as the American War of Independence. This war, by which the United States definitely separated themselves from the British connection, began with the affair of Lexington in Massachusetts, on April 19, 1775, and was virtually ended by the capitulation of Cornwallis at Yorktown, Va., on Oct. 19, 1781. In this article the progress of the war itself is alone considered, its political side being treated under UNITED STATES: *History*. From a military standpoint as well as politically it was a conspicuous and instructive conflict. It was conspicuous as being the most famous struggle in history where colonial dependencies defeated their mighty parent state, though the powerful aid of France, Spain and Holland must never be forgotten. It was instructive as presenting exceptional conditions and consequent errors in the attempt to break down the revolt. The reasons for Great Britain's failure appear in the progress of the war, which assumed two distinct stages: operations in the north, followed by operations in the south. In point of time and energy military activity was



AFTER THE PAINTING, "THE DAWN OF LIBERTY," BY COURTESY OF THE LEXINGTON (MASS.) HISTORICAL SOCIETY

THE FIRST ARMED CONFLICT OF THE REVOLUTION, A SKIRMISH AT LEXINGTON ON APRIL 19, 1775, BETWEEN THE "MINUTEMEN" UNDER CAPTAIN JOHN PARKER AND BRITISH REGULARS UNDER MAJOR JOHN PITCAIRN

about equally divided between these two fields. As the naval operations in connection with the war have a European interest as well, they are dealt with in a separate section.

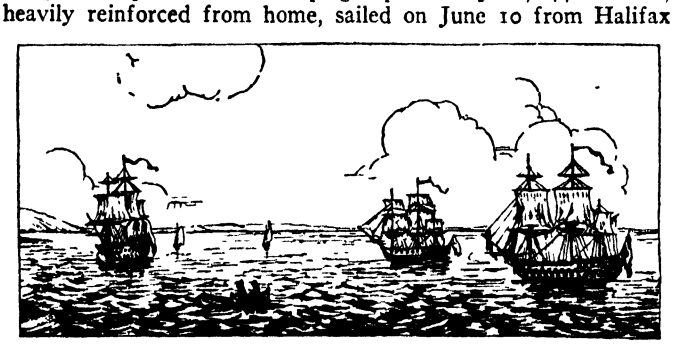
Land Operations.—To strike at the rebellion first in the north was natural and inevitable. To King George and his ministry, Massachusetts was the hotbed of disloyalty, the head and front of opposition to their colonial policy, and there coercion should begin. It was also a convenient point for a prompt display of authority, as the town of Boston was the headquarters of Gen. Gage, recently appointed royal governor of Massachusetts and commander of the king's troops in North America. He had with him four regiments of regulars, the initial force with which to overawe the restless and defiant population in his vicinity. While Gage is to be credited with advising his government that not less than 20,000 men would be necessary for the work in hand, he proceeded after some delay to suppress warlike preparations near Boston. His first determined effort brought about the skirmish of April 19, 1775 (*see* LEXINGTON), in which a detachment sent to seize some military stores collected at Concord suffered heavily at Lexington, Concord and other places, at the hands of the surrounding militia. This encounter roused the New England colonies, and in a few days some 16,000 of their townsmen marched in small bands upon Boston to protest against and resist further incursions; and in this irregular body we have the nucleus of the colonial forces which carried the war through. A noteworthy incident of the Lexington affair, and characteristic of the attitude which the provincials had maintained and continued to maintain for another year, was the official representation to the king that the regulars were the first to fire, and that the colonials returned the fire and fought through the day in strict defence of their rights and homes as Englishmen. Who actually fired the first shot, no man knows. They repeated their professions of loyalty to his majesty and the principles of the English constitution. Conscious, nevertheless, that a struggle impended, they instantly sent word to all the other colonies, whose whig elements sympathetically responded to the alarm. The war had opened.

The home government extended its precautions and preparations. General (Sir) William Howe, who succeeded Gage in the chief command in October, and Gens. (Sir) Henry Clinton and John Burgoyne were sent out at once with reinforcements. Cornwallis followed later. These four generals were identified with the conduct of the principal operations on the side of the British. The force at Boston was increased. The American Congress at Philadelphia, acting for the 13 colonies, voted general defensive

measures, called out troops and appointed George Washington of Virginia commander-in-chief. Before he reached the camp forming around Boston, a second and more important collision took place. On June 17, 1775, occurred the battle of Bunker Hill (*q.v.*), in which, although victorious, the British suffered heavily, losing one-third of their force in storming the hastily constructed lines of the "rebels." In moral effect the battle proved anything but a defeat to the Americans, who now drew a cordon of works around Boston, hemming Howe's army in a contracted, and, as it proved, untenable, position. On July 3, Washington took command of the American army at Cambridge and proceeded with what is known as the "siege of Boston," which was marked by no special incident, and closed with the American seizure of Dorchester Heights and the evacuation of the town by the British on March 17, 1776, Howe sailing away to Halifax, Nova Scotia. While the main interest centred at this point, the year 1775 was marked by two enterprises elsewhere. Fort Ticonderoga, the key to the passage of Lakes George and Champlain to Canada, was surprised and taken on May 10 by a small band under Col. Ethan Allen, while Col. Benedict Arnold headed an expedition through the Maine woods to effect the capture of Quebec, where Sir Guy Carleton commanded. Arnold joined Gen. Richard Montgomery, who was already near the city, and the combined force assaulted Quebec on Dec. 31, only to meet with complete defeat. Montgomery was killed and many of his men taken prisoners. Demonstrations against Canada were soon discontinued, Arnold drawing off the remnant of his army in May 1776.

The events of 1775, though partly favourable to America, were but a prelude to the real struggle to come. For the campaign of 1776 both sides made extensive preparations. To the home government the purely military problem, although assuming larger dimensions and more difficulties, still seemed to admit of a simple solution, namely, to strike hard where the rebellion was most active and capable of the longest resistance. Defeated there, it would quickly dissipate in all quarters. As much more than one-half of the population and resources of the colonists lay north of Chesapeake Bay—New England alone having an estimated population of over 700,000 persons—it was only a question as to what point in this area should be made the future base of operations. Largely upon the representations of Howe, Burgoyne and others, it was determined to shift the field from Boston to New York city, from there to hold the line of the Hudson river in co-operation with a force to move down from Canada under Carleton and Burgoyne, and thus effectually to isolate New England.

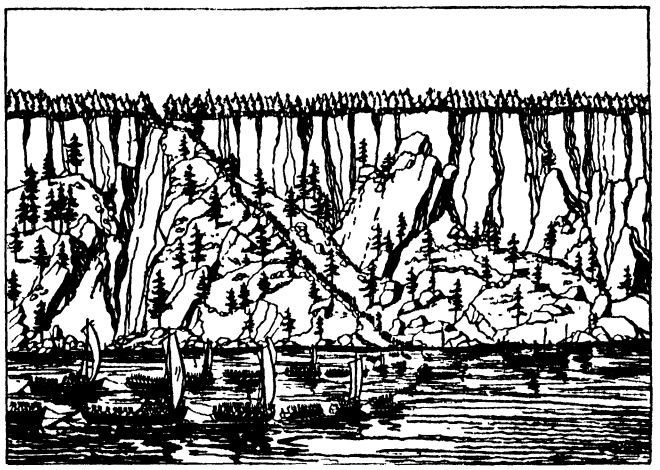
Upon this plan the new campaign opened in June, 1776. Howe, heavily reinforced from home, sailed on June 10 from Halifax



AFTER A SKETCH BY AN ENGLISH OFFICER ABOARD ONE OF THE FLEET BY COURTESY OF THE N Y. PUBLIC LIBRARY

THE BRITISH FLEET UNDER ADMIRAL HOWE AT ANCHOR IN NEW YORK HARBOUR JUST AFTER THE BATTLE OF LONG ISLAND

to New York and on July 5 encamped on Staten Island. Washington, anticipating this move, had already marched from Boston and fortified the city. His left flank was thrown across the East river beyond the village of Brooklyn, while his front and right on the harbour and North or Hudson river were open to a combined naval and military attack. The position was untenable since the British absolutely dominated the waters about Manhattan. Howe drove Washington out of New York, and forced the abandonment of the whole of Manhattan Island by three well-directed movements upon the American left. On Aug. 22 he crossed the Narrows to the Long Island shore with 15,000 troops, increasing the number to 20,000 on the 25th, and on the 27th surprised the Americans, driving them into their Brooklyn works and inflicting a loss of about 1,400 men. Among the prisoners were Gens. J. Sullivan and W. Alexander. (*See* LONG ISLAND.) Howe has been criticized, rightly or wrongly, for failing to make



AFTER A CONTEMPORARY SKETCH ATTRIBUTED TO LORD RAWDON, ENGINEER OFFICER ON CORNWALLIS'S STAFF. BY COURTESY OF THE N Y. PUBLIC LIBRARY

THE LANDING OF THE BRITISH FORCES IN NEW JERSEY

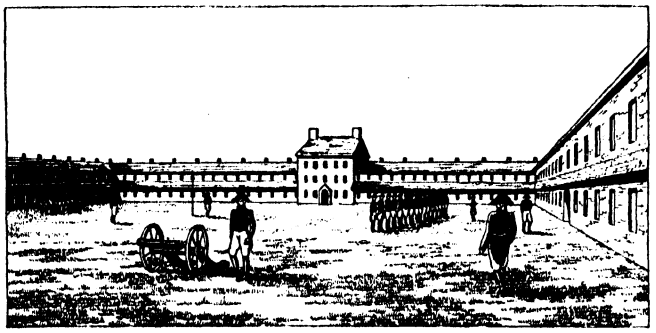
After the capture of Ft. Washington in New York the British crossed the Hudson under the Palisades and pushed across New Jersey with designs on Philadelphia

full use of his victory. Washington skilfully evacuated his Brooklyn lines on the night of the 29th, and in a measure relieved the depression which the defeat had produced in his army. On Sept. 15, Howe crossed the East river above the city, captured 300 of the militia defending the lines and occupied the city. Washington had withdrawn his main army to the upper part of the island. A skirmish, fought the next day, opposite the west front of the present Columbia university, and known as the affair of Harlem Heights, cost the British a loss of 70 of their light infantry. Delaying until Oct. 12, Howe again moved forward by water into Westchester county, and marching toward White Plains forced another retreat on Washington. In the fight on Chatterton Hill at the Plains, on Oct. 28, an American brigade was defeated. Instead of pressing Washington further, Howe then returned to Manhattan Island, and, Nov. 16, captured Fort Washington with nearly 3,000 prisoners. This was the heaviest blow to the Americans throughout the war in the north. The British then pushed down through New Jersey with designs on Philadelphia. Washington, still retreating with a constantly diminishing force, suddenly turned upon Lieut.-Col. Rall's advanced corps of Hessians at Trenton on Dec. 26, and captured nearly 1,000 prisoners. This brilliant exploit was followed by another on Jan. 3, when Washington, again crossing the Delaware, outmarched Cornwallis at Trenton, and marching to his rear defeated three British regiments and three companies of light cavalry at Princeton, New Jersey. Marching on to Morristown, Washington encamped there on the flank of the British advance in New Jersey, thus ending the first campaign fought on the new issue of American Independence, which had been declared on July 4, 1776.

While these closing successes inspirited the Americans, it was undeniable that the campaign had gone heavily against them. Having raised a permanent force for the war called the Continental Line, they awaited further operations of the enemy. Following up the occupation of New York, Howe proceeded in 1777 to capture Philadelphia. Complete success again crowned his movements. Taking his army by sea from New York to the head of the Chesapeake, he marched up into Pennsylvania, whither Washington had repaired to watch him, and on Sept. 26 entered the city. The Americans attempted to check the advance of the British at the river Brandywine, where an action occurred on the 11th resulting in their defeat (*see* BRANDYWINE); and on Oct. 4, Washington directed a well-planned attack upon the enemy's

camp at Germantown on the outskirts of the city, but failed of success. (*See* GERMANTOWN.)

Howe's victorious progress in Pennsylvania was neutralized by disasters farther north. Indeed his whole expedition to seize "the enemy's capital" was nothing less than an abandonment of an expedition from the north with which he was expected to co-operate. Clinton, whom he left at New York, protested against



FROM "ANNALS OF PHILADELPHIA," 1830

BRITISH BARRACKS AT PHILADELPHIA DURING HOWE'S OCCUPATION

this folly to the last. Lord George Germain in England was only in part to blame. Burgoyne marched from Canada in June 1777, with a strong expeditionary force, to occupy Albany and put himself in touch with Howe who was expected to come up the Hudson. Driving the Americans under Gen. Arthur St. Clair out of Ticonderoga, and making his way through the deep woods with difficulty, he reached the Hudson at Fort Edward on July 30. Gen. Philip Schuyler, commanding the Americans in that quarter, retreated to Stillwater, 30m. above Albany, barricading the roads and impeding Burgoyne's progress. Unjustified dissatisfaction with his conduct led Congress to replace Philip Schuyler by Gen. Gates. On Aug. 13, Burgoyne despatched a force to Bennington, Vt., under the German colonel Friedrich Baum, to capture stores and overawe the country. On the 16th Baum was attacked by Gen. John Stark with the militia from the surrounding country, and was overwhelmed. Col. Breyman, marching to his relief, was also routed. The misfortune cost the British 1,000 men. Equally unfortunate was the fate of an expedition sent under Col. Barry St. Leger to co-operate with Burgoyne by way of the Mohawk Valley. On Aug. 16 he was met at Oriskany by Gen. Nicholas Herkimer and forced to retreat. Despite these disasters Burgoyne pushed south to Stillwater, where he was defeated by Gates's improvised army of continentals and militia in two battles on Sept. 10 (Freeman's Farm) and Oct. 7 (Bemis's Height). On the 17th he was forced to surrender. (*See* SARATOGA, BATTLES OF.) This disaster was followed by the alliance between America and France in 1778, and later by the addition of Spain and Holland to England's enemies—events of far-reaching importance.

A noteworthy movement, in 1778–79, was the expedition of George Rogers Clark, under the authority of the State of Virginia, against the British posts in the north-west. With a company of volunteers Clark captured Kaskaskia, the chief post in the Illinois country, on July 4, 1778, and later secured the submission of Vincennes, which, however, was recaptured by Gen. Henry Hamilton, the British commander at Detroit. In the spring of 1779 Clark raised another force, and recaptured Vincennes from Hamilton. This expedition did much to free the frontier from Indian raids, gave the Americans a hold upon the north-west, of which their diplomats probably took advantage in the peace negotiations, and later, by giving the States a community of interest in the western lands, greatly promoted the idea of union.

In 1778 Sir Henry Clinton succeeded Howe in the chief command in America. With fewer resources than his predecessor, he could accomplish practically nothing in the north. In June, 1778, he evacuated Philadelphia, with the intention of concentrating his force at New York. Washington, who had passed the winter at Valley Forge, overtook him at Monmouth, N.J., and in an action on June 28 both armies suffered about equal loss. Thereafter (except in the winter of 1779, at Morristown) Washington made West Point on the Hudson the headquarters of his army, but Clinton avowed himself too weak to attack him there. In 1779 he attempted to draw Washington out of the highlands, with the result that in the manoeuvres he lost the garrison at Stony Point, 700 strong, the position being stormed by Wayne with the American light infantry on July 16. During the summer Gen. J. Sullivan marched with a large force against the Indians (all the Iroquois tribes except the Oneidas and part of the Tuscaroras siding with the British during the war) and against the Loyalists of western New York, who had been committing great depredations along the frontier; and on Aug. 29 he inflicted a crushing defeat upon them at Newtown, on the site of the present Elmira. In addition several Indian villages and the crops of the Indians were destroyed in the lake region of western New York.

Meanwhile the co-operation of the French became active. In July Count Rochambeau arrived at Newport, R.I., occupied by the British from 1776 to the close of 1779. An unsuccessful attempt was made to drive them out in 1778 by the Americans assisted by the French admiral d'Estaing and a French corps. The year 1780 is also marked by the treason of Gen. Benedict Arnold (*q.v.*), and the consequent execution of Major André. Minor battles and skirmishes occurred until in Aug. 1781 Washington undertook the project of a combined American-French attack on Cornwallis at Yorktown, Va., the success of which was decisive of the war (*see* p. 801).

Campaign in Georgia.—The inadequate results of the British campaigns against the northern colonies in 1776 and 1777 led the home Government to turn its attention to the weaker colonies in the south. Operations in the north were not to cease, but a powerful diversion was now to be undertaken in the south with a view to the complete conquest of that section. Success there would facilitate further movements in the north. An isolated



AFTER A PAINTING BY HOWARD PYLE IN WILSON'S "HISTORY OF THE AMERICAN PEOPLE," BY COURTESY OF HARPER AND BROTHERS

WASHINGTON AND STEUBEN AT THE AMERICAN ENCAMPMENT AT VALLEY FORGE WHERE WASHINGTON, USING STEUBEN AS MILITARY INSTRUCTOR, PREPARED HIS ARMY FOR THE FINAL CAMPAIGNS

attack on Charleston, S.C., had been made by Sir Henry Clinton and Sir Peter Parker as early as June 1776, but this was foiled by the spirited resistance of Gen. William Moultrie; after 1778 the southern attempts, stimulated in part by the activity of the French in the West Indies, were vigorously sustained. On Dec. 29 of this year Col. Archibald Campbell with an expeditionary corps of 3,500 men from Clinton's army in New York, captured Savannah, Ga., defeating the American force under Gen. Robert Howe. In the following month he pushed into the interior and occupied Augusta. Gen. Benjamin Lincoln, succeeding Howe,

undertook to drive the British out of Georgia, but Gen. Augustine Prevost, who had commanded in Florida, moved up and compelled Lincoln to retire to Charleston. Prevost, making Savannah his headquarters, controlled Georgia. In Sept. 1779 he was besieged by Lincoln in conjunction with a French naval and military force under Admiral d'Estaing, but successfully repelled an assault (Oct. 9), and Lincoln again fell back to Charleston. In this assault Count Casimir Pulaski, on the American side, was mortally wounded.

The prestige thus won by the British in the south in 1779 was immensely increased in the following year, when they victoriously swept up through South and North Carolina. Failing to achieve any advantage in the north in 1779, Sir Henry Clinton, under instructions from his government, himself headed a combined military and naval expedition southward. He evacuated Newport, R I. (Oct. 25), left New York in command of the German general Wilhelm von Knyphausen, and in December sailed with 8,500 men to join Prevost at Savannah. Cornwallis accompanied him, and later Lord Rawdon joined him with an additional force. Marching upon Charleston, Clinton cut off the city from relief, and after a brief siege compelled Lincoln to surrender on May 12. (*See* CHARLESTON) The loss of this place and of the 5,000 troops included in the surrender was a serious blow to the American cause. The apparent submission of South Carolina followed. In June Clinton returned to New York, leaving Cornwallis in command, with instructions to reduce North Carolina also Meanwhile an active and bitter partisan warfare opened. The British advance had been marked by more than the usual destruction of war; the Loyalists rose to arms; the Whig population scattered and without much organization formed groups of riflemen and mounted troopers to harass the enemy. Little mercy was shown on either side. The dashing rider, Col. Banastre Tarleton, cut to pieces (April 14, 1780) a detachment of Lincoln's cavalry, and followed it up by practically destroying Buford's Virginia regiment near the North Carolina border. On the other hand, daring and skilful leaders such as Francis Marion and Thomas Sumter kept the spirit of resistance alive by their sudden attacks and surprises of British outposts. Hanging Rock, Ninety-Six, Rocky Mount and other affairs brought their prowess and devotion into notice. By the month of Aug. 1780, with the main British force encamped near the North Carolina line, the field seemed clear for the next advance.

The threatening situation in the Carolinas alarmed Congress and Washington and measures were taken to protect the distressed section. Before Cornwallis could be brought to bay he was faced successively by four antagonists—Gens. Gates, Greene, Lafayette and Washington. They found in him the most capable and dangerous opponent of the war. Greene called him "the modern Hannibal." With Lincoln's surrender of nearly all the Continental soldiers in the south, a new force had to be supplied to meet the British veterans. Two thousand men, mainly the Maryland line, were hurried down from Washington's camp under Johann de Kalb; Virginia and North Carolina put new men into the field, and the entire force was placed under command of Gen Gates. Gates marched towards Camden, S.C., and on Aug. 16 encountered Cornwallis near that place. Each army by a night march attempted to surprise the other, but the British tactics prevailed, and Gates was utterly routed. The reputation he had won at Saratoga was ruined on the occasion by over-confidence and incompetence; De Kalb was killed in the action. Gen. Greene, standing next to Washington as the ablest and most trusted officer of the Revolution, succeeded Gates. Cornwallis marched leisurely into North Carolina, but before meeting Greene some months later he suffered the loss of two detachments sent at intervals to disperse various partisan corps of the Americans. On Oct. 7, 1780, a force of 1,100 men under Major Patrick Ferguson was surrounded at King's Mountain, S.C., near the North Carolina line, by bands of riflemen under Cols. Isaac Shelby, James Williams, William Campbell and others, and after a desperate fight on the wooded and rocky slopes, surrendered. Ferguson himself was killed. On Jan. 17, 1781, Gen. Daniel Morgan was attacked at Cowpens, south-west of King's Mountain, by Col. Tarleton with his legion. Both were leaders of repute, and a most stirring action occurred in which Morgan, with Col. William Washington leading his cavalry, practically destroyed Tarleton's corps. Despite the weakening his army suffered by these losses, Cornwallis marched rapidly through North Carolina, giving Greene a hard chase nearly to the Virginia line. On March 15 the two armies met at Guilford court house (near the present Greensboro, N.C.) and a virtually drawn battle was fought. The British, by holding their ground with their accustomed tenacity when engaged with superior numbers, were tactically victors, but were further weakened by a loss of nearly 600 men. Greene, cautiously avoiding another Camden, retreated with his forces intact. With his small army, less than 2,000 strong, Cornwallis declined to follow Greene into the back country, and retiring to Hillsborough, N.C., raised the royal standard, offered protection to the inhabitants, and for the moment appeared to be master of Georgia and the two Carolinas. In a few weeks, however, he abandoned the heart of the State and marched to the coast at Wilmington, N.C., to recruit and refit his command.

At Wilmington the British general faced a serious problem, the solution of which upon his own responsibility unexpectedly led to the close of the war within seven months. Instead of remaining in Carolina he determined to march into Virginia, justifying the move on the ground that until Virginia was reduced he could not firmly hold the more southern States he had just overrun. This decision was subsequently sharply criticized by Clinton as unmilitary, and as having been made contrary to his instructions. To Cornwallis he wrote in May: "Had you intimated the probability of your intention, I should certainly have endeavoured to stop you, as I did then as well as now consider such a move likely to be dangerous to our interests in the Southern Colonies" The danger lay in the suddenly changed situation in that direction; as Gen. Greene, instead of following Cornwallis to the coast, boldly pushed down towards Camden and Charleston, S C , with a view to drawing his antagonist after him to the points where he was the year before, as well as to driving back Lord Rawdon, whom Cornwallis had left in that field. In his main object, the recovery of the southern States, Greene succeeded by the close of the year; but not without hard fighting and repeated reverses "We fight, get beaten, and fight again," were his words. On April 25, 1781, he was surprised in his camp at Hobkirk's Hill, near Camden, by Lord Rawdon and defeated, both sides suffering about an equal loss. On May 22 he attempted to storm the strong British post at Ninety-Six but was repulsed; and finally on Sept. 8 he fought the last battle of the war in the lower southern States at Eutaw Springs, S.C. In the first part of the action Greene was successful after a desperate conflict; in the pursuit, however, the Americans failed to dislodge the British from a stone house which they held, and their severe loss in both engagements was over 500 men. The British lost about 1,000, one-half of whom were prisoners. Better success attended the American partisan operations directed by Greene and conducted by Marion, Sumter, Andrew Pickens, Henry Lee and William Washington. They fell upon isolated British posts established to protect the Loyalist population, and generally captured or broke them up. Rawdon found himself unable with his diminishing force to cover the country beyond Charleston; and he fell back to that place, leaving the situation in the south as it had been in the early part of 1780. On the American side, Greene was hailed as the deliverer of that section.

Virginia Campaign.—Cornwallis, meantime, pursued his Virginia project. Leaving Wilmington, N C., on April 25, 1781, he reached Petersburg on May 20. There he found British detachments, 2,000 strong, composed of troops whom Clinton had sent down separately under Gens. Benedict Arnold and William Phillips to establish a base on the Chesapeake, as a diversion in favour of the operations of Cornwallis in the Carolinas. Virginia at the moment presented a clear field to the British, and they overran the State as far north as Fredericksburg and west to Charlottesville. At the latter place Jefferson, governor of the State, barely escaped capture by Tarleton's men. A small American force under Lafayette, whom Wayne reinforced during the summer, partially

checked the enemy. At Green Spring, near Jamestown Island, Lafayette boldly attacked his antagonist on July 6, but had to save himself by a hasty retreat. Early in August Cornwallis retired to Yorktown to rest and await developments. There he fortified himself, and remained until the American-French military and naval combination, referred to on p. 799, appeared and compelled his surrender. (*See* YORKTOWN.)

With this event war operations ceased. Preliminary articles of peace, signed on Nov. 30, 1782, were followed by a definitive treaty concluded on Sept. 3, 1783. Charleston, S C., was evacuated late in 1782; New York on Nov. 25, 1783. The reasons of Great Britain's misfortunes and failure may be summarized as follows: Misconception by the home Government of the temper and reserve strength of her colonists, a population mainly of good English blood and instincts; disbelief at the outset in the probability of a protracted struggle covering the immense territory in America; consequent failure to despatch sufficient forces to the field; the safe and Fabian generalship of Washington; and finally, most decisive of all, the French alliance and European combinations by which at the close of the conflict Britain was without a friend or ally on the continent.

BIBLIOGRAPHY.—Though now sadly out of date, the most exhaustive reference work for this period is vol. vi. of Winsor's *Narrative and Critical History of America* (Boston, 1887). Its nine chapters, prepared by different writers, give a complete review of the struggle, both military and naval, and each closes with numerous illustrative notes, editorial criticisms and a full list of authorities The volume is interspersed, far more extensively and richly than any other treatise on the war, with reproductions of contemporary plans, maps, documents, portraits and prints. Supplementing Winsor and bringing the material down to recent date is C H. Van Tyne's *American Revolution* (Harper's "Am. Nation" Series, 1905), chap. xviii., on bibliographical aids and authorities General histories of the war are mainly of American authorship, such as· George Bancroft's *History of the United States* (Boston, 1883–85) which, in spite of minor errors of fact and judgment, will remain standard; J. Fiske's *American Revolution* (Boston, 1891); Carrington's *Battles of the American Revolution* (1876) is a critical study by a military officer; B. J. Lossing's *Pictorial Field Book of the Revolution* (1850–59) is not always accurate, but preserves local traditions and details. Monographs on single events or campaigns abound A French, *The Day of Concord and Lexington* (1925); H Murdock, *Bunker Hill;* Dawson's papers on Ticonderoga, "Storming of Stony Point," etc. (1866–), Johnston's "Campaign of 1776 around New York" (L I. Hist Soc, 1877), "Yorktown Campaign" (1881), etc ; Sargent's *Life of Major John André* (Boston, 1861), one of the best Revolutionary biographies; Gen William Stryker's *Battles of Trenton and Princeton* (Boston, 1898); and *The Battle of Monmouth;* Justin Smith, *Struggle for the 14th Colony* (1907); and others mentioned in Winsor, Van Tyne and Channing. English works are Lord Mahon's *History of England,* vol vi ; Sir George O. Trevelyan's *American Revolution,* a new study of cabinet and parliamentary politics of the period, with review of the military events; Hon J W. Fortescue, *History of the British Army,* vol iii. (1902); H. Belcher, *The First American War,* Vol. i., ii.; F. J. Huddleston, *Gentleman Johnny Burgoyne;* H. Nickerson, *The Turning Point of the Revolution;* Lecky, *A History of England in the 18th Century* (1903); Burgoyne's *State of the Expedition from Canada in 1777* (1780). The naval warfare is best studied in G W. Allen, *A Naval History of the American Revolution* (1913); C. O. Paullins, *Navy of the American Revolution* (1906); Captain Mahan, *Major Operations of the Navies in the War of Independence* (1913).

(H. P. J.; C. H. VAN T.)

THE WAR AT SEA

The largely economic origin of the American Revolution took on a prominently maritime aspect in its early phases. Heavily in debt from recent wars, England was also faced with a constantly increasing demand for overseas markets and marine expansion, on account of the "industrial revolution" through which she was then passing. Beginning in 1764 a series of laws were passed by parliament having in view both the raising of revenue through taxing the sea-borne imports of the colonies, and the favouring of English maritime trade by discriminations against colonial shipping. Laws looking solely to the latter object had been in existence for many years, but custom had given them little attention, and a large prosperous colonial merchant marine had grown up on a technically illegal trade and had become an important element in the economic structure of the colonies. Consequently the enforcement of these "Navigation Acts" was the cause of much hardship and resentment in America. As early as 1764 a British schooner so engaged was fired on in Rhode Island waters. In 1769 the sloop "Liberty," similarly employed, was seized and burnt at Newport. Such incidents became more common as British coercive measures increased, and when war finally broke there was a popular uprising on the sea quite comparable to that on land.

The onset of the Revolution found the colonies with no naval forces whatever, but with a large maritime population, and many merchant vessels commonly employed as the principal means of transport for both domestic and foreign trade. This merchant service was familiar not only with the sea, but also with warfare. Colonial ships and seamen had taken a prominent part in the large naval expeditions against Cartagena and Louisburg, had engaged in privateering during the more recent French war, and even during peace had habitually gone armed as a protection against pirates. In 1775 it was therefore natural that considerable numbers of colonial merchant vessels should turn to privateering; a general practice which was continued on a large scale until the close of the war, under legal authorization of individual colonies and of the Continental Congress. Records are incomplete but indicate that well over 2,000 private armed vessels were so employed during the course of the war, carrying upwards of 18,000 guns and 70,000 men. In addition, several of the colonies organized "State" navies which also engaged in preying upon hostile commerce These operations were on such a scale that they must be regarded as a primary American military effort of the war. Together with the operations of a few "Continental" vessels they constituted the only sustained offensive pressure brought to bear by the Americans which materially affected the attitude of the British people towards peace Such injury was done British commerce as to increase insurance rates to unprecedented figures, to seriously reduce available sources of revenue and to alarm the sea-coast population

In its military-naval aspect the war followed two distinct phases; the first ending when France allied herself with the colonies in 1778, until which time Britain had no foreign enemy, and was free to concentrate her whole strength against the Americans. In the second phase England ultimately had to contend against the fleets of France, Spain and Holland, and her consequent inability to meet the naval necessities in American waters was a major influence in the final and decisive campaign ending at Yorktown. With the large navy available during the first three years of the Revolution it was repeatedly urged by Viscount Barrington, the British secretary for war, that: "Conquest [of the colonies] by land is unnecessary when the country can be reduced first by distress, and then to obedience by our marine totally interrupting all commerce and fishery, and even seizing all ships in the ports with very little expense and less bloodshed" Instead of adopting such strategy the British naval forces were used primarily in direct support of army operations and in the protection of their own maritime commerce.

The pressing want of munitions for the Colonial army was the chief impulse in the creation of regular American naval forces. This need caused Benedict Arnold, formerly a sea captain, to march from the siege of Boston, and in association with Ethan Allen to make a surprise capture of the well-stocked stronghold of Ft. Ticonderoga on Lake Champlain, so early as May 10, 1775. The seemingly minor event had far-reaching results. Not only were munitions obtained, but the prompt seizure of all lake watercraft also gave to the colonies control of the only practicable line of communications from the St. Lawrence river to the Hudson valley. At first provoked by this overt act the Continental Congress at Philadelphia, then debating ways of forming a constitutional union with England, soon reversed its attitude, voted general defensive measures, and appointed George Washington commander-in-chief of the army. A few weeks after taking command of the Continental army besieging Boston, Washington organized a naval force to prey upon the British water communications of that port, and in this way essential munitions were obtained. In Oct. 1775 Congress voted funds for the first units of a small fleet of eight vessels which sailed from the Delaware on Feb. 17, 1776, under Commodore Esek Hopkins. The objective was Nassau

in the Bahama islands, where a quantity of powder was known to be stored. This was captured on March 3, and the valuable munitions taken in to New London. Meantime the British army under Howe had evacuated Boston and gone by sea to Halifax. Correctly estimating the future probabilities, Washington marched to New York and also provided for the defence of Lake Champlain. For the campaign of 1776 the British plan was to isolate New England by capturing and holding the line of the Hudson river. With this end in view, Howe, heavily reinforced, sailed in June for New York, while other forces undertook an advance via Lake Champlain. Here Arnold had retreated after an unsuccessful attack on Quebec, and had actively begun the construction of a fleet to retain control of the lake.

During the summer a British army of nearly 13,000 men advanced from Quebec to the lake but was compelled to halt until a sufficient naval force could be constructed to cope with Arnold's rapidly growing fleet. This they were able to do after some months through the assistance of artizans from their ships in the St. Lawrence river, and by reassembling on the lake a large vessel whose dismantled parts had been transported in small boats from Quebec. In a series of naval actions on Oct. 11, 12 and 13, Arnold's fleet of 15 vessels was destroyed. Meantime Howe had gained possession of the lower Hudson, but the season was now so late that the British command on Lake Champlain decided to abandon further operations until spring, and retreated into Canada. When in June of the following year Burgoyne renewed the advance from the north, Howe had shifted his operations by sea to the vicinity of Philadelphia, and Burgoyne was forced to surrender at Saratoga (Oct. 17, 1777) from lack of support. Thus had Arnold's fleet, by delaying the British army for nearly a year, contributed largely to the decisive battle of Saratoga which proved to be a turning point in the war.

Impressed by the evidence of American strength given at Saratoga, and wishing to recover her losses to England in previous wars, France entered into a treaty of alliance with the United States in Feb. 1778. The event marked the beginning of an entirely new phase in the war. Henceforth naval power was to be employed on a great scale and to affect vitally military operations in America, as well as the course of European history, and the fate of valuable possessions from the West Indies to the East Indies. Herein can be considered at any length only those events which bore directly on the American Revolution.

A French fleet under d'Estaing sailed from Toulon in April 1778, bound for America. Advance news of its coming caused a hasty evacuation of the Delaware by the British fleet then acting in support of the army occupying Philadelphia. Fearing to risk the loss of the army in the event of meeting a superior French fleet at sea, the British command decided to march the troops, bereft of their line of supply, by land to New York, where a junction with the fleet was again made. D'Estaing appeared off the port a few days later, but having missed the opportunity of a decisive victory in the Delaware, he sailed for Newport in accordance with an understanding made with Washington. While preparations were in progress at Newport for a joint attack by Americans and French upon the British garrison of 6,000 troops, the British fleet approached, having been reinforced from England. D'Estaing hastily abandoned the land operations and put to sea to meet them. A partial engagement ensued, followed by a gale which so damaged the ships as to persuade the French admiral to go to Boston for extensive repairs (Aug. 1778). On this account the American army before Newport was withdrawn. Meantime a second and more powerful French fleet had been fitted out at Brest with the object of indirectly assisting their overseas naval forces by holding the main strength of the British navy to its home waters. In July 1778 a large but indecisive fleet action was fought off Ushant. Under cover of these major operations Captain John Paul Jones of the "Continental Navy" with a small squadron based on French ports, carried on a series of raids against British coastal shipping.

At this period of history considerations of weather during the winter season usually caused the transfer of naval operations from the Western Hemisphere to the West Indies, which held the further attraction of being the richest of the world's commercial regions in value of products. Therefore when d'Estaing sailed from Boston in Nov. 1778, his destination was the Caribbean sea, for which locality most of the British fleet in America also sailed on the same day. The latter took 5,000 troops with them, thus greatly reducing the land forces opposed to the Continental army. During the next four years the West Indies were the scene of a large-scale naval war, the forces on each side being often augmented from home, and in the case of the French fleet, by Spanish reinforcements. D'Estaing was unsuccessful off St. Lucia in two attacks (Dec. 1778) upon the main British fleet, but, while the latter was guarding a trade convoy, during the following summer, he captured St. Vincent and then Grenada where an indecisive naval action was fought upon the return of the British fleet (July 1779). Meantime in the autumn of 1778 the British had sent a small expedition from New York, under naval convoy, to Savannah, which place was taken. These operations were extended to the neighbourhood of Charleston during the following year, and attracted the attention of d'Estaing. Arriving off Savannah from the West Indies with his whole fleet in Aug. 1779, he failed in an attempt to retake the place. Nevertheless upon receiving news of the Savannah affair, the British Gen. Clinton at New York was so concerned over the safety of his diminished army in the north that he abandoned Newport in order to concentrate his forces against possible French attack.

The summer of 1779 also saw the ill-starred "Penobscot Expedition." A British military-naval force having occupied what is now Castine, Me., the Massachusetts government undertook to dislodge it. A fleet of 40 vessels including three of the Continental navy and 20 transports, in all carrying 200 guns and 3,000 men sailed from Boston and began its attack on the British position on July 25. Fighting continued afloat and ashore until Aug. 13, when a superior British naval squadron arrived from New York and put the Americans to rout.

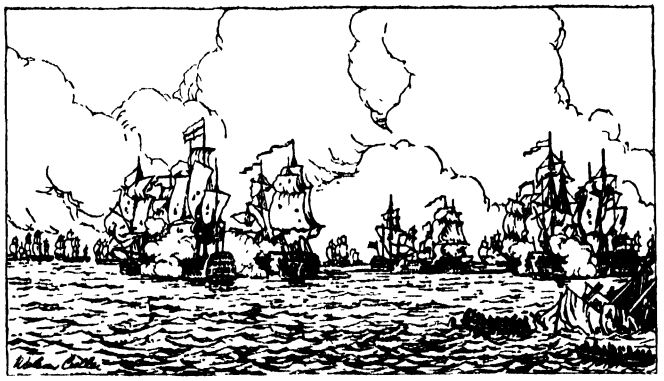
John Paul Jones, operating from French bases with a small squadron, made a cruise around the British Isles from Aug. to Oct. 1779. Many prizes were taken and the British frigate "Serapis" was captured after a memorable duel with the American flagship "Bon Homme Richard." The success of these operations was greatly aided by the fact of the absence in distant waters of practically the whole naval strength of Great Britain, and by the operations in the English channel of a large combined French and Spanish fleet in support of a threatened invasion of England from France.

On the American coast the year 1780 saw the inception of the British policy of conquering the Carolinas which involved such a division of forces as to bring about the ultimate loss of the war. An army detachment escorted by naval forces was sent from New York and captured Charleston in May. These operations were placed in some jeopardy by the arrival of a French squadron with 6,000 troops at Newport in July, but this was offset by British naval reinforcements reaching New York a day later. The British operations in the Carolinas were also covered by the activity in the West Indies of a large naval force under Admiral Rodney, which had been recently sent out from England. Three indecisive actions were fought, near Martinique in April and May 1780, against the French fleet under Admiral Guichen, which was finally reinforced by a Spanish squadron.

Not meeting with the success which had been anticipated, Cornwallis, commanding the southern British army in America decided upon a movement into Virginia where naval support could be utilized to better advantage. Meantime on the James river, Benedict Arnold (then under British allegiance) had been ravaging the country, and at the request of Washington the French squadron at Newport had proceeded to the Chesapeake; but after an indecisive action with a British squadron (March 1781), had returned to Newport. Cornwallis joined Arnold on March 20, at Petersburg, with the intention of undertaking vigorous offensive operations in Virginia. But the commander-in-chief, Gen. Clinton, who was at New York, felt that the forces available were insufficient for such an undertaking, and ordered Cornwallis to intrench himself in a strong position which would control a fleet

anchorage. Cornwallis complied by moving to Yorktown, where he arrived on Aug. 22 with 7,000 troops. It should be observed here that England's ability to support her forces in America at this stage was seriously impaired by Holland joining the alliance against her. In Aug. 1781 a severe naval action was fought in the North sea between the Dutch and British fleets. England's naval forces were further involved in the defence of Gibraltar, Minorca and India.

The joint military-naval combination which brought about the surrender of Cornwallis and the virtual end of the war in America,



BY COURTESY OF THE N.Y HISTORICAL SOCIETY

THE BRITISH FLEET UNDER RODNEY DEFEATS DE GRASSE, 1782

The French fleet under De Grasse attempted the capture of Jamaica. Rodney pursued and defeated him off the island of Dominica in an engagement that detracted from rather than added to the reputations of both officers. A large part of the French fleet escaped

was very unusual It involved the timely concentration at Yorktown of widespread forces; a co-ordination of effort which was very difficult to accomplish with the means of communication and the slow mobility of that period The most important element in the situation was naval control, since Cornwallis' supplies and reinforcements must come by sea and Washington's army near New York could not be moved with sufficient celerity to the critical area except by utilizing water transport on Chesapeake bay The co-operation of the main French fleet, which for several years had been operating against the British fleet in the West Indies, was essential, and its aid was requested by both Washington and Rochambeau. Admiral de Grasse concurred in the plan and sailed from Haiti on Aug 25, 1781, with 28 ships of the line. Gaining advance information of this move through intercepted messages, the British admiral also left the West Indies and was the first to reach the Chesapeake, but not being certain of de Grasse's destination, continued on to New York. Here it became evident from the southerly movements of the united armies of Washington and Rochambeau, that Yorktown was the main Franco-American objective, and Admiral Graves hastily sailed on Aug 31 for that locality.

Meantime Admiral de Grasse had arrived in the Chesapeake and had stationed cruisers in the James river to prevent Cornwallis from escaping to the south. On Sept 5 the British fleet of 19 ships of the line appeared off the Chesapeake entrance where it was partially defeated by 24 French ships present. Admiral Graves remained in the vicinity for the next seven days, still hoping for an opportunity to reach Yorktown and assist in its defence, but the French fleet, increased to a total of 36 ships of the line by the arrival of the Newport squadron, took up an intervening position inside the bay. On Sept 13 Graves therefore departed for New York. The control of the Chesapeake being then undisputed, the allied troops were transported by water from the north to Williamsburg whence they marched to the investment of Yorktown. Here, with his sea communications completely severed, Cornwallis surrendered on Oct. 19, 1781; virtually ending the war on the American continent.

The French admiral, having rendered this vital service to his ally, now returned to the West Indies, whither he was followed by Hood. In Jan. and Feb. 1782 he conquered St. Christopher, in spite of the most determined opposition of the British. The next purpose of the French was to combine with the Spaniards for an attack on Jamaica. Sir George Rodney, having returned to his command with reinforcements, baffled this plan by a series of operations which culminated in the battle of April 12, 1782. This, combined with the success of the British in withstanding repeated naval attacks against Gibraltar, took the heart out of the French and Spaniards and made them ready for peace. After preliminary articles had been signed in Nov. 1782, the naval campaign between British and French squadrons in India continued until June 1783.

In retrospect the American Revolution is seen to have developed from small beginnings into one of the greatest naval wars in history. During its progress the early issues of colonial maritime rights and independence became subordinated in European eyes to that of the control of the then commercially very valuable West Indies, and other objects. The fleet operations which in a few weeks decided the fate of Yorktown, and of the American cause, were merely incidental to the vast naval campaign carried on over a period of five years in Caribbean, European and Indian waters.

BIBLIOGRAPHY.—Captain A T. Mahan's, *The Major Operations of the Navies in the War of American Independence* (1913) is the most authoritative, comprehensive and impartial work available; Gardner W. Allen's *A Naval History of the American Revolution* (1913), is a careful and more detailed account of American naval operations. *See* also Henry Cabot Lodge, *The Story of the Revolution* (1898); Sir W. Laird Clowes, *The Royal Navy: A History* (1897–1903), and Louis Edouard Chevalier, *Histoire de la Marine française pendant la Guerre de l'Indépendence Americaine* (1877). (D. W. K.)

AMERICAN SMELTING AND REFINING COMPANY, THE, was first organized in 1899 as a consolidation of companies engaged in the business of custom lead smelting and refining. In 1902 a further consolidation was made with the interests of the Messrs Guggenheim, who thereafter were in executive charge of the company. Under their administration the company went largely into custom copper smelting and refining and later into custom zinc smelting. It also became an important miner of metals

The company in 1927 operated lead, silver, copper and zinc mines in the United States, British Columbia, Mexico and Peru It had 16 smelters and refineries in the United States, five smelters in Mexico and one in Peru During the year 1927 its plants produced 1,479,899 oz. gold; 80,671,759 oz silver; 476,988 tons lead; 536,830 tons copper; 52,170 tons spelter

The balance sheet as of Dec 31, 1927, was as follows:

ASSETS	
Property and investments	$131,642,493.26
Cash and government securities	35,382,817 83
Inventories and other miscellaneous assets	60,710,459.85
Total assets	$227,735,770.94
LIABILITIES	
FUNDED DEBT AND CAPITAL STOCK:	
Bonds outstanding	$ 47,591,400 00
Preferred stock outstanding	50,000,000 00
Common stock outstanding	60,998,000 00
	$158,589,400.00
Current and miscellaneous liabilities	19,546,484 75
Reserves	22,552,661 87
Profit and loss surplus	27,047,224 32
	$227,735,770.94

(E L N.)

AMERICAN SOCIETY FOR THE PREVENTION OF CRUELTY TO ANIMALS, THE, was organized in 1866 and incorporated in New York State Its charter gives it special prosecuting powers within that jurisdiction. Directly or indirectly, it is the parent of all humane societies in the United States and of many abroad. Its administrative work through its hospital and shelters is chiefly confined to New York city

The society was founded by Henry Bergh, who, when secretary of the American Legation in Russia, became incensed over the ill-treatment of animals on the streets and decided to start an anti-cruelty work in America. On his way home he studied the methods of the R.S P.C A. in England. There were at that time in America no effective laws for animal protection and no organ-

ization to enforce such as existed. Bergh spent his remaining 22 years in tireless activity on behalf of animals. After his death the society, with endowments by him and others, was developed administratively and is undoubtedly the wealthiest and strongest body of its kind in the world. A dispensary and hospital was erected in 1912 and doubled in 1927. Animal shelters are maintained in various parts of the city, and offices are kept open at all hours to answer emergency calls.

AMERICAN SOCIETY OF NATURALISTS is an "association of working naturalists for the discussion of methods of investigation and instruction, laboratory technique and museum administration, and other topics of interest to investigators and teachers of natural history; and for the adoption of such measures as shall tend to the advancement and diffusion of the knowledge of natural history in the community." It was founded at Springfield, Mass., in 1883. With the development of special societies in the different biological fields the position of the naturalists has become more general, and since 1908 the programmes have related particularly to the subject of organic evolution. Meetings are held annually and consist of an afternoon symposium and an evening address by the president, ordinarily on some general aspect of evolution. Membership in 1927 was 438.

AMERICAN SUGAR REFINING COMPANY, THE, incorporated in New Jersey, U.S.A., on Jan 10, 1891, succeeded the Sugar Refineries Company, organized in 1887. The capital stock in 1891 was $50,000,000, was increased in 1892 to $75,000,000, and in 1901 to $90,000,000 The stock consists of 450,000 shares of 7% cumulative preferred and 450,000 shares of common. In 1922 $30,000,000 of 15-year 6% debenture bonds were issued. The stockholders number approximately 24,000, of whom about one-half are women.

The company, including its subsidiaries, owns five refineries for manufacturing refined sugar from raw cane sugar, obtained chiefly from Cuba, Porto Rico, Philippines and Louisiana. The refineries have a daily melting capacity of about 16,000,000lb. It supplies more than one-fifth of the refined sugar consumed in the United States. It has two modern raw sugar factories at Cunagua and Jaronu in Cuba, with 500 sq m. of land, 191m. of railroad and the capacity to produce 600,000,000lb. of raw sugar each year.

The Brooklyn Cooperage Company, a subsidiary, is one of the largest manufacturers of barrels in the world (A. B. W.)

AMERICAN TELEPHONE AND TELEGRAPH COMPANY, THE. The first telephone company was formed in 1876 when the inventor, Alexander Graham Bell, assigned to the Bell Patent Association his first two telephone patents On July 9, 1877, this first association was succeeded by the Bell Telephone Company, first as a trusteeship and later as an incorporation. This company in turn was succeeded, in 1879, by the National Bell Telephone Company, which represented the Bell interests until the American Bell Telephone Company was organized on March 20, 1880, and that in turn became the parent Bell company until Dec. 1, 1899, when the directors voted to transfer all the assets of the company, both in stock and in property, to the already existing American Telephone and Telegraph Company.

After this transfer, accomplished by an exchange of stock, the American Telephone and Telegraph Company became the central or parent company of the Bell system, which now furnishes telephone service in every State in the United States of America. This company owns more than 93% of the common stock of the regional operating companies, called the Associated companies, owns and operates directly long-distance lines interconnecting these regional companies and maintains a central organization for scientific research, standardization of methods and materials, patents and aid in financing. Some of these services are rendered by separate companies controlled by the American Telephone and Telegraph Company, such as the Bell Telephone laboratories, a research organization, and the Bell Telephone Securities Company, which informs and aids the purchaser of securities of the Bell system. The American Telephone and Telegraph Company also provides for telephone equipment through the Western Electric Company, which it controls through stock ownership.

The American Telephone and Telegraph Company's charter, granted in 1885, stated that the purpose of the company was to build and operate telephone lines for long-distance communication connecting the regional operating companies, including "the constructing, buying, maintaining and operating of lines of electrical communication within the State of New York, and from points within the State of New York to points anywhere in the United States, in Canada and Mexico, and by cable and other appropriate means anywhere through the rest of the world."

The outstanding stock of the American Telephone and Telegraph Company, including instalment payments on stock not yet issued, was in Dec. 1927 $1,142,289,200, par value. It was owned by 423,580 stockholders, of whom not one owned as much as 1% of the stock. The average holding was 26 shares The total of all Bell system stocks, including instalments, was $1,351,939,840, par value, owned by more than 525,000 stockholders The total assets of the Bell system amounted to $3,457,467,311, of which $3,013,985,120 represented telephone plant.

The Associated Bell companies own and operate 13,726,000 telephones in the United States. There are, in addition, 4,639,000 telephones, owned by nearly 9,000 independent telephone companies to which the Bell system gives telephone connection over its lines under contract. This makes a total of more than 18,365,000 telephones served by the Bell system. This service is rendered over a network of more than 63,500,000m. of wire, of which 56,823,000m. are Bell owned. During the year 1927 the Bell system made a daily average of 55,195,000 telephone connections throughout the United States network.

In the Bell system, all told, there are more than 353,000 employees, drawing a total monthly payroll of over $45,000,000.

By the steady improvement of telephone service the Bell system is increasing the range and improving the efficiency of American business and social life, while the extension of the service by trans-oceanic telephony, which began with the opening of telephone service between New York and London on Jan. 7, 1927, will connect the American telephone system with the systems of a large part of Europe.

During the five years ending in 1927 construction expenditure for additions, betterments and replacements amounted to $1,800,000,000. During the next five years it was expected that further expansion of the telephone business, as well as further improvements in the service, would require the expenditure for construction of approximately $2,000,000,000 (W. S. G.)

AMERICAN TOBACCO COMPANY, THE, one of the world's largest manufacturers of tobacco, cigarettes and other tobacco products. So far as its name is concerned it goes back to 1890, and so far as its corporate organization is concerned goes back to Oct. 1904 when, under the laws of New Jersey, the old American Tobacco Company, the Consolidated Tobacco Company and the Continental Tobacco Company, were merged. The general offices of the company are in New York city; its manufacturing is done in Brooklyn, N.Y., Richmond, Va., Reidsville, N.C., Durham, N.C., and, through a subsidiary called Nashville Tobacco Works of which it owns all the stock, in Nashville, Tenn. It has warehouses for the gathering and storage of leaf tobacco in Virginia, North Carolina, South Carolina, Kentucky, West Virginia and Tennessee. It owns a substantial majority of the preferred and common stocks of the American Cigar Company, which is engaged in the manufacture and sale of cigars.

The growth of the cigarette business in America, as compared with other tobacco products, has been very marked, and it is estimated that the American Tobacco Company has approximately one-third of the cigarette business. It is difficult to form an estimate as to the other branches of the business, but in variety of output the American Tobacco Company exceeds any of its competitors.

The outstanding capitalization consists of $52,699,700 of preferred stock, issued at par, $40,242,400 of common stock of the par value of $50 a share, which has voting rights with the preferred stock, and $57,401,800 of common stock B which receives the same rate of dividend and has the same rights in liquidation as the common stock, but has no voting power. The total surplus at the end of 1927 was $39,421,241.27.

AMERICAN WAR OF 1812: *see* WAR OF 1812.

AMERICAN WOOLEN COMPANY, THE, one of the world's largest manufacturers of cloth, was incorporated in 1899. It acquired eight companies manufacturing woollen goods and began operations early in the same year. Through stock ownership the company controls and operates the National and Providence Worsted Mills, Providence, R.I.; Woolen and Worsted Mills, Inc., American Woolen Company of New York, American Woolen Company of Kentucky, Shawsheen Mills and Webster Mills of Massachusetts. Altogether, the company and its subsidiaries have owned and operated some 60 mills situated in New England, New York and Kentucky. Toward the close of 1925, 55 of these plants were in operation. Until 1923 the management carried on a policy of expansion, the practice being to continue each new mill's identity until it cleared all obligations and then consolidate it with the parent concern. In 1925–26 the wool market suffered a severe decline; in the latter year the woollen and worsted industries of the country operated at about 60% capacity, and in 1927 the company closed several of its less important mills. At the end of 1926 the company's net working capital was about $60,000,000; current assets, $75,954,000, a ratio to liabilities of nearly 5 to 1; authorized capital stock, $40,000,000 common and $50,000,000 cumulative preferred. The executive offices of the company are in Boston, Massachusetts. (A. G. P.)

AMERICA'S CUP, an international yacht-racing trophy first won by the schooner "America" of the New York Yacht club in 1851. In 1850 an English merchant suggested to friends in the United States that one of the fast New York pilot boats be sent to England in the ensuing year to take part in a yacht race to be held during the time of the Great Exhibition at London. In response to this invitation, George Steers, of New York, designed and built for Commodore J C. Stevens, of the New York Yacht club, the wooden-keel schooner-yacht "America," about 100ft. long and of 170 tons displacement. Crossing the Atlantic in July, 1851, this vessel took part on Aug. 22 in a race open to the yachts of all nations. In sailing the course, which was around the Isle of Wight, the "America" defeated the entire fleet of 14 vessels of the Royal Yacht squadron, thereby winning a silver cup valued at £100. In 1857 the owner of the "America" gave this cup to the New York Yacht club, to be held thereafter as an international yacht-racing trophy. From 1870, when the American schooner "Magic" defeated the British schooner "Cambria," to 1920, when the American yacht "Resolute" defeated Sir Thomas Lipton's Shamrock IV., 13 attempts, all unsuccessful, have been made by the British to recapture the America's Cup.

See Ahmed John Kenealy, *Yacht Races for the America's Cup, 1851–1893* (1893); W. S. Quigley, *The America's Cup* (1903); Herbert Lawrence, *The America's Cup Races* (1914), and Alfred Johnson, "Harvard Men and the America's Cup," *Harvard Graduates' Magazine,* vol. xxxv., p. 53–66 (1926).

AMERICUS, a city of Georgia, U.S.A., about 71 m S.S.W. of Macon, on the Dixie highway, the Central of Georgia railway, and the Seaboard Air Line; the county seat of Sumter county. The population in 1920 was 9,010, of whom 4,629 were negroes Americus is the trading centre of one of the richest agricultural regions of the South. Cotton is still an important crop, yielding about 30% of the agricultural income of the county, but diversification is increasing, and other crops (especially corn, oats, hay, peaches, pecans, melons and vegetables) are becoming relatively more important. Some farmers produce their entire supply of feed and food, except coffee, sugar and salt. There is a creamery in the city, and several factories. Americus was settled in 1832 and was chartered as a city in 1855.

AMERIND or **AMERINDIAN,** a word coined by Major J. W. Powell, director of the bureau of American Ethnology, to designate the aboriginal inhabitants of the American continent. The term "American Indian" being too cumbersome for general use, was frequently abbreviated to "Indian," thereby leading to confusion with the inhabitants of the East Indies. See *Handbook of American Indians North of Mexico* (1907) *s.v.* Amerind.

AMERIND FOLKLORE offers an exceptional field to the student, since its psychological factors are racially homogeneous and practically untouched by intrusive influences. Its cultural complexes exhibit subtle intergradings all the way from simple hunting societies to town-building agricultural co-operative communities. The continuity of aboriginal cultures in Mexico with those of the United States, and the easily discoverable environmental influences, afford a unique opportunity for the study of diffusion by contact. Much has been lost by neglect, but there is compensatory gain in the employment of native Amerind scholars in collection and interpretation.

The basis of Amerind exoteric lore is the tribal origin and migration myth, which can be found in the form of simple hero cycles, more or less ritualized lays, or, as in the case of the New Mexican Pueblos, in epic form comparable in literary value to anything produced at similar cultural levels in Europe. Other exoteric material concerns itself with the explanation of natural phenomena and with social and economic practices. One of the most interesting groups of such rites and legends deals with the origin of wealth as "capital," with the invention of "interest" and the distribution of economic surplus.

Amerind myth in general refers chiefly to cultural rather than military exploits, and deals with heroes who seek prestige through social benefits conferred and the attainment of magical power. The esoteric myths relate to the methods by which such power is attained, its use in curing the sick, ensuring the food supply and the increase and security of the tribe. The happy ending of any Amerind tale is the certainty of having attained this "medicine," although in tales not primarily magical, all the usual primitive story elements can be found: lovers who die for love, tests for proving love, the devoted male friends, the animal helper, the magic talisman or fetish, the dull boy who becomes chief or shaman, and the beginnings of a Cinderella myth. Among magical happenings which have no esoteric significance are the animal wife, the star or moon maiden, deific twin brethren, other-world adventures, dwarfs, ogres and such supernaturals as underwater people, wind and thunder people. Ghosts play an important part in both exoteric and esoteric myth. Communication with them is a constant resort, and there are societies of personators of the ancestral spirits. Virgin birth, sacrificial death and resurrection occur in connection with vegetation rites, along with animal impersonators and masked metamorphic powers of nature. Rites and ceremonials achieve a high level of aesthetic presentation, approaching early Greek dance-drama and sacerdotal comedy. Music, poetry, colour design, dance and dramatic dialogue are not inferior to the sacred lore of other tribes at similar cultural levels.

The Amerind's concept of his universe is animistic, the *wakonda* or animating spirit being thought of as resident in some degree in everything, but concentrating in important natural objects, such as the sun, the sea, the buffalo. Personalization of these centres of spiritual energy is still rather a figure of speech than a belief among Amerinds, and a general concept of a Great Spirit, Father All Father, Universe Man, is found in the more advanced tribes. (M. A.)

For examples of Amerind Folklore, *see* the works of Frank Hamilton Cushing and Alice Cunningham Fletcher. For Mexican Folklore, *see* Carl Lumholtz, *Unknown Mexico* (1903).

AMERSFOORT, town in the province of Utrecht, Holland, on the navigable Eem, and a junction station 14m. by rail N.E. by E. of Utrecht. Pop. (1900) 19,089, (1927) 35,959 It is situated among sandy heaths and woods. The Koppelpoort, an old gateway, ends an avenue bordering the canal. The large plain church of St George dates from the 13th century. There is a Jansenist church, with seminary attached, a town hall and a court of primary jurisdiction. Its chemical and tobacco industries received a great impetus during Holland's neutrality (1914–18).

AMERSHAM, market town of south Buckinghamshire, England, placed in the narrow valley of the Misbourne stream, giving access to Wendover and Aylesbury via the Chiltern hills. Population of civil parish (1921) 4,221. At the time of the Domesday survey Amersham was divided into six holdings. The manor was held by Geoffrey de Mandeville. Henry VIII. granted it to Sir John Russell, one of whose descendants, the earl of Bedford, conveyed it to the Drake family in 1638. Amersham was formerly a borough by prescription, but lost its privileges in 1832. The

church of St. Mary is almost entirely Perpendicular, and has a beautiful south porch and brasses of the 15th, 16th and 17th centuries. The town has flour mills and breweries; and straw-plaiting and lace making survived until the end of last century. In modern times Amersham has developed as a residential centre, being served by the Met. and G.C. Joint Railways.

AMERY, LEOPOLD CHARLES MAURICE STENNETT (1873–), British politician, was born at Gorakhpur, North West Provinces, India, Nov. 22, 1873, and was educated at Harrow and Balliol college, Oxford. He was elected a fellow of All Souls college in 1897, and, after travelling for a year in the Near East, in 1899 joined the staff of *The Times*, London, and acted as chief correspondent to that paper during the first year of the South African War (1899–1900), remaining associated with it till 1909; during this period he edited and wrote the greater part of *The Times History of the South African War*. He began his political career in 1903, as a strong advocate of imperial preference and tariff reform and, having contested in the Unionist interest seats at Wolverhampton and Bow and Bromley, was elected in 1911 M.P. for the Sparkbrook division of Birmingham. During these years he also travelled extensively in Canada, Australia, New Zealand, South Africa and other parts of the British empire. From 1914 to 1916 he served with the British army, first in France and later in the Near East, and from 1917 to 1918 was a secretary of the War cabinet on the personal staff of the secretary for war and of the Imperial War cabinet, and a member of the inter-allied military staff at Versailles. In Jan. 1919 he became under-secretary for the Colonies and in 1921 parliamentary and financial secretary to the Admiralty. From Oct. 1922 to Jan. 1924 he was first lord of the Admiralty in the Unionist cabinet. In Nov. 1924 he became secretary of state for the Colonies, and in July 1925 also secretary of state for dominion affairs. In this latter capacity he took part in the Imperial Conference of 1926 and made a tour round the British dominions in 1927–28.

He has published various works, including *The Problem of the Army* (1903); *Fundamental Fallacies of Free Trade* (1906); *The Great Question* (1909); *Union and Strength* (1912).

AMES, FISHER (1758–1808), American statesman, orator and political writer, was born at Dedham, Mass., on April 9, 1758. He graduated at Harvard college in 1774, and began the practice of the law at Dedham in 1781, but eventually abandoned that profession for the pursuit of politics. He was a prominent member of the Massachusetts convention which (Feb. 1788) ratified for that state the Federal Constitution, and in the same year in the lower house of the state legislature, he distinguished himself by his eloquence and readiness in debate. During the eight years of Washington's administration (1789–97) he was a prominent Federalist member of the national House of Representatives. On April 28, 1796, when the Republicans, hostile to the Jay Treaty, were on the point of holding up the appropriation necessary for its execution, Ames made what has been considered the greatest speech of his life and secured the passage of the appropriation When Washington retired from the presidency, Congress voted him an address and chose Ames to deliver it. Ames was one of the group of New England ultra-Federalists known as the "Essex junto," who opposed the French policy of President John Adams in 1798, and were conspicuous for their British sympathies. He died on July 4, 1808.

His writings and speeches, which display great fertility of imagination, were collected and published, with a memoir of the author, in 1809, by the Rev. Dr. J. T Kirkland. A more complete edition was published by the statesman's son, Seth Ames, in 1854.

AMES, JAMES BARR (1846–1910), American educator and legal scholar, was born in Boston, Mass., on June 22, 1846. He graduated from Harvard university in 1868 and from its law school in 1872. Entering the faculty of Harvard as instructor in history, he was made associate professor of law in 1873 and professor of law in 1877. In 1895 he was appointed dean of Harvard law school, a post which he occupied with distinction until his death 15 years later. Because of his profound learning and rare power as a teacher he exercised marked influence both upon the development of law and upon legal instruction. He grasped the relation of law and morals at a time when current legal thinking insisted upon contrasting them or upon absolutely divorcing them. In consequence, his ideas as to what ought to be the law have prevailed rather than those of his contemporaries who conceived that it was unnecessary to look outside of the positive legal materials. For the use of students he published valuable case books on the law of torts, equity jurisdiction, negotiable paper, suretyship, admiralty, pleading at common law and other divisions of law. His *Essays in Legal History* (1912), collected and published after his death, constitute an enduring contribution to historical jurisprudence. He died at Wilton, N.H., on Jan. 8, 1910.

See Charles W. Eliot, "James Barr Ames," *Harvard Law Review*, vol. xxiii, p. 321–324 (1910); and Joseph H. Beale, "James Barr Ames: His Life and Character," *ibid.*, p. 325–329.

AMES, JOSEPH (1689–1759), English author, was born at Yarmouth on Jan. 23, 1689. He wrote an account of printing in England from 1471 to 1600, *Typographical Antiquities* (1749). Ames disregarded printed lists and consulted the title-pages of the books themselves. An interleaved copy of the work with many notes in the author's hand is now in the British Museum. Editions of his works were published with added information by William Herbert (1785–90), and T. F. Dibdin (1810–19). Ames's occupation is variously given. It is uncertain whether he was a ship-chandler, a patten-maker, a plane-iron-maker, or an ironmonger; but he led a prosperous life at Wapping, and amassed valuable collections of antiquities. He died on Oct. 7, 1759 His other works are catalogues of English printers, of the collection of coins which belonged to the earl of Pembroke, of some 2,000 English portraits, and *Parentalia* (1750), a memoir of the Wrens, undertaken in conjunction with Sir Christopher Wren's grandson, Stephen Wren. Part of his correspondence in bibliography is included in Nichols's *Literary Anecdotes and Illustrations*.

AMES, JOSEPH SWEETMAN (1864–), American physicist, was born in Manchester, Vt., on July 3, 1864. He received his education at Johns Hopkins university from which he graduated in 1886 and received the degree of doctor of philosophy in 1890 He was assistant and associate in physics there in 1888–93 and associate professor from 1893 to 1899 when he was made professor of physics. In 1901 he was appointed director of the physical laboratories in which he conducted extensive researches in electro-dynamics and spectroscopy.

His published works include *Theory of Physics* (1897), *Manual of Experiments in Physics* (1898), *Free Expansion of Gases* (1898), *Prismatic and Diffraction Spectra* (1898), *Elements of Physics* (1900), *Induction of Electric Currents* (1900), *Text-book of General Physics* (1904) and *The Constitution of Matter* (1913).

AMES, OAKES (1804–1873), American manufacturer, capitalist and politician, was born in Easton, Mass., on Jan. 10 1804. As a manufacturer of shovels, with his father and his brother Oliver (1807–77), he amassed a large fortune. From 1863 to 1873 he was a Republican member of the national House of Representatives. As a member of the committee on railroads he became interested in the project to build a trans-continental railway, connecting the eastern States with California. In 1865 he took charge of the work, and to him more than to any other one man the credit for the construction of the Union Pacific railway was due. The execution was effected largely through a construction company, the Crédit Mobilier Company of America. In disposing of the stock of this company, Ames, in 1867–71, sold shares to members of Congress at a price much below what they eventually proved to be worth. This gave rise in 1872–73 to a congressional scandal. After an investigation by a committee of the House, which recommended the expulsion of Ames, a resolution was passed on Feb. 28 1873, "that the House absolutely condemns the conduct of Oakes Ames . . . in seeking to secure congressional attention to the affairs of a corporation in which he was interested, and whose interest directly depended upon the legislation of Congress, by inducing members of Congress to invest in the stocks of said corporation." Many have since attributed this resolution to partisanship, and the influence of popular clamour. In 1883 the legislature of Massachusetts passed a resolution vindicating Ames. He died at North Easton, Mass., on May 8 1873.

See CRÉDIT MOBILIER OF AMERICA and the references there given. For a defence of Oakes Ames, see *Oakes Ames, A Memorial Volume* (Cambridge, Mass., 1884).

AMES, WILLIAM (1576–1633), English Puritan divine and controversialist, known as AMESIUS, was born at Ipswich, Suffolk, and died at Rotterdam. Ames was educated at Christ's College, Cambridge, and became a fellow of his college. He raised a great stir in 1609 by a sermon denouncing the "heathenish debauchery" attending the feast of St. Thomas. He was obliged eventually to leave England and spent the rest of his life in Holland, where he engaged in numerous theological controversies. He was for a short time chaplain to Sir Horatio Vere in Holland, then professor of theology at Franeker, Friesland (1622–33), and had just removed to Rotterdam when he died.

The tracts which he wrote against Grevinchovius he collected in *Coronis ad Collationem hagiensem,* which was prepared in view of the Synod of Dort 1618–19. His works include *Medulla theologiae,* a manual of Calvinistic doctrine for his students; *De conscientia eius iure et casibus; Fresh suit against Ceremonies,* posthumously published, which is said to have made Richard Baxter a nonconformist; and Latin commentaries on the Psalms and St. Peter's epistle.

See John Quick's ms. *Icones Sacrae Anglicanae; Life* by Nethenus, prefixed to collected edition of Latin works (Amsterdam, 1658); Winwood's *Memorials,* vol. iii pp. 346–47; Neal's *Puritans,* i. 532; Fuller's *Cambridge (Christ's College)*; Hanbury's *Hist. Memorials,* i. 533; *Collections of the Massachusetts Historical Society,* vol. vi. (4th series, 1863), pp. 576–577.

AMES, WINTHROP (1871–), American theatrical producer, was born in North Easton, Mass., on Nov. 25, 1871. He graduated at Harvard in 1895, and spent the following year in special study at the university. For eight years he edited and published art and architectural works in Boston. Then followed a year abroad where he studied the continental drama, and in 1905 he became manager, in association with Loren F. Deland, of the Castle theatre, Boston, where for three years they conducted a very notable stock company. In 1909, he became director of the New theatre (now the Century) in New York city, where he made the first attempt in recent years to establish a repertory theatre. With the passing of the New theatre, he began, in 1912, independent production and management, erecting two theatres, the Little and the Booth. He contributed a wide variety of productions, among them *Snow White,* the first play given in New York city especially for children. He also revived the Gilbert and Sullivan operas.

AMES, a city of Story county, Iowa, U.S.A., in the centre of the state, 35 m. N. of Des Moines; on two lines of the Chicago and North Western, and on the Fort Dodge, Des Moines and Southern (electric) railway. The population, nearly all native white, increased from 2,422 in 1900 to 6,570 in 1920 and 9,332 in 1925 (State census). The town was laid out in 1864 and incorporated in 1869. It was named after Oakes Ames, one of the owners of the railway. It is the headquarters of the State Highway Commission, which employs about 1,000 men over the state. A commission-manager form of government was adopted in 1920.

Ames is the seat of the Iowa State College of Agriculture and Mechanic Arts, established in 1858, as a "state agricultural college and model farm," and broadened in scope in 1862 to meet the conditions of the Congressional "land-grant" act of that year. In 1927 the college property was valued at $8,750,869. The central campus of 125 ac. is a beautiful park. An inner plaza of 20 ac., containing a campanile with a chime of ten bells cast in Loughborough, England, is surrounded by stately buildings of white Bedford stone. Around these is an outer ring of shops and laboratories. Abutting on the central campus are farms for teaching and experiment in agronomy, animal husbandry, bee culture, dairy husbandry, horticulture, poultry raising, veterinary science, and other branches, comprising in all nearly 2,000 acres. There are 70 buildings for college purposes. The meats laboratory includes an amphitheatre with 500 seats; greenhouses contain 33,000 sq.ft. under glass; the automobile laboratory is 80 by 207 ft.; the new library (1925) has a capacity for 250,000 volumes; the main Home Economics building (1927; 400 ft. long) is supplemented by the Nursery School near by, where the work in child care and training is conducted, and by three well planned houses for the courses in home management. The engineering division of the college is as large as the division of agriculture. The administrative and teaching staff numbers more than 500, and the annual enrolment of students is more than 5,000, adding more than 50% to the resident population of the city.

AMESBURY, a market town, Wiltshire, England, lying in the rich and well-wooded valley of the Avon, amid the chalk downs of Salisbury Plain, 8 m. N. of Salisbury; population of parish (1921) 1,530. The neighbourhood is very rich in remains of prehistoric man, among which Stonehenge (*q.v.*), 1½ m. W., is the greatest surviving megalithic structure in the British Isles. On a hill overlooking the village is a large earthwork, "the Ramparts," which perhaps marks a preceding settlement. At Amesbury (Ambresberia, Aumbresbery) a witenagemot was held in 932, while (*c* 980) Ethelfrida, queen dowager of Edgar, erected here a nunnery in expiation of the murder of her stepson. At the time of Domesday Amesbury was a royal manor. From the 12th century the nunnery was attached to the abbey of Fontevrault, and was enriched by royal charters and private gifts. The grant of a weekly market and fair dates from 1317. The church of St. Mary is largely Early English, with some richly decorated windows. Amesbury abbey, built by Inigo Jones for the dukes of Queensberry, stands close to the village.

Pipeclay abounds in the neighbourhood, and in the 17th century Amesbury was famous for its pipes. Its interests are now largely agricultural, frequent sheep fairs being held The town profits from the permanent army camps in the vicinity (particularly from Larkhill) and from the tourist traffic visiting Stonehenge and other objects of interest on the plain. Amesbury is served by a branch railway, running to the camp at Bulford, joining the S.R. between Andover and Salisbury.

AMESBURY, a town of Essex county, in north-east Massachusetts, U.S.A., on the Merrimac river, between the city of Newburyport and the New Hampshire border, 43 m. N. of Boston. It is served by the Boston and Maine railroad, and is connected by electric line with Haverhill and Newburyport and summer resorts on the coast. The town covers a land area of about 13 sq. miles. The surface is hilly. The population in 1925 was 11,229. The principal manufactures are automobile bodies and accessories, hats, fibre-board, peanut products, bent glass, abrasives, castings and shoes.

Amesbury was settled in 1642, as a part of Salisbury, and in 1654 became practically independent, although not legally a township until 1666. It was named (1667) after the English town in Wiltshire. Quakers settled here as early as 1701. Josiah Bartlett (1729–95) a signer of the Declaration of Independence, was born here. Shipbuilding was an important industry in the 18th and especially in the first quarter of the 19th century. A nail factory, one of the earliest in the country, was built in 1796. The manufacture of iron began about 1710; of hats in 1769; of carriages in 1800; and of cotton goods in 1812. Amesbury was the home of John G. Whittier from 1836 to 1892, and many of his poems describe the surrounding country and the life of the community.

See Joseph Merrill, *History of Amesbury* (Haverhill, 1880); S. T. Pickard, *Whittier-Land: a Handbook of North Essex* (Boston, New York, 1904).

AMETHYST, a violet or purple variety of quartz used as an ornamental stone. The name is generally said to be derived from the Gr. *α*, "not" and *μεθύσκειν*, "to intoxicate," expressing the old belief that the stone protected its owner from strong drink. It was held that wine drunk out of a cup of amethyst would not intoxicate. The colour of amethyst is usually attributed to the presence of manganese, but as it is capable of being much altered and even discharged by heat it has been referred by some authorities to an organic source. On exposure to heat, amethyst generally becomes yellow, and much of the cairngorm or yellow quartz of jewellery is said to be merely "burnt amethyst."

The amethyst was used as a gem-stone by the ancient Egyptians, and was largely employed in antiquity for intaglios. It is now used for episcopal rings. It is a very widely distributed mineral, but

fine, clear specimens fit for cutting as ornamental stones are confined to comparatively few localities. Such crystals occur either in cavities in mineral-veins and in granitic rocks, or as a lining in agate geodes. Many of the hollow agates of Brazil and Uruguay contain a crop of amethyst-crystals in the interior. Much fine amethyst comes from Russia, especially from near Mursinka in the Ekaterinburg district.

AMETROPIA. The normal refractive condition of the eye is known as emmetropia. Any departure from this condition is called ametropia. Like a camera, the eye is provided with a lens and a light-sensitive membrane, the retina The cornea and the transparent substances which fill the eyeball aid the refractive power of the lens. In an ideal eye at rest, parallel rays come to a clear focus on the retina. Although only about 2% of properly examined eyes exactly meet this standard, the majority of normal eyes closely approach it. When, however, due to defects in the refractive mechanism, parallel rays do not come to a clear focus on the retina of a resting eye, the condition is called ametropia. Such defects may be abnormalities in length of the eyeball or irregularities in the curvature of the cornea or lens, and the resulting varieties of ametropia are called myopia, hyperopia and astigmatism. (*See* ASTIGMATISM.)

AMHARA, the central province of Abyssinia. The chief town, Gondar (*q v*), by which name the province is also known, was the residence of the negus negust, or emperor, of Abyssinia from the middle ages up to 1854.

AMHARIC. The most important language spoken in Abyssinia (*q v.*) is Amharic, which belongs to the Semitic family (*q.v.*), but has been greatly modified by Hamitic influences. The order of the words is that usual in Hamitic speech, the verb coming last and subordinate words preceding those with which they are associated. Laryngeal consonants are absent and the system of writing, which dates from the 2nd century A D, is remarkable for the great number of forms required, since each of the 26 consonants has seven vowel forms, while a special sign is added to mark the softened pronunciation in vogue. Very considerable phonetic modifications have taken place, resulting often in a total change of form. As regards syntax, the governed noun is placed after the genitive, while the attributive relative clause is placed before its substantive. Few traces remain of the feminine forms or of the ancient plural of the noun. Not more than half of the vocabulary—after allowing for phonetic modifications—can be found to tally with that of other Semitic languages. (*See* C. Armbruster, *Initia Amharica.*)

AMHERST, JEFFREY AMHERST, BARON (1717–97), British field-marshal, served in Germany and the Low Countries as aide-de-camp to Gen. (Lord) Ligonier, and was present at Dettingen, Fontenoy and Roucoux. He then served on Cumberland's staff, and took part with the duke in the later campaigns of the Austrian Succession war, in the battle of Val, and the North German campaign of 1757, including the battle of Hastenbeck. In 1758 William Pitt gave Amherst command of an expedition to attack the French in North America.

The first victory of the expedition, the capture of Louisburg (July 26 1758), was followed by other successes, and Amherst was given the chief command of all the forces in the theatre of war. In the campaign of 1759 Amherst's own share was the capture of Ticonderoga and Crown Point, while Ft. Niagara fell to another column, and Quebec was taken by Wolfe. In 1760 a concentric march on Montreal was carried out with complete success. Amherst was immediately appointed governor-general of British North America. His conduct of the operations against the Indians under Pontiac was, however, far from being as successful as his generalship against regular troops; and he returned to England in 1763.

He was created a peer in 1776, was promoted to the rank of general in 1778, and aided in suppressing the Gordon Riots of 1780. For the rest of his active life, with a short interval in 1782–83, he was commander-in-chief. In 1796 Lord Amherst, who had retired from the Horse Guards in 1795, was made field-marshal; and he died Aug. 31 1797 at "Montreal," his residence in Kent. Amherst college (*q.v.*) was named in his honour.

AMHERST, WILLIAM PITT AMHERST, EARL (1773–1857), governor-general of India, was the nephew of Jeffrey, Baron Amherst, and succeeded to his title in 1797. Upon his return from an abortive mission to China in 1816, his ship, the "Alceste," after a cruise along the coast of Korea and to the Luchu Islands, was wrecked on a sunken rock in Gaspar Strait.

The ship in which he returned to England in 1817 touched at St. Helena, and he had several interviews with the Emperor Napoleon (*see* Ellis's *Proceedings of the Late Embassy to China,* 1817; McLeod's *Narrative of a Voyage in H.M S. "Alceste,"* 1817). Lord Amherst held the office of governor-general of India from Aug. 1823 to Feb. 1828. The principal event of his government was the first Burmese war of 1824, resulting in the cession of Arakan and Tenasserim to Great Britain. He was created Earl Amherst of Arakan in 1826. Upon his return to England, he lived in retirement till his death in March 1857.

See A. Thackeray and R. Evans, *Lord Amherst* ("Rulers of India" series), 1894.

AMHERST, a village and district in the Tenasserim division of Lower Burma. The village is about 30m. S. of Moulmein. It was founded by the British in 1826 on the restoration of the town of Martaban to the Burmese, and named in compliment to the governor-general of India of that day; but in 1827 the headquarters were transferred to Moulmein. Amherst is now merely a fishing village and a bathing-place for Moulmein. For a description of Amherst district *see* BURMA.

AMHERST, county town, Cumberland county, port of entry in Nova Scotia, Canada, at the head of Chignecto bay and on the Canadian National railway, 138m. from Halifax. Pop. (1921) 9,998. It is in a rich agricultural and mining district, contains numerous factories, and has an especially large trade in lumber and ship-building It distributes goods, and exports railway carriages, engines, boilers, stoves, etc

AMHERST, a town of Hampshire county, Mass., U.S.A, in the central part of the State, with a population in 1925 of 5,972 (State census). The village of Amherst, about 100m. W. of Boston, is situated on a plateau within a rampart of hills on the east side of the Connecticut river; and is served by the Boston and Maine and the Central Vermont railways. It is a quiet, academic village, with shady streets and attractive homes.

Amherst college (*q.v*) stands on a hilltop which commands a broad outlook. The Massachusetts agricultural college (incorporated 1863; opened 1867) has a campus of 700 ac. about a mile north of the village centre, and a demonstration farm of 755 ac., 6m. farther north. The enrolment in the college in 1926–27 was 570 in the courses leading to the degree of bachelor of science, and 406 in the several shorter courses which are offered to meet the needs of men and women who cannot spend four years in study.

The town seems to have been settled in 1731. It was originally part of Hadley, was incorporated as a "district" in 1759, and as a town in 1775. It was named after Gen. Jeffrey Amherst (1717–97). Noah Webster lived in the village (1812–22) while working on his *Dictionary.* Emily Dickinson (*q v.*) and Helen M. Fiske (Helen Hunt Jackson, *see* JACKSON, HELEN MARIA) were born there.

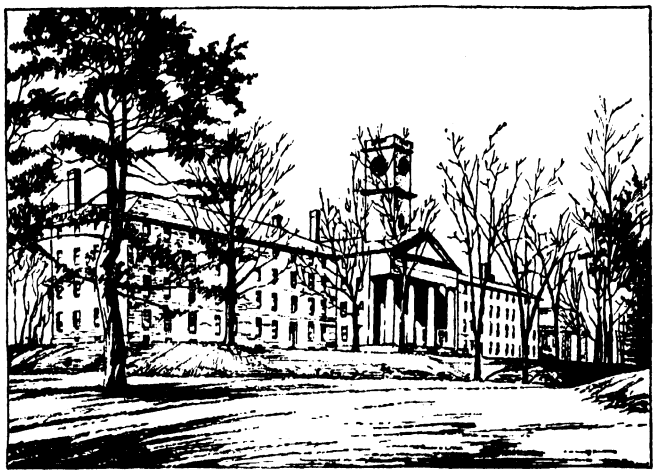
See William Seymour Tyler, *A History of Amherst College* (1896), and Carpenter and Morehouse, *The History of the Town of Amherst* (1896).

AMHERST COLLEGE, one of the best known of the so-called small New England colleges, is situated in a beautiful amphitheatre of hills in the town of Amherst (*q.v.*), Massachusetts. It was founded in 1821 but did not receive its charter until 1825. Like most early colleges of New England, it was established with the chief aim of preparing students for the ministry. Although soon after its founding the college began to widen the scope of its activities, it has preserved to the present day the idea of a liberal as opposed to a vocational training. Consistent with this purpose it has never added graduate or professional schools, adhering strictly to a course leading to the degree of A.B. with an ever real, though diminishing, emphasis upon the ancient classics.

The college grew rapidly for a score of years, but then experi-

enced a period of reaction which nearly cost the institution its life. There was a revival under the presidency of the eminent geologist, Edward Hitchcock (1845–54) and another reaction at the time of the Civil War. Since then its history has been one of quiet, but steady growth.

In 1927 it numbered 750 students and a faculty of 70 teachers. The material resources of the college amounted to $3,000,000



BY COURTESY OF AMHERST COLLEGE

CHAPEL ROW, AMHERST COLLEGE, SHOWING THE ORIGINAL BUILDINGS

in buildings and equipment, and to $6,600,000 in invested funds. Its buildings consisted of four dormitories, five halls devoted to administration and instruction, two large laboratories, one of which is divided between physics and chemistry (a new chemistry laboratory being in process of construction), and the other between biology and geology, a library, chapel, church, a gymnasium equipped with a natatorium and squash courts, a large indoor athletic field and skating rink, a music building and an observatory. The library, thoroughly modern in its appointments, contained approximately 150,000 books. The observatory is equipped with two domes, one housing a telescope with an 18in. Clark objective, and the other with a 7in. telescope (Clark objective) for student use. The geological and biological building contains the famous Hitchcock ichnological collection, the Adams shells, a part of the Audubon collection of birds, an extensive mineral collection including a rare assortment of meteorites, and fossil groups arranged to illustrate the theory of evolution. About 100ac. of land are devoted to athletic sports, the larger portion being used for intramural sports upon which the college lays an ever increasing emphasis.

For its size (6,000 graduates in the first hundred years), the college has had an exceptional number of graduates of distinction, among others being Henry Ward Beecher and Calvin Coolidge. It has been eminent in foreign missionary work, especially in the field of education. The Syrian Protestant college (now the American university) of Beirut, Syria, was founded by Daniel Bliss of the class of 1852; the Doshisha, the first institution of higher learning in Japan, by Joseph Neesima of the class of 1870; and Robert college, in Constantinople, owed a very large part of its early success to President George Washburn of the class of 1855. (G. D. O.)

AMHURST, NICHOLAS (1697–1742), English political writer, was born at Marden, Kent, Oct. 16 1697, and died at Twickenham, April 12 1742. He was educated at Merchant Taylors' School and St. John's College, Oxford. At Oxford he wrote many satirical poems on university life, and in 1719 was expelled. Some of his satirical papers were published in 1726, as *Terrae Filius: or the secret history of the University of Oxford.* In London he became a pamphleteer against Walpole's Government, editing *The Craftsman,* which was the organ of Lord Bolingbroke and William Pulteney. Amhurst was in prison for a short time in 1737 for suspected libel. When his political friends overthrew Walpole in 1742 they appear to have forgotten Amhurst.

AMIAK: *see* NILOTES.

AMIANTHUS, a name applied to the finer kinds of asbestos (*q.v.*), in consequence, it is said of the mineral being unaffected by fire (Gr. *ἀμίαντος,* undefiled). Some of the finest amianthus, with long silky flexible fibres, occurs in the district of the Tarentaise in Savoy. According to Dr. J. W. Evans, the ancient amianthus, derived mostly from Karystos in Euboea and from Cyprus, was probably a fibrous serpentine, or chrysotile (now called locally *παμπακόπετρα,* or cotton-stone).

See *Mineralogical Mag.,* vol. xiv. no. 65 (1906), art. by J. W. Evans.

AMICABLE NUMBERS (also known as *amiable numbers* or, less commonly, as *agreeable numbers*), two integers each of which is equal to the sum of the aliquot parts (*q.v.*) of the other. For example, 220 and 284 are amicable numbers, for the aliquot parts of 220 are 1, 2, 4, 5, 10, 11, 20, 22, 44, 55 and 110, the sum of which numbers is 284. Similarly, the sum of the aliquot parts of 284 (that is, of 1, 2, 4, 71 and 142) is 220. These two numbers are mentioned by the Greek arithmetician, Iamblichus (*c.* 325). Mathematicians have discovered 63 other pairs.

AMICE (Lat. *amictus,* from *amicire,* to wrap round), sometimes called *humerale* (from *humerus,* shoulder), a liturgical vestment of the Western Church. It is a rectangular linen cloth, with a small cross sewn or embroidered in the middle, which is wrapped round the neck, shoulders and breast. It is first laid on the head, then allowed to fall on the shoulders, and finally folded round the chest and tied with the strings attached for that purpose. It is worn under the alb, except at Milan and Lyons, where it is put on over it. The vestment was at first a perfectly plain white cloth, but from the 10th century onwards it was often richly embroidered, and the custom arose of decorating the upper border with an "apparel" forming a sort of stiff collar which appeared above the chasuble or dalmatic.

The Latin word *amictus* was applied to any wrap-like garment, and, according to Father Braun, the liturgical amice originated in the ordinary neck-cloth worn by all classes of Romans. The first record of its liturgical use is in the 1st Roman Ordo (8th century), when it was worn only with the dalmatic and was known as the *anabolagium* (*anagolaium, anagolagium,* Gr. *ἀναβόλαιον*), a name it continued to bear at Rome till the 11th century. In the 9th century it spread to other countries: it is mentioned in an inventory of vestments given by Abbot Angilbert (d. 814) to the monastery at Centula (St. Riquier) and in the *de clericorum institutione* of Hrabanus Maurus (*c.* 820). The amice was worn first simply as a shoulder-cloth, but towards the end of the 9th century the custom grew up of putting it on over the head and of wearing it as a hood, either while the other vestments were being put on or, according to various local uses, until the celebrant reached the altar. This ceased at Rome in the 15th century, when the apparel disappeared; but two relics of it survive—(1) in the vesting directions of the Missal and the priest's prayer, "Place on my head the helmet of salvation," etc., (2) in the ordination of subdeacons, when the bishop lays the vestment on the ordinand's head with the words "Take the amice, which symbolizes discipline over speech."

The amice was rejected with the other "Mass vestments" in England at the Reformation. Its use has, however, been revived in many Anglican churches. (*See* VESTMENTS.) A vestment akin to the amice is worn in the Armenian and some other oriental churches, but it is unknown to the Orthodox Eastern Church.

See Joseph Braun, S.J., *Die liturgische Gewandung,* pp. 21–56 (Freiburg im Breisgau, 1907), and bibliography to the article VESTMENTS.

AMICI, GIOVANNI BATTISTA (1786–1863), Italian astronomer and microscopist, was born March 25 1786, at Modena and died at Florence, April 10 1863. His name is best known for the improvements he effected in the mirrors of reflecting telescopes and especially in the development and construction of the microscope.

AMICIS, EDMONDO DE (1846–1908), Italian writer, was born at Oneglia, in Liguria, Oct. 21 1846. He was educated for the army, and fought at the battle of Custozza in 1866. In 1867 he became director of the *Italia Militare,* Florence. In the following year he published *La Vita Militare,* a book of

sketches of military life. After his retirement from the army in 1870 de Amicis travelled in Europe and Africa, and published a number of travel books which were long popular. The most important of these are his descriptions of London (1874), Spain (1873), Holland (1874), Constantinople (1877) and Morocco (1875). He died suddenly of heart disease at Bordighera on March 12, 1908.

Among his other wellknown works are: *Il Romanzo d'un Maestro*, and the widely read *Il Cuore* (translated into English as *An Italian Schoolboy's Journal*). Later works are *La Carozza di tutti, Memorie, Speranze e glorie, Ricordi d'infanzia è di scuola, L'Idioma gentile*, and a volume of short stories, *Nel Regno dell' Amore*.

AMICUS CURIAE, a term used primarily in law, signifying a person (usually a member of the Bar) who, having special knowledge but not being engaged in the action, intervenes during its hearing to give information for the assistance of the court, either upon some fact relevant to the issue or upon a point of law, such as the effect of a local custom, the precedent of some decided case, etc.

AMIDES (*Acid-Amides*), chemical compounds which may be considered as derived from ammonia by replacement of its hydrogen with acyl residues, which are the characteristic groups of organic acids, derivable from these by removal of the acidic hydroxyl group or groups; the substances produced are known as primary, secondary or tertiary amides, according to the number of hydrogen atoms replaced. Of these compounds, the primary amides of the type $R{\cdot}CO{\cdot}NH_2$ are the most important, the group $\cdot CO{\cdot}NH_2$ being called the amido group. They may be prepared by the dry distillation of the ammonium salts of the acids (A. W. Hofmann), by the partial hydrolysis of the nitriles, by the action of ammonia or ammonium carbonate on acid chlorides or anhydrides, or by heating the esters (*q v*) with ammonia They are solid crystalline compounds (formamide excepted); the lower members of the series are soluble in water, the solubility, however, decreasing as the carbon content of the molecules increases. They are easily hydrolysed, breaking up into organic acids and ammonia or when boiled with acids or alkalies. They form compounds with hydrogen chloride when this gas is passed into their ethereal solution; these compounds, however, are very unstable, being readily decomposed by water. On the other hand, they show faintly acid properties, since the hydrogen of the amido group can be replaced by metals to give such compounds as mercury acetamide $(CH_3CONH)_2Hg$ Nitrous acid decomposes them, with elimination of nitrogen and the formation of the corresponding acid:

$$RCO{\cdot}NH_2 + ONOH = R{\cdot}COOH + N_2 + H_2O.$$

When distilled with phosphoric anhydride they yield nitriles. By the action of bromine and alcoholic potash on the amides, they are converted into amines containing one carbon atom less than the original amide, a reaction which possesses great theoretical importance (A. W. Hofmann), and is also of industrial interest in the Badische synthesis of indigo (*q.v.*), for in accordance with Hofmann's reaction phthalimide is converted by alkali hypochlorite into anthranilic acid:

$$R{\cdot}CONH_2 \longrightarrow R{\cdot}CONHBr \longrightarrow R{\cdot}NH_2 + K_2CO_3 + KBr + H_2O.$$

Formamide, $H{\cdot}CONH_2$, is a liquid readily soluble in water, boiling at about 195°C with partial decomposition. Acetamide, $CH_3{\cdot}CONH_2$, a white deliquescent crystalline solid, which melts at 82–83°C and boils at 222°C, is usually prepared by distilling ammonium acetate. Benzamide, $C_6H_5{\cdot}CONH_2$, crystallizing in leaflets which melt at 130°C, is prepared by the action of ammonium carbonate on benzoyl chloride It yields a silver salt which with ethyl iodide forms benzimido-ethyl ether, a behaviour which points to the silver salt as being derived from the tautomeric imidobenzoic acid:

$$C_6H_4{\cdot}C(:NH){\cdot}OH \longrightarrow C_6H_4C(:NH){\cdot}OAg \longrightarrow C_6H_4C(:NH){\cdot}OC_2H_5.$$

AMIDINES, the name given to compounds of general formula $R{\cdot}C(:NH){\cdot}NH_2$, which may be considered as derived from the acid-amides, $R{\cdot}CO{\cdot}NH_2$ (*see* AMIDES) by replacement of oxygen by the divalent imino (=NH) group. They may be prepared by the action of ammonia or amines on imide chorides or on thiamides; by the action of ammonium chloride or hydrochlorides of amines on nitriles; by condensing amines and amides in presence of phosphorus trichloride; by the action of hydrochloric acid on acid-amides; and by the action of ammonia or amines on imino-ethers. They are colourless crystalline bases, which are unstable; they readily take up the elements of water (when boiled with acids or alkalis), yielding amides and ammonia. On dry distillation they yield nitriles and ammonia. With β-ketonic esters, $HO(CH_3)C{:}CH{\cdot}CO_2R$, they yield oxypyrimidines.

Formamidine, $HC(:NH)NH_2$, is only known in the form of its salts, the crystalline hydrochloride being obtained by the action of ammonia on the hydrochloride of formimido-ethyl ether.

Acetamidine, $CH_3C(:NH){\cdot}NH_2$, is alkaline in reaction, and readily splits up into acetic acid and ammonia when warmed with acids. Its hydrochloride crystallizes from alcohol in colourless deliquescent prisms.

Benzamidine, $C_6H_5{\cdot}C(:NH)NH_2$, forms colourless crystals which melt at 75–80°C.

AMIEL, HENRI FREDERIC (1821–1881), Swiss philosopher and critic, was born at Geneva Sept. 27, 1821. He studied philosophy at Berlin 1844–48. In 1849 he was appointed professor of aesthetics at the academy of Geneva, and in 1854 became professor of moral philosophy. These appointments, conferred by the democratic party, deprived him of the support of the aristocratic party which comprised nearly all the culture of the city. This isolation inspired the one book by which Amiel lives, the *Journal Intime*, which, published (2 vols. 1882–84) after his death, obtained a European reputation. It was translated into English by Mrs. Humphry Ward, and attracted many readers, partly because of the high praise given to it by Matthew Arnold, and partly because it interpreted many lonely souls to themselves. He died in Geneva, on May 11, 1881.

BIBLIOGRAPHY.—See *Life of Amiel* by Mlle. Berthe Vadier (Paris, 1885); Paul Bourget, *Nouveaux essais* (Paris, 1885); E. Scherer, introd. to the *Journal* and in *Études sur la litt. contemp.* (vol. viii.).

AMIENS, north France, capital of the department of Somme, on the left bank of the Somme, 81m. N. of Paris on the Northern railway to Calais. Pop. (1926) 82,215 Though involved in the World War and severely bombarded, the city retains its pre-war aspect The old town occupies the low-lying area between the arms of the rivers Somme and Avre. The site of the ancient ramparts is occupied by boulevards; and suburbs, themselves bounded by another line of boulevards, have arisen beyond these limits, while the city also extends to the right bank of the Somme. The busy quarter lies between the river and the railway. The older quarter is situated directly on the Somme; its narrow and irregular streets intersected by the eleven arms of the river and skirted on the north by the canal derived therefrom.

Amiens occupies the site of the ancient *Samarobriva* capital of the Ambiani, from which it probably derives its name. At the beginning of the 4th century Christianity was preached there by St. Firmin, its first bishop. Its territory formed the mediaeval countship of Amienois, and early in the 12th century the citizens profiting by rivalry of count and bishop gained a charter of enfranchisement. The fief became a dependency of the French crown in 1185. In 1435, by the treaty of Arras it fell to the dukes of Burgundy, until 1477. Surprised by the Spaniards in 1597, the city was recaptured from them after a long siege by Henry IV. Till 1790 it was the capital of the Government of Picardy (*q v*). The famous treaty between Great Britain, France, Spain and Holland which took its name from Amiens was signed here in March 1802. In the Franco-German War (*q.v.*) Amiens, after an important action, fell into the hands of the Prussians on Nov. 28, 1870. In the World War the city was taken by the Germans on Aug. 30, 1914; but after the battle of the Marne the front was established some 20m. eastwards, where it remained till 1918. Amiens then became the first concentration point for British troops disembarking at Boulogne in 1914, and the first air-craft park was established here. It remained of high importance on the lines of communication and in March 1918 the Germans made a great effort to break through between the British and French armies at the Amiens salient. They advanced to with-

in eight miles of the town, which was evacuated by civilians and bombarded daily by heavy guns. The cathedral was struck nine times, and the roof pierced. Other buildings were damaged, and much havoc done in the Rue de Beauvais. Reconstruction, however, proceeded apace after the war. Amiens has the park or Promenade de la Hotoie to the west and several fine squares, notably the Place Longueville and the Place St. Denis with the statue of the famous 17th century scholar Charles Ducange.

The cathedral of Notre Dame (*see* ARCHITECTURE: *Romanesque and Gothic Architecture in France;* and CATHEDRAL) is one of the finest Gothic churches in France. Erected on the plans of Robert de Luzarches, chiefly between 1220 and 1288, it consists of a nave, nearly 140ft. in height, with aisles and lateral chapels, a transept with aisles, and a choir (with deambulatory) ending in an apse surrounded by chapels. The total length is 469ft., the breadth 216ft. The façade, which is flanked by two square towers, has three decorated portals, the central portal having a remarkable statue of Christ of the 13th century; they are surmounted by two galleries, the upper one containing 22 statues of the kings of Judah in its arcades, and by a fine rose-window. A slender spire rises above the crossing. The southern portal is remarkable for a figure of the Virgin and other statuary. The interior contains beautifully carved stalls and a flamboyant choir-screen, and is remarkable for the height of the nave and the boldness of the columns supporting the vaulting. Of the other churches of Amiens, St. Germain (15th century) has good stained glass. The *hôtel de ville,* begun 1550, a belfry of the 14th and 18th centuries and several old mansions are of interest. The learned associations of Amiens include the *Société des Antiquaires de Picardie,* by whom the museum was built in 1854–64, and the early prehistoric collections illustrate the classic area of the Somme.

The city is the seat of a bishop, a prefect, a court of appeal and a court of assizes, and headquarters of the II. Army Corps. There are also tribunals of first instance and of commerce, a board of trade-arbitrators and a chamber of commerce. The textile industries, celebrated since the middle ages, include velvet, cotton, wool, silk, hemp and flax-spinning, hosiery and a variety of mixed fabrics. Though seriously affected by the World War the wool and textile industries have regained their pre-war conditions. Manufactures of machinery and chemicals, and printing, dyeing, and iron-founding are also carried on. Market gardens, known as *hortillonnages,* intersected by small canals derived from the Somme and Avre, cover a considerable area north-east of Amiens; and the city trades in vegetables, grain, sugar, wool, oil-seeds and in the duck-pasties and macaroons for which it is renowned. A very important fair for all species of merchandise is held annually.

AMIENS, BATTLE OF (1918). This is the name for the offensive of the British 4th and French 1st Army under Sir Douglas Haig's orders, an offensive which, launched by surprise on Aug. 8, 1918, and coming close after the Allied counterstroke on the Marne (*see* WORLD WAR and MARNE, SECOND BATTLE OF THE), inaugurated the unbroken tide of advance which culminated in the Armistice, on Nov. 11, 1918. After the German spring offensive had been finally stopped in front of Amiens, this sector had an interval of comparative quiet, except for frequent small raids by the Australians holding it, while the struggle developed on other parts of the front.

Towards the end of June, the 4th Army commander, Gen. Rawlinson, decided that an operation on rather a larger scale than the Australians had so far carried out had every chance of meeting with success. On July 4, six Australian battalions, working in close co-operation with some 60 tanks, together with four companies of the American 33rd division, which was attached to the 4th Army for training, attacked on a front of nearly three and a-half miles, and with consummate ease and only small losses captured the ridge running from Villers-Bretonneux down to the Somme at Hamel. This operation gave greater depth and valuable positions for observation to the British line, while at the same time it denied to the enemy important observation over much of the Somme valley. It also showed that the German infantry was no longer the determined foe that it had been in 1916 and 1917, and that the enemy's defences were not formidable. The real significance of the operation was its evidence that on the 4th Army front a well organized attack, supported by tanks well trained beforehand to co-operate with infantry, would have every prospect of breaking through the enemy's defences, given the element of surprise

On July 17 Rawlinson submitted proposals to Haig for an attack by the 4th Army on a front of approximately 16m. from Moreuil to Morlancourt. The plan was at once approved by Haig, who, in response to a request from Gen. Foch that the British should take the offensive on the Lys front with a view to recovering the important position on Kemmel hill, recommended that the venue for the British offensive should be changed to the Amiens front. To this proposal Foch assented with the modification that the French 1st Army (Debeney) should attack on the southern portion of the front between Moreuil and the River Luce (about three and a half miles) shoulder to shoulder with the British 4th Army, both armies operating under the direct orders of the British commander-in-chief.

On July 28 Foch issued his orders "The object of the operation," he said, "is to disengage Amiens and the Amiens-Paris railway, as well as to beat and push back the enemy between the Somme and the Avre. The offensive, covered on the north by the Somme, is to push forward as far as possible in the direction of Roye." The Amiens–Roye road was fixed as the dividing line between French and British, and Aug. 10 was to be the day of attack. This date was subsequently advanced to Aug. 8.

Preparations for Surprise Attack.—On July 26 orders were received that the preparations, which Rawlinson had already begun in anticipation of sanction being given to his proposed operation, were to be pressed forward with all speed. The essence of the whole plan was secrecy. Unless the existing conditions both as regards the state of the hostile defences and the absence of reserves could be maintained success could not be guaranteed, and in consequence it was not until July 31 that divisional commanders even were told the true story of the operations, a false but adequate reason having been given for the preparations.

On Aug. 1 the strength of the 4th Army was seven divisions, one cavalry division, three tank battalions (about 110 tanks), 11 squadrons R A F. and 1,000 guns and howitzers By zero hour on Aug. 8, this force had been increased to 13 divisions, three cavalry divisions, 12 tank battalions (about 456 tanks), 17 squadrons R A.F., and over 2,000 guns and howitzers, of which 672 were "heavies." In addition, one division, retained in the hands of the commander-in-chief, was brought into the area, while two others arrived on the day of the battle. The cavalry, about 96 whippet tanks, and part of the artillery were moved by road, the remainder being brought up in some 290 special trains, 230 for personnel and guns and 60 for ammunition and *matériel.*

As the Canadian Corps, at the time in reserve near Arras, had not been involved in the desperate fighting earlier in the year, it was realized that wherever it was identified in the line by the enemy an early offensive would certainly be expected The first problem, therefore, was to camouflage its move and to keep its presence secret up to the last possible moment. With this object a few Canadian units were moved into the line near Kemmel, whilst the remainder moved down to the Amiens front, though it was not allowed to take over its part of the front line until just before zero hour on Aug. 8. The task also of introducing and registering a very large number of guns without detection was no easy matter. All movements of artillery units and the formation of ammunition dumps had to be done at night. A strictly limited number of guns only were allowed to fire daily, nothing above the normal number of rounds being permitted.

General Plan of Attack.—The British front of attack was divided between the Canadian Corps (Currie, four divisions) from the Amiens–Roye road to the Amiens–Chaulnes railway, 7,500yds ; the Australian Corps (Monash, five divisions) thence to the Somme, 7,500yds.; and the 3rd Corps (Butler, four divisions) thence to the River Ancre, 5,000yds ; while to each corps a proportion of tanks was allotted The task of the 3rd Corps was to form a defensive flank north of the Somme, whilst the French 1st

Army would carry out a similar task on the right of the Canadians. Three successive objectives were assigned at distances respectively of two to two and a-half, three to five, and six to eight miles from the original starting line. With the ample provision of tanks it was possible to repeat and improve upon the Cambrai experiment (*see* CAMBRAI, BATTLE OF) of Nov. 1917, and thus to gain the full value of surprise; a preliminary bombardment was omitted, the artillery, infantry and tank action commencing simultaneously at zero hour, up to which moment there was no divergence from the ordinary daily routine of trench warfare. With the French, however, the situation was different, as tanks were not available to assist them, and Debeney decided to bombard the enemy's defences for 40 minutes prior to the infantry advance. The zero hour, 4.20 A.M., of the 4th Army advance synchronised with the opening of the French bombardment.

The hostile forces believed to be available to oppose the British were six divisions in first line with eight in reserve of the German 2nd Army (Marwitz), while in front of the attacking corps of the French 1st Army were the two left divisions of the German 2nd Army and one division of the German 18th Army (Hutier). By the morning of Aug. 8 all preparations for the battle were complete, and the Allied forces, all unsuspected by the enemy, were about to enter upon the first stage of their march to the Rhine.

The British Attack, Aug. 8.—At 4.20 A.M. (approximately one hour before sunrise) Rawlinson's 4th Army, under cover of a powerful barrage, debouched to the assault. Thick ground mist veiled the advance from the eyes of the Germans, who were completely surprised and overwhelmed with little resistance along nearly the whole front. The Canadian Corps attacked with three divisions in line, the 3rd, 1st and 2nd in order from the right. The Canadian 3rd Division, making light of the difficult task of debouching from a narrow bridgehead on the south bank of the River Luce, captured Hangard and Demuin, and by noon had carried its front forward to the second objective, between Mézières and Cayeux. The 3rd Cavalry Division then went through, followed by the Canadian 4th Division, but, after taking Beaucourt, was held up by machine-gun fire. The infantry on coming up succeeded in pushing forward, though they were unable that day to capture Le Quesnel, the final objective.

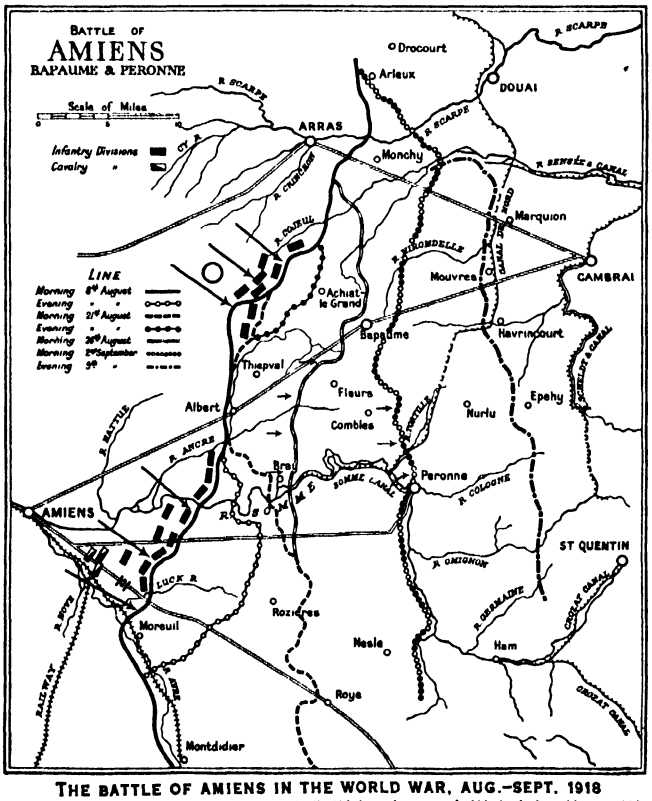
The Canadian 1st Division in the centre reached the first objective by 6 20 A.M.; but the Canadian 2nd Division on its left only attained it an hour and a half later, having met with strong opposition at Marcelcave. At 8 20 A.M. the advance was resumed, the German machine-gunners putting up considerable resistance against the Canadian 2nd Division. The 1st Cavalry Division now sent forward two brigades, one of which passed through the Canadian 2nd Division and drove far into hostile territory, attaining the final objective in conjunction with the infantry, which followed up, clearing the ground in rear of the cavalry. By the end of the day's fighting the Canadian Corps had, with the exception already noted on the extreme right, carried out its appointed task, and captured over 5,000 prisoners and 161 guns.

Progress in the Centre.—The Australian Corps in the centre of the British attack had their 2nd and 3rd Divisions in the front line with the 5th and 4th in support, the 1st Division being in reserve. The leading line, aided most effectively by the tanks, reached the first objective with little opposition. The 5th and 4th Divisions then continued the advance, pushing on beyond Bayonvillers and Morcourt, and occupied the second objective by about 10.30 A.M., when a brigade of the 1st Cavalry Division passed through towards Harbonnières and armoured cars raced forward down the Brie road, penetrating far into the enemy's back areas. Behind them, the Australians, throwing back their left to face the enemy on the north bank of the Somme, pushed forward their centre and right to the final objective just west of Vauvillers and Proyart, where they found the cavalry held up. During the day the Australians took nearly 8,000 prisoners and 173 guns.

North of the Somme the 3rd Corps had not met with the same measure of success. The plan had been disarranged by a local German attack near Morlancourt on Aug. 6, which forced back a part of the Allied line some 800 yards. In addition the terrain was not so suitable for tank manoeuvres as south of the river. The attack opened with the 58th, 18th and 12th Divisions from right to left. After the first objective had been gained, the further advance broke down against the resistance of the enemy holding the Chipilly spur, while further north the enemy counter-attacked and drove back the advanced attacking troops. Nevertheless the 3rd Corps captured during the day nearly 2,400 prisoners and 40 guns.

The results of this most successful day's battle were the complete defeat and rout of 11 German divisions, a gain of ground to an average depth of six to seven miles on a front of eight miles, the capture of over 16,000 prisoners, 373 guns, several thousand machine-guns and quantities of ammunition and stores. Most important of all, the battle destroyed the last hope of German victory. "It was," says Ludendorff, "the black day of the German army in the war . . . To continue would be a gamble. The war would have to be ended."

The French Attack, Aug. 8.—At 4.20 A.M., simultaneous with the British assault, the French bombardment of the enemy's position on the commanding ground in the angle between the rivers Avre and Luce opened, and at 5 05 A.M. the French infantry in this sector debouched to the attack. For this operation Debeney allotted three divisions of the 31st Corps, of which one division was given the task of capturing Moreuil. Despite a stubborn defence, the enemy was gradually driven back and Moreuil wood



THE BATTLE OF AMIENS IN THE WORLD WAR, AUG.–SEPT. 1918
The successive stages of the great British advance initiated by the battle of Amiens, Aug. 8, 1918, brought the British to the outworks of the Hindenburg Line which they then attacked, breaking through at the end of September. The morale of the German Army was broken, and the way paved for the final victory three months later

taken. This feature was of great importance, as its capture secured the flank of the British advance. At 8 20 A.M. the next corps to the south, the 9th Corps, crossed the Avre, south of Moreuil, and extended the front of attack, which by the end of the day's fighting reached the general line Plessier–Fresnoy (excl.). Although the French attack did not quite reach its final objective for the day, its main task of securing the British flank was carried out, while some 3,000 prisoners and many guns were captured. The other two corps of the French 1st Army did not take an offensive rôle until next day. The result also enabled Gen. Fayolle, com-

manding the French reserve group of armies, to carry out his plan of extending the battle front farther to the south on Aug. 9.

Continuation of British Advance, Aug. 9–11.—It was decided by Rawlinson that the 4th Army should on Aug. 9 continue its advance to the line Roye–Chaulnes–Bray–Dernancourt. The main attack was entrusted to the Canadian Corps, which was to push south-east to the line Roye–Hallu, whilst the Australian corps was to secure its left between the latter place and Méricourt, and the 3rd Corps to advance to Etinehem and form a defensive flank north of the Somme.

Early in the morning the Canadians captured the village of Le Quesnel, thus completing the capture of all the objectives allotted to the main British attack for the 8th. During the day, assisted by cavalry, they advanced the line an average of five miles and halted for the night on a general line east of Rouvroy and Méharicourt. To the north the Australians reached Lihons hill and captured Framerville after stubborn fighting. The 3rd Corps, north of the Somme, cleared the Chipilly spur and occupied Morlancourt. During the day six German divisions reinforced the front from neighbouring armies. On Aug. 10 and 11 the advance continued against ever-stiffening resistance and hostile counter-attacks, eventually reaching the general line Le Quesnoy–Lihons–Raincourt, whilst north of the river the Etinehem spur was completely cleared.

It was now clear that to push the offensive farther would lead to disproportionate loss with little corresponding gain The enemy had reformed his front, shattered on the 8th, by fresh troops from other portions of the line, and had settled down on the edge of the area devastated in the Somme battles of 1916, where a maze of old trenches, wire and shell holes rendered defence easy and rapid advance impracticable. Rawlinson had engaged all his 13 divisions, units were tired and in need of a breathing-space. He therefore decided to allow his troops a few days' rest while preparing for a renewal of the attack on Aug. 15. Units in the line were relieved and tired infantry and cavalry withdrawn into reserve.

French Operations, Aug. 9–11.—On Aug 9 Debeney made an encircling attack, south-east and north-east with his 10th and 35th Corps, his objective being Montdidier. The former was checked, and thus the garrison of the town managed to slip out, but the town was occupied and the rearguard captured on the morning of Aug 10 In the meantime the 31st Corps to the north reached the line Pierrepont–Arvillers. By the night of the 11th it gained the western outskirts of Roye On Aug 10 Fayolle brought in the French 3rd Army (Humbert) on the right. Attacking on the front Courcelles–Gournay in the direction of Lassigny, it made an advance of an average depth of three to four miles. Next day the front was extended still farther southwards, but, owing to the enemy's resistance becoming stronger, progress was thenceforward slow.

British Operations, Aug. 12–21.—Owing to the difficulty of reorganizing the front of attack and of bringing up the guns, the attack arranged for Aug. 15 did not materialize, and up to the 21st only local actions took place on the 4th Army front. British attacks alternated with hostile counter-attacks, the line after hard fighting reaching Damery–Lihons–Proyart–Dernancourt. On Aug 17 Haig decided to transfer temporarily the centre of gravity of the British offensive to the 3rd and 1st Army areas. The Canadian Corps was taken out of the line and the French 1st Army took over the British front as far north as Lihons. During the period Aug. 8–21 the 4th Army had forced back the Germans to a depth of 12m., had defeated or engaged with its own 13 divisions no less than 27 of the enemy's, had taken over 23,000 prisoners and 400 guns and had killed and wounded more than an equivalent number, at a cost to itself of some 27,000 casualties.

French Operations, Aug. 12–21.—During this period the French 1st Army, which remained under Haig's command until the 16th, also came to a halt, but the French 3rd Army, whose advance was assisted by the French 10th Army's attack east of the Oise, after a hard and determined defence succeeded in occupying Lassigny on Aug. 21. In the 12 days' fighting Humbert's army of seven divisions had driven eight hostile divisions from their strong vantage-ground and had taken 5,000 prisoners and 100 guns.

General Results of the Battle.—The course and results of the fortnight's fighting may be summed up as follows: The three Allied armies (British 4th, French 1st and 3rd), with 32 divisions, had attacked and defeated the German 2nd and 18th Armies of 42 divisions. The Allies had advanced to a depth of 6–13m. on a front of 47m. taking 40,000 prisoners and 600 guns. Most important of all, the Allied lateral communications between Paris and the north had been cleared, and a wide breach had been made in the German front, susceptible, as events were to show, of being rapidly widened to either flank by further Allied attacks. A shattering blow had been dealt to the *morale* of the German Army and their high command, from the effects of which neither was destined to recover. The battle of Amiens was the first page in the story of the Allied victory of 1918.

THE BATTLE OF BAPAUME–PÉRONNE

This operation is dealt with here as it formed the immediate sequel to the battle of Amiens, in the scheme of the British offensive leading up to the assault of the Hindenburg Line. At the time the front of Byng's 3rd Army, which was the northern neighbour of Rawlinson's Army, was held as follows: 5th Corps (Shute, with three divisions) from the left of the 4th Army just north of Albert to Beaucourt, 4th Corps (Harper, with five divisions) thence as far as opposite Ablainzeville, 6th Corps (Haldane, with four divisions) thence to the army boundary south of Arras. Preparations were at once put in hand, the operations being timed to begin on Aug. 21, by which date the rapid advance of the 4th Army had been checked on the western edge of the old Somme battlefields of 1916.

Attack by 3rd Army.—On Aug. 21 a preliminary operation was carried out by the 4th and 6th Corps together with the left division of the 5th Corps, in order to get within striking distance of the enemy's main defensive position along the Arras-Albert railway. This attack, which was entirely successful and resulted in the capture of some 2,000 prisoners, enabled Byng to spend the 22nd in bringing up his guns preparatory to the main attack on the 23rd, on which date a general advance on the whole army front, together with that portion of the 4th Army which was north of the Somme, was timed to take place.

On the 23rd Byng attacked on a front of 16m. from just north of Albert to the Cojeul Though stubborn resistance was encountered considerable progress was made, the objective being reached all along the line The 4th Corps, in the centre, pushed forward to Bihucourt and Loupart wood, while the 6th Corps captured Ervillers and established itself east of the Arras–Bapaume road in the vicinity of Boyelles. On the right the 5th Corps, in conjunction with the 3rd Corps (4th Army), pushed out its right and established itself on the hills overlooking the town of Albert just west of La Boisselle. During the day 5,000 prisoners and a number of guns were taken.

The advance was continued on the 24th and 25th, by the evening of which the 4th Corps had pushed forward as far as the line Favreuil–Mory, thus threatening the enemy's line of retreat from Bapaume. To the south the 5th Corps, after capturing the Thiepval stronghold on the 24th, attained a general line west of Contalmaison and Courcelette. On the left the 6th Corps occupied St. Léger and Henin-sur-Cojeul but was held up in front of Croisilles.

Fourth Army Operations.—The operations of the 3rd Army were closely supported by the 4th Army troops north of the Somme. On the 22nd the 3rd Corps and left Australian Division attacked on a front of 7,000yd., reaching all their objectives to a depth of from 2,000 to 3,000 yards. In the afternoon a strong counter-attack developed against the 3rd Corps right division, and much of the ground won earlier in the day was lost. During the next three days the advanced continued in conjunction with the 3rd Army, and on the evening of the 25th the front had reached a general line along the high ground west of Suzanne-Mametz. South of the Somme the Australian Corps on the 23rd advanced up to the edge of the old Somme battlefield, capturing 3,000 prisoners and 23 guns. As a result of the critical situation caused by these operations, the German Higher Command ordered

Von Boehm, commanding the group of armies between the Ancre and the Aisne, to fall back to the general line Quéant-east of Bapaume–Péronne–Ham. This movement was carried out on the 26th and 27th.

On the 26th the 5th Corps made a rapid advance, whilst the 4th Corps continued to swing round to the north-east of Bapaume, occupying Beugnâtre. On the evening of the 25th, the 17th Corps (Ferguson) relieved the 6th and undertook the difficult task of dispossessing the enemy of his strong position in the vicinity of Croisilles. During the next week a stubborn defence was shown all along the front, which by the evening of Sept. 2 had reached the enemy's position on the line Morval–Haplincourt–Noreuil. During the 13 days' fighting the 14 divisions of the 3rd Army had engaged 23 hostile divisions, had taken from them 11,000 prisoners and many guns and had driven them back a depth of 8–13m. on a front of 20m, besides inflicting heavy losses in killed and wounded.

On the 4th Army front north of the Somme, the 3rd Corps, together with the 3rd Australian Division, continued the advance in touch with the 3rd Army. South of the Somme the advance had been rapid, and on the evening of the 29th the river had been reached between Cizaucourt and Biaches, whence the line continued northwards to Combles. In view of the small prospect of success afforded by an attempt to force the strongly-held river line south of Péronne, Rawlinson decided that the next operation must be a strong advance by the centre and left towards Nurlu in order to turn the river line. Before that could be done, however, the key to it, the dominating height of Mont St. Quentin, which commanded all the country to the north and west, including all the river passages by which it could be approached, had to be captured.

Capture of Mont St. Quentin.—Although the operations which resulted in its capture by the Australians extended over only a few miles of front, they were of such importance to the general advance and so brilliantly executed that a description will be given in rather greater detail. On the 30th a bridge-head on the north bank of the river near Cléry was seized, and by 4 A.M. on the 31st the 5th Brigade (2nd Australian Division) had crossed over and by 7 A.M. had captured Mont St. Quentin village, the right being held up in front of Anvil wood. Shortly afterwards a strong counter-attack developed and drove the British line back to the road on the south-west side of the village. As a result of the day's fighting the 5th Brigade of some 1,200 rifles had penetrated to a depth of 2,000yd., and, though reduced to only 600 rifles, had held out on a wide front of 4,000yd. against repeated and desperate counter-blows.

Next morning the 6th Brigade, which had crossed the river the evening before, passed through the 5th Brigade, and after a short bombardment stormed the village and wood and established itself on the height. Meanwhile the 14th Brigade (5th Australian Division) also passed through south of the 6th Brigade, and, brushing aside all opposition, entered and occupied Péronne, only a small portion of the suburbs on the north-east remaining in the enemy's hands. Next day the Australians occupied Allaines, and the 3rd Corps St. Pierre Vaast and Vaux woods The line of the Somme had been turned, due, as a detailed account would show, to the brilliant initiative of every commander, from the army commander to the section leader, and to the magnificent fighting qualities of the Australian soldier. Between Aug. 22 and Sept. 2 the 4th Army of nine divisions had engaged 23 of the enemy's divisions and taken 23,000 prisoners and many guns.

Results of the Battle.—Byng's and Rawlinson's armies totalling together 23 divisions had defeated 46 German divisions. On a front of 28m. they had advanced to a depth of six to 13m., capturing 34,250 prisoners and 270 guns. The whole area of the Somme battlefields, which had cost the British five months of bitter fighting in 1916, had been reconquered in less than a fortnight; more than half the ground gained by the German spring advance had been recovered, the only good natural line of defence west of the Hindenburg system had been broken, and the shifting of the moral and material balance in favour of the British and against the Germans was not only heartening to the troops of the Allies but had become patent to the world.

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AMIL MARDUK or **EVIL MERODACH:** *see* MARDUK.

AMINES, in chemistry, derivatives of ammonia (*q.v.*) in which one or more of the three hydrogen atoms are replaced by alkyl or aryl groups. The replacement of one hydrogen atom by one alkyl or aryl group gives rise to primary amines; of two hydrogen atoms by two groups to secondary amines; of three hydrogen atoms by three groups to tertiary amines. The tertiary amines possess the power of combining with one molecular proportion of an alkyl iodide to form quaternary ammonium salts. The structural relations of these compounds may be shown thus:

NH_3;
ammonia;
NH_2R;
primary amine;
NHR_2;
secondary amine;
NR_3;
tertiary amine;
NR_4I;
quaternary ammonium iodide.

Aliphatic Amines.—These compounds possess properties very similar to those of ammonia, the lowest members of the series being combustible gases readily soluble in water. The next higher members of the series are liquids of low boiling point also readily soluble in water, the solubility and volatility, however, decreasing with the increasing carbon content of the molecule until the highest members of the series are odourless solids of high boiling point and are insoluble in water. They are all strong bases, readily forming salts with the mineral acids, and double salts with the chlorides of gold, platinum and mercury. They are ionized in aqueous solution to a much greater extent than ammonia, the quaternary ammonium bases being the most ionized.

Many methods have been devised for the preparation of primary amines, methylamine having been isolated in 1849 by A. Wurtz on boiling methyl isocyanate with caustic potash, $CON{\cdot}CH_3+2KHO=CH_3NH_2+K_2CO_3$. The other methods are:—the reduction of nitriles with alcohol and sodium (A. Ladenburg, 1886); heating the esters of nitric acid with alcoholic ammonia at 100° C (O. Wallach, 1881); the action of reducing agents on nitro-paraffins; the action of zinc and hydrochloric acid on aldehyde-ammonias; the reduction of phenylhydrazones and oximes of aldehydes and ketones with sodium amalgam in the presence of alcohol and sodium acetate (J. Tafel, and H. Goldschmidt, 1886) the acidic hydrolysis of the isonitriles, $R{\cdot}NC+2H_2O=R{\cdot}HN_2-H_2CO_2$, heating the mustard oils with a mineral acid; the hydrolysis of the alkyl phthalimides (S. Gabriel, 1887); distillation of the amino-acids with baryta; the action of bromine and caustic potash on the acid-amides (A W Hofmann, 1885); and the hydrolysis of substituted urethanes (Th. Curtius, 1894).

The secondary amines are prepared, together with the primary and tertiary, by the action of ammonia on the alkyl iodides (*see* below), or by the hydrolysis of para-nitroso derivatives of tertiary aromatic amines, such as para-nitrosodimethylaniline, thus:

$$NO{\cdot}C_6H_4{\cdot}N(CH_3)_2+H_2O=NO{\cdot}C_6H_4{\cdot}OH+NH(CH_3)_2.$$

By the action of ammonia on the alkyl iodides a complex mixture of primary, secondary and tertiary amines, along with a quaternary ammonium salt, is obtained, the separation of which is difficult. The method worked out by A. W. Hofmann in 1850 for the ethylamines is as follows:—the mixture is distilled with caustic potash, when the primary, secondary and tertiary amines distil over, and the quaternary ammonium salt remains behind unaffected. The aqueous solution of the amines is now shaken with

diethyl oxalate, when the primary amine forms a crystalline dialkyloxamide and the secondary amine an insoluble liquid, which is an ethyl dialkyloxamate, the tertiary amine not reacting: $(CO_2C_2H_5)_2 + 2NH_2R = (CO{\cdot}NHR)_2 + 2C_2H_5OH$; $(CO_2C_2H_5)_2 + NHR_2 = C_2H_5O_2C{\cdot}CONR_2 + C_2H_5OH$. The tertiary amine is then distilled off, the residual products separated by filtration and finally hydrolysed by a caustic alkali.

A more general method due to O. Hinsberg (1890) consists in treating the mixed bases with benzene sulphonic chloride (or *p*-toluene sulphonic chloride). The primary base gives an acidic derivative, $C_6H_5{\cdot}SO_2{\cdot}NHR$ soluble in aqueous alkali, the secondary base furnishes the compound, $C_6H_5SO_2NR_2$, insoluble in alkali, whereas the tertiary base does not react, the process is applicable to both aliphatic and aromatic amines.

The primary, secondary and tertiary amines may be readily distinguished by their behaviour with various reagents. Primary amines when heated with alcoholic potash and chloroform yield isonitriles, which are readily detected by their offensive smell. The secondary and tertiary amines do not give this reaction. With nitrous acid, the primary amines yield alcohols, the secondary amines yield nitrosamines and the tertiary amines do not react: $R{\cdot}NH_2 + ONOH = R{\cdot}OH + N_2 + H_2O$; $R_2NH + ONOH = R_2N{\cdot}NO + H_2O$. The condensation with benzene sulphonic chloride in the presence of alkali also furnishes a method of diagnosis (*see* above). Primary amines heated with carbon disulphide in alcoholic solution are converted into mustard oils, when the dithiocarbamate first produced is heated with a solution of mercuric chloride Primary and secondary amines condense with *o*-xyxylene dibromide giving two and one molecular proportions of hydrogen bromide, respectively. Tertiary aliphatic amines form additive compounds with this reagent (Scholtz 1898).

Methylamine, CH_3NH_2, occurring in *Mercurialis perennis*, in bone-oil and herring brine, is also a decomposition product of many alkaloids. At ordinary temperatures it is a gas with a strong ammoniacal smell, burns readily and is exceedingly soluble in water. Dimethylamine $(CH_3)_2NH$, found in Peruvian guano, is a heavy vapour which liquefies at 7° C and has a strong fish-like smell. Trimethylamine $(CH_3)_3N$, is a vapour very similar to dimethylamine, but liquefies at 3·2–3·8° C. It is usually obtained from "vinasses," the residue obtained from the distillation of beet sugar alcohol. The three methylamines can be obtained from ammonia and form aldehyde solution and a suitable separation for each of the three has been devised by E Werner (1917). Tetramethylammonium iodide, $N(CH_3)_4I$, the chief product obtained by the action of methyl iodide on ammonia (Hofmann), crystallizes in quadratic prisms and has a bitter taste. By warming its aqueous solution with an excess of silver oxide, it is converted into tetramethylammonium hydroxide $N(CH_3)_4OH$, which crystallizes in hygroscopic needles, and has a very alkaline reaction. This hydroxide forms many crystalline salts, absorbs carbon dioxide and precipitates many metallic hydroxides. On dry distillation it is decomposed into trimethylamine and methyl alcohol. If the nitrogen atom in a quaternary ammonium salt is in combination with four different groups, then the molecule is asymmetric, and the salt can be resolved into optically active enantiamorphous isomerides (W. J. Pope, 1901 [*see* STEREOCHEMISTRY]).

Diamines.—The diamines contain two amino-groups and are of importance because two of them are identical with the ptomaines produced by the putrefactive action of bacteria on albumen and other related substances. Ethylenediamine, $C_2H_4(NH_2)_2$, may be prepared by heating ethylene dibromide with alcoholic ammonia to 100° C (F. S. Cloez, 1853); or by the action of tin and hydrochloric acid on cyanogen (T. Fairley, 1864) It is an alkaline liquid, which when anhydrous boils at 116·5° C. Nitrous acid converts it into ethylene oxide. It combines directly with many metallic salts. (S. F. Jörgensen, 1889.) Trimethylenediamine, $NH_2{\cdot}(CH_2)_3{\cdot}NH_2$, prepared by the action of ammonia on trimethylene bromide (E. Fischer, 1884) is a liquid which boils at 135–136° C. Tetramethylenediamine (putrescine), $NH_2{\cdot}(CH_2)_4{\cdot}NH_2$, is prepared by reducing ethylene dicyanide (succinonitrile) with sodium in absolute alcoholic solution (A. Ladenburg, 1886). It melts at 27° C and is easily soluble in water. Pentamethylenediamine (cadaverine), $NH_2{\cdot}(CH_2)_5{\cdot}NH_2$, is prepared by reducing trimethylene cyanide in ether solution by zinc and hydrochloric acid (A. Ladenburg, 1883). Cadaverine is a syrup at ordinary temperatures and boils at 178–179° C. It is readily soluble in water and alcohol, but only slightly soluble in ether.

Aromatic Amines.—The aromatic amines in some respects resemble the aliphatic amines, since they form salts with acids, and double salts with platinum chloride, and also distil without decomposition. On the other hand, they are much weaker bases than the aliphatic amines, their salts undergoing hydrolytic dissociation in aqueous solution. The primary aromatic amines may be prepared by the reduction of the nitro-hydrocarbons, the reducing agents used being either alcoholic ammonium sulphide (N. Zinin), zinc and hydrochloric acid (A. W. Hofmann), an alcoholic solution of stannous chloride containing hydrochloric acid (R Anschutz, 1886), tin and hydrochloric acid, or on the manufacturing scale iron and water acidified by hydrochloric acid They may also be obtained by the reduction of nitroso compounds and of azo- and hydrazo-compounds and of hydrazones, by distilling the amino-acids with lime, by heating phenols with ammonio-zinc chloride (V. Merz, 1880), and by heating the secondary and tertiary bases with concentrated hydrochloric acid to about 180° C At about 300–400° C the alkyl chloride formed in this reaction attacks the benzene nucleus and replaces hydrogen by an alkyl group or groups, forming primary amines homologous with the original amine; thus methylaniline hydrochloride is converted into para- and ortho-toluidine hydrochloride, and phenyltrimethylammonium iodide is converted into mesidine hydriodide.

The primary aromatic amines are colourless liquids or crystalline solids which are sparingly soluble in water, but readily soluble in the common organic solvents. When heated with alkyl or aryl iodides they are converted into secondary and tertiary amines. When heated with concentrated sulphuric acid they become sulphonated. They form condensation products with aldehydes, benzaldehyde and aniline giving rise to benzylideneaniline, $C_6H_5N{:}CH{\cdot}C_6H_5$, and when heated with organic acids forming anilides. They give the isonitrile reaction (*see* above) when warmed with chloroform and a caustic alkali, and form alkyl thioureas when heated with an alcoholic solution of carbon bisulphide. When warmed with a solution of nitrous acid, they are converted into phenols; if, however, nitrous acid be added to an ice-cold solution of a primary amine in excess of mineral acid, a diazonium salt is formed (*see* ANILINE, AZO-COMPOUNDS and DIAZO-COMPOUNDS).

The secondary amines may be of two types—namely, the purely aromatic amines, and the mixed secondary amines, which contain an aromatic residue and an alkyl group. The purely aromatic amines are obtained by heating the primary amines with their hydrochlorides, and, in some cases, by heating a phenol with a primary aromatic amine and a catalyst (anhydrous zinc chloride or 1% of iodine). The mixed secondary amines are prepared by the action of alkyl iodides on the primary amines, or by heating salts of the primary amine with alcohols under pressure. (*See* ANILINE.) The mixed secondary amines have basic properties, but the purely aromatic secondary amines are only very feeble bases. Both classes readily exchange the imide hydrogen for acid radicals and give nitrosamines with nitrous acid.

The tertiary amines may also be of two types, the purely aromatic and the mixed type. The mixed tertiary amines are produced by the action of alkyl halides on the primary amines. The simplest aromatic tertiary amine, triphenylamine, is prepared by the action of brombenzene on sodium diphenylamine (C. Heydrich, 1885).

Benzylamine, $C_6H_5{\cdot}CH_2{\cdot}NH_2$, may be prepared by reducing benzonitrile in alcoholic solution with zinc and acetic acid (O. Mendius, 1862), or by metallic sodium (E Bamberger, 1887). It can also be obtained together with di- and tri-benzylamines by the action of ammonia on benzyl chloride (S Cannizzaro, 1865) It is a liquid which boils at 183° C, has a strongly alkaline reaction, and is miscible in all proportions with water, alcohol and ether Diphenylamine, $(C_6H_5)_2NH$, the simplest representative of the true aromatic secondary amines is prepared by heating aniline and

aniline hydrochloride for some hours to 210–240° C (Ch. Girard and G. de Laire, 1866). It crystallizes in white plates, which melt at 45° C and boil at 302° C.

Aromatic Diamines.—The simplest aromatic diamines are prepared by reducing the three nitranilines. Ortho-phenylenediamine, $C_6H_4(NH_2)_2$, crystallizes from water in plates, which melt at 102–103° C and boil at 256–258° C. The ortho-diamines are characterized by the large number of condensation products they form (*see* IMINAZOLES, QUINOXALINES, etc.). Meta-phenylenediamine crystallizes in rhombic plates which melt at 63° C and boil at 287° C. It is easily soluble in water and alcohol. Para-phenylenediamine may be prepared as above, and also by the reduction of aminoazobenzene. It crystallizes in tables which melt at 140° C and boil at 267° C. When heated with 10% hydrochloric acid to 180° C the three diamines yield the corresponding dihydroxybenzenes (J. Meyer, 1897). The three classes of aromatic diamines may be distinguished by their behaviour towards nitrous acid. The ortho-compounds condense to azimino benzenes, the meta-compounds yield azo-dyestuffs and the para-compounds yield bis-diazo compounds of the type $XN_2{\cdot}C_6H_4{\cdot}N_2X$. (*See* DIAZO-COMPOUNDS.)

REFERENCE.—T. E. Thorpe, *Dictionary of Applied Chemistry* (1921). "Amines," p. 185. (G. T. M.)

AMINOSIS, the abnormal presence of amino-acids in the organism. Proteins are made up of long chains of amino-acids. In the process of metabolism the proteins are split up into their constituent amino-acids. Some of these acids are used in the synthesis of new body proteins, but the majority are further reduced by oxidation and deaminization, to carbon dioxide and water. The amine radical (NH_2) is synthesized into urea and excreted as such. In certain abnormalities of metabolism, this change does not take place and the body loses the power of converting the amino-acids into their normal end products. In these circumstances we find amino-acids in the urine. There are several types in this group. The most important form is when homogenistic acid is found in the urine. This substance, in the presence of oxygen and alkali, gives the urine a dark brown colour.

AMIOT, JEAN JOSEPH MARIE (1718–1793), French Jesuit missionary, was born at Toulon in Feb. 1718. He entered the Society of Jesus in 1737 and was sent in 1750 as a missionary to China. He soon won the confidence of the Emperor Kien-lung, and spent the remainder of his life at Peking, where he died Oct. 9 1793. Amiot provided a key to the thought and life of the Far East, by his *Dictionnaire tartare-mantchou-français* (*Paris*, 1789). His other writings are to be found chiefly in the *Mémoires concernant l'histoire, les sciences et les arts de Chinois* (Paris, 1776–91). The *Vie de Confucius*, the 12th vol. of that collection, is complete and accurate.

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AMIR or **AMEER,** a title common in the Mohammedan east (from an Arabic word meaning "commander," from the root *amr*, "commanding"). The form *emir* is also employed in English. The word originally signified a naval or military commander, but very early came to be applied to any high office-bearer, lord or chief. The caliph had the style of *Amir ul Omara*, "lord of lords." *Amir ul Muminim*, or "commander of the faithful," the title of the sultans of Turkey, was first assumed by Abu Bekr, and was taken by most of the various dynasties which claimed the caliphate.

The use of the word is akin to that of the English "lord," sometimes connoting office, as in *Amir ulaḥghal* (minister of finance) under the Almohades (*cf.* "lord of the treasury"), sometimes mere dignity, as in the case of the title of honour borne by all descendants of the Prophet. Sometimes it connotes the meaning of "sovereign lord," in which sense it was assumed by the rulers of Afghanistan and Bukhara, the title implying a lesser dignity than that of sultan. The word (confused not unnaturally with the particle usually attached to it) is the origin of the English "admiral."

AMIR 'ALI, SEYYID (1849–1928), Indian jurist and Muslim leader, was born April 6, 1849, of an Arab family, tracing descent from the Prophet, which migrated from Persia and settled at Mohan in Oudh in the middle of the 18th century. At Hugli college, Calcutta, he graduated in 1867. He came to London and was called to the bar of the Inner Temple in 1873. He had already published *A Critical Examination of the Life and Teachings of Mahomed*, the first of a series of books of Islamic modernist interpretation and apologetics, which have given him a recognized place in English literature. He was for some years a lecturer on Mohammedan law at the Presidency College, Calcutta, and afterwards President of the faculty of law at the university there. He was also chief presidency magistrate of Calcutta and in 1890 was appointed a judge of the Bengal High Court, being the first Mohammedan to reach the bench in India. He was made a C.I.E. in 1887. In 1904 he retired and settled in England. He was the first Indian to be sworn (Nov. 1909) of the Privy Council and to serve on its judicial committee. But his chief ambition in life was the advancement of the Indian Muslims, both morally and materially, along practical and constitutional lines and his activities paved the way for the Morley-Minto and subsequent reforms. He died at his home at Rudgwick, Sussex, on Aug 3, 1928.

AMIS ET AMILES, the title of an old French romance. In its earlier and simpler form it is the story of two friends, one of whom, Amis, was smitten with leprosy because he had committed perjury to save his friend. A vision informed him that he could only be cured by bathing in the blood of Amiles' children. When Amiles learnt this he killed the children, who were, however, miraculously restored to life after the cure of Amis. The tale was probably of Oriental origin, and was eventually attached to the Carolingian cycle as a 12th-century *chanson de geste*, written in decasyllabic assonanced verse, each stanza being terminated by a short line. Amis has married Lubias and become count of Blaives (Blaye), while Amiles has become seneschal at the court of Charlemagne, and is seduced by the emperor's daughter, Belliant. The lovers are betrayed, and Amiles, fearing to fight in a false cause, goes in search of Amis, who personates him in the ordeal by combat. He thus saves his friend, but in so doing perjures himself. Then follows the leprosy of Amis, and, after a lapse of years, his discovery of Amiles and cure. The legend of Amis and Amiles occurs in many forms with slight variations.

See L Gautier, *Bibl. des chansons de geste* (1897); also the essay by W. Pater in *The Renaissance* (1893). The tale is published in good modern translations.

AMITERNUM, an ancient town of the Sabines, about 5m. N. of Aquila, in the broad Aternus valley from which, says Varro, it took its name. Stormed by the Romans in 293 B.C. it suffered in the wars of the Republic, but its fertility made it prosperous under the empire. It lay at the point of junction of four roads—the Via Caecilia, the Via Claudia Nova and two branches of the Via Salaria. There are considerable remains of an aqueduct, an amphitheatre and a theatre, all of the imperial period, while in the hill on which the village of S. Vittorino is built are some Christian catacombs. Sallust was born at Amiternum.

AMITOSIS, a term used in biology to denote the processes of cell division when the nucleus does not pass through the complicated series of changes normally associated with that phenomenon (*see* MITOSIS). Amitosis occurs in some of the lower forms of life and also in malignant growths (cancers) in the higher forms. (*See* CYTOLOGY.)

AMLWCH (ăm'lo͝och), market town of Anglesey, north Wales, situated on slightly rising ground on the north-east coast of the island, 15 m. N.W. of Beaumaris. Rather more than three miles distant on the coast are the remains of a Romano-British earthwork, while near at hand a mediaeval settlement is represented by the Llanllaianau monastery. Amlwch seems to have been one of the fishing villages that grew up on the coast in association with these older sites.

In the 18th century the town came into prominence as the port for the rich copper mines of Parys mountain about two miles south of the town. There are traditions of the mines being worked intermittently from Roman days, but they reached their maximum

activity between 1768 and 1870, and they are now derelict. The population in 1841 was 6,217 and in 1921 was 2,699. Industries at one time included slate-quarrying, still carried on to a limited extent, .shipbuilding, iron and brass foundries, alum, vitriol, manure and tobacco works. Amlwch is the terminus of the branch line from Gaerwen to Amlwch, formerly the Anglesey Central Railway, and now run by the L.M S.R.

AMMAN, JOHANN CONRAD (1669–*c.* 1730), Swiss physician, was born at Schaffhausen and practised at Amsterdam He was one of the earliest writers on the instruction of the deaf and dumb and first called attention to his method in his *Surdus loquens* (Amsterdam, 1692), which was often reprinted and was reproduced by John Wallis in the *Philosophical Transactions* (1698).

AMMAN, JOST (1539–91), Swiss artist, celebrated chiefly for his engravings on wood, was born at Zurich. Of his personal history little is known beyond the fact that he removed in 1560 to Nuremberg, where he continued to reside until his death in March 1591. A large number of his original drawings are contained in the Berlin collection of engravings. The genuineness of not a few of the specimens to be seen elsewhere is at least questionable A series of copperplate engravings by Amman of the kings of France, with short biographies, appeared at Frankfort in 1576 He also executed many of the woodcut illustrations for the Bible published at Frankfort by Sigismund Feierabend. Another serial work, the *Panoplia omnium liberalium mechanicarum et sedentariarum artium genera continens,* containing 115 plates, is of great value. Amman's drawing is correct and spirited, and his delineation of the details of costume, etc , is minute and accurate.

AMMAN, a city of Palestine (*see* PHILADELPHIA).

AMMANATI, BARTOLOMEO (1511–92), Florentine architect and sculptor. He designed many buildings in Rome, Lucca and Florence, an addition to the Pitti Palace being one of his most celebrated works He also built the beautiful bridge over the Arno, known as Ponte della Trinita The three arches are elliptic, and, though very light and elegant, have resisted the fury of the river, which has swept away several other bridges at different times. Another important work was the fountain for the Piazza della Signoria. In 1550 Ammanati married the poet Laura Battiferri.

AMMANFORD, urban district, Carmarthenshire, Wales. Pop (1921) 6,984 Situated near the junction of the river Amman with the Loughor 17 miles E. of Carmarthen town. This region has associations with Welsh folk-lore, particularly the hunting of Twrch Trwth (Mabinogion), and with the Physicians of Myddfai (a village in East Carmarthenshire). In the 18th and 19th centuries considerable quantities of local carboniferous limestone were burnt and carried long distances by road to West Wales for marling purposes. Ammanford grew with the export trade in coal, and its importance increased especially after 1885 as the use of anthracite spread. After 1900 rapid strides were made and Ammanford doubled its population in ten years—(1901) 3,500; (1911) 6,074. With the growing demand for anthracite in place of steam coal in modern industry (1918–28) and the amalgamation of almost all the anthracite collieries in South Wales into a large unit with world-wide influence and markets, Ammanford and district have escaped to some extent the universal depression in the coal industry since 1918. The population is still increasing and new pits were sunk in 1928.

Ammanford has a station on the Pantyffynon–Garnant branch of the G.W.R , and is also served by Pantyffynon and Tirdail on the Llanelly and Llandilo branch line over parts of which the G W.R. and L.M S.R. have running powers. Ammanford was made an urban district in 1903 and since 1918 is included in the East Carmarthenshire (Llanelly) parliamentary area.

AMMENDORF, a town lying on the river Elster between Halle and Merseburg, Prussian Saxony. Pop. (1925) 12,185 It is a centre for lignite and briquette industries, also producing machines, chemicals, paper and cardboard.

AMMIANUS MARCELLINUS, Roman historian, was born about A.D. 325–330 at Antioch; the date of his death is unknown but he must have lived till 391, as he mentions Aurelius Victor as the city prefect for that year. He was a Greek of noble birth. He entered the army at an early age and was sent to serve under Ursicinus, governor of Nisibis and *magister militae.* He returned to Italy with Ursicinus, when he was recalled by Constantius II. and accompanied him on the expedition against Silvanus the Frank. With Ursicinus he went twice to the East and barely escaped with his life from Amida or Amid (mod. Diarbekr), when it was taken by the Persian king Shapur (Sapor) II. When Ursicinus lost his office and the favour of Constantius, Ammianus seems to have shared his downfall; but under Julian, Constantius's successor, he regained his position. He accompanied Julian in his campaigns against the Alamanni and the Persians; after the death of Julian he took part in the retreat of Jovian as far as Antioch, where he was living in 371. Eventually he settled in Rome, where, at an advanced age, he wrote (in Latin) a history of the Roman empire from the accession of Nerva to the death of Valens (96–378), thus forming a continuation of the work of Tacitus. This history (*Rerum Gestarum Libri XXXI*) was originally in 31 books; of these the first 13 are lost, the 18 which remain cover the period from 353 to 378. It is a clear, comprehensive and impartial account of events by a contemporary of soldierly honesty, independent judgment and wide reading. His style is generally harsh, often pompous and extremely obscure, occasionally even journalistic in tone, but the author's foreign origin and his military life and training partially explain this. Further, the work being intended for public recitation, some rhetorical embellishment was necessary, even at the cost of simplicity. Though a professional soldier Ammianus gives excellent pictures of social and economic problems, and in his attitude to the non-Roman peoples of the empire he is far more broad-minded than Livy and Tacitus In his description of the empire—the exhaustion produced by excessive taxation, the financial ruin of the middle classes, the progressive decline in the morale of the army—we find the explanation of its fall before the Goths 20 years after his death.

The work was discovered by Poggio, who copied the original ms. *Editio princeps* (bks 14–26) by Sabinus, 1474; completed by Accursius, 1533; with variorum notes, by Wagner-Erfurdt, 1808; latest edition of text, Gardthausen, 1874–75 English translations by P. Holland, 1609; Yonge (Bohn's Classical Library), 1862; also Max Büdinger, *Ammianus Marcellinus und die Eigenart seines Geschichtswerkes* (1895), F. Liesenberg, *Die Sprache des Ammianus Marcellinus* (1888–90); T. R Glover, *Life and Letters in the Fourth Century* (1901); Abbé Gimazane, *Ammianus Marcellinus, sa vie et son oeuvre* (Toulouse, 1889), a work containing a number of very doubtful theories. For a criticism of his views on Roman society *see* S Dill, *Roman Society in the Last Century of the Western Empire* (1898).

AMMINES, in chemistry, compounds resulting from the addition of ammonia, NH_3, to metallic salts or other binary chemical compounds (*See* CHEMISTRY: *Inorganic;* CO-ORDINATION, VALENCY) The ammine formed from copper sulphate is the essential constituent in Schweitzer's reagent which is used as a solvent for cellulose in the preparation of one kind of artificial silk

See A Werner, *New Ideas on Inorganic Chemistry* (1911); M. M. J. Sutherland, *The Metal Ammines* (1928).

AMMIRATO, SCIPIONE (1531–1601), Italian historian, born at Lecce, in the kingdom of Naples, lived under the patronage of Duke Cosimo I , of Florence, who gave him a residence at the Medici Palace and the Villa Zopaja on the understanding that he should write his *Istorie Fiorentine* (1600), the work by which he is best known.

AMMON: *see* EGYPT: *Religion.*

AMMON, CHRISTOPH FRIEDRICH VON (1766–1850), German theological writer and preacher, was a very voluminous author. His principal theological work was the *Fortbildung des Christenthums zur Weltreligion* (Leipzig, 1833–40). *Entwurf einer reinbiblischen Theologie* appeared in 1792 (2nd ed. 1801); *Summa Theologiae Christianae* in 1803 (other eds., 1808, 1816, 1830); *Das Leben Jesu* in 1842, and *Die wahre und falsche Orthodoxie* in 1849.

See Herzog-Hauck *Realencyklopädie;* Otto Pfleiderer *The Development of Theology in Germany since Kant,* pp. 89 *seq.*

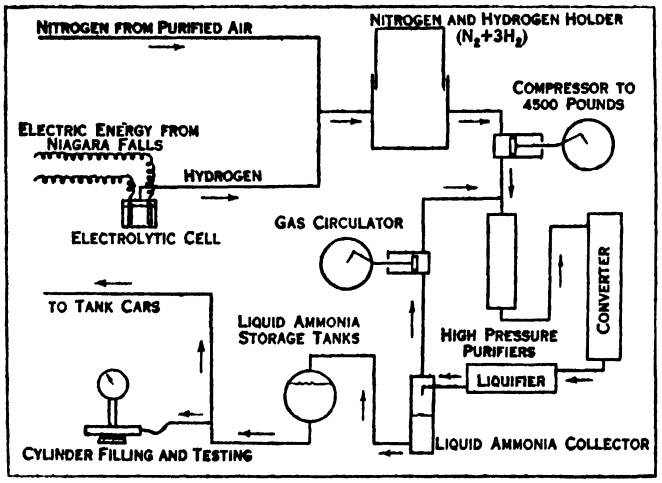
AMMONIA and its salts have been known from very early times, sal-ammoniac being mentioned by Pliny. By the

action of alkalis on this, Basil Valentine obtained free ammonia in the 15th century; later, ammonia was obtained by distilling the hoofs and horns of oxen, and was therefore called "spirits of hartshorn." J. Priestley was the first to isolate gaseous ammonia (1774), which he called "alkaline air." In 1777 K. W. Scheele showed it to contain nitrogen, and shortly afterwards C. L. Berthollet ascertained its composition to be NH_3.

Ammonia is found in small quantities as the carbonate in the atmosphere, being produced from the putrefaction of nitrogenous animal and vegetable matter; ammonium salts are also found in small quantities in rain-water, whilst the chloride and sulphate are found in volcanic districts. Fertile soils, sea-water, and plant and animal liquids (such as urine) also contain ammonium salts.

Ammonia is obtained by the dry distillation of animal and vegetable products, and also by the decomposition of its salts (usually the chloride or sulphate) by alkaline hydroxides or slaked lime: $2NH_4Cl+Ca(OH)_2=2NH_3+CaCl_2+2H_2O$. It may be obtained by the action of water on, *e.g.*, magnesium nitride Large quantities of ammonia and its salts (usually the sulphate) are obtained from the ammoniacal liquor of the gas works. Such ammonia is, however, difficult to purify from the pyridine which it contains, and the purest ammonia is now obtained synthetically.

The reversible reaction $N_2+3H_2\rightleftharpoons 2NH_3$ evolves heat when it produces ammonia, and therefore it becomes less favourable the higher the temperature; but as it also takes place with a decrease in volume, it is favoured by an increase of pressure. In practice a compromise is effected, for, although at 450° C. it would only be possible to effect combination of 0·24% of the gases (if present in the theoretical proportion) under atmospheric pressure, and at 550° C. only 0·08%, yet at the lower temperature reaction is so slow as to be unprofitable in working The higher temperature is therefore chosen, and under 200 atmospheres pressure (as used by Haber) the equilibrium concentration is 12% and under 1,000 atmospheres (as used by Claude) it is 40%. The nitrogen (often from liquid air) and hydrogen (often from purified "water gas") are dried, compressed, and circulated at 550° C. over a catalyst, the best being a very pure iron, obtained by reducing the oxide in a current of hydrogen at this temperature. The ammonia produced is either passed through a refrigerator and collected as a liquid, or absorbed in water.



BY COURTESY OF MATHIESON ALKALI WORKS, INC

DIAGRAM SHOWING HOW NITROGEN FROM THE AIR AND HYDROGEN FROM AN ELECTROLYTIC CELL ARE CONVERTED INTO AMMONIA

Another industrial process of some importance in the production of ammonia is that whereby calcium cyanamide, $CaCN_2$, is heated under 3 atmospheres pressure with water in order to liberate traces of acetylene, and then under 11 atmospheres at 180° C. with a current of superheated steam, the resulting ammonia being blown over and collected. For fuller details of these processes *see* NITROGEN, FIXATION OF.

Ammonia is a colourless gas possessing a characteristic pungent smell and a strongly alkaline reaction; it is lighter than air, its specific gravity being 0·589 (air=1). It is easily liquefied and the liquid boils at −33·7° C., and solidifies at −78° C. to a mass of white crystals. It is extremely soluble in water, one volume at 0° C. and normal pressure absorbing 1,300 volumes of ammonia, and a saturated solution at 15° C. contains 36%. It forms two hydrates with water, NH_3,H_2O and $2NH_3,H_2O$, both of which melt at −79° C., *i.e.*, only one degree below the melting point of pure ammonia. All the ammonia contained in an aqueous solution of the gas may be expelled by boiling. It does not support combustion and it does not burn readily unless mixed with oxygen, in which case it burns with a pale greenish flame. Ammonia gas has the power of combining with many substances, particularly with metallic halides; thus, with calcium chloride it forms the compound $CaCl_2,8NH_3$, and consequently calcium chloride cannot be used for drying the gas. With silver chloride it forms two compounds—$AgCl,3NH_3$ at temperatures below 15° C., and $2AgCl,3NH_3$ above 20° C. When heated, these substances liberate ammonia and the silver chloride remains; by this method M. Faraday was able to liquefy ammonia for the first time (1823) Ammonia is decomposed into its elements at a red heat or by the passage of electric sparks. Chlorine takes fire when passed into strong ammonia solutions, nitrogen and hydrochloric acid (or ammonium chloride) being formed, and unless the ammonia is present in excess the highly explosive nitrogen chloride NCl_3 is also produced With iodine it reacts to form nitrogen iodide, which was originally supposed to contain nitrogen and iodine only; later, however, it was found to contain hydrogen also F. D. Chattaway showed it to be $N_2H_3I_3$ and O Silberrad further showed its constitution to be NH_3,NI_3. The hydrogen in ammonia is capable of replacement by metals, thus magnesium burns in the gas with formation of the nitride, Mg_3N_2, and when the gas is passed over heated sodium or potassium, sodamide, $NaNH_2$, or potassamide, KNH_2, is formed.

Liquid ammonia is used for the artificial preparation of ice. It shows a slight but definite electrical conductivity, though it is not certain what ions are responsible for this, and salts dissolved in it are fairly strongly dissociated into ions, but not nearly so extensively as in aqueous solutions. Moreover, certain metals dissolve in it to give very deep blue solutions which may possibly contain, *e g*, $NaNH_2$, $Ba(NH_3)_6$, etc. The works of E. C. Franklin (*Amer. Chem J*, 1899 *et seq*), C A. Kraus (*e g*, *J. Amer. Chem. Soc.* 1922, 44, p. 1949, 1925, 42, p. 749) and C. Frenzel should be consulted for fuller details as to solutions in liquid ammonia

One of the most characteristic properties of ammonia is its power of combining directly with acids to form salts; thus with hydrochloric acid it gives ammonium chloride (sal-ammoniac), and with nitric acid ammonium nitrate, etc. It is of great interest, however, that ammonia and hydrochloric acid will not react if they are both perfectly dry (H. B. Baker; *see* DRYNESS, CHEMICAL); moreover, perfectly dry ammonium chloride does not exhibit the reverse phenomenon of dissociation into its components, which is so characteristic of ammonium salts.

The aqueous solution of ammonia is very basic in its reactions, but it is not very definite as to whether this is due to an ammonium hydroxide, NH_4OH, to free ammonia as such, or to ammonia allied in some way with water, for there is doubtless an equilibrium involved:

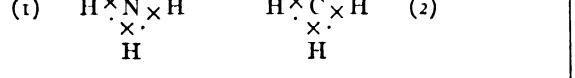
$$xNH_3,yH_2O \rightleftharpoons NH_3 + H_2O \rightleftharpoons NH_4OH \rightleftharpoons NH_4^+ + OH^-.$$

According to A. Hantzsch and T. S. Moore, the apparent "strength" of ammonia as a base is very low, for only about 1% of the total ammonia is present in the form of ions in decinormal (*i.e.*, 0·17%) aqueous solution, but as these may be derived from a relatively small proportion of NH_4OH, it is possible that the latter molecule is fairly strongly ionized. When boiled, solutions of ammonium salts tend to lose ammonia, and if the acid is "weak" both it and the ammonia may be boiled away completely, but as most of the ammonia may be present in a form other than NH_4OH, this again is no evidence that the latter is a weak base, especially as the above equilibria would tend to replace the volatile NH_3 at the expense of the NH_4OH. From a consideration of the ease of dissociation of the double sulphates $CuSO_4,M_2SO_4,6H_2O$ (where M=NH_4,K,Rb or Cs), R. M. Caven places

ammonium hydroxide as a base between rubidium and caesium hydroxides in strength.

Numerous attempts have been made to isolate the radical NH_4, but the most that has been achieved is to obtain evidence as to its existence in an amalgam or in solution. The addition of sodium amalgam to a cold concentrated solution of ammonium chloride gives a spongy mass which resembles the amalgams of the alkali metals in some respects but not in others; it readily decomposes into ammonia and hydrogen. H. H. Schlubach and F. Ballouf added very cold ammonium chloride to a solution of potassium in liquid ammonia at −70° C, and, as only one-third of the theoretical amount of hydrogen was evolved and solubility would not account for more than a trace of the rest, it is assumed that the free ammonium, NH_4, remains in solution; the remainder of the hydrogen is given off at −40° C.

The precise constitution of the ammonium radical or ion has been a matter of much speculation, but W. H. Mills and E. H. Warren have now shown that the nitrogen atom is situated at the centre of a regular tetrahedron with the hydrogen atoms at the four corners, and this has been confirmed by Mills, J. D. Parkin and W. J. D. Ward (*see* STEREOCHEMISTRY for further details). The ammonium ion and the methane molecule therefore have similar structures, as might be anticipated on the electronic



(1) (2)

theory, for, if they are written as (1) and (2) respectively (where, in each case, the crosses represent electrons originally belonging to the N and C atoms, and the dots those belonging to the H atoms), it is seen that the nitrogen atom shares 8 electrons equally with hydrogen atoms and has lost one of its five electrons, thereby becoming positively charged, whereas the carbon atom has a half share in its own four electrons and in four others, thereby remaining neutral.

Ammonia finds a wide application in organic chemistry as a synthetic reagent; it reacts with alkyl iodides to form amines (*q.v.*), with esters to form amides (*q.v.*), and with halogen fatty acids to form amino-acids; it combines with isocyanic esters to give alkyl-ureas, and with the mustard oils to give alkyl-thioureas. Aldehydes also combine directly with ammonia.

The alkyl-amines, which may be regarded as derived from ammonia by successive replacement of hydrogen atoms by alkyl groups, are not very strong bases, but the trialkyl-amines react with alkyl iodides to give tetra-alkyl-ammonium iodides, $NR_3+RI=NR_4I$, which resemble the alkali-metal iodides, and this resemblance between alkali metals and the tetra-alkyl-ammonium group is still more pronounced in the corresponding hydroxides (obtained by the action of moist silver oxide on the iodide of the base), for these are strongly caustic bases which absorb carbon dioxide and generally resemble potassium hydroxide. The relative stability of the quaternary ammonium grouping is further illustrated by the fact that the corresponding amalgams are much more stable than that of ammonium. H. N. McCoy and W. C. Moore obtained a tetramethylammonium amalgam which did not decompose below 10° C. Moreover, Schlubach and Ballouf, using a method analogous to that described in the case of the ammonium radical, found evidence for the existence of a tetraethylammonium which was stable in liquid ammonia at the ordinary temperature if kept in an atmosphere of nitrogen. When all four alkyl groups of a quaternary ammonium salt are different, the compound can be resolved into optical isomerides, and W. J. Pope and S. J. Peachey resolved benzylphenylallylmethylammonium salts into dextro- and laevo-rotatory forms (*see* STEREOCHEMISTRY).

Salts.—Ammonium fluoride, NH_4F, may be obtained by neutralizing ammonia with hydrofluoric acid; it has a sharp saline taste, and the crystals are very soluble in water; it decomposes silicates on being heated with them. It is a powerful preservative.

Ammonium chloride, NH_4Cl. (*See* SAL-AMMONIAC.)

Ammonium bromide, NH_4Br, can be prepared by the direct action of bromine on ammonia. It crystallizes in colourless prisms which have a saline taste and are very soluble in water. Like the chloride, it sublimes on heating. It is sometimes used medicinally instead of potassium bromide.

Ammonium iodide, NH_4I, can be prepared by the action of hydriodic acid on ammonia. It is soluble in alcohol and exceedingly so in water. It turns yellow on keeping, unless kept in sealed tubes away from light. With iodine it gives the tri-iodide, NH_4I_3; if chlorine is passed into its solution in which iodine is suspended, the comparatively stable dichloroiodide, NH_4Cl_2I, is obtained.

Ammonium chlorate, NH_4ClO_3, decomposes at about 100° C. into nitrogen, oxygen and chlorine. The perchlorate, NH_4ClO_4, obtained from an alkaline perchlorate and an ammonium salt, has been used in high-explosive shell, but is rather too sensitive to shock.

Ammonium carbonates. The commercial salt is known as sal volatile or salt of hartshorn; it is obtained by heating the chloride or sulphate with chalk and condensing the vapours. When resublimed, it forms hard fibrous masses of composition $NH_4HCO_3+NH_2{\cdot}COONH_4$ (*i.e.*, bicarbonate and carbamate in molecular proportion), or, more probably, $(NH_4)_2CO_3+2NH_4HCO_3+H_2O$, which is a sesquicarbonate; it possesses a strongly ammoniacal smell. The normal carbonate, $(NH_4)_2CO_3$, is obtained by saturating a concentrated solution of the foregoing with ammonia; it can be obtained in a crystalline condition, but readily loses ammonia on exposure and reverts to the sesquicarbonate.

The bicarbonate, NH_4HCO_3, is obtained by saturating a solution of the commercial carbonate with carbon dioxide; it is sparingly soluble in water and readily loses carbon dioxide.

Ammonium thiocyanate (or sulphocyanide), NH_4NCS, can be obtained from carbon disulphide and ammonia; it isomerises to thiourea, which is used in the rubber industry; it is also of use in quantitative analysis (*see* CHEMISTRY: ANALYSIS).

Ammonium nitrate, NH_4NO_3, prepared from the acid and ammonia, exists in four different crystalline forms which are, respectively, stable over the temperature ranges: below −16°, −16° to 32°, 32° to 84°, and 84° to 169·6° (the melting point). Its dissolution in water produces a considerable lowering of temperature which is utilized in freezing mixtures. On being gently heated it is decomposed into water and nitrous oxide: $NH_4NO_3=N_2O+2H_2O$.

Ammonium nitrite, NH_4NO_2, is formed in the oxidation of ammonia by ozone or hydrogen peroxide; it is best obtained by double decomposition of sodium nitrite and ammonium chloride, the resulting sodium chloride being much less soluble; if silver nitrite is used the product is purer. The solution can be concentrated to give crystals which can be sublimed in a vacuum at 80° C, but they readily decompose to give water and nitrogen: $NH_4NO_2=N_2+2H_2O$.

Ammonium phosphates. The normal phosphate, $(NH_4)_3PO_4$, can be obtained by adding excess of ammonia to the acid phosphate, $(NH_4)_2HPO_4$ or to a concentrated solution of the acid; its solution readily loses ammonia. The diammonium hydrogen phosphate, $(NH_4)_2HPO_4$, is obtained by evaporating the foregoing solutions; on heating, the crystals melt and decompose, leaving a residue of metaphosphoric acid, HPO_3. The dihydrogen phosphate, $(NH_4)H_2PO_4$, crystallises from solutions which are distinctly acidic with phosphoric acid.

Ammonium sodium hydrogen phosphate, $(NH_4)NaHPO_4$, is known as microcosmic salt (*q.v.*).

Ammonium sulphate, $(NH_4)_2SO_4$, is prepared from the ammoniacal liquor of gas-works (*see* GAS: MANUFACTURE) and purified by recrystallization. The aqueous solution tends to lose ammonia on boiling. Its chief use is as an artificial manure, and much of that being sold for this purpose is made from synthetic ammonia.

Ammonium persulphate, $(NH_4)_2S_2O_8$, is prepared by the electrolytic oxidation of a cold, saturated solution of the sulphate, in the presence of dilute sulphuric acid, a high anodic current density being used; it is more conveniently obtained by double decomposition from ammonium chloride and sodium persulphate. It is

difficult to prepare in a state of high purity, and is very soluble in cold water (58 grams in 100 grams of water at 0° C.).

Ammonium sulphide, $(NH_4)_2S$, is obtained as micaceous crystals by passing sulphuretted hydrogen and a slight excess of ammonia through a well-cooled vessel. Excess of the sulphuretted hydrogen gives rise to the hydrosulphide, NH_4HS. Both are very soluble white solids. The former is usually sold as a concentrated aqueous solution, which finds a considerable use in analysis. The sulphide solution dissolves sulphur to give a series of ill-defined polysulphides.

According to A. E. H. Tutton, many of the ammonium salts display a close resemblance to the corresponding salts of rubidium and caesium in their crystallographic characteristics, the similarity being especially striking in the case of the former metal.

Ammonia readily combines with many metallic salts (as with calcium and silver chlorides, above) to give ammines (*q v*), which are often of great theoretical interest. *See* also MERCURY for the "infusible" and "fusible white precipitates" of pharmacy.

Compounds are known which may be regarded as derived from ammonia by the replacement of hydrogen atoms by the sulpho-group; thus, potassium ammon-trisulphonate, $N(SO_3K)_3$, $2H_2O$, is obtained as a crystalline precipitate by the addition of excess of potassium sulphite (or metabisulphite) to a solution of potassium nitrite: $KNO_2+3K_2SO_3+2H_2O=N(SO_3K)_3+4KOH$. It can be recrystallized from alkaline solution, and on boiling with water is converted successively into the disulphonate, $NH(SO_3K)_2$, and monosulphonate, $NH_2{\cdot}SO_3K$, the latter being the salt of the stable aminosulphonic acid. The chief interest of the disulphonate lies in the fact that its hydrogen atom is acidic, for the corresponding ammonium salt, $NH(SO_3NH_4)_2$, gives a triammonium salt $NH_4{\cdot}N(SO_3NH_4)_2$, and both of these are formed by direct union of sulphur trioxide and ammonia. For further details of such compounds, the works of E. Divers and of F. Raschig should be consulted, especially the latter's *Schwefel- und Stickstoffstudien*, 1924.

Hydrazine. If a solution of sodium hypochlorite is added to a fairly concentrated solution of ammonia containing 0·2% of glue, hydrazine, $NH_2{\cdot}NH_2$, or chloroamine, NH_2Cl, is produced according to the conditions; the latter is fairly stable and may be distilled in a vacuum.

Detection and Estimation.—Solutions of ammonia and ammonium salts, even if very dilute, give a distinct yellow or yellowish-brown coloration with Nessler's solution, owing to the formation of a complex iodide, NHg_2I,H_2O, which is obtained as a precipitate from stronger solutions; this is also the basis of a colorimetric method for estimating minute traces of ammonia in drinking-water. Larger quantities of ammonia or its salts can be detected by the evolution of the characteristic smell of the free ammonia on heating with caustic alkalis or lime. The quantitative estimation may be effected by (1) distillation of salts or ammoniacal liquors with sodium or potassium hydroxide and absorption of the liberated ammonia in an excess of standard sulphuric acid, the excess being titrated by alkali; (2) by absorption of ammonia in hydrochloric acid and precipitation as the chloroplatinate, $(NH_4)_2PtCl_6$; or (3) by the addition of neutral formaldehyde to a neutral solution of an ammonium salt, whereby hexamethylenetetramine is formed and the acid originally in combination with the ammonia is set free and may be titrated:

$$4NH_4Cl+6CH_2O=(CH_2)_6N_4+4HCl+6H_2O.$$

(A. D. M.)

AMMONIACUM or **GUM AMMONIAC,** a gum-resin exuded from the stem of a perennial herb (*Dorema ammoniacum*), family Umbelliferae. The plant grows to the height of 8 or 9ft., and its whole stem is pervaded with a milky juice, which oozes out on an incision being made at any part. This juice quickly hardens into round tear-like bodies, forming the "tear ammoniacum" of commerce. "Lump ammoniacum," the other form in which the substance is met with, consists of aggregations of "tears," frequently incorporating fragments of the plant itself, as well as other foreign bodies.

AMMONITE, a group of extinct Mollusca, belonging to the class Cephalopoda (*q.v.*), which also includes the octopus and cuttle-fish. They possessed an external shell, coiled in a flat spiral and divided into chambers very similar to that of the modern nautilus (*q.v.*). Many reached a great size, the largest, *Pachydiscus seppenradensis*, from the Cretaceous of Westphalia, having a shell 6ft. 8in. in diameter. The Ammonites began in the Carboniferous period and became extinct at the end of the Cretaceous.

AMMONITES, a people of ancient Transjordania, believed to be allied to Israel, but still more closely to Moab. Their home was to the north and north-east of Moab, and their chief city, Rabbath-Ammon (later Philadelphia, the modern Ammān) stood on the banks of a tributary of the Jabbok. Like the Moabites, the Ammonites seem to have combined the pastoral life with a limited amount of agriculture. Their religion was similar to that of their neighbours, but was notorious for the extent to which human sacrifice was offered to their god Milcom or Melek.

It is, of course, impossible to discuss the actual history of Ammon, but the tribe is occasionally mentioned in the annals of other peoples, especially those of Israel Belonging to the same general Hebrew stock, they had dispossessed the aborigines, whom they called Zamzummim, and settled down before the time of the Exodus, in a district bounded to the north by the river Jabbok Expelled by Sihon from the northern parts of their territory and driven eastwards, they had been left unmolested by the Israelites in their passage to Palestine, but, nevertheless, had remained hostile to them. They were in alliance with David, but on the death of Nahash made an effort to escape from association with Israel. The country was overrun, Rabbath was captured, and the people reduced to servitude.

We hear but little of Ammon during the period of the Hebrew kingdoms, but Shalmaneser III speaks of a small contingent (1,000 men) in the allied army which met him at Karkar (*see* AHAB), and a century later Tiglath-pileser III and his successors received tribute from Ammon They do not seem to have been concerned in the great revolt of 701, and Sennacherib was content to receive tribute from them. In 587 they supported Zedekiah at the beginning of his rebellion against Nebuchadrezzar, but, apparently, submitted; and Ammonite troops were amongst those that sacked Jerusalem From this time onwards implacable enmity seems to have existed between Israel and Ammon. It was at the instance of a king of Ammon that Gedaliah was murdered, and the partial depopulation of Judah saw numbers of them entering the country. In his attempt to restore the purity of the Judaean community, Nehemiah found that a certain Tobiah, an Ammonite, was one of his bitterest opponents, and this tribe offered a strenuous resistance to the aggrandizing policy of the Maccabean princes. They still formed a large community in the days of Justin Martyr. (T. H. R.)

AMMONIUM exists only in combination as a monovalent basic radicle, NH_4. (*See* AMMONIA.)

AMMONIUS HERMIAE (5th century A.D.) Greek philosopher, the son of Hermeias. He taught at Alexandria and had among his scholars Asclepius, John Philoponus, Damascius, and Simplicius. His commentaries on Plato and Ptolemy are lost. Of his commentaries on Aristotle we have—(1) one on the *Isagoge* of Porphyry (Venice, 1,500 fol.); (2) one on the *Categories* (Venice, 1,503 fol.), the authenticity of which is doubted by Brandis; (3) one on the *De Interpretatione* (Venice, 1,503 fol.). They are printed in Brandis's scholia to Aristotle, forming the fourth volume of the Berlin *Aristotle;* they are also edited (1891–99) in A. Busse's *Commentaria in Aristot. Graeca.* The special section on Fate was published separately by J. C. Orelli, *Alex. Aphrod., Ammonii, et aliorum de Fato quae supersunt* (Zürich, 1824). A life of Aristotle, ascribed to Ammonius, but with more accuracy to John Philoponus, is often prefixed to editions of Aristotle. It has been printed separately, with Latin translation and scholia, at Leyden, 1621, and Helmstadt, 1666, and at Paris, 1850. Other commentaries on the *Topics* and the first six books of the *Metaphysics* still exist in manuscript.

For a list of his works *see* J. A. Fabricius, *Bibliotheca Graeca,* v. 704–707; C. A. Brandis, *Über d. Reihenf. d. Bücher d. Aristot. Org.,* 283 f.; K. Prantl, *Gesch. d. Logik,* i. 642.

AMMONIUS SACCAS (*c.* 160–242), the founder of Neoplatonism, was originally an Alexandrian porter, and, according to Porphyry as quoted by Eusebius, a Christian. His self-instruction in philosophy was thorough enough to attract disciples of such calibre as Longinus, the grammarian, Origen, and Plotinus. Since he designedly left no writings, practically nothing is known about his doctrines. From casual remarks of Nemisius and Hierocles, he is said to have taught the incorporeity of the soul and to have attempted a reconciliation of Plato and Aristotle. It is impossible to determine to what extent he influenced Plotinus.

BIBLIOGRAPHY.—E. Zeller: "Ammonius Sakkas u. Plotinus" in *Archiv. f. Gesch. der Philosophie* (1894); L. J. Dehaut *Essai historique sur la vie et la doctrine d'Ammonius Saccas* (Brussels, 1836); T. Whittaker *The Neo-Platonists* (Cambridge, 1918).

AMMUNITION, a military term which includes projectiles used with ordnance, rifles and similar weapons, together with the requisite propellents, fuses, cartridges and means of ignition.

I. AMMUNITION FOR ORDNANCE

HISTORICAL

Berthold Schwartz, a German monk, is credited with the invention of cannon in Europe in 1313. The first projectiles used with these primitive weapons were bolts, darts, stone shot and "langridge." The darts, made of iron and feathered with brass, were wrapped in leather to prevent windage. "Langridge" consisted of bits of iron, nails, flints, and similar material, which were ordinarily contained in a sack or container and may be considered the forerunner of grape and case shot. The propellent charge was gunpowder, fired by red hot bars or spikes. Round shot of metal were known in early times but did not entirely supersede stone shot until the 17th century, for economical and practical reasons.

The use of shell was advocated at a very early date, but the absence of fuses made their successful employment dangerous and difficult The original shell were known as "grenades" when spherical, and "bombs" when oblong, the word shell itself being of later introduction. In 1376 shell were used at Jadra by the Venetians, and later, in 1421, shell were employed at the siege of St. Boniface in Corsica. These shell were fitted with a primitive fuse consisting of "sheet iron tubing with priming." At about this time also, the method of ignition by red hot iron was superseded by priming the vent with loose powder. The shell of this period consisted of two hemispheres of stone or bronze joined with hoops and hinged. Shot still remained the paramount projectile for guns. About the middle of the 15th century case shot were used at the siege of Constantinople, and the first incendiary shell was invented by Valturio in 1460.

Improvements were slow in these early times but the use of metal, particularly cast iron, was gradually extended as the guns improved in design. In the 16th century "hail shot" were used, which were similar to case shot with the addition of a bursting charge, and they also had a primitive match fuse which was ignited by the propellent charge. A German projectile of this type was invented by Zimmerman in 1573 in which the bursting charge filled half the container. In 1543 shell filled with "wildfire" were known in England, and the use of shell in Europe was on the increase. In 1579 Stephen Batory, king of Poland, suggested the employment of red hot shot, but little use was made of the device. The idea persisted, however, and was fully exploited at the siege of Gibraltar in 1779–1783.

In 1596 Sebastian Hälle suggested the idea of the modern time fuse and modern percussion fuses; but the chemistry of the day could not provide the requisite chemicals, and the fuse of the time remained the simple iron tube filled with composition. During the 17th century attempts were made to improve fuses, and in 1650 a primitive fuse was tried, based on the principle of a flint lock. It was not successful, and the gunner still awaited a satisfactory "percussion powder." In 1672 a gunner in the service of Van Galen, prince bishop of Munster, invented the carcass. It contained incendiary matter and had a primitive fuse. This projectile developed into a spherical projectile with vents. Its use persisted until the 19th century, when it disappeared with muzzle loading ordnance. In 1681 bombs were fired at sea by the French at the bombardment of Algiers. During this period smoke shell made their appearance, being paper projectiles which replaced earlier smoke balls

General improvement in ammunition occurred in the 18th century, and in 1784 Shrapnel invented the projectile which bears his name. It differed in principle from previous similar projectiles in that its charge was in reality an opening charge and was not intended to impart velocity to the contained bullets The use of shell was becoming more general and was being extended to guns as well as mortars. The standard material was cast iron, but bronze, lead, brass and glass were also tried.

The 19th century witnessed enormous improvements in war material generally. In 1800 Howard isolated mercury fulminate, and shortly afterwards Forsyth patented a percussion mixture and Hawkins invented a percussion cap. The consequent development of fuses was rapid. Percussion fuses were introduced about 1842 and improved means of ignition led to practicable time fuses of modern principle in 1864 and time and percussion fuses in 1867. The evolution of these types led logically to the modern fuse. In 1855 the introduction of Martin's shell, which was filled with molten iron, made red hot shot obsolete. Quilted grape and Caffin's grape were both in use but died out with muzzle-loading ordnance.

The introduction of rifled ordnance involved considerable changes in ammunition, and elongated projectiles were introduced and were provided with means of rotation, such as lead coats, studs and gas checks, leading finally to the modern projectile with driving bands. The shell began gradually to oust the shot. In 1865 steel shot were introduced for use against ironclads, but owing to expense they were superseded by Palliser chilled iron shot in 1867. In 1887 forged steel armour-piercing shot were introduced and lingered on in various services until quite modern times, but all shot of this type have been largely superseded by armour piercing shell. The development of shell was rapid, and between 1880–1890 steel became the paramount material. The development of common high explosive and armour-piercing shell now becomes a matter of modern history. Segment shell and ring shell were born and died. To sum up, the 19th century saw the gradual decline of shot and case shot and the rise of the modern shell.

TECHNICAL

A round of ammunition for a gun comprises four main constituents: (*a*) the projectile, with its filling, (*b*) the cartridge, (*c*) the means of ignition and (*d*) the fuse.

The fuse is screwed into the projectile, normally at the nose, but sometimes in the base, and the means of ignition may be either an integral part of the cartridge or a separate component.

PROJECTILES

Types of Projectiles.—Projectiles for ordnance may be divided into two main classes, shot and shell. The only shot now found in modern armaments are proof shot, practice shot, paper shot and case shot. Proof shot are solid shot used for proving ordnance and charges. Practice shot are solid shot used for practice purposes. Paper shot are used to test gun mountings which cannot fire service projectiles in peace time, owing to their siting. They are made mainly of paper or pulp and their weight is calculated to exert the same stress on the mounting as a service round, but they break up in the bore when fired. Case shot generally consist of three or more long steel segments held in position inside a thin, tinned canister, the whole being filled with bullets. The top and bottom are formed of steel plates and in larger natures, the shot is stiffened by a central bolt. It is not much used in modern equipments.

The natures of shell now used are: common pointed or C.P. shell; high explosive or H.E. shell; shrapnel shell; armour-piercing or A.P. shell; and special shell, of kinds such as gas, smoke, star (illuminating) and incendiary. These various types of shell

are employed because different effects are desired on the target, but there are certain properties common to all shell. For example, they must not break up in the gun when it is fired; they should give long ranges and accurate shooting and they should be cheap and easy to manufacture. It can, therefore, be seen that the design of a shell is a compromise between conflicting qualities, but as a result of experience the following facts are generally true.

Weight.—Roughly, the weight, in pounds, of a shell suitable for a given gun is half the cube of the calibre in inches

Length.—A shell should be at least 2 calibres but normally does not exceed 4½ calibres in length. If a ballistic cap or hollow point is fitted the maximum length may be increased.

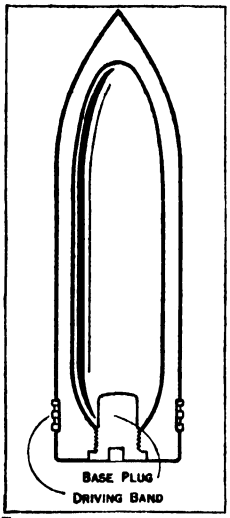


FIG. 1.—DIAGRAM OF COMMON POINTED SHELL

Shape.—The modern shell consists usually of a cylindrical body with a tapering head. An ogival head is generally considered the best shape for overcoming air resistance and ensuring accuracy but conical and other smooth shapes may be employed. Theoretically, with high velocity shell, the longer the head the greater is the range obtained, but in practice the length of head is limited by considerations of accuracy. With low velocity projectiles an increase of range may be obtained by stream lining or boat tailing the base, but the use of this device is restricted by practical considerations.

Material.—Modern shell are ordinarily all made of cast or forged steel.

Driving Bands.—To obtain rotation, a copper or alloy band is pressed into an undercut groove near the base of the shell. This centres the projectile and in conjunction with the rifling of the gun, gives the necessary rotation. With heavy shell two or three bands may be employed.

Caps.—To increase the penetration of pointed projectiles used against armour, solid caps of steel may be fitted over the points and fixed by soldering and indenting. These caps are employed with C.P. and A.P. shell.

C.P. Shell.—These shell are intended for the attack of light armour. They are prepared to take a base fuse and are filled with gunpowder or high explosive. Sometimes the points may be specially hardened and fitted with caps to give better penetration. (*See* fig. 1.)

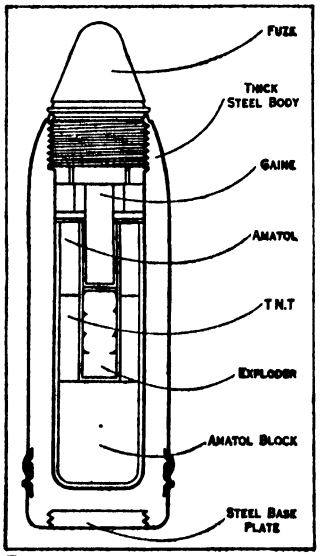


FIG. 2.—DIAGRAM OF MODERN BRITISH HIGH EXPLOSIVE SHELL

H.E. Shell.—High explosive, as a filling for artillery shell, was first suggested by Turpin in 1886, who advocated the use of picric acid in a dense form. With slight modifications, it was adopted by the French as melinite, by the Germans as granatfüllung 88, by the British as lyddite, and by the Japanese as shimose. Modern British H.E. shell are normally of forged steel with solid bases, a special steel base plate being fitted in a recess in the base to give added strength. The walls may be comparatively thin, which gives good effect against material, or, alternatively, the walls may be thick enough to give good effect against personnel. The nose of the shell is prepared to take a fuse. In some countries solid bases are not considered essential in these shell. Explosives used as H.E. shell fillings are ordinarily picric acid, TNT (trinitro-toluene), and amatol, which is a mixture of TNT and ammonium nitrate. Other substances used are dinitro-benzene trinitroanisol and guncotton, and, during the World War, many other fillings were tried. These explosives are generally inert and not easily detonated, and hence an exploder system is ordinarily found between the fuse and the filling itself. In some cases, where detonation gives little or no smoke, some smoke-producing mixture is included in filled shell to assist observation of fire. A typical modern British H.E. shell is illustrated in fig. 2. The steel body is stout, giving good fragmentation. The filling is amatol, with a proportion of TNT to facilitate detonation. The exploder system in this particular case is represented by a gaine and an exploder. Fig. 3 illustrates a modern German H.E. shell evolved during the war. The filling calls for little comment. There are several points of interest in comparison with earlier shell. The base is closed by an adapter, which is contrary to British practice. Three driving bands are employed and a decoppering ring is fitted. Two fuse holes are provided, which permit of either nose or base fusing, or even the use of two fuses at the same time. This shell also provides a good example of the ballistic cap or false ogive

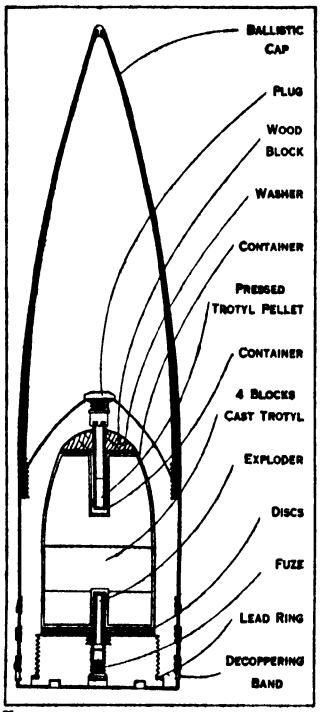


FIG. 3.—DIAGRAM OF MODERN GERMAN HIGH EXPLOSIVE SHELL

Shrapnel Shell.—The shrapnel shell was invented in 1784 by Lieut. Henry Shrapnel, R.A., and was originally called the "spherical case shot." The idea of the inventor was to keep the bursting or opening charge as small as possible so that the velocity of the shell would be imparted to the bullets. After considerable delay this projectile was adopted by the British Government, and was apparently first used in action against the French, at the battle of Rolica in 1808. In 1852 the British army adopted the name "shrapnel" in honour of its inventor. With the development of ordnance the design of this shell has been modified, but the principle involved remains the same. The body of a modern shrapnel shell is made with thin walls, and it is closed either by a fuse socket or by a separate head, the part in either case being merely lightly attached. A fuse is screwed into the socket or head. The other parts of the shell are shown in the illustration. The bullets are made of heavy metal, but their weights vary with the size of shell. (*See* fig. 4.)

The central tube may or may not be provided with powder pellets. The action of the shell is simple. When the fuse functions a flash passes down the centre tube and ignites the opening charge, which pushes out the bullets and head.

A.P. Shell.—These shell are intended to penetrate armour and then burst effectively. The solid head is especially hardened and the walls are tough. They are generally fitted with caps to give an increased penetration. Old pattern shell may be filled with powder, but modern projectiles (fig. 5) are filled with H.E.

Special Shell.—Gas shell were introduced by the Germans during the World War, and were developed by them into weapons of great offensive power. Ordinarily shell bodies of H.E. design were utilized and filled with a liquid or solid substance which volatilized on exposure to the air, giving a concentration of gas sufficiently strong to disable an unprotected man. The shell were usually opened by a small charge of explosive, the fuse employed being of the instantaneous type. In later patterns of shell the chemical ingredients were inclosed in a bottle which was buried in an ordinary H.E. filling. The shell functioned as an ordinary H.E. shell with the additional deleterious effect due to the chemical.

Smoke shell are really another product of the World War. In

design they resemble gas shell and are filled with composition intended to give smoke clouds for purposes of concealment. They are actuated by direct action fuses and contain small H.E. opening charges. Incendiary shell, also introduced by the Germans, contain incendiary substances and are used with either time or percussion fuses. They call for no further comment. The star shell has many advantages. The latest type of illuminating shell may be considered as well represented by that illustrated in fig. 6. There is a time fuse which can be set for any time up to 33 seconds. When the fuse functions the flash from the magazine ignites the powder in the dome of the shell and blows off the head of the shell The flash from the powder passes down a side channel to the powder charge in a small magazine in the base of the shell; the powder explodes and ejects the star and parachute from the body, and at the same time the star composition in its case is ignited by means of quick-match strands and powder pellets embedded in the composition. After ejection, the parachute opens and keeps the star floating in mid-air until it burns out.

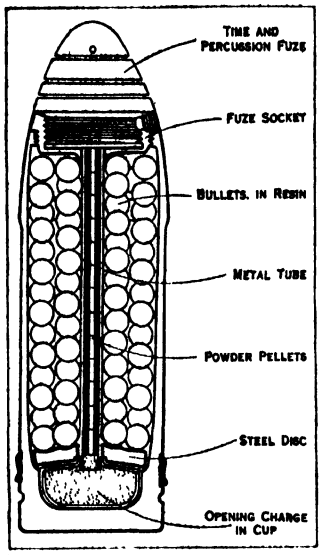


FIG. 4.—DIAGRAM OF MODERN SHRAPNEL SHELL

Cartridges.—Cartridges for ordnance are divided into two main classes, called breechloading or B.L. and quickfiring or Q.F., and each class is subdivided into gun and howitzer cartridges.

The terms B.L. and Q.F. are essentially British, but in other countries the two classes are distinguished by different names.

Propellents.—The actual propelling charges are smokeless propellents of the nitrocellulose type, with or without an admixture of nitroglycerine. They are somewhat difficult to ignite, and hence an igniter of gunpowder is usually embodied in the cartridge. The propellent may be manufactured in various forms, *e g*, sticks or cords, tubes, flakes, and disks, the form and size providing a means of controlling the burning. Well known modern propellents of various forms are Cordite, Röhrenpulver, N.C.T., Ballistite, Ringpulver and Flake.

B.L. Cartridges.—B L. cartridges for guns consist of cylindrical bundles of propellent enclosed in silk bags with shalloon disks containing gunpowder stitched on to one or both ends. With heavy charges, the cartridge may be made up in part-charges and loops provided for lifting. For howitzers, the cartridges are made up in portions which allow varying charges to be used, and consist of a mushroom shaped core with rings or bundles of propellent attached by tape. (*See* fig. 7.)

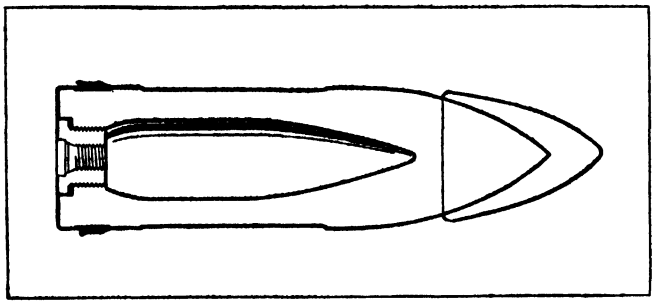


FIG. 5.—DIAGRAM OF ARMOUR PIERCING SHELL, USED IN ATTACKING ARMOURED CARS AND AIRCRAFT IMPENETRABLE TO THE NORMAL BULLET

Q.F. Cartridges.—The essential feature of these cartridges is the brass case which carries the propellent. With small guns the cartridge case is usually attached to the shell, but in heavier calibres the cartridge is a separate component. The use of the brass case in certain circumstances leads to rapidity of fire and simplification of breech mechanisms and it gives safety against accidental ignition. On the other hand, brass is expensive in itself and adds to the weight of the cartridge, entailing increase in transport. Unsuccessful attempts have been made to introduce other metals, such as steel or aluminium. (*See* fig. 8.)

Means of Ignition.—B L. cartridges are ignited by means of tubes. A tube in its simplest form is a brass cylinder containing a charge of fine grain powder, which is ignited by friction, by percussion (fig. 9) or electrically. The tube is a separate part of the round in this case, is inserted in the vent of the gun and fired by the breech mechanism. Q F. cartridges carry their own means of ignition, which are usually called primers or caps. A typical modern percussion primer is illustrated in fig. 10. The cap of the primer is fired by the impact of the firing mechanism, and the subsequent flash ignites the powder in the magazine and thence the propellent charge.

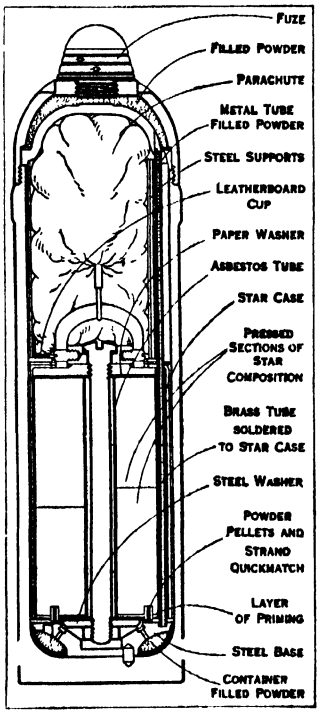


FIG. 6.—DIAGRAM OF SECTION OF A GERMAN 15 CM. STAR SHELL

Fuses.—A fuse is a piece of mechanism which is employed to initiate the bursting, explosion, or detonation of a shell at the required place or time. Embodied in the fuse design are devices which make it safe in handling, transport, and during the passage of a shell up the bore of a gun.

Fuses may be classified as follows: (1) Percussion fuses (*a*) Direct action (D.A.), (*b*) Graze action, nose or base. (2) Time, or time and percussion fuses, combined (*a*) Combustion, (*b*) Mechanical or clockwork.

(1) (*a*) Direct action fuses function as a result of a direct blow on the nose, a hammer or needle being forced on to a detonator. A modern pattern of D.A. fuse is the British fuse No. 106 illustrated in fig. 11, from which its general construction will be understood. It is protected before loading by a safety cap, which is removed by hand. A split steel collar is interposed between the underside of the hammer head and the top face of the fuse body, and round this collar the safety tape is wound. On firing, the tape weight is gripped between the hammer head and body. When the shell leaves the bore the weight is released, flies off, unwinds, and carries the tape with it, tearing away the split collar. The hammer is then supported only by a thin shearing wire. On impact, the hammer is driven in, shearing the copper wire, the detonator is fired, and in turn fires the magazine. A safety shutter is provided, which only opens after the shell leaves the bore of the gun. Another type of D.A. fuse, somewhat less sensitive than the ordinary type, is the direct action impact type (D.A.I.). Such fuses merely differ from ordinary D.A. type in that the suspension of the needle or hammer is very much stronger, and hence the fuse requires a stronger blow on the nose in order to make it function.

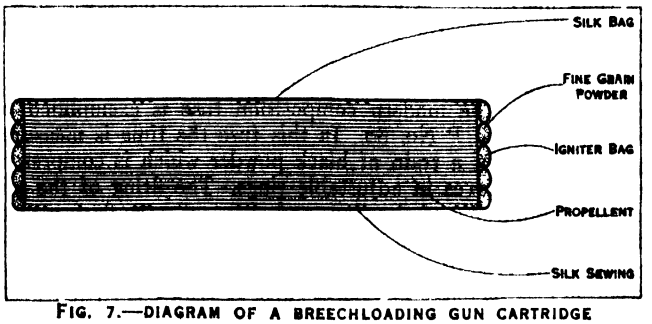


FIG. 7.—DIAGRAM OF A BREECHLOADING GUN CARTRIDGE

(*b*) Graze fuses or check action fuses function as a result of the forward movement of a graze pellet relatively to the main body of the fuse. When the shell receives a check in velocity a pellet carrying a detonator moves forward on to a fixed needle or alternatively a needle pellet moves on to a detonator. A typical nose graze fuse is illustrated in fig. 12. The illustration represents the German fuse Kz. f Spgr. m. K., and shows its general construction. Before firing, the detonator pellet is kept away from the needle by five interlocking brass leaves held in position by a brass ferrule supported on a split brass sleeve. On firing, the ferrule sets back clear of the safety leaves and rebound is prevented by two lugs on the sleeve. When the shell leaves the bore, the brass leaves open out one by one under the influence of centrifugal force, leaving the fuse in a sensitive condition or "armed." Creep action of the detonator pellet during flight is prevented by the so-called creep spring. On graze, the pellet flies forward on to the needle and the detonator fires, the flash passing through a hole in the pellet to the exploder in the shell. A practice common in German design is to arrange a combination of direct and graze action effects in one fuze. In this type the detonator is housed in a movable pellet which functions in the usual way. The needle is formed on the inner end of a rod, the outer end of which projects from the top of the fuse. On impact, the detonator pellet moves forward on to the needle as in an ordinary graze fuse, but in addition to this action the needle is also forced on to the detonator by direct action.

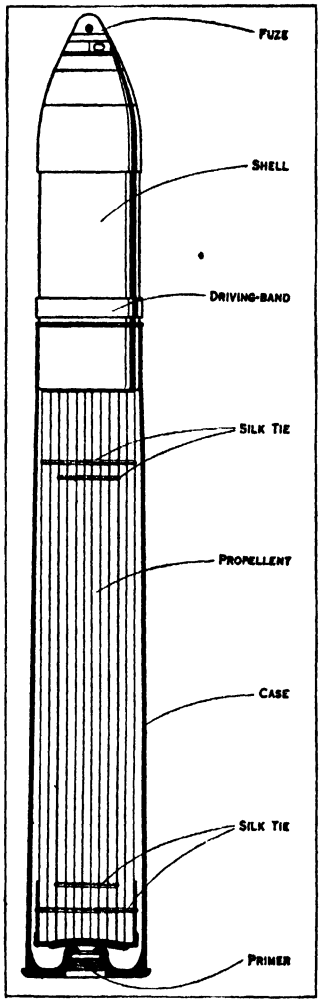


FIG. 8.—A QUICKFIRING CARTRIDGE

(2) A time fuse is one which can be set to burst a shell at a certain predetermined time after firing. A time and percussion fuse, commonly known as a T and P fuse, embodies, in addition to the time mechanism, a graze percussion mechanism which will function independently should the shell strike any object in flight or on impact with a target. Time fuses are divided into two main classes, (*a*) burning or composition and (*b*) mechanical or clockwork. The modern composition fuse is exemplified by the British T and P No. 80. In this fuse the time is measured by the burning of a train of black powder which is compressed into annular grooves in adjustable rings. The firing of the gun initiates the burning of the rings and eventually the flash reaches the magazine and thence the opening charge of the shell. The movable ring type of time fuse is almost universal but a notable exception may be noted in French fuses of type No. 23–31, which is set by punching a hole at the appropriate point in a composition filled lead tube by a machine called a debouchoir. (*See* fig. 13.)

The use of burning composition in time fuses is by no means ideal, and for many years experiments have been carried out with a view to obtaining a clockwork or mechanical apparatus. Various patterns were tried but none was satisfactory until 1916, when the Germans brought into use a clockwork fuse Doppelzünder 16 (T and P fuse 1916 pattern) which may be considered as typical of this class. This fuse is illustrated in figs. 14 and 15, the illustrations being diagrammatic and the description which follows is of principle and arrangements only. The clock train is driven, as in a watch, by a coiled spring in a barrel, but the escapement is original and peculiar. A straight steel spring takes the place of the hair-spring, which would be rendered useless by the effect of rotation and shock of discharge, and as the length of the straight spring is adjustable, the movement of the pallet, of the balance, and therefore that of the escapement wheel and the clock train, is controlled and regulated. A horizontal hand, the position of which depends on the setting of the fuse, has, on its under surface, a notch, into which fits the upturned end of the lever at the top of the striker. When the clock train is started the hand moves round with it, but is prevented from rising and releasing the lever by a ring attached to the conical housing of the fuse. This ring is provided with two slots into which the hand can fit; thus, when the clock is working, the rotation brings the hand into coincidence with the slots, and when forced up by the action of a small spring it releases the upturned end of the lever. The striker, previous to firing, has been held in the safe position by a collar on it, which rests on a shoulder of the centrifugal bolt, but when this bolt is moved away by the rotation of the shell the outer end of this shoulder still rests on a steel pin. When the upturned end of the lever is freed from the notch in the lower side of the hand, as previously described, it flies out and rotates the striker, so that the collar clears the steel pin and allows the striker to fall and fire the detonator. The setting of the fuse and the hand is accomplished by turning the housing with a suitable key, this housing being free to move before firing. On discharge it is very ingeniously clamped to the body of the fuse by means of steel pins in a ring in its under surface. This ring sets back and the pins are driven through the flange of the clock case, a groove being turned on its under side to thin the metal and thus to allow of easy penetration. The clock train, wound up like a watch, is started at the moment of firing by the setting back of a detent.

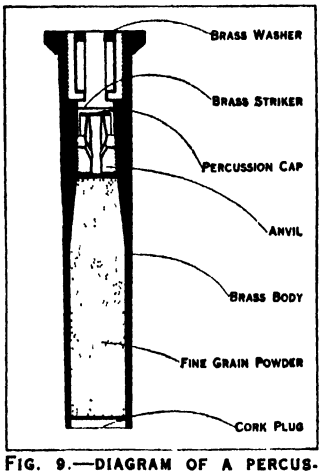


FIG. 9.—DIAGRAM OF A PERCUSSION TUBE

II. AMMUNITION FOR OTHER WEAPONS

HISTORICAL

Small arm ammunition is used with rifles, machine-guns, revolvers and pistols. Its early history is closely allied to that of ammunition for ordnance, but as early as 1586 a composite cartridge was used by musketeers, consisting of a bullet and powder charge wrapped in paper. The paper was torn or bitten, the powder poured into the barrel, and the bullet and paper rammed home. The means of ignition were devices such as matchlocks, wheel locks and flint locks, which ignited powder primers. The early bullet was a spherical leaden ball. Primitive cartridges were used by Gustavus Adolphus in 1625, and later are found in England with S.B. (smooth bore) muskets, their use persisting up to the time of the Crimea.

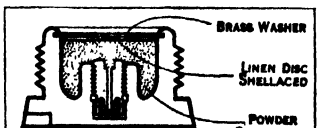
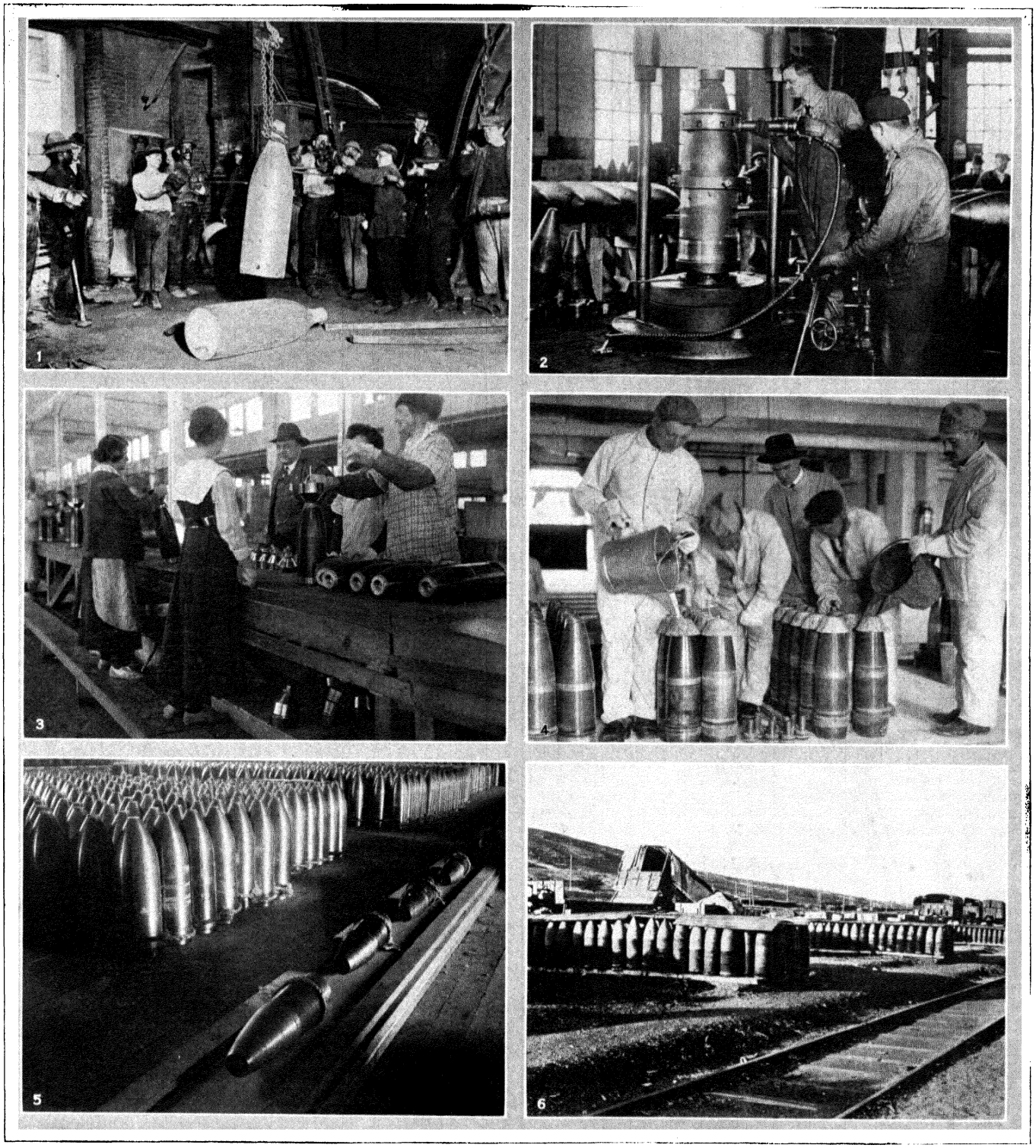


FIG. 10.—DIAGRAM OF A PERCUSSION PRIMER

Rifled small arms were known in the 15th century and were used by the Danes in 1611, Bavarians 1640 and by the French in 1742. At about this last date the use of the rifle was becoming more general and the ammunition was similar to that of the S.B. musket. The excellent use of the rifle made by the American colonists in the War of Independence expedited its introduction into the British and Continental armies. The problems with this early ammunition were the prevention of windage and fouling and to make the ball take the rifling. By 1800 rifles were in general use and the development in ammunition was accelerated by the invention of "percussion powder" and "percussion caps." In 1826 Delvigne devised a system of distorting the



BY COURTESY OF THE UNITED STATES WAR DEPARTMENT

MANUFACTURING AND STORING HIGH EXPLOSIVE SHELLS

1. A hot shell casting being lifted out of the mould. Molten steel is poured from cupola to mould, the rough casting is then lifted out and transported by special mechanical equipment to finishing room
2. Finishing the shell. The shell after being cast is set up in specially equipped lathes and machined with great accuracy by high-speed tools
3. The loading counter, showing the finished shells ready to be loaded with high explosives, TNT. (trinitrotoluene), or chemicals
4. Caps being placed in position and explosives being poured into shells
5. The filled shells ready for shipment, in the shell store, a building for this purpose under special regulations
6. An ammunition dump. The shells are stored on battens and covered with tarpaulins, which are removed whenever conditions are favourable, to permit ventilation and to prevent "sweating." The shells are never exposed to the direct rays of the sun

bullet by ramming, to make it take the rifling, but this led to inaccuracy. In 1833 Poncharra improved the Delvigne system by introducing a "sabot" below the bullet. He also used greased paper for lubrication.

In 1835 Greener introduced an expanding oval bullet, fitted with a metallic tapered plug in its base. In 1837 the Brunswick bullet was introduced. It was spherical and had a belt to fit the

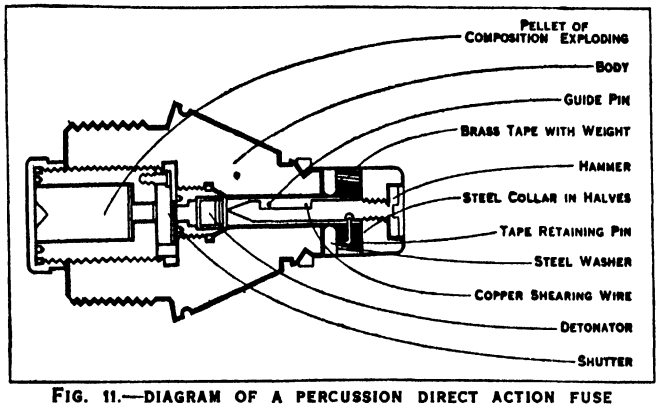


FIG. 11.—DIAGRAM OF A PERCUSSION DIRECT ACTION FUSE

Brunswick rifling. In 1848 the Minié rifle was devised, firing a bullet similar to the Greener, but it had an iron cup in the base instead of a plug. In the meantime a percussion lock for firearms was becoming universal, but the development of the cartridge was slow. The Minié system persisted for many years and other devices, such as Pritchett's bullet, were tried, all with the object of getting rotation. At about the same time as the invention of the Minié the Prussian needle gun (invented by Dreyse in 1838) was adopted by the Prussian army. It had an elongated oval bullet which fitted into a cup-shaped wad containing a percussion cap. The charge was in a paper cylinder, which was tied to the bullet over the cap. The obturation was bad, but the system was a great advance in rapidity of fire.

In 1855 the cup in bullets of the Minié type was replaced by a boxwood plug, and eventually the boxwood was itself superseded by a clay plug. In 1854 Whitworth invented the hexagonal bullet for use in his rifle. It was successful but was unsuitable for S.A. (small arm) requirements. Fouling and loading difficulties persisted. In 1865 Metford demonstrated the advantages of the hardened bullet, which made shallow grooves permissible and reduced fouling. In 1867 breech-loading rifles and brass cartridge cases were coming into general use, owing to the great success of the needle gun in 1866. In 1866 the brass cartridge case of the Boxer type was introduced. It was formed of rolled brass strip and attached to the bullet by a cemented paper joint. The lower end fitted into a brass cup fitted with a cap. Cannelures filled with beeswax provided lubrication. In about 1880 solid drawn cases were suggested and shortly afterwards introduced. In 1883 Rubin designed a composite bullet which was made of lead, with a copper jacket, and in 1887 cupro-nickel was introduced for jackets in certain armies. About this time the introduction of smokeless propellents of the modern type led to great developments in S.A.A. (small arm ammunition). In 1886 nitro-cellulose powder was invented by Vieille and adopted by the United States, France and other nations. In 1891 cordite was adopted by Great Britain The further development of S.A.A. becomes a matter of modern technical history.

TECHNICAL

A round of small arm ammunition, commonly called a cartridge, consists of (*a*) a cartridge case, (*b*) percussion cap, (*c*) propellent charge and (*d*) a bullet. For all S.A.A. certain standards of accuracy and range are necessary, and erosion, wear, metallic fouling, and hang fires should be eliminated.

Parts of the Cartridge.—(*a*) The cartridge case is made of solid drawn brass and is shaped to suit the chamber of the weapon. The front of the case is soft, to allow for the necessary expansion for gas sealing purposes, whereas the rear end is hard to give the necessary strength for extraction. A flange or groove is provided at the base to facilitate the extraction of the empty case. A small chamber is formed at the base to house the cap, and fire holes are provided for the ignition flash.

(*b*) The percussion cap is made of brass or copper and fits accurately into the recess in the base of the cartridge case. It is secured by pressing over the metal of the case. The cap is filled with suitable composition which is readily fired by percussion. Owing to a tendency to deterioration of the composition under warm and damp conditions, the modern practice is to overload the cap and protect it by varnishing or other means.

(*c*) The propellent charge may be either nitro-cellulose powder, which is the custom in the United States of America, or one containing a proportion of nitro-glycerine as in British cordite. It is claimed for nitro-cellulose that it gives the same velocities with lower maximum pressures, but it is more susceptible to dampness.

(*d*) A good bullet should be symmetrical in shape and mass. The modern rifle bullet consists of an evelope and core, the envelope being made of a fairly soft alloy and the core of lead. Cupro-nickel and soft steel have been used for envelopes generally, but in America an alloy of 90% copper has been tried with success. The shape of the rifle bullet is important in obtaining a long range and the necessary accuracy. For this reason modern rifle bullets are provided with sharp points struck with circles of radius equal to 8 times the calibre Stream-lining or boat-tailing the bases of rifle bullets will also give increased range; but this practice has not been universally adopted, owing, probably, to difficulties of manufacture and possible inaccuracy of shooting. Machine-gun ammunition is similar to rifle ammunition and is ordinarily interchangeable

Special Bullets.—A tracer bullet was introduced during the World War, for rifles and machine-guns. The base was stemmed with a burning composition, which was ignited by the propellent gases, and hence the bullet left a visible wake of smoke or flame. Armour piercing bullets have also been introduced to attack

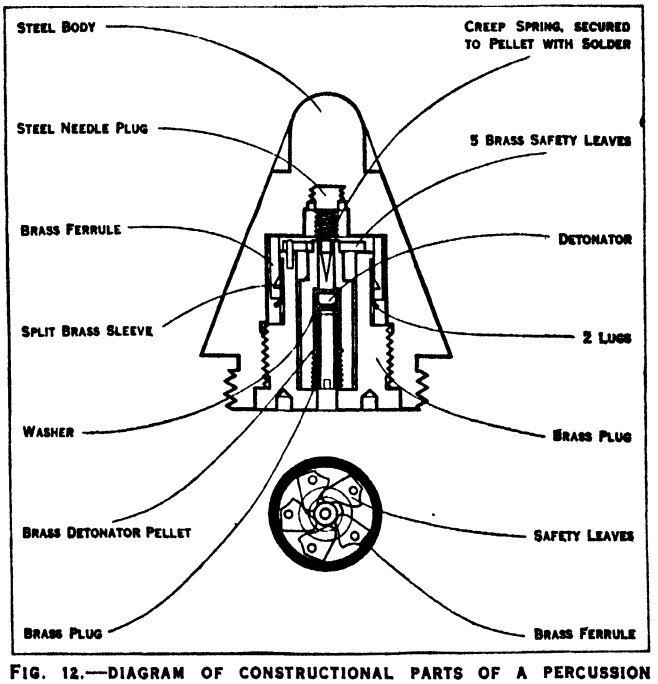


FIG. 12.—DIAGRAM OF CONSTRUCTIONAL PARTS OF A PERCUSSION GRAZE FUSE

armoured cars, aircraft and similar targets which defeat the normal service bullet. They are jacketed with harder envelopes and have a core of specially treated steel, the space between the core and envelope being filled with a lead surround. These bullets can be fired from an ordinary service rifle and will penetrate about 0·25in. of armour. A further modification of this bullet of 0·5in. calibre can be fired from specially constructed weapons and will penetrate nearly 1·00in. of armour.

Pistol Ammunition.—In the British army the 0·455in. calibre revolver, with its heavy, unjacketed lead-antimony bullet.

has remained unchanged for 30 years. As a man-stopping projectile at point blank range it remains unbeaten, but its weight and poor accuracy at longer ranges limit its value. Most nations have adopted automatic pistols for their subsidiary weapon, and for these, jacketed bullets, either of copper or cupro-nickel, are employed. The various nations differ as to optimum calibre for pistol ammunition, but the tendency appears to be away from the light comparatively high-velocity bullet, such as the German

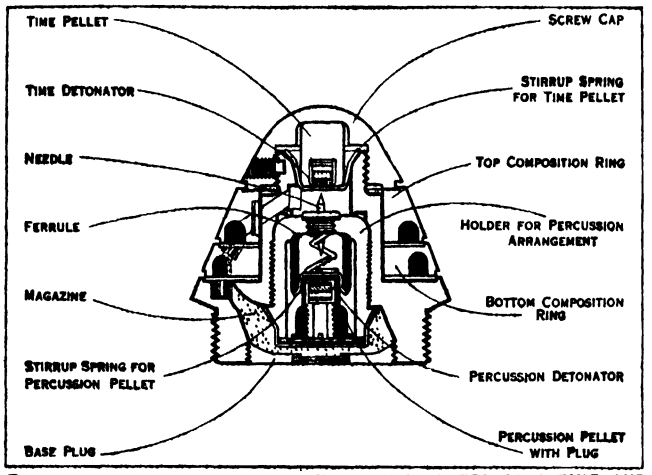


FIG. 13.—DIAGRAM OF THE CONSTRUCTIONAL PARTS OF A TIME AND PERCUSSION FUSE

0·300 Mauser, which was sighted up to 1,000yd., thus holding the pistol to its true rôle, namely, that of a man-stopping weapon at short range.

Aeroplane Bombs.—The aeroplane bomb was developed in the World War and became an important offensive weapon. The main difference between aeroplane bombs and gun projectiles is one of strength. The latter may have to attain a muzzle velocity of about 2,000ft. per sec. in the length of the piece, and this entails pressures running up to 20 tons to the square inch. The former is merely dropped, so that the stresses on it when falling are very little greater than those encountered in normal handling and transport, and it is only when penetration of concrete buildings or armoured decks is sought that anything more than a thin steel case is required to contain the H E. filling As regards shape, the terminal velocity of an aeroplane bomb is never above 1,100 ft. per sec., hence the stream-lining of the tail is just as important as the contouring of the head. Most bombs are therefore pear-shaped, with vanes attached to the cone of the tail to ensure that the bomb drops nose first.

Method of Detonation.—To initiate the detonation of the H.E. filling on impact with the target, fuses or similar devices are used. These are usually simple mechanisms depending for their arming on the unscrewing of vanes by the air stream whilst falling. In general a safety pin, which is only withdrawn from the fuse when the airman drops the bomb, is used as an additional safety precaution. The building up of the detonation wave is accomplished by a central exploder, which may run the whole length of the bomb or, as in gun shell, only a few inches into the H E. filling. (C. W. F.)

THE UNITED STATES

A round of ammunition for a gun, in the United States, consists of a cannon primer, a propelling charge with its container, a projectile and a fuse.

ARTILLERY AMMUNITION

Types of Projectiles.—Two general types of projectiles are used for field, siege and coast artillery known as shell and shrapnel. Shell are made of steel and are filled with low explosives (black powder), high explosives (TNT) or chemicals. Low explosive shell produce fragments upon explosion; high explosive shell, blast effect and fragments; and chemical shell, gas or smoke cloud effect. Other types such as star or illuminating shell are used for special purposes. Artillery shell are made in sizes from slightly over one inch in diameter, weighing about one pound to 16 inches in diameter, weighing over a ton. Shrapnel are filled with a number of balls and when the time fuse, with which a shrapnel is fitted, functions, the powder charge of the shrapnel is exploded. The balls are expelled forward in the form of a cone, with action similar to that of a shot gun. Shrapnel are usually used only in field and anti-aircraft guns.

Fuses.—Fuses are used in practically all service projectiles, to detonate, ignite or scatter the bursting charge of the projectile at the time and under the circumstances desired. Point fuses are usually used in high explosive and chemical shell to obtain quick action and burst the shell before it has penetrated the ground. Base fuses are in general used in projectiles for penetrating hard substances, such as armour plate, concrete, etc., where a point fuse would crush and fail on impact. Most fuses used in shell function upon impact, while fuses used in shrapnel and anti-aircraft shell are of the time type, which are designed to function at some predetermined time after the projectile leaves the gun and during the flight of the projectile. The time fuse used in shrapnel intended for ground targets is designed also to function upon impact. The time interval in most time fuses is obtained by means of the burning of a powder train, the length of which is varied by the setting of the fuse. A mechanical time fuse is one in which the desired time interval is obtained through a mechanical device rather than the burning of powder.

High Explosives and Bursting Charges.—The principal high explosives used are trinitrotoluene (TNT), picric acid, ammonium picrate and amatol, a mixture of trinitrotoluene and ammonium nitrate In the case of shrapnel, however, where balls are ejected from a case, this shattering effect is not desired, and a "low explosive," such as black powder, is therefore used In this case the time required for the explosion to be completed is relatively large as compared to the time for detonating explosives, and the heated gases, being developed more slowly, do not exercise such a

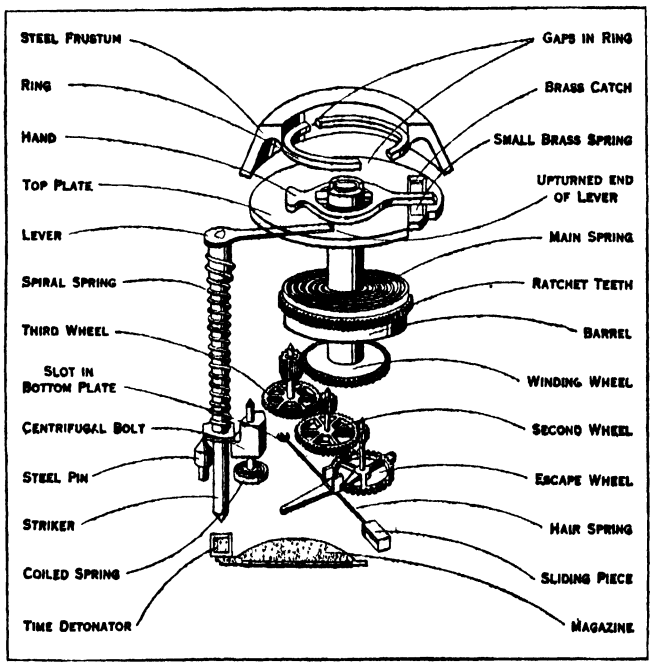


FIG. 14.—DIAGRAM ILLUSTRATING ACTION OF MECHANICAL TIME FUSE

disruptive effect. In the case of "high explosives," such as T.N.T., detonation is initiated by means of some highly sensitive detonating agent such as mercury fulminate in the fuse. In the case of "low explosives," however, explosion is brought about by means of simple ignition.

Propelling Charges and Cases.—The propelling charge, usually of smokeless powder (nitrocellulose, cordite, etc.), in the case of the smaller calibres of ammunition, is contained in a brass case, known as a cartridge case, which has a primer in the base to ignite the smokeless powder, and is crimped to the base of the

projectile. This type of ammunition is known as "fixed ammunition," and is usually in calibres from 37mm. to 4·7 inches. In the case of "semi-fixed ammunition," the cartridge case is not crimped to the projectile. This type is used with howitzers where the powder charge is in the form of zoned bags within the cartridge case, and where it is necessary to adjust the weight of charge for different ranges. In the larger calibres of guns, where the projectile is heavy, it would be impractical to use a complete round. The projectile, propelling charge and primer, therefore, are issued separately. In loading the gun, the projectile is first rammed to its seat and then the propelling charge is inserted. The propelling charge in "separate loading ammunition" consists of smokeless powder in one or more bags. Raw silk is used for these bags as this material is practically entirely consumed by the combustion of the smokeless powder, and leaves no smoldering fragments. In this way the danger of igniting the next propelling charge before the breech block of the gun is closed is avoided. In the case of guns, the propelling charge may be in one section or several, depending upon the weight of the complete charge. For example, since the weight of a charge for the 16-inch gun may be as much as 800lb., the charge is divided into four or six sections for ease of handling. In the case of the large calibre mortars, where various weights of charge are used to obtain various ranges, the total charge is zoned; *i.e.*, divided into several bags.

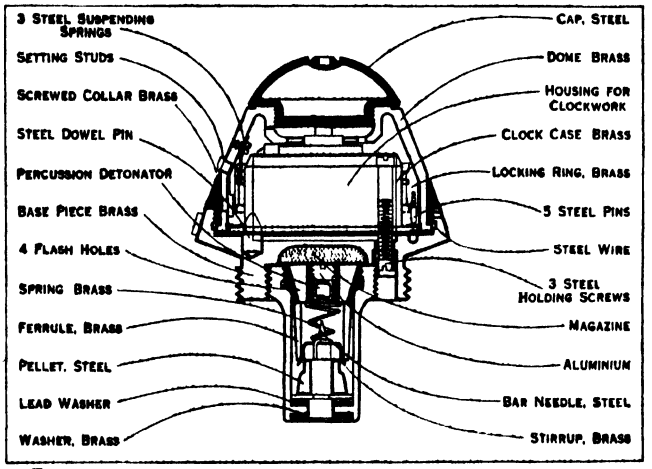


FIG. 15.—TIME AND PERCUSSION MECHANICAL CLOCKWORK FUSE

Primers and Igniters.—The primer, used to ignite the propelling charge of smokeless powder, is a small brass case loaded with a charge of black powder, which, in the case of the smaller calibres, is sufficient to produce efficient ignition of the propelling charge. The primer has in its head a small percussion cap which is struck by the firing pin of the gun, thus igniting the black powder charge, which in turn ignites the propelling charge. In the case of the smaller calibres, where cartridge cases are used, the primer is assembled in the head of the cartridge case. With larger calibres, the primer is assembled in the breech mechanism of the gun With larger calibres additional igniting powder (black powder) also is required. This is usually made up in the form of a bag attached to the rear of the propelling charge. In some of the largest calibres this additional igniter may extend through the core or centre of the propelling charge. The size of this igniter increases with the calibre of the gun. In the case of the 16in. gun an igniter of 6lb. may be used.

III. SMALL ARMS AMMUNITION

Ammunition for Small Arms.—In America military small arms ammunition for rifles consists of a cartridge composed of a bottle-necked, rimless cartridge case containing a non-corrosive primer, a charge of nitrocellulose smokeless powder, and a conical, sharp pointed bullet having a core of lead and a jacket composed of copper and zinc. For revolvers and pistols the bullet is not always jacketed, but may be composed of an alloy of lead, tin and antimony. For rifles, five cartridges are usually secured together at the head of the cases by means of a clip, thus permitting all five cartridges to be inserted in the magazine of the rifle in one motion. Small arms cartridges are usually packed in cardboard cartons of 20 to 50 rounds, or in cloth bandoliers of 60 rounds for convenient issue, and these cartons or bandoliers are in turn packed in wood boxes of 1,000 to 2,000 rounds for transportation purposes.

Primers.—The primer, inserted in a cup at the rear end of the cartridge case, serves to ignite the primer and contains the priming mixture. Formerly priming mixtures all contained a large percentage of potassium chlorate, but it has recently been found that this was almost the sole cause for the serious corrosion in the bores of small arms. The most recent development in primers in the United States has been the complete elimination of potassium chlorate from the priming mixture, thus making the ammunition non-corrosive.

Powders.—Formerly all reliable smokeless powders were of the nitroglycerine type. While such powders have been greatly improved, the greatest advancement has been in the development and perfection of nitrocellulose powders to the point where they can now be considered the equal of any nitroglycerine powders in reliability, while having very great advantages in the matter of lessened erosion. Improved nitrocellulose powders have more than doubled the life of the barrels of small arms.

Bullets.—Prior to 1906 bullets for small bore military rifles were cylindrical, with a rounded nose or point. The bullets for the ·30 calibre U S. rifles of the models of 1892 to 1903 weighed 220 grains, being composed of a lead core with a jacket of cupro-nickel. In 1906 the bullet was decreased in weight to 150 grains and the point was changed to a sharp form The sharp point greatly lessened the air resistance, and the lighter weight permitted more powder to be used, thus greatly increasing the velocity (2,250 f s. to 2,700 f.s), and flattening the trajectory. In 1926 a still further improvement was made in this bullet, the weight being increased to 172 grains and the form changed to a boat-tailed or streamline shape With the same initial velocity as previously, this change in weight and form increased the maximum range of the rifle and its cartridge from 3,300yd. to 5,600yd., and very greatly increased the range to which the sheaf of fire from machine-guns could be effectively controlled. At the same time the material of the bullet jacket was changed from cupro-nickel to a composition of copper 90 parts, zinc 10 parts, the change doing away entirely with the metal fouling of the bores of small arms which had always been troublesome with bullets jacketed with cupro-nickel.

Sporting Small Arms Ammunition.—Improvements in sporting cartridges for rifles have paralleled the military cartridges in details Black powder cartridges and those with heavy bullets are now obsolete. Modern cartridges are of the ultra high velocity type, employing light bullets at muzzle velocities from 2,300 to 3,500ft per second The bullets are made to expand on impact by leaving a portion of the lead core exposed at the point or by a hollow point. The continent of North America does not contain any dangerous or thick-skinned game, and hence in the United States there has been little or no development of the extremely powerful sporting cartridge, such as is needed for the heavy game of Africa and southern Asia. Instead, developments have tended towards greatly increased accuracy and very flat trajectory Most sporting rifle cartridges now employ bullets jacketed with an alloy of copper and zinc to avoid metallic fouling, and the non-corrosive primer has become quite general in its application

In ammunition for shotguns a progressively burning, nitrocellulose powder has quite generally been adopted for the better grades of cartridges. This new powder has enabled the velocity to be increased several hundred feet per second, with little increase in the breech pressure, and with no bad effect on the patterns.

AEROPLANE BOMBS

Types of Bombs.—Bombs are of two main types, *explosive* and *chemical bombs* The *explosive bombs* are further subdivided into *demolition* and *fragmentation bombs*. The *demolition* bombs

are intended for destruction of enemy works and depend primarily upon blast or shock effect for the destruction of these structures. The destructive effect is the result of the detonation of the high explosive content of the bombs, which is usually TNT. The explosive charge constitutes approximately 50% of the total weight of bombs. The largest size of demolition bomb ever manufactured is one weighing 4,000 pounds. Most of the bombs are streamline in shape. The present tendency in design is towards bombs which have a cylindrical body and a nose in the form of a modified ellipse either secured to or integral with the cylindrical portion. *Fragmentation* bombs are intended for use against personnel. They depend upon the fragmentation of the metal case at or above the surface of the ground to produce casualties. These bombs are much smaller than the demolition bombs, the largest weight of bomb being approximately 50 pounds. They are filled with about 15% of TNT. The main type of *chemical* bomb is the smoke bomb. These bombs are intended for use as obscuring agents. At present the formation of smoke screens is employed to mask known enemy observation posts, to conceal and protect the front flanks of attacking troops from enemy observation and to blind hostile machine-guns. Titanium tetrachloride and white phosphorus are the two chief chemicals used as smoke producing agents.

Bomb Fuses.—Demolition bombs are usually equipped with both nose and tail fuses, while fragmentation bombs and chemical bombs are equipped with nose fuses only. The fuses are of two types, the *arming vane type* and *arming pin type*. When assembled to the bomb, prior to the release of the bomb from the plane, the fuses are usually in an unarmed condition, that is, mechanical restraints prevent the fuses from firing the primer or detonator which initiates the detonation. In the case of the arming pin type of fuse these mechanical restraints are removed immediately upon release from the plane, while in the case of the arming vane type of fuse all the mechanical restraints are removed only after the arming vanes have made a definite number of revolutions due to the action of the air and the bomb has fallen a considerable distance from the aeroplane. Upon impact the firing pin of the fuse fires the primer or detonator which initiates the detonation. Where it is not desired that the bombs detonate, they are released so that the mechanical restraints within the fuses will not be removed. On impact the firing pin of the fuse is thus prevented from coming into contact with either the primer or detonator which in turn prevents detonation of the bomb. Fragmentation and chemical bombs are equipped with detonators which permit them to function instantaneously upon impact, while demolition bombs are equipped with detonators which permit of either instantaneous or delay functioning after impact.

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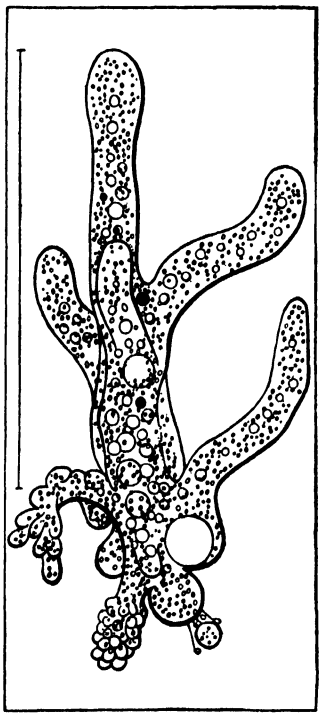
AMMUNITION SHIPS: *see* FLEET AUXILIARY VESSELS.

AMNESIA, a term used in psychopathology for functional disturbances of memory (Gr. ἀμνησία, forgetfulness). An amnesia may be *general,* in which case all functions of memory are involved, or *partial,* in which case only certain groups of ideas, proper names, the meanings of words, special events and their associations, and the like, are screened from memory. (*See* HYPNOSIS.)

AMNESTY, an act of grace by which the supreme power in a State restores those who may have been guilty of any offence against it to the position of innocent persons. It includes more than pardon, inasmuch as it obliterates all legal remembrance of the offence. Amnesties, which may be granted by the Crown alone, or by act of parliament, were formerly usual on coronations and similar occasions, but are chiefly exercised towards associations of political criminals, and are sometimes granted absolutely, though more frequently there are certain specified exceptions. Thus, in the case of the earliest recorded amnesty, that of Thrasybulus at Athens, the 30 tyrants and a few others were expressly excluded from its operation; and the amnesty proclaimed on the restoration of Charles II. did not extend to those who had taken part in the execution of his father. Other celebrated amnesties are that proclaimed by Napoleon on March 13 1815, from which 13 eminent persons, including Talleyrand, were excepted; the Prussian amnesty of Aug. 10 1840; the general amnesty proclaimed by the emperor Francis Joseph of Austria in 1857; the general amnesty granted by President Johnson after the Civil War in 1868; and the French amnesty of 1905. The last act of amnesty passed in Great Britain was that of 1747, which proclaimed a pardon to those who had taken part in the second Jacobite rebellion.

An amnesty clause is usually inserted in peace treaties granting immunity from prosecution for acts committed contrary to laws and customs of war by members of the armed forces of the respective belligerents or by their subjects. Not infrequently, however, named persons or persons alleged to have committed war crimes, subjects of the defeated belligerent, are excepted from the amnesty clause and a stipulation for their surrender is expressly included in the treaty. Instances of such exceptions are the Treaty of Peace with the Boers in 1881, the Vereeniging Treaty of 1902, and the Peace Treaties between the Allies and Associated Powers and Germany and her allies after the World War. A belligerent may, however, punish his own subjects, unless the contrary is stipulated in the treaty of peace. For instance, Russia in 1878 stipulated that Turkey should grant an amnesty to such of her own subjects as had compromised themselves during the war (H H L B)

AMNIOTA, a term sometimes used in zoology to denote collectively the reptiles, birds and mammals. The word refers to the presence in all three groups of a membrane, the amnion, round the developing young and enclosing a fluid-filled space. (*See* VERTEBRATE EMBRYOLOGY.)



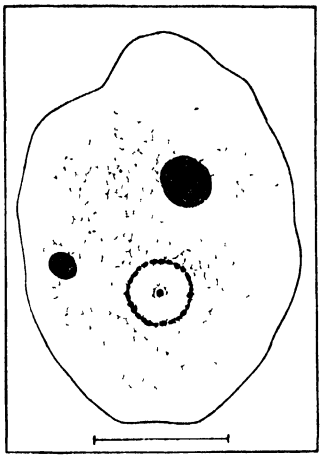
FROM F V HAYDEN "FRESHWATER RHIZOPODS"

AMOEBA INHABITING FRESH WATER This unsymmetrical shape is one of many that the amoeba can assume. It has no mouth but takes in and discharges food from any part of its body. The circle and dots on the lower right are food particles being ejected in this way. (The line along the left side represents ½ mm.)

AMOEBA, the name given to certain microscopic animals (*see* PROTOZOA) which creep along and engulf their prey by outthrust and retraction of *pseudopodia,* or lobose processes of the naked undivided protoplasmic mass of which their bodies are composed (*see* PSEUDOPODIUM). These animalcules are found in fresh water and in the sea, and many live on or in the bodies of other animals, both invertebrate and vertebrate; man himself may harbour six different species in his alimentary canal. The first account of an amoeba was that by Roesel, who in 1755 gave a graphic description of the flowing movements and consequent change of shape in the "proteus" as he called it. The same kind of movement is shown by certain cells of the metazoan body; for instance, by developing eggs of sponges and by the white corpuscles of the blood of many animals. The myxomycetes, some of the flagellates and certain of the sporozoa also have amoeboid stages in their life-history. Bütschli regarded amoeboid movement as a physical phenomenon due to alterations in the surface tension, and he showed that "artificial amoebae" consisting of drops of oil-soap emulsion, creep about actively for several days by pseudopodia. Verworn and others then demonstrated that the type of pseudopodium formed by an amoeba can be changed by increasing the alkalinity of the surrounding medium.

Pelomyxa, which is a giant of the group, measures as much as 3mm. But the majority of amoebae are not visible to the naked eye, and the small forms that develop in the surface film on an organic infusion measure only about ·01mm.

Where it comes in contact with the surrounding fluid, the protoplasm of an amoeba is usually clear and comparatively firm: this layer is the "ectoplasm." The interior "endoplasm" is more fluid and very often granular; the streaming movements that accompany pseudopodium formation can be followed by watching the circulation of these granules. There is no mouth or anus; food is taken in and the undigested remains cast out at any point on the surface. Amoebae living in ponds or in gently running streams feed on algae, diatoms, and other protozoa; the amoebae in organic infusions devour bacteria, and the same is true of the endoparasites, which are probably really harmless scavengers. *Entamoeba histolytica,* however, which is known to be the causal organism of a form of dysentery in man, devours red blood corpuscles. The amoebae and associated flagellates living in damp earth are believed to exert a considerable influence on the bacterial content and consequent fertility of the upper layers of the soil.



FROM G DOBELL, "THE AMOEBA LIVING IN MAN"

A SPECIES OF AMOEBA THAT SOMETIMES INHABITS THE HUMAN SYSTEM AND IS RESPONSIBLE FOR A FORM OF DYSENTERY THE THREE CIRCLES ARE CORPUSCLES OF RED BLOOD IT HAS TAKEN IN AS FOOD (The line below the figure represents 1/100 mm.)

Each simple protoplasmic mass constituting an amoeba contains a nucleus, usually with a central karyosome and peripheral chromatin, and when the full-grown body divides by binary fission, which is the normal mode of multiplication, the nucleus divides also. This nuclear division involves a scrupulous distribution of the chromatin to the two daughter individuals; there is, in fact, a modified mitosis (*q v*) In certain cases it has been shown that repeated division of nucleus and cytoplasm within a "cyst" gives rise to a new brood. As yet, no sexual phase has been clearly demonstrated in any true amoeba. A constant feature of all fresh-water amoebae is the fluid-filled "contractile vacuole" (*q v*), which opens to the surface by a pore and is often regarded as conveying nitrogenous waste to the exterior; the absence of this structure in marine and endoparasitic species suggests that it may also be concerned with regulating osmotic pressure.

The delicate bodies of amoebae are liable to rapid desiccation when exposed to air. They can tide over these periods of danger by adopting a spherical form and surrounding themselves with a protective envelope or cyst. Such cysts may be dispersed by air-currents or through the agency of insects such as flies, and if they fall into a suitable environment, the envelope ruptures and the contained amoeba emerges.

Most known species of amoeba can now be cultivated in the laboratory, the bacteria-loving forms on special agar media; and recently certain of the parasitic forms, even those like *Entamoeba histolytica* from a warm-blooded host, have been successfully grown *in vitro.* (D. L. M.)

AMOK, RUNNING: *see* AMUCK, RUNNING.

AMON, the human-headed god of Thebes, was probably a local variety of the ancient god Min of Coptos The temple of Karnak was his home; it was called "the Thrones of the Two Lands" (*Nesut-toui*). He had also a temple of later foundation in southern Epet (Luxor).

AMONTILLADO, one of the two chief types of sherry wine exported. It is sweet and full-bodied, and derives its name from the town of Montilla in southern Spain (*see* SHERRY).

AMONTONS, GUILLAUME (1663–1705), French physicist, was born in Paris Aug. 31 1663, and died there Oct. 11 1705. In 1687 he presented to the Academy of Sciences an hygrometer of his own invention, and in 1695 he published his only book, *Remarques et expériences physiques sur la construction d'une nouvelle clepsydre, sur les baromètres, les thermomètres et les hygromètres.* In 1699 he published some investigations on friction, and in 1702 and 1703 two noteworthy papers on thermometry. (*See* COLD)

AMORA: *see* TALMUD; GAON

AMORETTI, little loves, cupids. The title of a sequence of sonnets (published 1595), written by Edmund Spenser (*q.v.*) and dedicated to Elizabeth, probably the daughter of James Boyle, whom he married in 1594 The verses record the course of his wooing and close with the beautiful ode or *Epithalamion* celebrating his wedding.

See Emile Legouis, *Spenser,* chap. iv. (1926).

AMORITES. The Amorites are known from the Bible (together with the Jebusites, Hivites, etc.), as a pre-Israelite people in Canaan, and also as the inhabitants of two trans-Jordan kingdoms (Num. xxi). The later Israelites believed that this primitive race was one of giants (Amos ii. 9; Deut iii. 11).

The non-biblical material has markedly increased our knowledge and has also complicated it. Egyptian illustrations of the New Kingdom show the Palestinian Amorites to have been a race much more like the northern Europeans than the Semites; long headed, with blue eyes, straight nose and thin lips. Even the royal name *Akvāruvash,* the reputed contemporary of the ancient king Narām-Sin of Akkad (about 2530 B C), in the Hittite copy of an inscription of the latter, seems to be Aryan or Indo-European (*cf* Forrer, *Die Boghaz-koi-Texte in Umschrift,* II. 1, no. 3, col 1, line 12.) The mixture of races, however, which went on from the earliest times in Canaan and over a considerable area of the surrounding countries must be taken into account.

Another impression is gained from the Babylonian material of the earliest period, where "west" (as one of the quarters of the heavens) and "the land of the Amorites" (*Amurru,* ideogr. *Mar-Tu*) were of identical meaning. The Amorites were inhabitants of a territory lying west of Babylonia, and the majority of them belonged (as forerunners of the Aramaeans) to the western Semitic race

The motherland of these peoples was the region of the Middle Euphrates: Khana (near the modern Tell-Ishâra, south of the mouth of the Khabur), Mari (near the extensive ruin-mounds Werdi and El-Erzi), Shukhi (between the modern 'Ana and Hit), Subir-Subartu (the modern El-Jezireh, as far as the Tigris) and Naharina (the north-western part of El-Jezireh, near the old Harrān). According to the old king list a dynasty from Mari had actually reigned over Babylon about 2900 B C, and the names and statues of old kings of the Sumerian period of the kingdom of Mari have been recovered. But the identification of this Mari with the old capital of the Amorites is still uncertain.

The Amorites were gradually driven out of their mother-territory by an invasion of the Kharri and Mittanni from the north. In Babylonia they settled at first in their own villages and townships (*e g.,* in Sippar) as merchants and as mercenary soldiers; but they soon began to reach out after sovereignty. About 2057 B.C (according to Thureau-Dangin about 2105 B C) Sumu-abum founded the Amorite kingdom of Babylon. Hammurabi, his fifth successor, through his victory over the king Rīm-Sin of Larsa, united the whole of Babylonia under his sway (1925 B C). This period of the Amorite dynasty meant for Babylonia the richest flowering of her culture. None the less, after 300 years, the Amorite kingdom in Babylonia fell before an invasion of the Hittites (under King Murshilish I., 1758 B C).

Meanwhile the Amorites had settled in the west of Lebanon and in the mountainous parts of Canaan, and perhaps even ruled Egypt for a short time. It is, in fact, probable that the foreign domination of Egypt, the so-called Hyksos (*c.* 1800–1580 B C), is connected with the wanderings of this Amorite people. This period was that of the Amorites' greatest power; what they lost in Babylonia was won in Egypt, Canaan and Syria. But after the downfall of the Hyksos kingdom the Amorites were in their turn subjugated by the native Egyptian Pharaohs of the 18th dynasty,

especially by Thutmoses III. Only in Lebanon were they able to maintain what seems to have been a small Amorite kingdom, first under Egyptian and then under Hittite overlordship. The capital of this kingdom was probably Kadesh in Orontes, the modern Tell Nebi Mendi which is situated in the plain south of Homs (Emesa). From the Tell el-Amarna and Boghaz-keui cuneiform inscriptions we can follow the history of this kingdom for some 200 years (1400–1200 B.C.); we know, for instance, that under the rulers Abd-ashirta, Aziru and their successors, it extended its sway for a time to the rich Phoenician seaports. The trans-Jordan kingdoms of the monarchs Sihon and Og (Num. xxi.) must have been the final offshoots of the great Amorite kingdom.

The importance and influence of the Amorites were overrated by the late Professor A. T. Clay of Philadelphia; though his is the merit of having drawn attention to their importance. On the other hand, Bauer's careful researches have led him to an underestimation. According to him, *Amurra*, meaning the land to the west, or "the west," is a geographical term; the mercenary soldiers who dominated Babylon under the "dynasty of Amurru" were from a hill country of that name, lying, however, to the north-east; and the Amorite kingdom in the Lebanon and Orontes districts should be wholly separated from both of these. Thus the geographical and historical relations remain unintelligible.

There is a rich but scattered abundance of material on the language of the Amorites in the proper names and in the name-lists from the time of the first Babylonian dynasty, in the foreign words and proper names to be found in Egyptian texts, and, above all, in the foreign words and glosses of the El-Amarna letters. From this it is seen that the language represents an earlier stage of the Hebrew language (*q.v.*).

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AMOROSO (Ital.), a musical term signifying that the passage so marked is to be played in an amorous style, that is, with warmth and tenderness; *con amore* has the same meaning

AMORPHISM is a term derived from α, privative, and μορφή, form, and is used in chemistry and mineralogy to denote the absence of regular or crystalline structure in a body; the adjective "amorphous," formless or of irregular shape, is used technically in the foregoing sciences and also in biology, etc.

AMORTISEMENT: *see* AMORTIZATION.

AMORTIZATION, the paying off of a debt or obligation, or the extinguishment of an asset by means of a series of partial payments or charges, prorated to extend over the period during which the obligation or asset will exist. Such amortization payments are usually in annual or semi-annual amounts, each of which is sufficient to cover the interest, if any, and also to provide for a certain reduction of the principal.

The amortization principle is used in finance for the purpose of obliterating the premium or discount on bonds which are bought or sold above or below their par value. As bonds approach their maturity date, at which time they will be paid off at par, their carrying value approaches their par value, actually reaching it at the time of redemption. If such bonds have been bought or sold at a premium or at a discount then such premium or discount must be amortized by the time of maturity in order to bring these two values to a point of coincidence in the accounts. If a bond is bought above par, at a premium, and repaid at par, the owner loses an amount equal to the premium; if it is bought below par, at a discount, and redeemed at par, the owner gains an amount equal to the discount. If the bond is sold above par, at a premium, and redeemed at par, the issuer gains an amount equal to the premium; if it is sold below par, at a discount, and redeemed at par, the issuer loses an amount equal to the discount. This premium or discount which is gained or lost as the case may be, should be amortized over the life of the bond by periodic charges or credits.

The amortization of bond discount by the issuers will work out as follows. A thousand dollar 5% bond is sold at 80% of its face value. This increases the company's liabilities by $1,000 and increases its assets by the amount of cash realized, $800. The difference of $200 is the bond discount and is entered under this name as an asset. This is, of course, only a balancing item or practically a dummy asset, and if the company is to make its real assets equal to its increased liabilities it must add to its property an amount equal to $200. The most usual way is to lay aside from earnings annually a predetermined sum either fixed (approximate method) or varying (scientific method), which over the life of the bond will amount to the discount of $200. Amortization of premiums may be accomplished in a similar manner.

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AMORY, THOMAS (*c.* 1691–1788), British author, published *Memoirs; containing the lives of several Ladies of Great Britain; a History of Antiquities, etc.* (1755) and *Life of John Buncle Esq.* (1756 and 1766). Both books are an extraordinary mixture of fiction, autobiography, scenic description and theological discussion. Of the two *John Buncle* is by far the more readable. "The hero," says George Saintsbury, "becomes less nebulous; in fact he is, at least, of the world of Dickens, when he sits down, in the highest state of contentment, and, in fact, of positive carol, to a pound of steak, a quart of peas, another (or several others) of strong ale and divers cuts of fine bread." "The soul of Rabelais," says Hazlitt, "passed into John (*sic*) Amory."

See an edition of the *Life of John Buncle* by E. A. Baker (1904); also W. Hazlitt, "On John Buncle," in vol. i. of the 1902 ed. of Hazlitt's *Works;* and G. Saintsbury, "Growth of the Modern Novel," in the *Cambridge History of English Literature*, vol. xi.

AMOS. I. The Book.—Like others of the Prophetic books of the Old Testament, the Book of Amos is a compilation which probably reached its present form long after the time of the prophet whose words it enshrines. We can trace the usual three types of source: (*a*) oracular matter, comprising most of this book; (*b*) reminiscences either written or dictated by the prophet himself, usually in prose (vii. 1–8, viii. 1–3, ix. 1–4)—these are accounts of the prophet's intercourse with his God while in the familiar condition of "ecstasy"; and (*c*) narrative by a third person describing an event in the life of the prophet (vii. 10–17). The passages under heading (*a*) consist of short, sometimes fragmentary, sections, each embodying an individual and separate message; some of them seem to be snatches from hymns of praise, which may or may not be the work of Amos himself (*e.g.*, v. 7,8–9), and the final compiler seems to have appended to his collection a hopeful section by a later hand (ix. 8b–15), which was intended to tone down the uniform gloom of the prophet's predictions. Possibly the prophet himself was responsible for the arrangement of the oracles on the nations (i. 3–ii. 7a); if not, then the compiler of this section shows a rhetorical and dramatic power not unlike that of the prophet himself.

II. The Man.—Amos, whose activity is to be dated about 760 B.C. (viii. 9 suggests that Amos had experienced the eclipse of 763), was a native of Tekoa, in southern Judah. He belonged therefore, to a social order which still remained largely pastoral, and, though he knew the agricultural and commercial life of central Palestine and its cities, he approached it as an outsider. He himself lived the life of the semi-nomad, accustomed to the wide spaces of the southern hills, where the appearance of two travellers together was a rarity to be explained only on the ground that they had planned to journey together. He knew the habits of the lion, the bear, the birds, the snakes, and of those who hunted them or feared them. Though clearly an "ecstatic" (Heb. *nābī'*), he indignantly repudiated the suggestion that he belonged to the professional party of "prophets" whose interference in politics had produced a revolution 100 years before his time. But he had the

clearness of insight which comes from lonely communion with nature, and he had, too, the intense conviction that it was the word of his God that he had to deliver.

III. His Message.—Since the days of David, Israel had been growing steadily out of the old nomad social and economic order into that of a commercial and agricultural state. Such a transition is always attended with risks, and these had become most obvious in the century preceding Amos. The old system of small proprietors, prevalent up to the middle of the 9th century, had given way to large estates worked by serf or slave labour. The result was a national emasculation, and the means by which the change was produced involved not only a failure to appreciate the demands of humanity, but also commercial immorality and shameless judicial corruption. Popular religion, to some extent inherited from the Canaanites, gave no help; on the contrary it condemned the would-be reformer (vii. 10 *seq.*), and its methods and ritual proved to be diametrically opposite to the real interests of morality. On the one hand, Amos found extravagant luxury, jingoism and oppression; on the other a proletariat from whom all virility had been crushed. Such a state could not hope to survive.

Unlike the Rechabites, who stood for a return to the simpler conditions of the nomad stage, Amos had no social programme to offer. Instead, he called men back to the God of their fathers, and insisted that the nation could find safety only in moral and spiritual reform. He presented men with a God who was essentially Law, acting not by casual whim but on invariable principle. To him the God of Israel was the Lord of creation, of history and of universal morality, and His supreme demand was for *justice*. That alone could save the people from their impending fate, for that alone would admit in practice the rights of human personality. The supreme contribution of Amos to the world's religious thinking was that he insisted that God is *good*

Among English works on Amos the most advanced is Harper's Commentary (*Internat. Crit. Comm.*), to which should be added Driver's *Joel and Amos* and Sir G. A. Smith's *Twelve Prophets*. More recent work of a popular type is to be found in J. E. McFadyen's *Cry for Justice* and the chapter on this book in *Prophecy and the Prophets in the Old Testament* by T. H. Robinson, who has also published a translation in colloquial English. (T. H. R.)

AMOSITE, a variety of asbestos characteristic of a definite geological horizon in the Lydenburg and Pietersburg districts of the north-eastern Transvaal; it possesses well developed fibrous structure and the colours range through greys and whites to yellowish greys. The material is a silicate of iron containing also magnesia and lime or soda. The deposits contain a high percentage of long fibres; spinning stock 4–7in. in length is common and lengths up to 11in. have been observed. The name is derived from the synthetic word *Amosa*, made by combining the initial letters of the name of one of the principal producing companies, Asbestos Mines of South Africa; the term was suggested as a distinctive trade name by A. L. Hall (Geol. Survey, Union of South Africa) in recognition of the distinctive characteristics of the fibre.

AMOY (24° 27′ N. 118° 4′ E.), a treaty port in the province of Fukien on the highly indented south-eastern coast of China It lies at the head of a wide bay, studded with islands, into which flows the Kiulung river, whose basin occupies the south-east of the province. The harbour lies in the lee, *i.e.*, to the west, of Amoy island and is one of the finest on the coast. Its natural hinterland comprises only South-east Fukien and its trade with the interior is becoming more and more confined within these limits. In the past it has had a much larger significance, for it lay on that part of the Chinese coast first reached by traders approaching China by sea from the Indian Ocean. Both the English and Dutch first traded with China through Amoy which in the 18th century monopolized the Chinese junk trade to the "Straits" and Java. It still retains close connections with Malaya whose Chinese population is drawn largely from Fukien and emigrates mainly through Amoy. This relationship with Malaya is illustrated by the foundation of Amoy university by K. K. Tan, a Fukienese, by means of wealth acquired in Malaya. Moreover, Amoy has had trading relations with Formosa, once part of Fukien, but since the cession of Formosa to Japan these have become less intimate. Its tea export, once its staple trade, drawn originally from Fukien itself and later from Formosa, has dwindled away. Although its total trade has risen in value from Hk.Tls. 10,058,401 in 1867 to Hk.Tls. 37,648,311 in 1926, it has fallen among Chinese ports from 8th to 15th place and in population from 300,000 to 114,000. Amoy is a port of call for coastal steamship services, has ship-repairing facilities and industrial activities, such as canning and sugar-refining, arising out of the sub-tropical agriculture of its hinterland. The foreign population resides in a self-governing international settlement on Ku-lang Su island, across the harbour from Amoy island.

AMPELIUS, LUCIUS, possibly a tutor or schoolmaster, and author of an extremely concise summary—a kind of index—of universal history (*Liber Memorialis*) from the earliest times to the reign of Trajan. The little work, in 50 chapters, gives a sketch of cosmography, geography, mythology (chaps. i–x.) and history (chap. x.–end). The historical portion, dealing mainly with the republican period, is untrustworthy, and the text in many places corrupt; the earlier chapters are more valuable and contain some interesting information. In chap. viii. (*Miracula Mundi*) occurs a reference to the famous sculptures of Pergamum, discovered in 1871, excavated in 1878, and now at Berlin: "At Pergamum there is a great marble altar, 40ft. high, with colossal sculptures, representing a battle of the giants." Nothing is known of the author.

The first edition of Ampelius was published in 1638 by Salmasius (Saumaise) from the Dijon ms., since lost, together with the Epitome of Florus; the latest edition is by Wölfflin (1854), based on Salmasius's copy of the lost codex.

See Gläser, *Rheinisches Museum*, ii. (1843); Zink, *Eos*, ii. (1866); Wolfflin, *De L. Ampelii Libro Memoriali* (1854).

AMPELOPSIS, a genus of the vine family, Vitaceae, strongly resembling the grape-vine in habit, comprising some 25 species native to warm regions in Asia and North America, some of which are cultivated as ornamental climbers. Of these, the pepper-vine (*A. arborea*), somewhat shrubby, with pinnate leaves, and the simple-leaved ampelopsis (*A. cordata*) occur in the southern United States. The Virginia creeper (*q.v.*) was formerly placed under this genus, while *A. cuspidata* (*A. Veitchii*), introduced into England from Japan in 1868, has smaller leaves very variable in shape.

AMPÈRE, ANDRÉ MARIE (1775–1836), French physicist, was born at Polémieux, near Lyons, Jan. 22, 1775. When Lyons was taken by the army of the Convention in 1793, the father of Ampère, holding the office of *juge de paix*, was thrown into prison, and soon after perished on the scaffold. This event produced a profound impression on the susceptible mind of André Marie, and for more than a year he remained sunk in apathy. From about 1796 he gave private lessons at Lyons in mathematics, chemistry and languages; and in 1801 he removed to Bourg, as professor of physics and chemistry, leaving his ailing wife and infant son at Lyons. His wife died in 1804 and he never recovered from the blow. In 1809 he became professor of mathematics at the École Polytechnique in Paris. Here he continued his scientific researches and multifarious studies with unabated diligence. He was admitted to the Institute in 1814.

It is on the service that he rendered to science in establishing the relation between electricity and magnetism and in developing the science of electro-magnetism, or, as he called it, electrodynamics, that Ampère's fame mainly rests. On Sept. 11, 1820, he heard of H. C. Oersted's discovery that a magnetic needle is acted on by a voltaic current. On the 18th of the same month he presented a paper to the Academy, containing a far more complete exposition of that and kindred phenomena (*see* ELECTROKINETICS). The whole field thus opened up he explored with characteristic industry and care, and developed a mathematical theory which not only explained the electro-magnetic phenomena already observed but also predicted many new ones. His original memoirs on this subject may be found in the *Ann. Chim. Phys.* (1820–1828). Late in life he prepared a remarkable *Essai sur la philosophie des sciences*, and wrote many scientific papers, including two on the integration of partial differential equations (*Jour. École Polytechn.*, x., xi.). He died at Marseille on June 10, 1836. The great amiability and simplicity of Ampère's character are well brought out in his *Journal et correspondance* (1872).

AMPÈRE, JEAN JACQUES (1800–1864), French philologist and man of letters, only son of André Marie Ampère, born at Lyons. In an extended tour in northern Europe, he studied the folk-songs and popular poetry of the Scandinavian countries. Returning to France, he delivered in 1830 a series of lectures on Scandinavian and early German poetry at the Athenaeum in Marseille. The first of these was printed as *De l'Histoire de la poésie* (1830), and was practically the first introduction of the French public to the Scandinavian and German epics Ampère became professor of the history of French literature at the Collège de France. A journey in northern Africa (1841) was followed by a tour in Greece and Italy, in company with Prosper Mérimée and others. This bore fruit in his *Voyage dantesque* (printed in his *Grèce, Rome et Dante*, 1848), which helped to popularize the study of Dante in France. In 1848 he became a member of the French Academy, and in 1851 he visited America From this time until his death at Pau he was occupied with his chief work, *L'Histoire romaine à Rome* (1861–64).

BIBLIOGRAPHY.—The *Correspondance et souvenirs* of A. M. and J. J. Ampère (1805–54) was published in 1875. Notices of J. J. Ampère are to be found in Sainte-Beuve's *Portraits Littéraires*, vol. iv., and *Nouveaux Lundis*, vol. xiii.; and in P. Mérimée's *Portraits historiques et littéraires* (2nd. ed., 1875).

AMPERE, the practical unit of electric current. It is equal to 10^{-1} absolute electro-magnetic units. (*See* UNITS, PHYSICAL.)

AMPERE METER or **AMMETER,** an instrument for measuring electric currents. Ammeters used for the measurement of *direct current* are moving iron or moving coil low resistance galvanometers (*see* GALVANOMETER). In the latter form of instrument the current passes through a coil hung in the field of a permanent magnet, and this causes a deflection of the coil to which a pointer is attached. This is more widely employed than the moving iron type on account of its more efficient damping, which is due to eddy currents set up in the instrument, and in the best types of precision instruments the pointer attains its equilibrium position in less than a second. For measuring *alternating current* by means of an electromagnetic ammeter, the instrument is, in general, a form of dynamometer (*q.v.*). It measures, by their relative motion, the current flowing through two sets of coils which are connected in series, so that a change in direction of current affects both simultaneously, with the result that their relative movement is unchanged and depends on the magnitude of the current alone. The Duddell galvanometer is an alternating current electromagnetic ammeter which indicates the magnitude of the current by means of the relative motion of two straight parallel portions of a single wire carrying the current and situated in a permanent magnetic field The *hot wire ammeter* may be used to measure either alternating or direct current, the movement of its pointer depending on the linear expansion of a wire when it is heated by the current.

AMPERSAND, the name of the sign, *&* or &, which is a combination of the letters *e, t,* of the Lat *et*, and; a corruption of the mixed English and Latin phrase, "and *per se* and," of which dialect forms are, "ampussyand," or "amperseand."

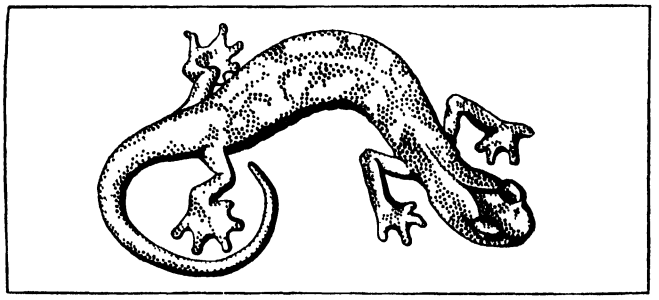
AMPHIARAUS, a celebrated seer and prince of Argos, son of Oïcles (or Apollo) and Hypermestra. He took part in the voyage of the Argonauts and in the chase of the Calydonian boar. He foresaw the disastrous issue of the war against Thebes and at first refused to share in it; but Eriphyle, bribed by Polyneices with the fatal necklace of Harmonia, persuaded him to set out on the expedition. Knowing his doom, he bade his sons, Alcmaeon and Amphilochus, avenge his death upon their mother.

On the defeat of the Seven, Amphiaraus, pursued by Periclymenus, would have been slain had not Zeus opened a chasm into which the seer, with his chariot and horses, disappeared. Henceforth he was numbered with the immortals and worshipped as a god. Near Oropus, on the supposed site of his passing, his sanctuary arose, with healing springs and an oracle famous for its interpretation of dreams (Pausanias i. 341–342). There was another temple dedicated to him on the road from Thebes to Potniae, and here was the oracle of Amphiaraus consulted by Croesus and Mardonius.

See Herodotus viii. 134; Pindar, *Olymp.* vi., *Nem.* ix.

AMPHIBIA, the term applied to one of the six classes of vertebrate animals. This class includes the frogs, toads, salamanders and coecilians, forms which stand in the zoological scale midway between the fishes and the reptiles. Many aquatic animals, such as crocodiles and seals, are amphibious, but, as their organization shows, belong to some other class of vertebrates.

The term Batrachia is still employed by many students of systematic zoology, although Stejneger made it clear that this name



BY COURTESY OF THE AMERICAN MUSEUM OF NATURAL HISTORY

FIG. 1.—THE HARMLESS ITALIAN CAVE SALAMANDER. HYDROMANTES ITALICUS (DUNN) THAT CLIMBS UP VERTICAL SURFACES OF ROCK IN SEARCH OF INSECT PREY. BECAUSE OF ITS COLD, MOIST SKIN THE SALAMANDER WAS BELIEVED IN MEDIAEVAL TIMES TO BE IMMUNE TO THE ACTION OF FIRE

is a pure synonym of the much older term Salientia of Laurenti. The arguments for and against the use of the term Amphibia have been given in detail by Boulenger but his conclusion in favour of the term Batrachia has not been accepted by the majority of herpetologists to-day.

Amphibia are cold-blooded vertebrates having a smooth or rough, but not scaly skin, very rich in glands. Most have four legs and live on land, but, unlike other tetrapods, they respire to a large extent through their skin The eggs are usually laid in the water, the larva passing through an aquatic existence before metamorphosing into the gill-less adult The eggs, even when laid on land, are without a calcareous shell, and do not develop the amnion or allantois of higher vertebrates Modern Amphibia are readily distinguished from reptiles by many differences of skeleton, but the most primitive fossils were so similar to contemporary reptiles that no sharp distinction can be made between them. Recent palaeontological finds have also tended to bridge the gap between Amphibia and the fishes, but here a complete series of intermediate forms is still lacking. Modern Amphibia are the specialized descendants of a great group of more or less aquatic forms living in late Palaeozoic and Triassic times It is these extinct forms which represent the actual ancestors of reptiles and to them one must turn for the ground plan of skeletal organization from which all higher types evolved.

EVOLUTION

The First Land Vertebrates.—The most primitive of the fossil Amphibia are unquestionably the Embolomeri. Already in Carboniferous times the group contained, as shown by Watson, "primitively aquatic animals which show no signs of ever having possessed terrestrial ancestors," as well as others which were obviously terrestrial, and still others which had secondarily returned to life in the water. "Despite their diverse habits, the fundamental morphology of the skeleton is strikingly uniform throughout the group." It is clear from the researches of Watson that the ancestral fish changed to a tetrapod before the latter became permanently adapted to land life.

The first tetrapods, therefore, swam in the waters with their fish ancestors. *Eogyrinus*, the best known of these most primitive tetrapods, had a long body and probably a flattened tail. It very probably lived on fishes in the pools of a rather arid and quickly drying country. As the pools dried up *Eogyrinus* would move, or at least was equipped to move, in the manner of an eel overland to other pools. Its skull agreed closely with that of its osteolepid ancestors differing chiefly in having a long tract of the basis cranii unossified, permitting a certain movement in the

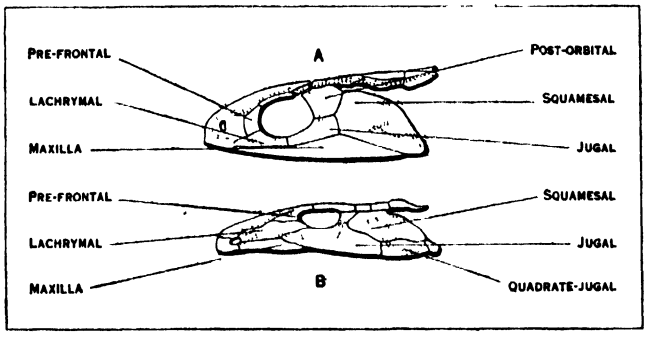
skull. The spiracular notch was very likely covered by a tympanic membrane for, as shown in certain other Embolomeri, the hyomandibular had already been converted into a stapes, even though no opening for its insertion into the otic capsule had yet appeared. The pectoral girdle was attached to the skull by post-temporals as in many fish, and this girdle differed from the primitive bony fish apparatus only in the addition of the interclavicle, a new dermal element, to its ventral surface in the mid-line. The pelvis was not firmly attached to the vertebral column as in later vertebrates, but the ilia rested on long sacral ribs and were held by muscles very much in the same way that the scapula is secured in the thorax. The limbs were small and capable of only a limited motion in any direction.

The Embolomeri are the most primitive labyrinthodonts and gave rise directly to the Rachitomi, and the latter in turn to the Stereospondyli. The Phyllospondyls and Lepospondyls, already present in the Carboniferous, evolved either from specialized Embolomeri or primitive Rachitomi. There is no good evidence of these having arisen independently from fishes. The urodeles and frogs have come from Phyllospondyls, while the coecilians seem to have arisen from Lepospondyls. Fossil intermediates between any modern Amphibia and these ancient orders are lacking and our conclusions are based on a comparison of their skeletal characters.

The Skeleton.—Once vertebrate life was established on land it reverted not once but many times to the aquatic habitat long before the modern Amphibia appeared. Despite the frequent change of habitat the skeletal organization of the first Amphibia continued to evolve steadily in definite directions with time In recent Amphibia, too, the fundamental structure has changed slowly while the various groups may show the widest adaptations Ranids may be arboreal, aquatic or fossorial; plethodontids may be the same.

Skull.—The first tetrapods inherited a skull very similar to that of their fish ancestors. It consisted of a cartilaginous box or chondocranium, covered completely above by dermal bones and internally strengthened by bones which replaced the cartilage in part. This skull, the prototype of all tetrapod skulls, differed remarkably from that of modern Amphibia by the far greater number of skull elements it contained, by the greater ossification of the chondocranium and by its reptile-like form.

The skull of the Embolomeri agreed in most details with that of the osteolepid fishes. The skull roofs were similar (figs. 2 and



FROM WATSON, "EVOLUTION AND ORIGIN OF AMPHIBIA"

FIG. 2.—SIDE VIEW OF THE SKULL OF EMBOLOMERI, PRIMITIVE AMPHIBIANS, WHICH LIVED MILLIONS OF YEARS AGO, COMPARED WITH THAT OF ITS ANCESTOR, THE OSTEOLEPID, AN EXTINCT FISH WHOSE FOSSILS HAVE BEEN FOUND IN SCOTLAND

A. Osteolepis macrolepidotus B. Palaeogyrinus decorus

3), except for a cluster of small bones in the nasal region in osteolepids. The distribution of the lateral line canals in both skulls facilitates the identification of lacrymal, prefrontal, jugal, postorbital, postfrontal, supra and intertemporals. The spiracular notch of *Ostelepis* has become the otic notch and the elements bordering this and the orbit may be readily homologized (fig. 2). The palates agree remarkably in the small size of the interpterygoid vacuities and the almost identical position of the palatal and jaw bones (fig. 3). The large pterygoids are bordered externally by the prevomers, palatines and ectopterygoids. The distribution and replacement of the large teeth are identical in fish and tetrapod. An internal nares is present in all osteolepids and "is identical in position, size, and borders with that of certain Embolomeri." The osteolepids very probably breathed air in the manner of the Embolomeri.

The lower jaw of the first tetrapods differed greatly from that of modern Amphibia in the far greater number of elements it contained. It was, however, identical with that of the osteolepid jaw.

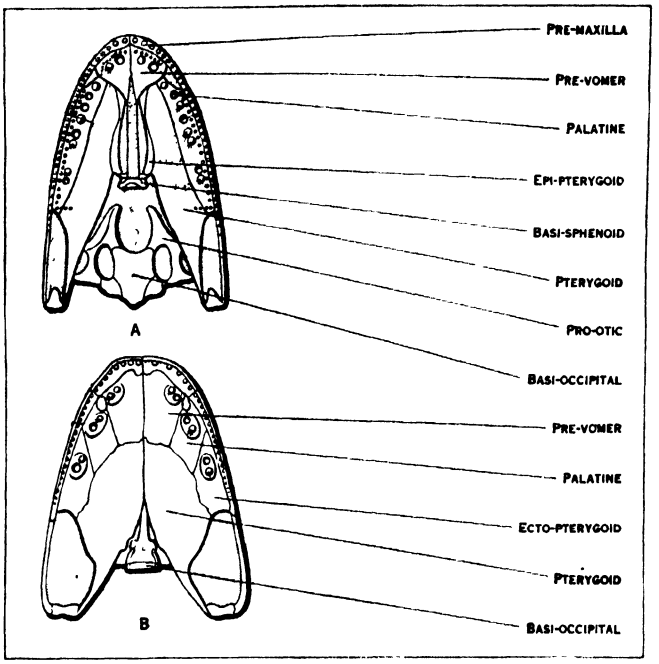


FIG. 3.—PALATE VIEW OF THE SKULL OF EMBOLOMERI COMPARED WITH THAT OF AN OSTEOLEPID FISH

A. Eusthenopteron B. Baphetes

The brain case of osteolepids and Embolomeri were very similar but not identical. In both the basioccipital formed a circular condyle perforated by the notochord. The exoccipitals extended upwards to a well-developed supraoccipital. The basisphenoids of both had definite basipterygoid processes with which epipterygoids articulated. The great difference is seen in the palatal view The osteolepids had a large part of their basis cranii unossified. In this they differed from all other vertebrates, save their descendants, the coelacanths. This character would seem to exclude the osteolepids from the immediate ancestorship to the tetrapods, but the numerous resemblances of brain case, skull roof and jaws show that the osteolepids must have been closely allied to the ancestor fish.

Once this reptile-like, highly ossified and complex skull of the ancestral fish became established in land forms, it underwent an enormous specialization. The successive stages in its specialization may be traced in the Rachitomi and Stereospondyli and to a lesser extent in the other orders of Amphibia. Very soon there began a progressive fenestration, the bones tending to segregate along lines of greatest stress. The solid dome-like skull roof progressively lost various dermal elements until in the modern frogs only the premaxillary, maxillary, nasal, quadratojugal, squamosal, frontal and parietal are left. The more primitive urodeles still retain a lachrymal and prefrontal in addition to the frog's equipment. The quadratojugal, although appearing as a separate element during ontogeny in the urodeles, later fuses with the quadrate. This loss of elements was perhaps largely due to a shortening of the skull. The Embolomeri had 12 cranial nerves; and in the evolution of this group and the Rachitomi the hypoglossal foramen in the exoccipital is carried farther backward until in the most specialized labyrinthodonts, the Stereospondylia of the Upper Trias, it no longer perforates the skull wall, the twelfth nerve passing out behind the skull as in modern Amphibia.

The second great change which developed as the tetrapod

series evolved was the gradual flattening of skull. It changed from tropibasic to platybasic, not the reverse as some embryologists have maintained. The trabeculae were no longer squeezed together, and the interorbital septum became hollowed out into a trough.

The third fundamental change was a progressive weakening of the bony organization of the skull. The brain case became progressively less well ossified. Basioccipital, basisphenoid and supraoccipital became reduced and disappeared. Hence, the original tripartite condyle became converted into a pair of well separated exoccipital condyles. The tripartite condyle is retained in many reptiles, but in the promammals a withdrawal of the basioccipital leads to a condition exactly parallel to that of modern Amphibia

On the palate the interpterygoid vacuity became progressively wider (fig. 3). The pterygoid lost its connection with the basipterygoid process and higher labyrinthodonts depended entirely on the parasphenoid for its support. In frogs and certain primitive urodeles (some hynobiids, etc.) the pterygoid cartilage extends forward and fuses with the nasal capsule. The bony pterygoid which forms around it has much the form of the pterygoid of the Rachitomi but posteriorly it makes different contacts. The ectopterygoid is lost in all urodeles and frogs but still retained in a few coecilians. The palatine is variable in occurrence. Within a single genus of frogs some species may possess and others lack an ossified palatine. The most remarkable changes occur in the prevomer of modern forms. In urodeles the palatine undergoes a radical change at metamorphosis, part becoming lost and part apparently fusing with the prevomers. This combined prevomer and palatine tends to invade the parasphenoid region in the various families of urodeles, sending back long dentigerous processes on either side of the parasphenoid region (salamandrids) or ventral to it (plethodontids). In most plethodontids the posterior processes break off as one or two separate dentigerous areas overlying the parasphenoid as "parasphenoid teeth." A few frogs (brevicipitids) have succeeded in similarly dividing the prevomers, but the posterior elements overlie the palatine, not the parasphenoid region. A few others have the prevomers fused into a single element (*Xenopus*). In all urodeles except certain primitive salamandrids and hynobiids and a few higher forms, the pterygoid fails to reach the maxilla, and in the *Plethodontidae* it never ossifies at all, although it may extend forward to the maxillae. It is the reduced pterygoid and maxilla which make the urodele palate seem so unlike the anuran, although they are both fundamentally alike and referable to the Rachitomi plan. If the palate of such a primitive salamandrid as *Tylototriton* is compared with that of a frog or of *Eryops*, the fundamental resemblance becomes obvious.

The most reduced part of the modern amphibian skull is the lower jaw. The Embolomeri inherited a complex mandible of ten pieces. In the Rachitomi and Stereospondyli there occurs a gradual reduction of the mandible in width, a loss or fusion of elements, until in primitive urodeles there was left only a dentary, a prearticular and articular and an angular. Coronoids are present in the larvae of most urodeles. The angular is fused with the prearticular in all urodeles above the *Cryptobranchoidea*. In coecilians a very early fusion of the jaw elements occurs in most genera, but the resulting element probably contains a coronoid as well as the dentary, articular and prearticular, for two rows of teeth are present in many forms. In the Salientia the reduction is carried to an extreme, for only the dentary and prearticular are recognizable. The articular ossifies in very few Salientia and is then fused to the prearticular. The anterior end of Meckel's cartilage ossifies as a pair of distinct elements in some *Ranidae, Hylidae* and *Bufonidae*.

While the changes in the skull and jaws discussed above proceeded regularly in the evolution of the Amphibia and may be classified as trends of evolution or orthogenetic changes without a primary adaptive significance, there were other modifications taking place which seem more definitely correlated with the environment. Perhaps the most important of these were those associated with the ear. The first tetrapods as represented by *Eogyrinus* possessed a stapes and very probably a tympanic membrane, but no fenestra ovalis. The sound waves were thus transmitted from the stapes through the otic capsule. This condition was scarcely different from that of fishes where no stapes was present. Another piscine character was the absence of a cranial wall between the labyrinth and the brain. The latter character was handed on to certain Rachitomi but later Amphibia walled off the auditory apparatus from the brain, leaving only a foramen for the auditory nerve. With the assumption of land life the fenestra ovalis was completed in the lateral wall of the otic capsule. The Salientia inherited this auditory apparatus in a slightly modified form. All Caudata have suffered a loss of the tympanum and middle ear. The stapes is connected in the larva with the quadrate, and sound waves are transmitted through the lower jaw resting on the substratum to the quadrate and thence via the stapes to the inner ear. In the metamorphosed individual the head is raised from the ground and the stapes is usually connected by a muscle with the shoulder girdle. Vibrations are thus apparently sent through the fore-legs of the adult urodele to the ear.

The osteolepid ancestors of the Amphibia had five branchial arches, while the modern Amphibia have at most four. The latter possess, however, a pair of laryngeal cartilages which may or may not represent the fifth branchial arch. The gill arches in the adult urodele or frog are modified by reduction and fusion.

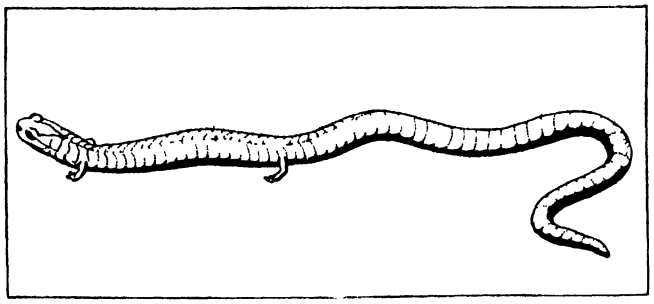
Vertebrae.—The major groups of the Amphibia are classified to a large extent on the form and composition of their vertebrae. To evolve the first tetrapod vertebrae from those of their fish ancestors did not require any radical alterations. The immediate ancestors of the Embolomeri are not known to have embolomerous vertebrae, but they probably had vertebrae which could be easily resolved into the embolomerous type. Most fish and Amphibia have the vertebrae more or less ossified and the cartilaginous blocks of the embryonic vertebrae after certain unequal growths fused. The basidorsals almost invariably grow up and around the neural tube tending to enclose it as a neural arch. The basiventral may either grow up around the notochord or it may remain rudimentary, while the basidorsal grows down toward it. The interdorsal and interventral may fuse and ossify or remain separate either ossifying or not. In the tail region of the fish *Amia* the interdorsals sometimes fuse with the interventrals but not with the basiventral. Thus, each neural arch may have two centra, an embolomerous condition. In the body region of the same fish interdorsals, interventrals and basiventrals may fuse as a single centrum.

Such a variability of vertebral composition becomes greatly restricted in the Amphibia. The first tetrapods retained the embolomerous or double centrum type of vertebrae for their entire column. The Rachitomi, being more cartilaginous, have the four pairs of embryonic blocks ossified, but separate, producing the rachitomous or "backbone-cut-into-pieces" type. In the most specialized labyrinthodonts a decided one-sided growth of the blocks has occurred, for the centrum is composed entirely of basiventral, the interdorsal and interventral either being greatly reduced or remaining cartilaginous.

The Lepospondylia and Phyllospondylia have sprung from either the Rachitomi or from a labyrinthodont stock slightly more specialized than the known Embolomeri. Their vertebrae are more embryonic than that of the Embolomeri in that the notochord is less restricted by the surrounding centrum. The vertebrae are, on the other hand, more specialized in that the interdorsal and interventral remain cartilaginous (*i.e.*, are not present in the fossils), the definitive centrum being formed by the basidorsal and basiventral which may remain separate in some branchiosaurs, but always fuse into a single ring in the microsaurs. In both these orders the vertebral column seems to consist of a series of rings, one for each somite, the septum, as shown by the position of the rib being, therefore, between the successive vertebrae unless by a secondary shifting, such as occurs in modern Amphibia, the rib arises from the side of the vertebra. All Phyllospondylia have their ribs arising in this secondary position while most Lepospondylia retain the more primitive position.

Primitive urodeles and frogs (*Liopelmidae*) have vertebrae

which are very similar to those of Branchiosaurs, except that they are more ossified. Further, in the trunk region of the recent forms, the basiventrals remain very small, and the main part of the centrum is formed by the basidorsals. Interdorsals and ventrals remain cartilaginous in the primitive types of modern Amphibia and frequently, as in *Ascaphus*, no joints are formed between the successive vertebrae. In the higher forms, however, the intervertebral cartilage (interdorsal plus interventral fused)



BY COURTESY OF THE AMERICAN MUSEUM OF NATURAL HISTORY

FIG. 4.—THE WORM SALAMANDER, BATRACHOCEPS ATTENUATUS (ESCHSCHOLTZ) SO-CALLED BECAUSE IT LIVES IN THE BURROWS OF WORMS, OR FOLLOWS CREVICES UNDER-GROUND FOR CONSIDERABLE DEPTH

splits in such a way as to form a ball-like surface on the anterior (opisthocoelus) or on the posterior end (procoelous) of the vertebrae. Usually in Salientia and frequently in Caudata the articular ball calcifies or ossifies. In a few frogs (*Megalophrys*, etc.) the ball may remain quite free of either the vertebrae before or the one behind it. This ball has been called a centrum by various authors. As it contains almost all of the interdorsal and interventral tissue it is homologous to the centrum of reptiles and mammals, but not to that of the Phyllospondyls, Lepospondyls or Stereospondyli. In the Salientia the form of the vertebrae as determined by the manner of fusing of the intervertebral ball affords one of the primary characters of classification

The Salientia are in various features of their skeleton more primitive than the urodeles, but the development of their vertebrae is far less diagrammatic. In the most extreme types, some terrestrial (*Pelobatidae*), others aquatic (*Pipidae, Discoglossidae*) the basidorsals and ventrals extend only a short distance towards each other before metamorphosis. At this time the notochord is greatly reduced and a much flattened vertebra results, formed, except for the articular ball, almost entirely by the basidorsal. The explanation of these coenogenic features may rest in the large notochord and very active tadpoles found in these forms. The developmental history if taken alone would throw very little light on the past history of these vertebrae.

Ribs.—The ribs of primitive Amphibians and reptiles articulate with all vertebrae, at least as far back as the middle of the tail. In phylogeny the sacral ribs become fused to the vertebrae first, then the caudals, next the lumbars, the cervical and finally the thoracic. In elongate urodeles the ribs have become reduced in number. *Siren* and *Amphiuma* have only the anterior thoracic vertebrae still retaining the ribs. In frogs the reductions have reached an extreme. Discoglossids retain three, liopelmids only two ribs in the adult. The pipids have two ossified ribs in the larva, but these fuse later to the diapophyses. The bits of cartilage on the ends of the diapophyses of the higher frogs have been considered homologues of the ribs. This is perhaps a matter of definition. No ossified ribs appear as distinct elements in the development of any Salientia above the *Pipidae*.

The ribs are long in the primitive labyrinthodonts and surround the body as a series of hoops. They never meet in the mid-line and never connect with the sternum. In some higher Rachitomi (*Cacops*) the ribs are short and directed outward. The microsaurs have long curved ribs, the branchiosaurs and modern Amphibia very short and rod-like ones. The ribs are shortest in the frogs and the long-bodied perennibranchs; longest in the primitive salamandrids. In *Tylototriton*, and its close relative *Triturus waltl*, the tips of the ribs may be long, pointed and actually protruding through the skin. This apparently serves as a special mode of protection, for when the animal is quickly seized the needle-like ribs may give a sharp prick.

The ventral side of the body of many Labyrinthodontia, Lepospondylia and Phyllospondylia were sheathed with a coat of closely set rods or plates. These apparently gave rise to the abdominal ribs of reptiles. In modern Amphibia only *Liopelma* has large myoseptal cartilages of apparently the same form as the abdominal ribs of lizards, but a few urodeles have splints of cartilage in a few of the myosepta which may possibly be similarly interpreted.

Pectoral Girdle.—The pectoral girdle of the first tetrapod was practically identical to that of the primitive bony fish except that a new dermal element, the interclavicle, had been added to its ventral surface in the mid-line. Four pairs of dermal elements were present in the first land vertebrates in addition to the interclavicle. These formed a half ring of bone on either side of the body directly behind the branchial arch region. The cartilage bones which form the bulk of the pectoral girdle of modern Amphibia were represented in these primitive forms merely as a simple buttress for the humerus on each side. Such a buttress may be called a scapula or a scapulo-coracoid, for it is only in the higher Amphibia that this ossifies from two centres.

Aquatic labyrinthodonts secondarily broadened their clavicles and interclavicles. A similar broadening of the ventral girdle elements is found in many modern Amphibia which are wholly aquatic. The dermal elements, however, continued to dwindle in the higher Amphibia. This seems to be directly correlated with a greater development of the leg and shoulder musculature brought into play by the increased use of the forelimbs

The branchiosaurs possessed a pectoral girdle very similar to that of the Rachitomi but more cartilaginous. The entire glenoid and coracoid regions remained unossified. A somewhat similar difference distinguishes the pectoral girdle of certain aquatic urodeles from that of their more terrestrial relatives.

The Salientia have retained the pectoral girdle of the more terrestrial Rachitomi in almost its entirety. The interclavicle has been lost and a new structure, the omosternum, has arisen by a forward elongation and usually a division of the coracoid cartilages. The broadened ventral ends of scapulo-coracoid bars have become fenestrated. The posterior rim ossifies as a separate centre, the coracoid, while the mesial and anterior part usually remains cartilaginous. The anterior rim is called the procoracoid, while the mesial part the coracoid cartilage. In spite of these different names the fundamental resemblance of the pectoral girdle of frog and labyrinthodont is obvious.

In higher Salientia many modifications of the pectoral girdle occur. In different families the coracoid cartilages may fuse in the mid-line producing a firmisternal type of girdle. In the *Brevicipitidae* procoracoid and clavicle may become lost entirely. Omosternum and sternum are subject to either ossification or loss. In the *Ranidae* and the *Polypedatidae* the former may become widely forked posteriorly. The sternum was possibly cartilaginous in the labyrinthodonts and branchiosaurs, although as it is never found fossil in these groups its presence has been denied. The sternum in the most primitive Salientia resembles greatly the abdominal ribs and may, in fact, have arisen from this series of elements.

The urodeles are specialized in the complete loss of the dermal elements. As if in compensation for this loss the coracoid cartilages are usually broadly dilated. The deltoid region has become extended into a long, so-called procoracoid in most forms, but the primitive genera of several families retain this in a less extended condition. The urodeles are primitive in that the scapulo-coracoid usually ossifies as a single piece, the ossification often extending far down into the coracoid region producing a structure very much as in *Eryops;* in *Siren* and *Pseudobranchus* the posterior ventral margin of the cartilage ossifies as a separate coracoid.

Pelvic Girdle.—The pelvic girdle of the first tetrapods has advanced beyond the conditions found in fishes in that a pubis, ischium and ilium are present meeting in the acetabulum in a triradiate suture. The ilium, however, was not firmly attached to the sacral ribs.

The ilium soon gained a firmer support to the sacral ribs, and even within the Embolomeri the girdle underwent some modification. *Diplovertebron,* according to Watson, failed to ossify its pubis, and this condition has been handed down to most modern Amphibia. The terrestrial labyrinthodonts retained a more ossified girdle which was almost indistinguishable from that of the contemporary cotylosaur reptiles.

Modern Amphibia have inherited the same plate-like pelvis of the primitive labyrinthodonts. The obturator foramen so characteristic of modern reptiles is not present and the pubis is usually unossified, as in the branchiosaurs and higher labyrinthodonts. In a few Salientia the pubis region is either calcified or ossified, but it rarely forms a separate bone. The pubis cartilage is of variable extent in the different families of urodeles, it being more extensive in aquatic than in terrestrial forms. A part of the pubis is unossified in even the most terrestrial Amphibia.

Many urodeles exhibit at the anterior end of the pubis a Y-shaped cartilage called an epipubis or an ypsiloid apparatus; as shown by Whipple, this structure serves to assist in controlling the form of the lungs in those urodeles which use this structure as a hydrostatic organ. It seems to be a neomorph in the urodeles, although certain liopelmids and pipids have a cartilaginous plate immediately anterior to the pubis. The primitive *Ascaphus* has developed a pair of rod-like cartilages which lie over the ventral surface of the pubis and function in directing forward the "tail" or copulatory apparatus of the male.

Limbs.—The Amphibia arose from some generalized crossopterygian. The skeletons of the paddles of only two of these primitive types of fishes are known. These fin bones are leg-like in that they consist of a proximal element or humerus subtending two distal elements, a radius and ulna. The outer row of elements, however, are more numerous than the supporting elements in the hands or feet of tetrapods. Undoubtedly a series of fusions and losses must have occurred in the change from fin to limb. The modifications are confined to the distal segment of the appendage. The fundamental ground plan of single-proximal, double-median and multiple-distal elements was already well established in the fish ancestors of the tetrapods.

The chief problem in the origin of the chiropterygium concerns the distal segment of the limb. How many fingers and toes were present in the first land vertebrates and how many carpal and tarsal elements formed their support? Watson has shown that *Diplovertebron* had five well-developed fingers and toes, as in the case of the oldest reptiles. He finds no evidence of a sixth or seventh digital ray, such as has been described in the rachitomous *Eryops.* This makes it highly probable that the prepollex and postminimus, if present at all, were cartilaginous, as in certain recent reptiles and mammals.

All Amphibia above the Embolomeri had only four digits in the hand, but many, to judge from their tracks, must have had a well-developed prepollex. Further, *Eryops* apparently had a stout prepollex, a rudiment of the fifth finger and a cartilaginous block representing a sixth. The prepollex was originally a supporting ray on the inner side of the hand. In modern Salientia it is almost universally present and often hypertrophied in the male to ensure a better grip in amplexus. In urodeles, even in forms which are not known to practise an amplexus, the prepollex is sometimes present and even bony. The modern Amphibia inherited a prepollex, four digits and a rudiment of a fifth digit in the hand.

In the foot of modern Amphibia there are five digits present, as in *Diplovertebron,* but also in most Salientia a prehallux, and in some primitive urodeles, both a cartilaginous prehallux and a postminimus. In burrowing Salientia the prehallux is greatly enlarged to form the core of a "spade." This gives the impression that the prehallux is a recent adaptive structure which has arisen in connection with the burrowing habit. Its wide occurrence in non-burrowing forms is, however, against such a hypothesis. It seems highly probable that the prehallux is a fundamental element and that the original tetrapod foot, like the hand, was seven rayed.

The oldest known carpus and tarsus are both from rachitomous types. In both there is found the maximum number of elements found in any Amphibian. The proximal row consists of four elements. Distal to this proximal row of elements there is a series of three elements called medialia by Schmalhausen, because of their position. Immediately distal to the medialia are the carpalia, 1–5 in the hand, and tarsalia, 1–5 in the foot.

Numerous fusions or, perhaps better, failures of the blastema to differentiate distinct elements have occurred in the carpus and tarsus of modern forms. The *Hynobiidae, Ambystomidae* and *Cryptobranchidae* approach most closely to the primitive condition. Some specimens of *Ranodon,* according to Schmalhausen, differ in their tarsus from *Trematops* only in that tarsalia 1–2 are fused. Urodeles with a reduced number of digits have suffered the greatest number of fusions The Salientia have also diverged considerably from the primitive type. In the carpus fusions have occurred in all three rows. The discoglossids and pelobatids exhibit fewer fusions than the higher families. The tarsus of the Salientia is peculiar in the great elongation of the tibiale and fibiale, and the loss or fusion of all the other elements save three or four of the tarsalia. This elongation of the proximal series gives the frog's hind leg the appearance of having three long segments instead of the usual two Such a specialization is undoubtedly an adaptation to jumping, although various species living to-day have given up that habit.

CLASSIFICATION

1. Labyrinthodontia.—Amphibia with a roofed skull, a lower jaw consisting of at least eight bones on each side and vertebrae consisting of neural arches and intercentra in all forms, with pleurocentra in addition in most.

The Labyrinthodontia are divided into three suborders, or grades: Embolomeri, Rachitomi and Stereospondyli. The first is from the Lower Carboniferous to Permian, the second, from the Permian and Triassic, and the last, from the Triassic. The skeletal organization of these groups has been discussed above. A detailed classification has been given by Watson

2. Phyllospondylia.—Small, very highly specialized Amphibia with a roofed skull, palate with very widely open interpterygoid vacuities, coracoid and pubis not ossified; ventral armour of small round scutes. *Branchiosauridae.* Carboniferous and Lower Permian.

3. Lepospondylia.—Small Amphibia with roofed skull and lepospondylous vertebrae. *Nectridia, Diplocaulidae, Aistopodidae.* Carboniferous and Permian.

4. Gymnophiona.—Recent worm-like Amphibia without limbs and with a very short tail; male with an intromittent copulatory organ. Tropicopolitan, excepting Madagascar. Apparently evolved from the Lepospondylia, but fossil annectant forms lacking. Nineteen genera are recognized.

5. Caudata.—Salamanders and newts (*qq v.*) are readily distinguished from other living Amphibia by their four limbs and tail. They are grouped into five suborders and eight families. The latter may be briefly characterized here.

(1). *Hynobiidae.*—A small group of Asiatic land salamanders distinguished from ambystonids, which they resemble externally, in having the angular free, premaxillary spines short not separating nasals and in practising external fertilization. There are five genera, but only *Hynobiius* has a wide range.

(2). *Cryptobranchidae.*—Two genera of semi-larval salamanders of large size directly evolved from the hynobiids, and differing in retaining a few larval characters in the adult. *Cryptobranchus* (*q.v.*) of eastern United States is more larval than the Japanese-Chinese *Megalobatrachus.*

(3). *Ambystomidae.*—A family of common American salamanders distinguished from salamandrids by their short prevomers and amphicoelous vertebrae, and differing from hynobiids in their fused angulars, long premaxillary spines and internal fertilization. The family includes three American genera, of which only *Ambystoma* with eleven species is well known.

(4). *Salamandridae.*—A varied group of aquatic forms, such as the newts, and terrestrial species, such as *Salamandra,* with vomerine teeth extending back as a series on each side of the parasphenoid and with the vertebrae opisthocoelous. The primi-

tive salamandrids are large, rough-skinned newts, having a bony, fronto-squamosal arch, high neural spines, and long ribs. The more specialized forms show a reduction of these elements and also of the maxillaries, pterygoids and basi-hyals. The *Salamandridae* are found in North America, Eurasia and North Africa.

(5). *Amphiumidae.*—A family including only the genus *Amphiuma.* The large "Congo Eel" or Conger is a semi-larval type derived from the salamandrids and agreeing with them in most important characters. It possesses lungs, a bony pterygoid, a posterior process from each prevomer and premaxillary spines elongated to separate the nasals.

(6). *Plethodontidae.*—A large group of salamanders abundant in America and including both aquatic and terrestrial forms, with a pterygoid that remains cartilaginous throughout life and with vomerine teeth carried back by processes during ontogeny to form one or two dentigerous patches over the parasphenoid. All plethodontids are lungless and possess a naso-labial groove to assist in freeing the nostril from water.

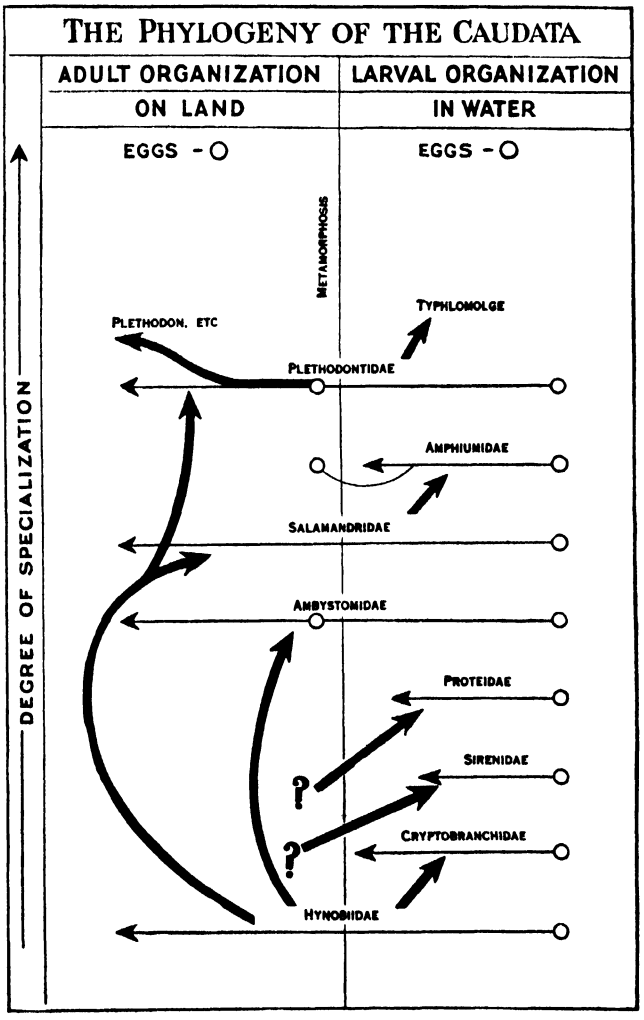


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DIAGRAM SHOWING THAT THE LARGE AQUATIC SALAMANDERS KNOWN AS PERENNIBRANCHS ARE NOT NECESSARILY PRIMITIVE SPECIES BUT PERMANENT LARVAE WHICH HAVE FAILED TO METAMORPHOSE. SOME HAVE GONE FARTHER IN THE METAMORPHIC PROCESSES THAN OTHERS

(7). *Proteidae.*—A group of permanently larval salamanders of unknown ancestry including only the European *Proteus* (*q.v.*) and American *Necturus.* Lungs are present, but the ypsiloid apparatus is absent. The pubo-ischium has a distinctive form, being long and pointed anteriorly. *Proteus* is a blind and pigmentless cave form while *Necturus,* represented by two species, is an active stream or pond dweller.

(8). *Sirenidae.*—Long-bodied *Siren* (*q.v.*) and *Pseudobranchus* of south-eastern United States form a group which agrees with the very young larvae of other families in possessing only the anterior appendages and in lacking many later ontogenetic developments of the skull. They differ when adult from the young of other families in possessing reduced pterygoids, a separate ossification of the coracoid and a well-developed Jacobson's organ. Their relationships to the other families of Caudata is unknown.

6. Salientia.—The frogs and toads with their short, tailless bodies and long hind legs are distinguished from other living Amphibia The order has been divided into four suborders, eleven families and many subfamilies, but only the families will be considered here.

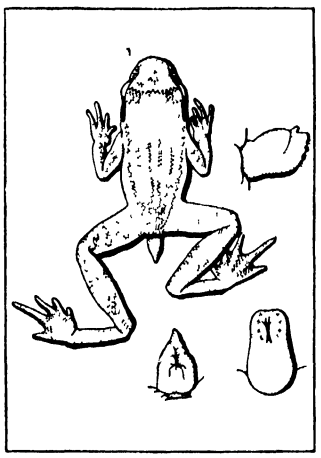

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FIG. 6.—MALE ASCAPHUS TRUEI (STEJNEGER), A PRIMITIVE FROG, SHOWING THE CLOACAL APPENDAGE OF THIS SEX. THE FIGURES ON THE RIGHT REPRESENT THE "TAIL" FULLY EXTENDED IN A BREEDING MALE

(1). *Liopelmidae.*—Primitive frogs with amphicoelous vertebrae and two pairs of ribs; a family including only *Liopelma* of New Zealand and *Ascaphus* of north-western United States. The latter is remarkable in possessing an extension of the cloaca in the male to form a "tail" This appendage is apparently used in copulation as fertilization is internal (fig. 6).

(2). *Discoglossidae.*—Primitive Old World frogs having opisthocoelous vertebrae, three pairs of ribs, sacral vertebra free with biconvex centrum. The family includes only two European, one Eurasian and one Philippine genus.

(3). *Pipidae.*—Aquatic Salientia which have lost the tongue and movable eyelids (except *Pseudhymenochirus* which retains a lower eyelid). Ribs are free in the larva, but ankylose to the diapophyses on metamorphosis. Various fusions occur in the vertebral column, the presacral vertebrae numbering five to seven. The sacrum is fused to the coccyx (rarely free with a single condyle). The pectoral girdle is partly or wholly firmisternal, the cartilages never broadly overlap as in the *Discoglossidae.* The family includes the Surinam toad (*q.v.*).

(4). *Pelobatidae*—Salientia without ribs at any stage of development, sacral vertebrae procoelous, ankylosed to coccyx or if free with only a single articular condyle for the latter; presacral vertebrae eight, either uniformly procoelous or with free intervertebral discs (interdorsals). The Pelobatidae agree with bufonids in the arciferal pectoral girdle and dilated sacral diapophyses; they differ from them in their single coccygeal condyle and primitive musculature. The family includes the spade-foot toads and certain forest frogs of the Seychelles, south-eastern Asia and the East Indies.

(5). *Palaeobatrachidae.*—Fossil frogs from the Jurassic, Oligocene and Miocene formations of Europe. They are procoelous, arciferal forms differing from the *Pelobatidae* in having a double condyle on the coccyx and in having the sacrum formed of two or three slightly dilated precoccygeal vertebrae. In limb proportions the *Palaeobatrachidae* approach the *Pipidae* and it is highly probable that the species were thoroughly aquatic.

(6). *Bufonidae.*—A dominant family of true toads (*q.v*) and neotropical "frogs" having a uniformly procoelous vertebral column and a double condyle to the coccyx (rarely fused to sacrum). They are arciferal and resemble the *Pelobatidae* in many characters, but differ in musculature and coccygeal articulation. The toothed bufonids are frequently designated as *Cystignathidae* or *Leptodactylidae.* They are more primitive than the toothless genera, but as they have given rise to toothless bufonids in different parts of the world, it makes a more natural system to group both together as a single family.

(7). *Hylidae.*—Bufonids with an intercalary cartilage or bone between the last two phalanges of each digit and usually with claw-shaped terminal phalanges. They are procoelous and usually

with dilated sacral diapophyses. Most, but not all, are tree-frogs (*q.v.*) and a few, such as *Acris,* are semi-aquatic. There are 15 genera of hylids. All of these, save *Hyla* (including *Hylella* and *Nyctimystes*), are confined to the neotropical region.

(8). *Brachycephalidae.*—A large group of small neotropical toads recently shown to be closely allied to the *Bufonidae* and to have no relationship to the *Ranidae* or *Brevicipitidae* with which they were formerly confused; procoelous forms with the two halves of the pectoral girdle partly or wholly fused in the mid-line.

(9). *Ranidae.*—Firmisternal frogs (*q.v.*) with cylindrical or slightly dilated sacral diapophyses, digits without intercalary cartilages, sacral vertebra convex anteriorly, the eighth vertebra biconcave and preceded by seven procoelous vertebrae Ranids are primarily Old World frogs, only one genus, *Rana,* reaching America. Africa seems to have been a centre of differentiation for the family, the greatest diversity of type occurring there.

(10). *Polypedatidae.*—Ranids with cylindrical sacral diapophyses and intercalary cartilages between the two last phalanges of each digit. The *Polypedatidae* are tropical tree-frogs of the Old World.

(11). *Brevicipitidae.*—A group of toads closely related to the ranids and differing chiefly in the more dilated sacral diapophyses. The more specialized forms have lost their teeth and all the ventral elements of the shoulder girdle save the coracoids. The family is cosmopolitan. Brevicipitids in the Asiatic, East Indian, and Malagasy regions seem to have run through independently on series of structural changes, often parallel in the three regions.

GENERAL MORPHOLOGY

Integument.—The skin of modern Amphibia may be rough and dry or smooth and moist, but it is never covered with scales as in nearly all reptiles. Many coecilians, however, have rings of minute scales hidden in the transverse folds of their skin. Aquatic or fossorial Amphibia, which rely to a large extent on their skin for respiration, usually have a thinner and smoother integument than terrestrial forms, but many exceptions to this rule occur, particularly in the *Pipidae* and *Bufonidae.* The fossil labyrinthodonts, phyllospondyls and lepospondyls were frequently well armoured with scales, especially on the ventral surface where these scutes of varying shapes and sizes were arranged, for the most part, in orderly rows converging toward the mid-line. In a few salamandrids and many tropical Salientia a secondary deposit of bone forms in the deeper dermal tissues and may produce encrustations ankylosed to the underlying bones. The bizarre casques of *Pternohyla, Triprion, Cerathyla,* etc. are of this character (fig 7) Less conspicuous bony covers to the skull appear in the spade-foot toads and various hylids, particularly the marsupial frogs. Similar bony growths extend to the derm of the back in various Salientia and in rare instances (*Brachycephalus*) may be ankylosed to the vertebrae. The epidermis covering warts or spines may be more or less cornified in modern Amphibia and in various urodeles (*Desmognathus, Necturus,* etc.) that on the digit tips is similarly modified. In a few hynobiids thick horny pads occur on the palms and soles, while in the larvae of others, the epidermis of the digits is extended into pointed claws. Similar horny claws occur on the three inner toes of the African pipids, and may have been found on all the digits of some extinct Amphibia, for in one of the most primitive labyrinthodonts the terminal phalanges have the form of curved claws.

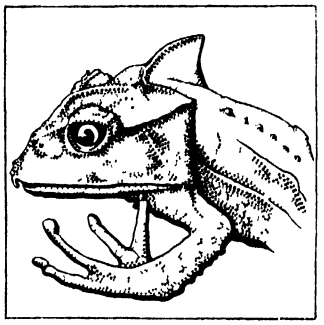

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FIG 7.—THE HORNED TREE FROG, CERATHYLA JOHNSONI (NOBLE) THAT CAN CHANGE ITS COLOUR TO MATCH ITS SURROUNDINGS, AND SO ESCAPE DETECTION

Secondary bony deposits in the form of plates, horns or pseudo-teeth are found on the skulls of many unrelated groups of Salientia

The integument of modern Amphibia is further distinguished from that of reptiles in being highly glandular. There are two main types of glands: the granular and the mucus. The first may be broadly distributed over the dorsal surfaces or massed in folds or warts on the sides of the body. Its secretion is creamy, very irritating to mucus membranes and poisonous when taken internally. The mucus glands are more uniformly distributed over the body. They produce a slime less irritating to the nasal passages and conjunctiva but, nevertheless, toxic when injected into lower animals. Amphibia differ enormously in both the quantity and kind of integumentary secretion. Some species, such as the toads, secrete only when mistreated, while others, such as *Bombina* and particularly the American *Plethodon glutinosus,* produce a copious irritating or sticky secretion when handled. Closely related species may differ considerably in their secretions. Brazil and Vellard report that the South American *Ceratophrys americana* has a virulent poison while the much larger and more brightly coloured *C. dorsata* possesses an innocuous skin secretion. Brightly coloured Amphibia are frequently not more poisonous than their dull coloured relatives, and some, such as the red-legged *Leptodactylus pentadactylus* may lack a poisonous secretion. Frequently the secretions are odorous, certain closely related forms of *Rana, Bufo* and *Hyla* being readily distinguished by their odour alone.

The skin of the larva differs from that of the adult in that the glands are unicellular and the epidermis consists of only two layers of cells. Larvae approaching metamorphosis and most perennibranchs have a thicker epidermis equipped with multicellular glands. The superficial layer of epidermis is periodically shed by the adults and usually in one place The first shedding of the entire epidermis occurs normally at metamorphosis, but perennibranchs, such as *Cryptobranchus* shed their skin in one piece before they lose their external gills, and the larvae of some salamanders shed their skin in minute pieces during part of their aquatic life.

Pigmentation.—The coloration of Amphibia is due in part to a diffuse pigment distributed throughout the integument, but chiefly to a number of cellular elements of which three main types may be recognized: first, white cells which owe their colour to a dense deposit of guanine (a substance allied to the urates); secondly, the yellow cells which contain droplets of oil; and thirdly, the dark brown or melanin filled cells. White cells are often clumped together in small areas under the epidermis producing the white flecks on the back of many salamanders, or the white spots in some tree frogs Other guanine-filled cells lie closely associated with the yellow and brown cells directly under broad areas of the epidermis and give the characteristic ground colour of these regions. Green is a mixed colour due to the blue rays of light reflected from the small guanine or "turbid cells" mixing with the yellow tone in the overlying yellow cells to produce a green. The blue reflections of the turbid cells are swamped by the white reflections of the subjacent tissues when the melanophores or dark cells are contracted. Brown is produced by the complete enclosure of the turbid cells by the expanded melanophores. The latter expand to surround the turbid cells when stimulated by cold, moisture and rough surfaces, or by hormones produced by the pars intermedia of the pituitary gland. The colour tone of a frog or toad at any one time may be due to either stimulations received through the skin or eyes or to the physiological (emotional) state of the individual.

Organs of Nutrition, Respiration, and Reproduction.—As these organs are only rarely used in defining natural groups of Amphibia they may be discussed here briefly. Amphibia are primarily carnivorous, only the larvae of the Salientia being more or less herbivorous in their diet. The intestine is therefore short, except in the tadpoles. The tongue is more developed in the primitive forms and may be rudimentary or absent in the aquatic species. The development shows that the urodele tongue arises out of two parts of which the hinder is homologous to the tongue of fishes, while the anterior and lateral part is a glandular fold which has been added to the first part during evolution.

Although the Amphibia have not evolved from the Dipnoans, they show many similarities in their venous and arterial systems. The heart of salamanders shows various modifications according

to the extent that the lungs are used in respiration. Many urodeles living near mountain streams have lost their lungs and respire entirely by their skins and well-vasculated throats. The entire family *Plethodontidae* is lungless. Many other salamanders use their lungs primarily as hydrostatic and not respiratory organs. Salamanders are mute or endowed with a very poor voice. Most Salientia have a larynx modified and equipped with vocal organs. Frogs call chiefly to attract mates in the spring.

Fertilization in the Amphibia may be external or internal. Most salamanders, except the *Hynobiidae* and *Cryptobranchidae,* are equipped with a spermatotheca, a series of tubules in the roof of the cloaca where the sperm remain after copulation until the time of fertilization. In these salamanders the sperm mass is emitted by the males in the form of spermatophores, small tufts of sperm attached to a gelatinous base. Courtship in the salamanders is primarily directed towards exciting the female sufficiently to ensure her picking up the spermatophore with the cloacal lips. The sperm then make their way into the spermatotheca by their own efforts. The Gymnophiona are equipped with a protrusible cloaca which is used as an intramittent organ. The male American liopelmid frog, *Ascaphus,* has a movable extension of the cloaca. In these forms fertilization is internal, as well as in certain little-known African frogs which have no special apparatus for transmitting sperm. The gonads are variously modified in different groups permitting a greater freedom of the seminal ducts from the kidneys. In *Bufo* a rudimentary ovary, Bidder's organ, is found in front of the testis and when the latter is removed it develops into a functional ovary. Sex reversal has also been recorded in both frogs and salamanders. (*See* SEX.)

Life History.—Most Caudata and Salientia lay their eggs in the water, where they hatch into larvae or tadpoles destined to live a more or less extended period in this element before metamorphosing into terrestrial adults similar to their parents. The larval state seems to be an old inheritance of the Amphibia handed down from their crossopterygian fish ancestors. Even the most primitive Amphibia underwent a metamorphosis, for the fossilized remains of both larval labyrinthodonts and branchiosaurs are known.

Metamorphosis represents a period of tremendous change in both the morphology and physiology of Amphibia. It is marked by such external changes in urodeles as the reduction of the external gills, the loss of the tail fin, the shedding of the larval skin, the formation of eyelids, etc. But fundamental changes in skull form and throat musculature take place. In Salientia metamorphosis is indicated by a freeing of the forelimbs by autolysis of local areas in the operculum, by radical changes in the shape and structure of the head, and by absorption of the tail. One of the recent achievements of physiology has been the demonstration that the changes of metamorphosis are produced by the thyroid hormone, or at least this hormone working in conjunction with that of the anterior lobe of the hypophysis. A review of the physiology of development cannot be given here, but reference may be made to the summaries of Remy ("Les sécrétions internes et les metamorphoses," *Amer. Sci. nat. Zool.* [10], vii), Uhlenhuth ("The internal secretions in growth and development of amphibians," *Amer. Nat.,* 1921) and Allen ("Influence of the hypophysis upon the thyroid gland in amphibian larvae," *Univ. Calif. Publ. Zool.,* xxi. 1927). (*See* ENDOCRINOLOGY, COMPARATIVE.)

Certain groups of urodeles, such as the *Cryptobranchidae, Sirenidae* and *Proteidae,* fail to metamorphose. This phenomenon appears as a variation in the life history of many urodeles, particularly in those species passing their larval period in cold water. Neoteny in the latter case is due to the failure of the thyroid to function, but the causes of arrested development in the case of groups unknown as metamorphosed individuals is more complex. In considering the relations of the perennibranchs, it is important to compare their organization with that of the larvae of other groups, not with that of the adults. Neoteny is not a new development in the Amphibia. It is found even in the Permian *Dwinosaurus.*

Some salamanders and many tropical Salientia produce large yolked eggs which they usually lay on land, although a few retain them within the oviducts until the young are born more or less fully developed. Only two frogs are viviparous and both are rare East African species (*Nectophrynoides tornieri* and *N. viviparа*). The breeding habits of the Amphibia are often elaborate and it is noteworthy that one may trace within the group a gradual evolution in many of the instincts associated with courtship and egg laying.

The larvae of the Amphibia frequently exhibit specializations which are of phylogenetic or at least taxonomic importance. The larvae of the marsupial frog and its allies possess enormous bell-shaped gills. All brevicipitid tadpoles, except those of certain South African genera which probably had an independent origin, have the same toothless, protrusible buccal apparatus. Where the life history is very specialized both larval modifications and breeding habits will tend to indicate the relationships of the forms. Thus, only *Protopipa* and *Pipa* carry their eggs in individual dermal chambers on the maternal parents' back; *Phyllobates* and *Dendrobates* are the only genera which transport to the streams their unspecialized tadpoles on the males' back; *Cryptobatrachus, Cerathyla, Gastrotheca* and *Amphignathodon,* the only ones which carry their eggs in a single mass on their backs (either exposed or enclosed in a dermal fold). The genera in each of these groups differed one from the other in matters of dentition and, hence, according to earlier classifications, would not be considered closely related. But recently when both anatomical and life history data were considered in further detail it was recognized that each of these groups is in fact a natural one.

Geographical Distribution.—Distribution of the urodeles does not agree with that of the Salientia and the latter is unlike that of the coecilians, for each of these groups probably spread from different centres, were affected by different barriers, and subjected to diverse conditions of travel. The present distribution of the Amphibia gives evidence of former union of the northern continents Cryptobranchid salamanders are found only in eastern Asia and eastern North America. Proteid salamanders are found only in Europe and North America One genus of plethodontids, *Hydromantes,* is found only in the two latter regions. One genus of salamandrids, *Triturus,* is holarctic, although a closely related form has apparently managed to work its way south of the Sahara. *Rana* and *Bufo* have closely related species in North America, Europe and Asia. The present distribution of the Amphibia also necessitates an early Tertiary connection between North and South America, for the plethodontid genus, *Ensatina,* is now found in Argentina, also the bufonid toads have undergone an enormous adaptive radiation in the latter continent. The ranids and some brevicipitids of South America may have reached the continent after the present Panamanian connection was formed, but the occurrence of several endemic genera of the latter group would favour an early migration for this family as well. The present distribution of the *Pelobatidae, Bufonidae, Ranidae, Polypedatidae* and *Brevicipitidae* apparently demands a land bridge between Asia and Africa during part of the Tertiary and possibly a direct connection with the Seychelles. Pelobatids are not found in Africa, but in Asia, some of the East Indies, Europe, and the Seychelles. The bufonid *Nectophryne* is found in the oriental region and the African rain forest. The African *Chiromantis* is closely allied to the oriental *Polypedates. Rana* must have been in Africa for some time, for it has split up into a number of endemic subgenera. Madagascar is frequently claimed to have derived its fauna directly from the oriental region. *Polypedates* is found in both regions. The Madagascan *Dyscophus* is closely allied to the Asiatic *Calluella.* But Madagascar lacks coecilians and *Bufonidae.* Its ranids and brevicipitids have undergone an extensive local specialization which would suggest isolation. Further, it possesses *Hyperolius, Megalixalus* and *Rana* in common with Africa. If these recent and aggressive genera have gained access to Madagascar without the aid of a land bridge it is highly probable that brevicipitid and ranid stocks may have done the same at an earlier period when other genera formed the dominant African fauna.

It is frequently claimed that the present distribution of the Amphibia affords some of the best evidence of the existence of

former land bridges in the southern hemisphere. Coecilians are tropicopolitan; pipid toads occur only in tropical Africa and South America. Hence, many zoogeographers would postulate a land bridge across the mid-Atlantic. There is good evidence that in the case of other primitive groups extensive migrations have occurred in the northern region without leaving any fossil remains. For example, one genus of liopelmids is found to-day in North-western United States, the other in New Zealand, and consequently liopelmids must have occurred in the intervening area at one time. Salientia do not make good or frequent fossils, but the occurrence of toothed bufonids ("leptodactylids") in Australia, Africa and South America has led Hewitt to assume a radiation of toads from the south to Asia and the two latter continents along three theoretical land masses existing in Mesozoic times. Such speculations have little in their support and it is far simpler to assume that all families of Amphibia, except the neotropical *Brachycephalidae,* arose in one of the northern continents and migrated south along existing continental land masses.

To-day ambystomids, sirenids and amphiumids are endemic to North America and may have originated there. The large family of *Plethodontidae* are found chiefly in that continent. Hynobiids are known only from Asia. Salamandrids have their headquarters in Europe, although Asia, North Africa and North America have received a few species. Discoglossids are palarctic, pelobatids mainly holarctic. Bufonids, hylids, ranids and brevicipitids have a world-wide range, but exhibit certain remarkable lacunae in their ranges. Thus, hylids are not found in the Ethiopian region (with a single possible exception) nor in most of South-eastern Asia and the adjacent islands; ranids, except the modern genus *Rana,* are absent from South America and Australia. The latter also lacks brevicipitids, except in the north-east. Papua has an amphibian fauna essentially like North-eastern Australia. It possesses bufonids, hylids, ranids and brevicipitids, but no pelobatids. The bufonids have undergone an adaptive radiation in Australia, while the brevicipitids did the same in New Guinea.

Economic Value.—Toads are of great use to farmers as they are indiscriminate feeders on insect life. In cases of an insect plague toads feed on the dominant insect and tend to restore the balance of nature. Frogs and toads are used for food in many parts of the world, but successful frog farms are rare. Frogs require from two to five years to reach maturity, and large quantities of living insect food are needed during this period. Hence, in America almost the entire frog crop is obtained in the wild state.

Dried frogs and salamanders are used for medicinal purposes in various parts of the world, particularly in the Orient. Their value as a cure is chiefly psychological. Probably the greatest use of Amphibia to humanity is their martyrdom to science. Frogs and salamanders both in adult and young stages have long been recognized as ideal laboratory animals. Some of our most fundamental discoveries in developmental mechanics (*See* EXPERIMENTAL EMBRYOLOGY), endocrinology (*q.v.*) and general physiology (*q.v.*) have been made with amphibian material.

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AMPHIBOLE, an important group of rock-forming minerals very similar in chemical composition and general characters to the pyroxenes and, like them, falling into three series according to the system of crystallization (from the Gr. ἀμφίβολος, "ambiguous"). They differ from the pyroxenes, however, in having an angle between the prismatic cleavages of 56° instead of 87°; they are specifically lighter than the corresponding pyroxenes, and in their optical characters they are distinguished by a stronger pleochroism and by a smaller angle of extinction on the plane of symmetry.

The amphiboles in their composition conform in general to the metasilicate formula $R''SiO_3$, and are usually classified as follows:—

ORTHORHOMBIC SERILS

Anthophyllite	$(Mg,Fe)SiO_3$
Gedrite	$(Mg,Fe)SiO_3-Al_2O_3$

MONOCLINIC SERIES

(*a*) Sesquioxide-free members	
Cummingtonite	$(Mg,Fe)SiO_3$
Grünerite	$FeSiO_3$
Tremolite	$Ca,Mg_3(SiO_3)_4$
Actinolite	$Ca(Mg,Fe)_3(SiO_3)_4$
(*b*) Sesquioxide-rich members	
Hornblende with variable and	$Ca(Mg,Fe)_3(SiO_3)_4$ $(Mg,Fe)SiO_3\cdot(Al,Fe)_2O_3$ $Na,Al(SiO_3)_2$
(*c*) Alkali amphiboles	
Glaucophane	$Na(Al,Fe)(SiO_3)_2\cdot(Mg,Fe)SiO_3$
Crocidolite	$NaFe'''(SiO_3)_4$
Arfvedsonite	$Na_2Fe_3''(SiO_3)_4$
Riebeckite	$2NaFe'''(SiO_3)_2FeSiO_3$

TRICLINIC SERIES

Aenigmatite Group	
Aenigmatite	$(Na,K,H)_4(Fe,Mg,Ca)_9(Fe,Al)_2(Si,Ti)_{12}O_{38}$
Cossyrite	$H_4Na_6Fe_{15}''Fe_2'''(Si,Ti)_{22}O_{67}$
Rhoenite	$(Ca,Na_2,K_2)Mg_4Fe''_2Fe_2'''Al_4(Si,Ti)_6O_{30}$

Though, as already stated, there is a close similarity in composition between the amphiboles and pyroxenes, the former are the more complicated and their nature less understood. Most amphiboles contain some alkalis, fluorine and water of constitution and do not with few exceptions crystallize from dry melts. Rhombic amphibole of composition $MgSiO_3$ (kupfferite) has been obtained as an unstable phase by rapid cooling of a $MgSiO_3$ melt. The natural rhombic amphiboles always contain water and usually some alkali. Gedrite may contain up to 22% Al_2O_3.

The cummingtonite-grünerite group of monoclinic amphiboles appears to form a solid solution series. The magnesian end member has been prepared by rapid cooling of a $MgSiO_3$ melt and also by subjecting kupfferite in the presence of water to a temperature of 375°–475°C. Cummingtonite occurs together with anthophyllite in anthophyllite schists and in parallel intergrowth with the latter mineral or with gedrite in pneumatolytically metamorphosed sediments as in Finland and Cornwall. Grünerite occurs in association with garnet and fayalite in the rocks known as eulysites and is a prominent constituent of the altered iron bearing rocks of the Lake Superior region.

A lime-magnesia amphibole of the composition $CaMgSi_2O_6$ has been prepared by rapid cooling of a melt of the composition 85% diopside 15% SiO_2, but in nature an amphibole of this composition is unknown. The sesquioxide-free amphiboles, tremolite and actinolite are most characteristic of metamorphosed calcareous sediments both thermal and dynamic, while in the metamorphosed igneous rocks—such as hornblende schists, the sesquioxide—rich hornblende is more common.

The hornblendes occurring as porphyritic crystals in some basalts, andesites and porphyrites, and known as basaltic hornblende are brown in thin slices and contain significant proportions of titanium. They are well known from the basalts of Bilin and

Schima (Czechoslovakia). They are distinguished by a very low optical extinction angle on the plane of symmetry. Hornblende is a common mineral of many types of igneous rocks as in granite, syenite and especially diorite; also in the crystalline schists.

The alkali amphiboles are distinguished by their very complicated composition and little is known of their constitution. They appear to form with hornblende a series of solid solutions which are represented by alkali amphiboles of intermediate composition. The alkali amphiboles may be subdivided broadly into two groups according to their composition, habit and mode of occurrence: an iron-poor light blue coloured group which are especially characteristic of the crystalline schists and an iron-rich dark blue coloured group which occur as prominent constituents of alkaline igneous rocks.

The first group is prominently represented by glaucophane and its alumina-rich relative gastaldite, while the second group is represented by the arfvedsonite-riebeckite series of amphiboles.

The arfvedsonite-riebeckite series occur in the alkaline igneous rocks such as nepheline syenite, tinguaite and phonolite. Riebeckite was first described from the granites of the island of Socotra. To be classed here is the hastingsite of the nepheline syenites of Ontario. Crossite, an alkali amphibole in the crystalline schists of Berkeley, California, is distinguished by possessing an optic axial plane normal to the plane of symmetry. Barkevikite, related to arfvedsonite is a brown pleochroic amphibole originally described from Barkevik (Norway).

The three minerals of the aenigmatite group, viz., aenigmatite, cossyrite and rhoenite are usually classed as triclinic amphiboles.

See also HORNBLENDE and TREMOLITE.

(C. E. T.)

AMPHIBOLITE, in petrology the name given to a grey, green or black, typically non-schistose rock consisting mainly of amphibole and a felspar of the plagioclase group, the use of the term being restricted, however, to rocks of metamorphic origin. The term may be contrasted with hornblende schist, which is of identical composition but possesses a well-defined schistose structure as compared with the granoblastic unfoliated structure of the amphibolite. As is the case with most petrological terms the exact connotation is not very strictly defined, and some authors reserve the term hornblende schist for schistose rocks built up essentially of amphibole. As accessory constituents may be noted a red lime-magnesia-iron garnet, epidote, zoisite, green pyroxene, scapolite, biotite, etc

The commonest amphibole is the aluminous monoclinic hornblende. Other varieties, however, occur, such as tremolite, actinolite, the soda amphibole glaucophane and, more rarely still, crossite. The magnesia-iron amphiboles of the cummingtonite-grunerite series, and the rhombic amphiboles anthophyllite and gedrite form essential constituents of certain amphibolites. The usual plagioclase felspar is an andesine or labradorite; in this zoning and lamellar twinning are often less marked than in the felspars of igneous rocks.

The amphibolites are typical rocks of the metamorphic group and as such attain a large development in all regions of crystalline schists and gneisses as in the old preCambrian shields and in metamorphic areas of later date. They occur principally in stocks or bosses representing basic igneous intrusions, or as long, narrow strips intercolated among outcrops of other metamorphic rocks. Genetically they fall into two groups, the ortho-amphibolites, which are transmuted igneous rocks, and the para-amphibolites, the metamorphic representatives of sedimentary rocks. The former are much the more common, and of these the greater number are derived without significant change in bulk composition from gabbros and dolerites. Igneous rocks containing much augite pass under the conditions prevailing in regional metamorphism where shearing stress is dominant into rocks of this kind, the pyroxene being converted to amphibole often with separation of iron ores and sphene. From more alkaline basic rocks the soda amphibole, glaucophane, is produced.

Plagioclase felspar is recrystallized with or without separation of some of the anorthite molecule as epidote or zoisite according to the grade of metamorphism imposed. The rock may thus be completely transformed into a granoblastic aggregate of new-formed minerals with entire loss of all igneous textures. Frequently, however, this transformation is only partial, and examination of a large number of specimens reveals a series of intermediate or transitional stages, proving conclusively the nature of the processes at work.

The sedimentary amphibolites or para-amphibolites, less common than those above described, are frequent in some districts, such as the northern Alps, southern highlands of Scotland, Green mountains, U S A. Many of them have been ash-beds, and their conversion into hornblende-schists follows exactly similar stages to those exemplified by basic crystalline igneous rocks. Others have been greywackes of varied composition with epidote, chlorite, felspar, quartz, iron oxides, etc , and may have been mixed with volcanic materials, or may be partly derived from the disintegration of basic rocks When they are most metamorphosed they are often very hard to distinguish from igneous hornblende-schists; yet they rarely fail to reveal signs of bedding, pebbly structure, sedimentary banding and gradual transition into undoubtedly sedimentary types of gneiss and schist.

Impure dolomitic limestones yield on metamorphism para-amphibolites strikingly similar to some ortho-amphibolites By mutual reaction of chlorite, kaolin, calcite and dolomite amphiboles and plagioclase felspars are produced. The original nature of these highly altered rocks, however, is frequently displayed in the rapid variation in mineral composition followed across the strike, corresponding to initial inhomogeneity of the original sediment. Amphibolites of this type are common in the Haliburton-Bancroft area of Ontario, where they occur, together with ortho-amphibolites, as enclosures in the Laurentian gneiss.

(C. E. T.)

AMPHIBOLOGY or **AMPHIBOLY,** in logic, a verbal fallacy arising from ambiguity in the grammatical structure of a sentence (Aristotle, *Organon, Soph. El*, ch. iv). It occurs frequently in poetry, owing to the alteration for metrical reasons of the natural order of words; Jevons quotes as an example Shakespeare, *Henry VI.*: "The duke yet lives that Henry shall depose " The success of ancient oracles was largely due to skill in amphibology

AMPHICTYONY, an association of ancient Greek communities centring in a shrine (from the Greek ἀμφικτίονες, "dwellers around"). The association primarily comprised neighbours, though the Delphic amphictyony came to include distant communities Neighbouring communities chose the sanctuary of some deity at which to hold their periodical festival for worship and their fair for the interchange of goods The Delian amphictyony reached the height of its splendour early in the 7th century B.C. The "Hymn to the Delian Apollo," composed about that time, celebrates the gathering of the Ionians at the shrine of their god on the island of Delos, to worship him with music, dancing and gymnastic contests. Peisistratus, taking possession of Delos, seems to have used the sanctuary as a means of extending his political influence. When, after the great war with Persia, the Aegean cities, under the leadership of Athens, united in a league (477 B C.), they chose as its centre the temple of the Delian Apollo. How far the institutions of the Delian confederacy were based upon the amphictyonic organization cannot be determined.

The removal of the Treasury to Athens in 454 B.C. deprived Delos of political importance. In 426 B C. the Athenians instituted a great festival to be held under their presidency every four years (Thuc iii. 104). At the end of the Peloponnesian War Athens was deprived of Delos, but she appears to have regained control after the victory of Cnidus (394 B.C.). The affairs of the temple were managed by a board of five Athenian amphictyons, assisted by some Delian officials

Far more famous is the Delphic amphictyony. It was originally composed of 12 tribes dwelling round Thermopylae—the Thessalians, Boeotians, Dorians, Ionians, Perrhaebians, Magnetes, Locrians, Oetaeans, Phthiotes, Malians, Phocians and Dolopians. The name of the council (*Pulaia*) and of one set of deputies (*pulagorai*), together with the importance of the temple of Demeter at Anthela, near Thermopylae, suggests that this shrine was

the original centre of the association. How and when Delphi became the centre is uncertain. The council of the league included deputies of two different kinds—*pulagorai* and *hieromnemones*. The latter were 24 in number, two from each tribe. Originally made up of neighbours, the league in time admitted the Dorians of the Peloponnese and the Athenians (as Ionians). After the second Sacred War, Macedon took the place of the Phocians and the Delphians partially displaced the Perrhaebians and Dolopians.

In the following century the Aetolians gained such dominance in the amphictyony as to convert the council into an organ of their league. They were never formally admitted to membership, but maintained their supremacy in the council by controlling the votes of their allies. A few minor changes were introduced under the supremacy of the Roman republic; Augustus increased the number of votes to 30 and distributed them according to his pleasure. In the age of the Antonines the association was still in existence.

The *hieromnemones* of the Thessalians, who held the presidency, were elected, but the office was ordinarily, as at Athens, filled by lot. As a rule they were renewed annually. Each *hieromnemon* was accompanied by two *pulagorai*, elected semi-annually. On one occasion Athens is known to have sent three. The *hieromnemones* were formally superior, but being usually mediocrities, readily became the tools of the *pulagorai*, who were orators and statesmen. The latter are rightly given credit for the acts of the council; it was the *pulagorai* who set a price on the head of the traitor Ephialtes (Herod. vii. 213), and who, on the motion of Themistocles, rejected the proposition of Lacedaemon for the expulsion of the States which had sided with Persia. The *pulagorai* had a right to propose measures and to take part in the deliberations. The *hieromnemon*, however, cast the vote of his community, though in the record his two *pulagorai* were made equally responsible for it. The inference is that the vote was determined by a majority of the three deputies.

The amphictyons met both in the spring and in the autumn at Delphi and at Thermopylae. The meeting at Thermopylae followed that at Delphi. The primary function of the council was to administer the temporal affairs of the two shrines. The duty of the *hieromnemones* was to inspect periodically the sacred lands, to punish those who encroached, and to see that the tenants rendered their quota of produce; and the council held the States responsible for the performance of such duties by their deputies. Another task of the council was to supervise the Treasury, to protect it from thieves, to increase the capital by investment and to control the expenditure. We find it contracting for the rebuilding of the Delphic temple after it had been destroyed by fire, adorning the interior with statues and pictures, inscribing the proverbs of the Seven Sages on the walls, bestowing crowns on benefactors of the god, preparing for the Pythian games, awarding the prizes and issuing coins. A law of great interest imposed an oath upon the members of the league not to destroy an amphictyonic city or to cut it off from running water in war or peace; but to wage war upon those who transgressed this ordinance, and to punish any others who sought to injure the god. In this regulation, which was intended to mitigate the usages of war among the members of the league, we have one of the origins of Greek inter-state law. It was also unlawful to levy tolls on pilgrims to the shrines. Other regulations were made to secure peace at the time of the festival, and occasionally the council was called upon to arbitrate in a dispute; but no provision was made to compel arbitration.

For the enforcement of such laws it was necessary that the council should have judicial power. As jurors the deputies took an oath to decide according to law or, in cases not covered by law, according to their best judgment. The earliest known penalty inflicted was the destruction of Crisa for having levied tolls on pilgrims. This offence was the cause of the first Sacred War. The second and third Sacred Wars, fought in the 4th century B.C., were waged by the amphictyons against the Phocians and the Amphissaeans respectively for trespassing on the sacred lands. The council fined the Dolopians for piracy, and the Lacedaemonians for having occupied the citadel of Thebes in time of peace.

The judgments of the council were sometimes considered unfair, and were defied by the States affected. The Lacedaemonians refused to pay the fine above mentioned; the Athenians protested against the treatment of Amphissa, and were slow in accepting the decisions given under the influence of Macedon. The inability of the council to enforce its resolutions was chiefly due to its composition; the majority of the communities represented were even in combination no match for individual cities like Athens, Sparta or Thebes. As in the League of Nations (*q.v.*), the support of the "great powers" was necessary if more than moral influence was to be employed. But the moral influence was usually powerful.

In addition to these associations there was an amphictyony of Onchestus and an amphictyony of Argos of which Epidaurus and Aegina were members.

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AMPHILOCHUS (ăm-fĭl'ǫ-kŭs), in Greek legend, a famous seer, son of Amphiaraus and Eriphyle and brother of Alcmaeon. According to some, he assisted in the murder of Eriphyle, which, according to others, was carried out by Alcmaeon alone. He took part in the expedition of the Epigoni against Thebes and in the Trojan war. After the fall of Troy he founded, in conjunction with Mopsus, another famous seer, the oracle of Mallos in Cilicia. The two seers afterwards fought for its possession, and both were slain in the combat. Amphilochus is also said to have been killed by Apollo (Strabo xiv. 675, 676). According to another story, he returned to Argos from Troy, but, being dissatisfied, left it for Acarnania, where he founded Amphilochian Argos on the Ambracian gulf. He was worshipped at Oropus, Athens and Sparta.

See Strabo xiv. pp. 675, 676; Thucydides ii. 68; Pausanias i. 34, iii. 15.

AMPHINEURA, group of marine invertebrate animals constituting a class of the Mollusca (*q.v.*), the majority with a shell of eight transverse plates. A much smaller number are devoid of a shell and have the general appearance of worms. Up to the present upwards of 120 genera of these animals have been described. They are all sedentary, slow-moving creatures usually of insignificant size, and are generally found in shallow water. Until recent years it was customary to regard the class as divisible into two orders, the shell-bearing Chitons or Polyplacophora and the worm-like Solenogastres or Aplacophora. The Chitons are divided into three suborders according to the structure of the shell, and the Solenogastres into two suborders, the Neomeniomorpha and Chaetodermomorpha Some zoologists, however, regard the Solenogastres as more closely allied to certain groups of primitive worms (Platyhelmia, Archiannelida) than to the Mollusca. J. Thiele (1925) has accordingly removed them from the Mollusca, in which they were placed by Spengel and Ray Lankester. The name Amphineura, which was used to designate the Chitons and Solenogastres collectively, is therefore abandoned by Thiele and the older name Loricata has been revived for the Chitons, which are still treated by Thiele as a class of the Mollusca. In this article the Solenogastres are included in the Mollusca and the unity of the Amphineura is upheld; but the question of the relationships of the Solenogastres cannot be regarded as finally settled. (*See* below.)

The Chitons are elongate, rather flattened animals, rarely exceeding a few inches in length. *Cryptochiton stelleri* attains a length of 20cm., and the smallest forms barely exceed half an inch when fully grown. The overlapping plates of the shell give them the appearance of wood-lice, a comparison perhaps more accurate than that involved in the German name *Käferschnecke*, or "beetle-snails." The outer covering of the animal constitutes the "mantle" on the upper surface and sides. On the lower surface it forms the solid and muscular foot. (*See* MOLLUSCA.) The cells of the mantle secrete the eight calcareous plates of the shell. In most genera of Chitons the separate valves are articu-

lated together, though with enough freedom to enable the animal to roll up into a ball like a wood-louse. The plates are pierced by a number of branching canals through which nerves pass to end on the surface of the shell in peculiar sense organs known as "shell-eyes." In some forms the shell becomes covered by the mantle. This is well seen in the large *Cryptochiton stelleri* of the north-east Pacific. The mantle also secretes horny or calcified

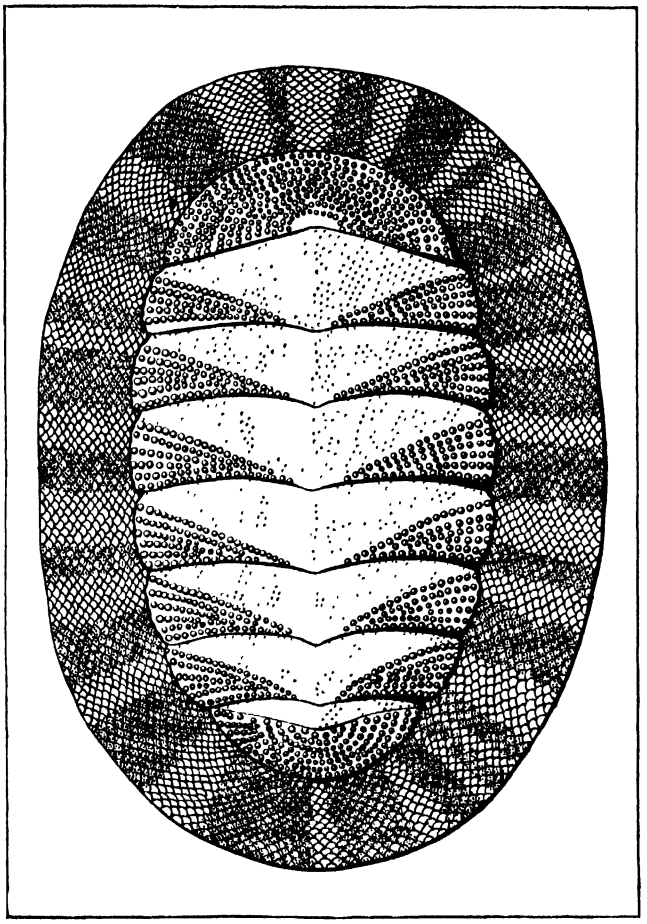

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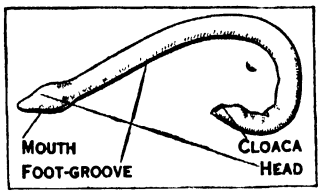
FIG. 1.—THE OVERLAPPING PLATES OF THE SHELL OF THE CHITON FUNEREUS, ONE OF THE SUBORDERS OF SHELL BEARING AMPHINEURA

spicules. These are found at the edge of the mantle (girdle), where it projects beyond the shell. In *Tonicia* and other genera the spicules are so large and numerous that they give the animal a rough and shaggy appearance. The cavity of the mouth contains the radula (*see* MOLLUSCA) or rasping tongue. The alimentary canal extends in a straight line from the mouth to the anus, which is situated at the posterior end of the body. It receives the ducts of the mucous and salivary glands and of the liver. The heart occupies a position in the middle line at the posterior end. A single aorta leads the blood from the heart, and it is eventually collected for oxygenation into two large cavities (sinuses). From these it passes to the gills, which project from the adjacent body-wall into the cavity formed by the edge of the mantle, where it overhangs the sides. The gills vary in number from four to 80. There are two kidneys, one on each side of the body. Their external apertures are at the posterior end of the body, and at their inner end they open into the pericardium (the cavity surrounding the heart). The nervous system consists of four main nerve trunks joined by transverse commissures and, unlike the main nerve cords of Gastropoda and other molluscs, is largely without ganglia. The sexes are separate in the Chitons. The ovary and testis have no communication with the pericardium as they have in the Solenogastres. The ova and spermatozoa are passed to the exterior by a pair of gonaducts.

Regarded as molluscs, the Solenogastres are mainly characterized by the loss of the shell, the substantial reduction or loss of the foot, and the fact that there are no separate generative ducts. The gonad (ovary or testis) opens into the pericardium and the ova or spermatozoa are discharged by the kidneys. The gills are concentrated in a posterior cavity (cloaca). In *Neomenia* and its allies there is, on the under surface of the body, a groove which is interpreted as the line of junction between the two edges of the mantle which have grown round the sides. In the *Chaetodermatidae* this groove is absent, and the animal is entirely cylindrical.

The embryological development of the Solenogastres is still imperfectly known; but, as far as it has been studied, it is held to endorse the conclusion that these animals are more nearly allied to certain groups of worms than to the Mollusca.

As a class the Amphineura have a world-wide distribution; but, while some genera (*e.g.*, *Lepidopleurus*) are found in nearly all seas, others have a more localized occurrence. The Chitons are found in a fossil state in the Ordovician. Their evolutionary history has been uneventful, no very marked departure from the main type of shell-structure being recorded. The Solenogastres have not so far been recognized as fossils. Both the Chitons and the Solenogastres are sluggish animals, creeping slowly about to no great distance. The Chitons are found on or under rocks and stones The chemical constitution of the rock is of small importance in determining the occurrence of these animals. They prefer a smooth surface and are usually found on rocks that weather to such a condition. Ashby found the greatest numbers on pure granite, "counting over 70 specimens of *Ischnoradsia* on a single rock no larger than a dinner plate" *Neomenia* and its allies live on corals and hydroids, while *Chaetoderma* prefers muddy and oozy bottoms. Some members of the class are found at very great depths, *e.g.*, *Leptochiton benthus* in 2,300 fathoms ("Challenger"); but most of them live in shallow littoral waters. The Chitons are mainly herbivorous and browse on the Algae that adhere to rocks The members of the Neomeniidae which live on corals and hydroids feed on those organisms and are thus carnivorous. Free-living Neomeniomorpha such as *Proparamenia* are probably more aggressive and active in their feeding-habits. *Chaetoderma* and its allies feed on minute organisms such as *Protozoa*, etc.



FROM SIR E RAY, "A TREATISE ON ZOOLOGY"

FIG 2.—THE VENTRAL LONGITUDINAL GROOVE AND CLOACA OF THE PRONEOMENIA GERLACHEI

The lack of satisfactory evidence as to the development of the Solenogastres makes it difficult to assess their relationships. The structural peculiarities on which Thiele, Odhner and others have relied in removing these animals from the mollusc lead us to believe that their affinity with the Chitons may not be so close as was formerly believed. But a critical test of their relationships can only be provided by a study of their development.

For the relationship of the Amphineura to the other groups of Mollusca, *see* MOLLUSCA.

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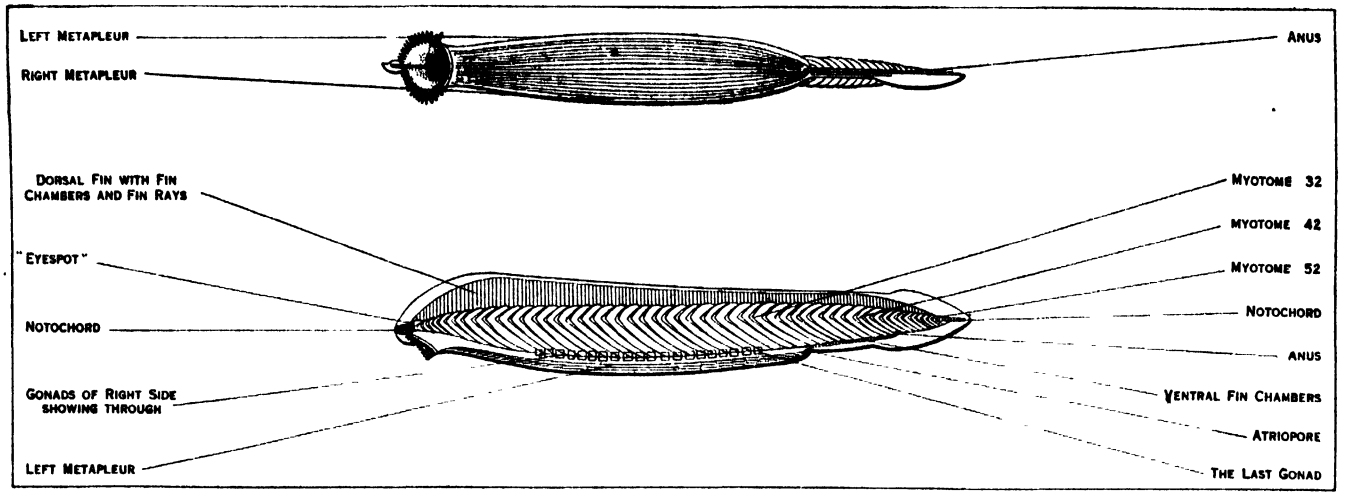
AMPHION and **ZETHUS,** in Greek mythology, the twin sons of Zeus by Antiope. When children, they were exposed on Mt. Cithaeron, but were found and brought up by a shepherd Amphion became a great singer and musician, Zethus a hunter and herdsman. After punishing Lycus and Dirce for cruel treatment of Antiope (q.v.), they built and fortified Thebes, huge blocks of stone forming themselves into walls at the sound of Amphion's lyre. Amphion married Niobe, and killed himself after the loss of his wife and children (Ovid *Metam.*, vi. 270).

AMPHIOXUS or **LANCELET,** a small, marine creature, neither fish nor worm, but something between the two, which is the simplest example of the Vertebrate type of structure. It was first discovered on the coast of Cornwall, and a preserved



AFTER KIRKALDY IN "THE QUARTERLY JOURNAL OF MICROSCOPICAL SCIENCE"

FIG. 1.—VIEWS FROM BELOW AND FROM THE LEFT SIDE OF THE ASYMMETRON CULTELLUS SHOWING THE SINGLE ROW OF GONADS (REALLY ON THE RIGHT SIDE) AND THE ASYMMETRICAL CONNECTION BETWEEN THE RIGHT METAPLEUR AND THE CAUDAL FIN. THE DRAWING IS SLIGHTLY ALTERED FROM KIRKALDY

specimen sent to Pallas, who was unacquainted with its lively movements, was described by him in 1774 as a slug, *Limax lanceolatus*. Couch rediscovered it in 1831, and his specimen was described and figured by Yarrell in 1836 under the title *Amphioxus lanceolatus* (*Brit. Fishes*, vol. ii.).

Characteristics.—The body of *Amphioxus* rarely exceeds 2½in. in length. It is laterally compressed and tapered at each extremity. From end to end above the alimentary canal runs a solid, elastic rod, the notochord, which plays an important part in the animal's movements. On each side of it run powerful longitudinal muscles, which are divided up into chevron-like segments, the myotomes, like the muscle-flakes of a whiting. Above the notochord lies a nerve-cord, corresponding to the spinal cord of Vertebrates, and giving origin, like it, to alternate pairs of sensory and motor nerves, which, however, remain distinct, and do not unite to form complex structures like the spinal nerves, with their double roots, in Vertebrates. There is, moreover, no centralized brain in front, and no trace of paired olfactory, optic and auditory sense-organs and nerves. Jaws, teeth and other prehensile organs are lacking, as well as skull, vertebral cartilages and paired limbs or fins. The circular, contractile mouth lies at the back of a preoral depression, the buccal cavity, on the underside of the snout. This cavity is fringed behind and on each side by stiff processes or cirri, provided with a solid, jointed, internal skeleton. They are capable of spreading outwards, thus freely opening the buccal cavity, or of bending inwards, when they overlap the entrance with a protective grating. A circlet of true, sensitive tentacles lies just inside the circular mouth. The cheeks of the buccal cavity are beset inside with parallel ciliated ridges, which are offsets from a primary pair of dorso-lateral ridges, diverging behind around the mouth, and converging forwards to surround an asymmetrical cilio-glandular depression known as *Hatschek's pit*. The entire organ is known as the *wheel-organ*. Its ciliary action is directed backwards towards the mouth. The alimentary canal is described below.

Classification.—There has been a tendency to include *Amphioxus* within the Vertebrata as *Acrania*, but this procedure exaggerates the resemblances of *Amphioxus* to the Vertebrates, since in all the essentials of its life and organization, as distinct from superficial form, *Amphioxus* is much more intimately related to the Tunicata (*q.v.*), and constitutes with them a well-defined group, termed by Balfour Protochordata, the distinctive features of which lie in the feeding-mechanism described below. The differences between *Amphioxus* and the Tunicata are chiefly that *Amphioxus* retains its notochord and powers of locomotion throughout life, while in Tunicata these are mostly restricted to the larval stage, and the notochord itself is confined to the tail. *Balanoglossus* (*q.v.*), which in certain respects foreshadows *Amphioxus*, stands at a much lower plane of general organization, and, with the Pterobranchia (*q.v.*), possesses mere rudiments of the characteristic notochord and neural canal. Thus the position of *Amphioxus* within the phylum Chordata is indicated by the following classification:

CHORDATA

I. Hemichordata { 1. Pterobranchia, *e.g.*, *Cephalodiscus*. 2. Enteropneusta, *e.g.*, *Balanoglossus*.

II. Protochordata { 1. Tunicata (=Urochorda). 2. Cephalochorda, *e.g.*, *Amphioxus*.

III. Vertebrata (=Craniata).

There are good reasons for regarding these three sub-phyla as marking successive stages in the progressive evolution of the Chordata, although in its possession of protonephridial excretory organs *Amphioxus* retains an archaic larval character (*cf. Actinotrocha*) which has been lost by all other Chordata.

In the latest revision of the Cephalochorda (Franz, 1922) two genera only are recognized, *Branchiostoma* (=*Amphioxus*) and *Asymmetron* (*see* below). Which is primitive? Franz decides in favour of *Amphioxus;* but, if their relationship with Tunicates is borne in mind, the unpaired gonads, the small size (9–10mm.) at sexual maturity, and the frequent presence of a caudal appendage in *Asymmetron* enable us to recognize in this form a possible stage of transition from a neotenic Ascidian towards *Amphioxus*, the unsegmented caudal appendage (which supports a well-marked caudal fin in the pelagic larva) being a vestige of the Ascidian larval tail. The relations of the metapleural ridges and ventral fin-fold are consistent with this view, since it is generally admitted that the continuity of these structures in *Asymmetron*, though one-sided, is more primitive than the discontinuity in *Amphioxus*. The species of *Asymmetron* fall into two groups according to the presence or absence of the caudal appendage, the second group corresponding with the genus *Heteropleuron* of Kirkaldy; but the variations of a vestigial organ furnish an insecure basis for a definite division of the genus.

1. ASYMMETRON, Andrews (Tattersall)—Gonads on right side only; left metapleur distinct, the right continuous with the ventral fin.

A—with a distinct caudal appendage. Species: *lucayanum* (62–71 myotomes), Bahamas, Zanzibar to Philippines; *macricaudatum* (58–66), Florida; *caudatum* (60–64), Louisiade archipelago; *orientale* (63–69), Maldives.

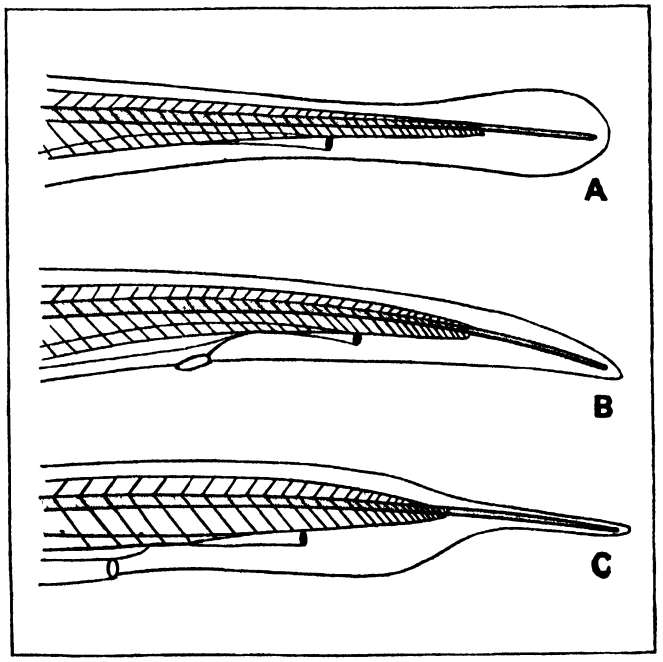
B—without a caudal appendage. Species: *cultellum* (50–56 my., notochord unusually prominent behind), E. Africa to Philippines and E. Australia; *cingalense* (61–64), Ceylon; *parvum* and *agassizii* (68–70), Maldives; *maldivense* (70–76), Maldives and Laccadives; *bassanum* (70–78), S.W. Australia; *hectori* (84–85), New Zealand.

2. AMPHIOXUS, Yarrell (=*Branchiostoma*, Costa). Gonads in paired series; right and left metapleurs ending symmetrically

behind the atriopore; no caudal appendage. Species: *lanceolatus* (58–62 my.), European coasts; *caribaeus* (57–60), Atlantic coasts of America; *haeckelii* (59–61), Ceylon; *belcheri* (63–66), E. Africa to Japan and Queensland; *californiensis* (64–69), California; *indicus* (69–71) (snout elongated), Indian Ocean; *capensis* (74–76), S. Africa; *elongatus* (77–80), Pacific coast of S. America.

Habits.—*Amphioxus* burrows in loose sand, into which it dives with amazing rapidity. It projects its snout above the surface, and remains perfectly still unless disturbed, when it darts out of the sand, gyrates wildly about in zig-zag fashion for a few seconds, and then plunges head-first in again. Except for these brief moments of activity, its habits are as sedentary as those of a fixed Ascidian. *Asymmetron* has similar habits, but *A. lucayanum* appears to be actively pelagic at night.

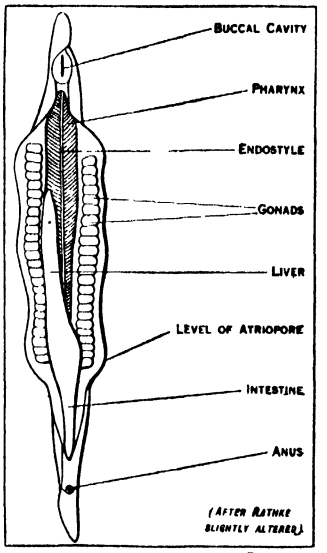
Feeding Mechanism.—*Amphioxus* agrees with the Tunicata, and differs from all other Chordata, in certain characteristic modifications of the front part of the alimentary canal or pharynx for the collection of minute floating organisms (microplankton) as food The canal itself in *Amphioxus* runs straight from mouth to anus, the latter being situated ventrally a short distance from the posterior extremity of the body, to the left of the ventral fin (in Tunicata also the anus is left-sided, but dorsal). The long, dilated pharynx is succeeded by a narrow gastro-intestinal region, provided in front with a hepatic caecum projecting forwards on the right side. There is no distinct stomach. The entire side-walls of the pharynx, and the body-wall investing it, are pierced by a paired series of close-set U-shaped or tongue-barred gill-slits, each of which extends obliquely backwards, and is divided up into smaller perforations, firstly by fusion of the apex of the tongue-bar with the ventral wall of the slit, and then by subdivision of the half-gill-slits into stigmata by outgrowth of synapticulae from the tongue-bars. The edges of all the perforations are strongly ciliated and lash outwards through the body-wall. To protect the fenestrated walls from injury, the whole pharyngeal region is sunk beneath the general level, and enclosed within a peribranchial chamber or atrium by downgrowth of the muscular body-wall and ventral fusion of a pair of epibranchial flaps (the subatrial ridges). This fusion is incomplete behind, leaving an aperture, the atriopore, situated ventrally, midway between pharynx and anus. The metapleurs are a pair of ventro-lateral ridges on the outer surface of the atrial wall.



AFTER ANDREWS, "AN UNDESCRIBED ACRANIATE ASYMMETRON LUCAYANUM" IN "STUDIES FOR THE BIOLOGICAL LABORATORY OF JOHNS HOPKINS UNIVERSITY"

FIG. 2.—DEVELOPMENT OF THE CAUDAL APPENDAGE OF ASYMMETRON LUCALANUM BY ATROPHY OF THE PRIMITIVE CAUDAL FIN OF THE LARVA
A. Larva of 6 mm. with 22 gill-slits, no caecum and atrium unclosed ventrally
B. Immature specimen with 27 gill-slits, small caecum and closed atrium
C. Mature adult of 14 mm. with 28 gonads
Note the incipient development in C of a secondary caudal fin in the postanal region of the myotomes which represents the normal "caudal fin" of Amphioxus

The narrow roof and floor of the pharynx are grooved longitudinally. The ventral groove or endostyle is beset with rows of gland-cells, and between them runs a median tract of cells bearing long flagella. Its lateral margins are finely ciliated, and diverge in front to encircle the pharynx inside the mouth as a pair of peripharyngeal bands. These bands bend backwards dorsally and merge into the ciliation of the upper or epipharyngeal groove, which leads into the oesophagus It is in fact the food-groove, and the rest of the pharynx is a collecting apparatus to supply it



AFTER RATHKE, "BERWERKUNGEN ÜBER DEN BANDES AMPHIOXUS"

FIG 3.—AMPHIOXUS LANCEOLATUS LAID OPEN VENTRALLY
Exposing the organs which project into the atrial cavity (pharynx, intestine with liver, caecum directed forwards, row of gonads in each side-wall)

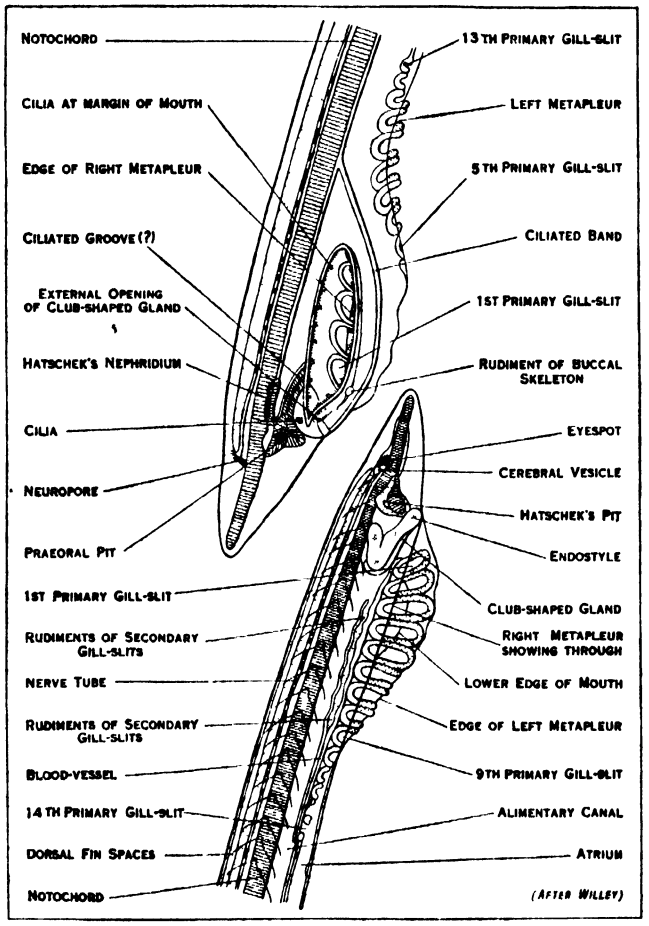
When *Amphioxus* is at rest, its mouth opens, and the cilia of its numerous gill-slits set up a current which flows steadily in through mouth and pharynx, and out through atrium and atriopore. At the same time the endostyle pours out a stream of mucilage, the greater part of which is flicked out of the groove right and left on to the side-walls of the pharynx, and is there swept upwards in the form of parallel longitudinal strings by the action of cilia coating the internal surface of the gill-bars In this way the fenestrated walls of the pharynx are traversed by a moving succession of slimy threads Food-particles entering with the water are sooner or later entangled in the mucilage and rolled upwards into the epipharyngeal groove which concentrates them and conveys them as a continuous food-rope backwards into the digestive part of the canal. The wheel-organ appears to assist this process in the buccal cavity by sweeping outlying particles on to the peripharyngeal bands.

Reproduction.—The sexes are separate. The gonads arise as pouches from the lower ends of the myotomes, and project into the atrium At the breeding season the pouches burst, and the sexual elements pass through the atrium to the exterior, where fertilization takes place.

Development.—On account of its relative yolklessness, the fertilized egg of *Amphioxus* provides a typical example of total and regular segmentation, and of gastrulation by invagination. Notochord and neural canal (the latter enclosing the blastopore) are developed as in the lower Vertebrates Paired mesoblastic somites arise as outgrowths, from the embryonic endoderm, and divide into the myotomes above and visceral elements below which unite to form the perivisceral coelom A primitive tripartite arrangement of the coelom is recognizable, as in *Balanoglossus*, the myotomes and perivisceral elements being derivatives of the third primitive or trunk segment (MacBride). The first primitive segment is cut off from the blind extremity of the archenteron as a single vesicle, which divides into two, the right half expanding as the head-cavity, while the left, which acquires an opening to the exterior, becomes reduced to form Hatschek's pit. Its aperture is clearly homologous with the proboscis pore of *Balanoglossus* and the water-pore of Echinoderm larvae. It is surrounded in the larva by a peculiarly ciliated patch, known as the *preoral pit*, which subsequently develops into the wheel-organ of the adult. Goodrich has given good reasons for regarding this organ as equivalent to the anterior part, at any rate, of the Vertebrate hypophysis.

Amphioxus hatches at about the eighth hour after fertilization as a ciliated embryo, with the neural folds, notochord and first few mesoblastic somites established, but without mouth or anus. The ciliated embryo elongates rapidly with the formation of additional somites, and at about the 36th hour passes into the first larval stage, characterized by perforation of the mouth, first gill-slit and anus. This stage is curiously asymmetrical, the mouth and single gill-slit being situated opposite one another to left and right. The mouth becomes enormously distended along the left side, while new gill-slits arise on the right side up to as many as 14. Subsequently (metamorphosis stage) the last six of these, as well as the first one, close up, and the remainder rotate below to their permanent position on the left side, while a new series arises above the first to replace it on the right. At the same time the mouth rotates forwards to a median position.

Various theories have been put forward to account for this temporary distortion. The present writer suggests that it is the consequence of a secondary reduction of yolk in the egg, accompanied by premature hatching, which has entailed the improvisation of a temporary feeding mechanism, the basis of which appears to be the enlargement and special ciliation of the mouth and an adaptation of the club-shaped gland for the supply of mucilage.



AFTER WILLEY

FIG. 4.—ANTERIOR REGION OF TWO PELAGIC LARVAE OF A. LANCEOLATUS Showing the large left-sided mouth with its ciliated margin and the opposite series of simple primary gill-slits

Of great interest are the origin of the endostyle as a V-shaped loop of the peripharyngeal band, thus recalling the adoral band of Echinoderm larvae, and the development immediately behind the endostyle, of the club-shaped gland, with two successive internal orifices on opposite sides of the endostyle, and a single external orifice below the left-sided mouth. Willey regarded this gland as a modified gill-cleft. The present writer identifies it with certain pharyngeal glands of Appendicularians, and interprets all of them as highly modified vestiges of the epicardium or budding-organ of Tunicata (*q.v.*).

Evolution.—If these views are correct, *Amphioxus* must have been derived from sessile ancestors of a primitive Ascidian stock, and its elongated form is the result of loss of fixation and retention of larval habits, modified by secondary adaptation to an arenicolous life. We have already seen that *Asymmetron* retains a caudal appendage which can be little else than a remnant of the Ascidian larval tail, and this accords with its possession of unpaired gonads as in Ascidians. The secondary symmetrization of the gonads in *Amphioxus* is paralleled in Ascidians themselves (Stolidobranchia). The main axis of Chordate evolution may thus be regarded as a line of sedentary plankton-feeding organisms, which began with an external apparatus of ciliated tentacles and food-grooves, and ended with an endopharyngeal mechanism of gill-slits and endostyle. From this Pterobranch-Ascidian line *Balanoglossus, Amphioxus* and the Appendicularians have been given off at different levels as successive paedomorphic offshoots. The line may be carried still farther back to the primitive stalked Echinoderms, to inheritance from which we must ascribe such features as the larval form of *Balanoglossus* (*Tornaria*), Hatschek's pit and the V-shaped endostyle of *Amphioxus*. Assuming that the ancestral Echinoderm handed on to its Hemichordate descendants a primitive type of Dipleurula larva, the Protochordate tadpole may readily have been derived from it by the substitution of muscular for ciliary means of progression. The adoral band may thus have been the forerunner of the endostyle, and the circumoral ciliated band, with its underlying nervous system, of the ciliated neural folds of Vertebrates, which at the outset have identical relations to mouth and blastopore.

That the Vertebrata have been derived from Protochordata, and not vice versa, is shown by the retention in Vertebrate embryos of unequivocal remnants of the Protochordate feeding mechanism of endostyle and tongue-barred gill-slits, as shown by the details of development of the thyroid and thymus glands.

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AMPHIPODA, an order of Crustacea (*q.v.*), with the body usually laterally compressed, the second and third pairs of thoracic appendages generally modified as prehensile organs and the three anterior abdominal appendages many jointed. The best-known form is the fresh-water shrimp (*Gammarus*), common in nearly all parts of the world.

AMPHIPOLIS (mod. YENI KEUI), ancient city of Macedonia, on the east bank of the River Strymon, where it emerges from Lake Cercinitis, about 3m. from the sea. Originally a Thracian town, known as *Ἐννέα Ὁδοί* ("Nine Roads"), it was colonized by Athenians with other Greeks under Hagnon in 437 B.C., previous attempts—in 497, 476 and 465—having been unsuccessful. In 424 B.C. it surrendered to the Spartan Brasidas without resistance, through the negligence of the historian Thucydides, who was with the fleet at Thasos. In 422 B.C. Cleon led an unsuccessful expedition to recover it; both he and Brasidas were slain. It was to have been restored to Athens by the Peace of Nicias (421) but remained long independent. In 357 Philip of Macedon occupied it in spite of Athenian opposition. The importance of Amphipolis was due to its command of the bridge over the Strymon, and the route from northern Greece to the Hellespont; it was also a depot for the gold and silver mines of the district, and for ship-timber. Under the early empire it became the headquarters of the Roman governor of Macedonia, though recognized as independent. Many inscriptions, coins, etc., have been found here, and traces of ancient fortifications and a Roman aqueduct are visible. (*See* S. Casson, *Macedonia, Thrace and Illyria* [1926], and Pauly-Wissowa, *s.v.*).

AMPHISBAENA is the name given to the main genus of a family of worm-shaped lizards, most of which inhabit the tropical parts of America, the West Indies and Africa. The commonest species in South America and the Antilles is the sooty or dusky *A. fuliginosa*. The body of the amphisbaena, from 18 to 20in. long, is of nearly the same thickness throughout. The head is small, and there can scarcely be said to be a tail, the vent being close to the extremity of the body. The animal lives mostly underground, burrowing in soft earth, and feeds on ants and other small animals. The name, which implies that the animal can move in either direction, was applied to a serpent in Greek mythology; and has been transferred to the lizard by zoologists because owing to the superficial resemblance between the head and tail the Brazilian natives call it the snake with two heads and believe that it can reverse the direction of its motion.

AMPHITHEATRE, a building, primarily for entertainments, in which the seats for the spectators surround the stage or arena. It is differentiated from the stadium (*q.v.*) by the fact that its shape approximates an ellipse. The amphitheatre was early developed in the Italian peninsula as the logical building for the local gladiatorial combats. The early amphitheatres were built of wood and were strictly temporary and it was only in the last century of the Republic that permanent amphitheatres of stone were erected (Pompeii *c.* 80 B.C.). In Rome an amphitheatre with a stone enclosing wall and wooden seats was built in 29 B.C. by C. Statilius Taurus.

But it is the earliest great Roman amphitheatre, the Flavian, or Colosseum, that has remained the outstanding and the largest example of the type. It was built by Vespasian and Titus upon the site of part of Nero's "Golden House." The Colosseum, as it now stands, was completed only after the great fire of A.D. 217, when the present upper storey, till then of wood, was added. The dimensions of this amphitheatre are 615 by 510ft. with an arena 281 by 177 feet. Its capacity is now estimated at about 50,000, the ancient Roman estimates, which varied from 80,000 to 100,000, being manifestly exaggerated Other great examples of the ancient amphitheatre are: the Amphitheatre Castrense in Rome, built of brick, probably during the reign of Trajan; the amphitheatre at Pompeii already mentioned, 444 by 342ft.; that at Capua, 557 by 458ft.; that at Verona, 502 by 403ft., probably of the time of Diocletian; that at Pozzuoli, 482 by 383ft., particularly famous for the perfect preservation of its stage arrangements; and, outside of Italy, those at Nîmes and Arles in France; Pola in Istria; and Thysdrus in Africa, all of these of approximately the same size—between 400 and 500ft. long and between 300 and 400ft wide. Besides these, fragmentary remains are found widely scattered throughout the Roman empire. In England, at Silchester, in Hampshire, there is an example in which the seats were placed largely on banked up earth.

In the typical Roman amphitheatre the arena was usually raised above an elaborate structure containing cells for wild beasts, storage room, connecting passages and rooms for gladiators, all ingeniously arranged to connect by means of many trap doors with the arena above (*see* illustration of Pozzuoli). Around this arena, and separated from it by a high wall, arose the seats of the spectators. These were divided by passageways running around the amphitheatre into several sections (maeniana); the lowest, known as the podium, for state officials; the next reserved for the wealthy or the nobles; and those above for the rest of the populace. Each of these was divided into wedge shaped sections (cunei) by radial walks and from them many exits (vomitoria) led down to the passages below the seats and so to the street. Apparently seats were always reserved, as they are usually carefully numbered; and tickets of clay bearing the seat numbers have been found. The seats were supported on walls running radially to the exterior between which the exit stairs were most ingeniously arranged so that the enormous crowds were distributed evenly to the exit arches which surrounded the ground storey. In addition, vaulted corridors ran elliptically around the outside, connecting the various radial elements; the arcaded exterior was, therefore, a necessary and logical expression of the construction.

In modern usage the word amphitheatre is sometimes used for a theatre or concert hall whose seats surround the central area, as, for example, the Albert Hall, London, and both the new and the old Madison Square Garden in New York. Modern open amphitheatres also exist, particularly in connection with the sports of the United States, as, for instance, the Chicago "stadium" (cap. 100,000), Franklin Field, Philadelphia (cap. 83,000), the Yale "Bowl" at New Haven (cap. 80,000), the Baltimore "stadium" (cap. 78,000) and that at Los Angeles (cap. 75,000). The largest of all structures of this type, however, is that at Wembley, near London, which accommodates 25,000 persons under cover, 10,000 at the ringside and 91,500 standing, or a total of 126,500. Other amphitheatres have been built or projected on the continent of Europe.

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AMPHITRITE, in mythology of ancient Greece, a sea-goddess, daughter of Nereus (or Oceanus) and wife of Poseidon. It was said that Poseidon saw her first dancing at Naxos among the other Nereids, and carried her off. She then fled from him over the sea, but was found by the dolphin of Poseidon, which was afterwards set among the stars In works of art she is represented either enthroned beside him or driving with him in a chariot drawn by sea-horses or other fabulous creatures of the deep, and attended by Tritons and Nereids.

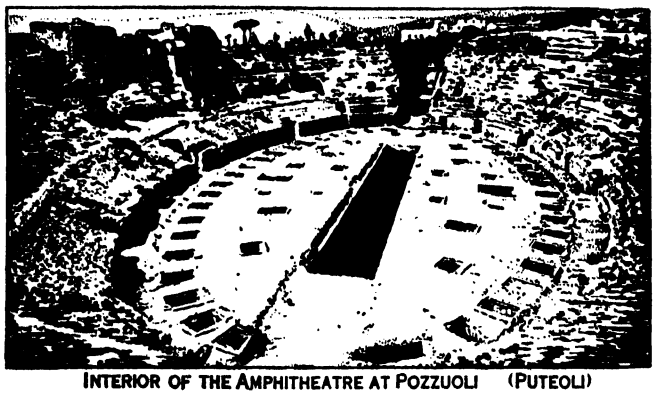
AMPHITRYON, in Greek mythology, son of Alcaeus, king of Tiryns. Having accidentally killed his uncle Electryon, king of Mycenae, he was driven out by another uncle, Sthenelus. He fled with Alcmene, Electryon's daughter, to Thebes, where he was cleansed from the guilt of blood by Creon, his maternal uncle, king of Thebes. Alcmene, who had been betrothed to Amphitryon by her father, refused to marry him until he had avenged the death of her brothers, all of whom except one had fallen in battle against the Taphians. Amphitryon accordingly took the field against the Taphians, accompanied by Creon, who had agreed to assist him on condition that he should slay the Teumessian fox which had been sent by Dionysus to ravage the country. The Taphians, however, remained invincible until Comaetho, the king's daughter, out of love for Amphitryon, cut off her father's golden hair, the possession of which rendered him immortal. Having defeated the enemy, Amphitryon put Comaetho to death and handed over the kingdom of the Taphians to Cephalus. On his return to Thebes he married Alcmene, who gave birth to twin sons, Iphicles being the son of Amphitryon, Hercules of Zeus, who had visited her during Amphitryon's absence.

The modern use of *Amphitryon* in the sense of a generous host is derived from Molière's comedy on the subject, iii 5

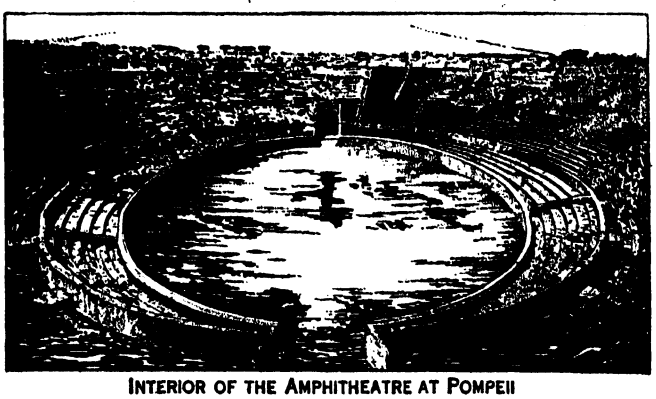
See Apollodorus ii. 54–62; Herodotus v 59; Pausanias viii. 14, ix. 10, 11, 17; Hesiod, *Shield*, 1–56; Pindar, *Pyth*, ix. 81.

AMPHORA, usually an earthenware vessel used by the ancient Greeks and Romans and so named from having a handle on each side of the neck (Gr. ἀμφί, on both sides; φέρειν, to carry). Amphorae either rested on a foot, or ended in a point so that they had to be fixed in the ground. The amphora was a standard measure of capacity among both Greeks and Romans, the Attic containing nearly nine gallons, and the Roman about six

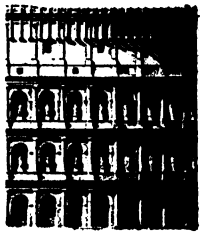
AMPLIATIVE JUDGMENTS or **PROPOSITIONS** are those in which something is affirmed that is not included in the definition or connotation of the subject. When the predicate merely unfolds or analyses the meaning of the subject, the proposition is called "explicative." (When the predicate is a *genus* or *differentia* of the subject, the proposition is explicative; if the predicate is a *proprium* or *accidens* the proposition is ampliative. *See* PREDICABLES.) Instead of "ampliative" the terms "augmentative" and "synthetic" are also used; and the terms "analytic" and "verbal" are sometimes used instead of "explicative." (*See* ANALYSIS and LOGIC.)



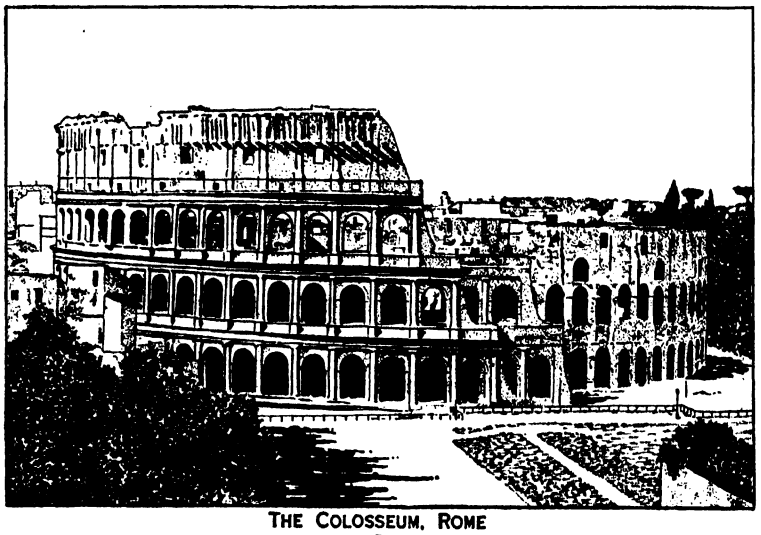
INTERIOR OF THE AMPHITHEATRE AT POZZUOLI (PUTEOLI)



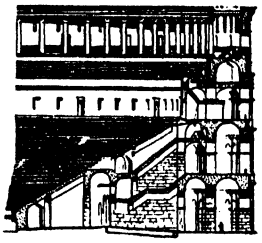
INTERIOR OF THE AMPHITHEATRE AT POMPEII



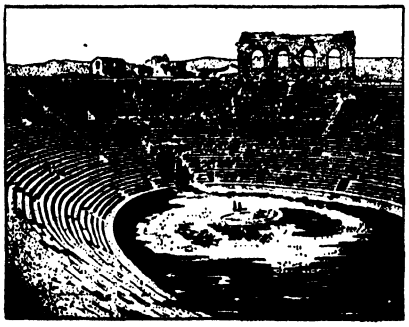
PART ELEVATION COLOSSEUM



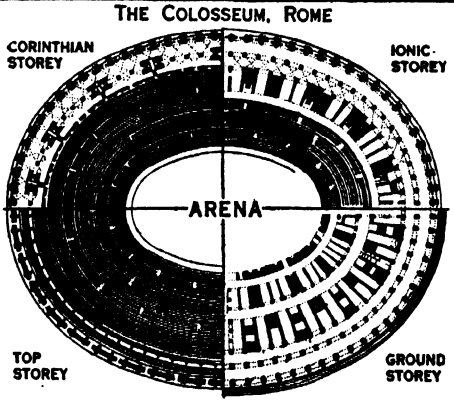
THE COLOSSEUM, ROME



SECTION COLOSSEUM



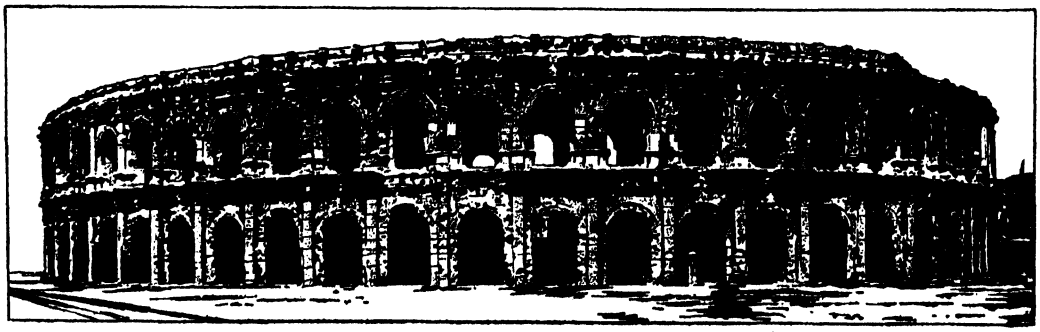
ARENA AND AUDITORIUM, VERONA



¼ PLANS, COLOSSEUM



LOWER, ARCHED CORRIDOR, COLOSSEUM



EXTERIOR OF THE AMPHITHEATRE AT NIMES (NEMAUSUS)

AMPHITHEATRES AT POZZUOLI AND POMPEII, FROM PHOTOS BY BROGI; PART ELEVATION, FROM D'ESPOUY, "FRAGMENTS D'ARCHITECTURE ANTIQUE" (MASSIN & CIE); COLOSSEUM SECTION, ARENA AND AUDITORIUM, AND ¼ PLANS, FROM "HISTORY OF ARCHITECTURE" BY B. FLETCHER (BATSFORD); ARCHED CORRIDOR, FROM PIJOAN AND SALVAT, "HISTORY OF ART"; AMPHITHEATRE AT NIMES, FROM PHOTO BY NEURDEIN

THE AMPHITHEATRE AT POZZUOLI SHOWS THE TRAPDOORS IN THE ARENA FLOOR BY WHICH ANIMALS OR GLADIATORS COULD BE INSTANTLY INTRODUCED INTO ANY PART OF THE ARENA. THE LARGEST LEADS TO A CORRIDOR CONNECTED WITH ALL THE CELLS BELOW THE FLOOR. IN THE COLOSSEUM SECTION NOTE THE POSITION OF THE STAIRS BY WHICH THE SPECTATORS ENTERED AND LEFT. THE AMPHITHEATRE AT VERONA SHOWS THE MANY VOMITORIA OR EXITS

AMPLIFICATION. In radio communication amplification may be considered as a magnification or enlargement of energy which takes place in an electrical circuit. It is a function by which the intensity of the electrical variations in the output circuit are increased without altering their wave forms. Amplification is essentially a relay action. In radio reception, the comparatively weak signal voltages impressed on a vacuum tube *amplifier* produce in the output circuit a correspondingly increased amount of power which is drawn from the "B" battery or other source of power in the plate circuit. The *amplification factor* is a number which expresses the magnitude of this effect.

AMPLIFICATION FACTOR OF A VACUUM TUBE, a quantity which is used to express the relative effects of the grid voltage and plate voltage in affecting the plate current of a vacuum tube. The amplification factor is the change in plate potential divided by the negative change in grid potential under the condition that the plate current remains unchanged. As most precisely used, the term refers to infinitesimal changes in the potentials as indicated in the defining equation. Amplification factor $\mu = -\frac{de_p}{de_g}, i_p = constant.$

AMPLIFIERS. The function of an amplifier is to increase the intensity of electrical or other fluctuations without seriously altering their wave form. Amplifiers are used extensively in electrical communication and also for rendering perceptible sounds and other vibrational waves that could not otherwise be observed.

In telephony the carbon transmitter amplifies the effect of the sound waves at the same time that it converts them into electrical waves. Thermionic amplifiers are inserted at intervals in long telephone lines and are also used to actuate loud-speaking receivers. In radio telephony and telegraphy, as well as in carrier current systems, in which the high-frequency currents are transmitted over wires, amplifiers are used in both the high and low-frequency paths. Amplifiers also find application in the reception of submarine cable signals and in submarine and subterranean signalling. Outside the communication field they make possible refined electric and other measurements; they have been used to assist the deaf to hear, to render heart sounds audible, to detect and locate aeroplanes and submarines, and for a variety of other purposes.

The essential features of an amplifier are a source of energy such as a battery, and a means whereby the flow of energy from this source may be controlled by the wave to be amplified in such a way that the variations of the original wave are reproduced upon an enlarged scale in the wave set up by this flow. Almost all of the amplifiers in use up to 1910 were of the type of the telephone transmitter, which depends upon variations in the electrical resistance of a mass of granular carbon which result from variations in mechanical pressure. When it was desired to amplify electrical variations as at an intermediate point in a long telephone line, a so-called "mechanical repeater" was used. Here the incoming current actuated a telephone receiver, the diaphragm of which agitated the carbon of a transmitter connected with the outgoing line. Various other devices based on changes in resistance with mechanical motion were developed to meet particular needs, notably those of submarine cable telegraphy.

With the beginning of the period under review the amplifying possibilities of electric discharge devices were coming to be recognized. After a period of experimentation in which a variety of forms were developed, those involving arcs and gaseous discharges gave way to the three-electrode high vacuum thermionic (*see* THERMIONICS) type variously known as audion, valve, triode, vacuum tube and pliotron. In the thermionic amplifier the current from the battery traverses a path between two electrodes in a highly evacuated glass bulb. The current between these electrodes consists of a stream of electrons emitted by the hot cathode or "filament" which is heated by current from an auxiliary source. The magnitude of this electron current is controlled by the potential of a third electrode or "grid" situated between the filament and plate and having openings through which the electrons pass. The source of the wave to be amplified is connected with the grid and filament so that the potential of the grid relative to the filament varies in accordance with the wave to be amplified. Similar variations are thus impressed on the current from the battery. Any external circuit included in the path of this current then receives an amplified copy of the impressed wave. To secure maximum amplification the amplifier proper is generally connected with the external circuits through special connecting circuits. Transformers are used for this purpose at voice frequencies and tuned circuits at radio frequencies.

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(R. V. L. H.)

AMPLITUDE, the extreme range of a fluctuating quantity. In mathematics and physics the word is generally used in connection with periodic functions or motions and denotes the maximum difference or displacement from the mean value (sometimes called the semi-amplitude since the whole range is double). In navigation the amplitude of a heavenly body is the angular distance of the point at which it rises or sets from the east or west point.

AMPSANCTUS or **AMSANCTUS** (mod. *Sorgente Mefita*), a small lake in the territory of the Hirpini, 10m. S E. of Aeclanum, close to the Via Appia. There are now two small pools which exhale carbonic acid gas and sulphuretted hydrogen. A temple of the goddess Mephitis had a cave with suffocating vapours and the place was brought into connection with legends of the infernal regions

AMPTHILL, ODO WILLIAM LEOPOLD RUSSELL, 1ST BARON (1829–1884), British diplomatist and ambassador, was born in Florence on Feb. 20, 1829, the son of Maj.-Gen. Lord George William Russell. His education, like that of his two brothers—Hastings, who became eventually 9th duke of Bedford, and Arthur, who sat for a generation in the House of Commons as member for Tavistock—was carried on entirely at home, under the general direction of his mother, whose beauty was celebrated by Byron in *Beppo*. Lady William Russell was as strong-willed as she was beautiful, and certainly deserved to be described as she was by Disraeli, who said in conversation: "I think she is the most fortunate woman in England, for she has the three nicest sons" In March 1849 Odo was appointed by Lord Malmesbury attaché at Vienna. He was employed successively in the foreign office in London, in Paris, Constantinople and Florence. In 1858 he was sent to reside in Rome, where he remained for 12 years, till Aug. 1870. During all that period he was the real though unofficial representative of England at the Vatican, and his consummate tact enabled him to do more than an ordinary man could have done in a stronger position. Although he sympathized with those who laboured to prevent the extreme partisans of papal infallibility from having everything their own way, yet he made it clear to his own government that all efforts were useless, and seems to have had no illusions as to the result of the debate. In 1868 Odo Russell married Lady Emily Theresa Villiers, the daughter of Lord Clarendon. In 1870 he was appointed assistant under-secretary at the foreign office, and in Nov. of that year was sent on a special mission to the headquarters of the German army, where he remained till 1871.

In 1870 Russia had taken advantage of the collapse of France and of her own cordial relations with Prussia to denounce the Black Sea clauses of the Treaty of Paris of 1856. Russell, in an interview with Bismarck, pointed out that unless Russia withdrew from an attitude which involved the destruction of a treaty solemnly guaranteed by the powers, Great Britain would be forced

to go to war "with or without allies." This strong attitude was effective, and the question was ultimately settled by the conference which met in London in 1871. Though the result was to score a distinct diplomatic success for the Liberal government, the bellicose method employed threatened to create trouble for the ministry in parliament. On Feb. 16, 1871, accordingly, Gladstone, in answer to a question, made an enigmatical statement on the subject which was interpreted as an attack on Russell. A little later in the same year, however, he was made ambassador at Berlin.

Russell remained at Berlin, with only brief intervals of absence, from Oct. 16, 1871, till his death at Potsdam on Aug. 25, 1884. He was third plenipotentiary at the Berlin congress. He was raised to the peerage in 1881. At the conference about the Greek frontier, which followed the congress of Berlin, he was the only British representative. During all this long sojourn in the Prussian capital he did everything that he could to bring about close and friendly relations between Great Britain and Germany.

He was succeeded as 2nd baron by his son, ARTHUR OLIVER VILLIERS RUSSELL (b. 1869), who was private secretary to Mr. Chamberlain, 1895–97, and governor of Madras, 1899–1906. In 1904 he acted temporarily as Viceroy of India. He served in France throughout the World War. The legitimacy of his grandson was impugned by the complex proceedings popularly known as the "Russell baby case," which, commenced in 1921, was ended in the infant's favour in 1924.

AMPTHILL, urban district, Bedfordshire, England, 44m. N.N.W. of London by the L.M.S.R. Pop. (1921) 2,270. It lies on the southern slope of a low range of hills, in a well-wooded district. The church of St. Andrew contains a monument to Richard Nicolls (1624–72), who received the submission of New Amsterdam (later New York) in 1664, and became its first English governor. Ampthill Park became in 1818 the seat of Lord Holland. In the park a cross marks the site of Ampthill Castle, the residence of Catherine of Aragon while her divorce from Henry VIII. was pending. Lace-making is said to have been introduced by Catherine of Aragon, but is now practically extinct. Straw-plaiting for hat-making survives to some extent, but the interests of the town are in the main purely agricultural.



FROM "LA SACRE DE LOUIS XV.," PARIS, 1722

"LA SAINTE AMPOULE," PROBABLY THE MOST CELEBRATED AMPULLA

For centuries this ampulla held holy oil for anointing French kings. According to legend it was brought from heaven by a dove for the coronation of Clovis. In the illustration it is shown suspended from the neck in a jewelled, gold case

AMPULLA, a small, narrow-necked, round-bodied vase for holding liquids, especially oil and perfumes. It was used in ancient times for toilet purposes and anointing corpses, being then buried with them. Gildas mentions *ampullae* as used by the Britons in his time, and St. Columba is said to have used an ampulla in crowning King Aidan. In the Western Church the name is still applied to the vessel containing the oil consecrated by the bishop for ritual uses. It occurs in the English coronation service in connection with the ancient ceremony of anointing by the archbishop of Canterbury, which is still observed. The ampulla of the regalia of England takes the form of an eagle. The ampulla known as *la sainte ampoule*, at Reims, from which the kings of France were anointed (supposed to have been brought from heaven by a dove for the coronation of Clovis), was destroyed at the Revolution. The word is used in biology for a certain portion of the anatomy of a plant or animal.

AMPUTATION means the removal of a part of the body. In a more restricted sense the term is applied to the removal of a part or the whole of a limb in continuity. The conditions under which amputation becomes necessary are: (1) injury, (2) gangrene, (3) infection, (4) malignant tumour, (5) deformity, (6) pain. Experience in the World War taught surgeons that amputation is necessary much less often than was formerly supposed. Advances in reconstructive surgery have made it possible to rehabilitate badly damaged limbs without amputation, and modern methods of preventing and controlling infection have lessened the danger from this source. However, some injuries still demand amputation under certain conditions, notably avulsion of part of a limb, compound fractures, crushing and lacerating wounds and irreparable injury of the main artery of a limb. In the case of a definite gangrene it is usually a choice between a slowly advancing process, with the probability of an infection sooner or later, and amputation. In severe infections of a limb, especially if complicated by lesions of bone or joints, amputation may be a life-saving measure. Malignant tumours often necessitate amputation; deformities and pain occasionally do so.

AMRAM (died 875), a famous *gaon* or head of the Jewish Academy of Sura (Persia) in the 9th century. He was author of many "Responsa," but his chief work was liturgical. He was the first to arrange a complete liturgy for the synagogue, and his Prayer Book (*Siddur Rab 'Amram*) was the foundation of most of the extant rites in use among the Jews. The *Siddur* was published in Warsaw in two parts (1865).

AMRAOTI, a town and district of India in Berar, Central Provinces. The district was reconstituted in 1905, when that of Ellichpur was incorporated with it. The town (pop., 40,694 in 1921) is the richest town of Berar, with the most numerous and substantial commercial population. It possesses a branch of the Bank of Bombay, with a famous cotton mart, as well as a large grain market, cotton presses, ginning factories and oil mills.

The district of Amraoti has an area of 4,704sq.m. In 1921 the population was 828,384. The district is an extensive plain, about 800ft. above sea-level, the general flatness being broken only by a small chain of hills, running in a north-westerly direction between Amraoti and Chandor, with an average height from 400 to 500ft. above the lowlands. The principal towns, besides Amraoti, are Karinja, Kolapur and Badnera.

'AMR-IBN-EL-ASS, or 'AMR (strictly 'AMR L. 'AS), the Arab conqueror of Egypt, belonged to the tribe of Koreish (Qureish). He had in his youth opposed Mohammed, but he returned to his allegiance and joined the fugitive prophet at Mecca. 'Amr was one of the three generals sent by Abu Bekr to invade Syria in 633, but the main direction of the Syrian campaigns lay with Khālid-b. al-Walīd, who was sent to Syria when the imperial army advanced. In 639 Omar sent him as head of an expedition to Egypt. With an army of only about 4,000 men he took Pelusium (Jan. 640), and, with the aid of a new army of 10,000 men sent by Omar, defeated the imperial troops at Heliopolis (July 640). He then reduced Babylon (near Cairo) and founded the city of Fostat there. By a treaty made with the patriarch Cyrus, Alexandria was surrendered (Sept. 17, 642). 'Amr became the first Mohammedan governor of Egypt, but Omar, who perhaps feared the strong personal influence exercised by 'Amr, sent 'Abdallāh ibn Sa'd ibn 'Abi Sarh to supersede him in Upper Egypt. Othman, Omar's successor, extended 'Abdallāh's rule to Lower Egypt. But in 645 'Amr had to be recalled to quell a revolt in Alexandria. He retook the city (646) and once more withdrew. The statement that he burnt the great Alexandrian library has no basis except in the allegations of Abulfaraj (Bar-Hebraeus), who lived six centuries later. After the reconquest of Alexandria 'Amr extended Mohammedan rule to Barca and even to Tripoli.

It was probably the desire to secure the governorship of Egypt for himself that ranged 'Amr on the side of Mu 'āwiya in his war against Ali after the death of Othman. After the battle of Siffīn (July 26–7, 657), when the dispute between Ali and Mu 'āwiya was put to arbitration, 'Amr represented Mu 'āwiya in the court held at Adhruh in 658 (*see* CALIPHATE and ALI). In 658 he reconquered Egypt in Mu 'āwiya's interest, and governed it till his death on Jan. 6, 664. In a pathetic speech to his children on

his death-bed, he bitterly lamented his youthful offence in opposing the prophet, although Mohammed had forgiven him and frequently affirmed that "there was no Mussulman more sincere and steadfast in the faith than 'Amr."

Sir W. Muir, *The Caliphate* (1891); E. Gibbon's *Decline and Fall;* M. J. de Goeje, *Mémoire sur la conquête de la Syrie* (Leiden, 1900); Alfred J. Butler, *Arab Conquest of Egypt* (1902); art. EGYPT, *History,* Mohammedan period.

'AMR IBN KULTHŪM, Arabian poet, author of one of the Mo'allaḳāt. Little or nothing is known of his life save that he was a member of the tribe of Taghlib and that he is said to have died of excessive wine-drinking. Some stories of him are told in the *Book of Songs* by Bar-Hebraeus (*q.v.*), vol. ix. pp. 181–5.

AMRITSAR, a city and district of British India. The city, the wealthiest in the Punjab, had in 1921 a population of 160,218, mostly Muslim and Hindu. About 200 looms are engaged in the carpet-making industry; an entrepôt trade in piece goods and a large business in skins and hides are carried on. It is a trade centre for the trans-Himalayan routes. The two yearly fairs are the most widely attended in the province. The town attained a certain notoriety in 1919 when riots occurred as a result of general unrest. On April 13 it was held necessary to disperse an unlawful gathering in the Jallianwala Bagh, and as a result nearly 400 Indians were killed by gunfire, and a considerable number wounded. Amritsar city is chiefly notable as the centre of the Sikh religion and the site of the Golden Temple, the chief worshipping place of the Sikhs. Ram Das, the fourth *guru,* laid the foundations of the city upon a site granted by the emperor Akbar. He also excavated the holy tank from which the town derives its name of Amrita Saras, or Pool of Immortality It is upon a small island in the middle of this tank that the Golden Temple is now situated. After many vicissitudes the city and surrounding district fell under the sway of Ranjit Singh at Lahore, and passed with the rest of the Punjab into the possession of the British after the second Sikh war. The Golden Temple is thus called on account of its copper dome, covered with gold foil. A Sikh college for university education was opened in the neighbourhood in 1897. Amritsar district is a nearly level plain, with a very slight slope from east to west. Numerous branches of the Upper Bari Doab canal intersect the district, affording ample means of irrigation. The North Western railway and Grand Trunk road, which runs parallel with it, afford the principal means of communication and traffic. The area of the district is 1,593sq.m; pop. (1921) 929,374. It is the headquarters of the Sikh religion, containing 287,004 Sikhs as against 204,435 Hindus and 423,724 Mohammedans. The principal crops are wheat, pulse, maize, millet, with some cotton and sugar-cane. There are factories for ginning and pressing cotton.

AMROHA, a town of British India, in the Moradabad district of the United Provinces; noteworthy for the tomb of Sheikh Saddu, a Mohammedan Saint. Pop. *c.* 42,000.

AMRUM or **AMROM,** a German island in the North sea, off the coast of Schleswig-Holstein, south of Sylt. Pop (1925) 858. It is 6m. long and 3m. broad, with an area of 10½sq m., and is reached from the mainland by a regular steamboat service to Wittdün; or at low water from Föhr. Amrum consists of a treeless sandy expanse, but a fringe of rich marshes affords good pasture-land. The principal place is Nebel, connected by a light railway with Wittdün. (*See* also FRISIAN ISLANDS.)

AMRU'-UL-QAIS or **IMRU'-UL QAIS, IBN HUJR,** Arabian poet of the 6th century, the author of one of the Mo'allaḳāt (*q.v.*), was regarded by Mohammed and others as the most distinguished poet of pre-Islamic times. He was of the kingly family of Kinda, and his mother was of the tribe of Taghlib. While he was still young, his father was killed by the Bani Asad, and his life was devoted to the attempt to avenge his father's death. He wandered from tribe to tribe to gain assistance, but his attempts were always foiled by the persistent following of the messengers of Mundhir of Hira (Ḥira). By means of Ḥārith of Ghassān he procured an introduction to the Byzantine Emperor Justinian. After a long stay in Constantinople he was named phylarch of Palestine, and received a body of troops from Justin II. With these he started on his way to Arabia. It is said that he was charged before the emperor with the seduction of a princess, and that Justin sent him a poisoned cloak, which caused his death at Ancyra.

BIBLIOGRAPHY.—His poems are contained in W. Ahlwardt's *The Divans of the six ancient Arabic Poets* (London, 1870), and have been published separately in M'G. de Slane's *Le Diwan d'Amro'lkais* (Paris, 1837); a German version with life and notes in F. Rückert's *Amrilkais der Dichter und Konig* (Stuttgart, 1843). Many stories of his life are told in the *Kitāb ul-Aghāni,* vol. viii., p. 62–77.

AMSDORF, NICOLAUS VON (1483–1565), German Protestant reformer, was born on Dec. 3 1483, at Torgau, on the Elbe and died at Eisenach on May 14 1565. He was educated at Leipzig, and then at Wittenberg Throughout his life he remained one of Luther's most determined and active supporters. He was with him at the Leipzig conference (1519), and the Diet of Worms (1521); and was in the secret of his Wartburg seclusion.

He assisted the first efforts of the Reformation at Magdeburg (1524), at Goslar (1531) and at Einbeck (1534); took an active part in the debates at Schmalkalden (1537), where he defended the use of the sacrament by the unbelieving; and (1539) spoke out strongly against the bigamy of the landgrave of Hesse. After the death of the count palatine bishop of Naumburg-Zeitz, he was installed there (Jan 20 1542), though in opposition to the chapter, by the elector of Saxony and Luther His position was a painful one, and he longed to get back to Magdeburg, but was persuaded by Luther to stay After Luther's death (1546) he took part in founding Jena University (1548); opposed the "Augsburg Interim" (1548); and superintended the publication of the Jena edition of Luther's works He urged the separation of the High Lutheran party from Melanchthon (1557), got the Saxon dukes to oppose the Frankfort Recess (1558) and continued to fight for the purity of Lutheran doctrine Many letters and other short productions of his pen are extant in manuscript, especially five thick volumes of *Amsdorfiana,* in the Weimar library. They are a valuable source for our knowledge of Luther. A small sect, which adopted his opinion on good works, which he held to be useless, was called after him.

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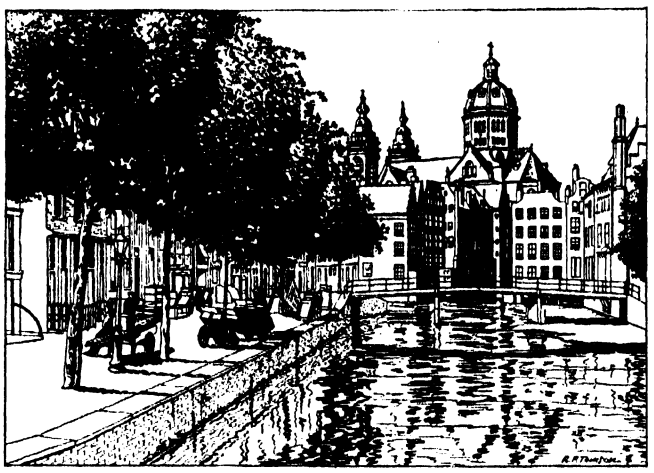
AMSLER, SAMUEL (1791–1849), Swiss engraver, was born at Schinznach, in the canton of Aargau. He studied his art under Johan Heinrich Lips (1758–1817) and Karl Ernst Hess, at Munich, and from 1816 pursued it in Italy, and chiefly at Rome, till in 1829 he succeeded his former master Hess as professor of copper engraving in the Munich academy. He was a passionate admirer of Raphael and had great success in reproducing his works Amsler's principal engravings are: "The Triumphal March of Alexander the Great" and a full-length "Christ," after the sculptures of Thorwaldsen and Dannecker; the "Entombment of Christ" and two "Madonnas" after Raphael; and the "Union between Religion and the Arts," after Overbeck, his last work, on which he spent six years.

AMSTERDAM, the chief city of Holland, in the province of North Holland, on the south side of the Y or Ij, an arm of the Zuider Zee, in 52° 22′ N. and 4° 53′ East. Pop. (1925) 718,046. It has communications by railway and canal in every direction; steam-tramways connect it with Edam, Purmerend, Alkmaar and Hilversum, and electric railways with Haarlem and the seaside resort of Zandvoort. Amsterdam, the "dam or dyke of the Amstel," is so called from the Amstel, the canalized river which passes through the city to the Y. Its beginnings centre around a small sea-fishing settlement In the 13th century it was held in fee by the lords of Amstel of the bishops of Utrecht and in 1204 Giesebrecht II. built a castle here. A little later Giesebrecht III constructed a dam to keep out the sea, and around the castle and dam the city grew. The first mention of the town is in 1275, in a charter of Floris IV., count of Holland, exempting it from certain taxes

In 1296 the place passed out of the hands of the lords of Amstel, owing to the part taken by Giesebrecht IV. in the murder

of Count Floris V. Count John (d. 1304), with the approval of the bishop of Utrecht, bestowed the fief on his brother, Guy of Hainaut. Guy gave the town its first charter in 1300, with a bailiff (*schout*) and judicial assessors (*scabini* or *schoppenen*), the overlord's supremacy being guarded, and an appeal lying from the *scabini*, in cases of disagreement, to Utrecht. In 1342 more extensive privileges were granted by Count William IV., including freedom from tolls by land and water in return for certain annual dues. In 1482 the town was surrounded with walls. During the religious troubles of the 16th century its prosperity increased owing to influx of refugees from Antwerp and Brabant. Amsterdam, influenced by its trading interests, did not join the other towns in revolt against Spain until 1578. In 1587 the earl of Leicester made an unsuccessful attempt to seize it. The great development of Amsterdam was due, however, to the treaty of Westphalia in 1648, by which its rival, Antwerp, was ruined, owing to the closing of the Scheldt. The city held out obstinately against the stadtholders, and in 1650 opened the dykes to prevent William II. seizing it. The same device was successful against Louis XIV. in 1672; and Amsterdam, now reconciled with the stadtholder, was one of the staunchest supporters of William III. against France. In 1787 Amsterdam was occupied by the Prussians, and in 1795 by the French under Pichegru. It was then made capital of the Batavian Republic and afterwards of the kingdom of Holland. In 1810 this was united with the French empire and Amsterdam was recognized officially as its third town, following Paris and Rome. The modern city has been built to a great extent over boggy ground and the foundations of the buildings were made secure by driving long piles into the firm clayey soil below. On the landward side the city is surrounded by a fosse or canal, and was at one time fortified; but the ramparts have been demolished and replaced by gardens and houses; one gateway, the Muiderpoort, still stands. Within the city are four canals (*grachten*) with their ends resting on the Y, extending in polygonal crescents nearly parallel to each other and to the outer canal. Each of these canals marks the line of the city walls and moat in some phase of growth. Lesser canals intersect the others radially, thus virtually dividing the city into a number of islands. The nucleus of the town lies within the innermost crescent canal, and, with the large square, the Dam, in the centre, represents the area of Amsterdam about the middle of the 14th century. At one end of the enclosing canal is the Schreijerstoren (1482) or "Weepers' Tower," on the ancient harbour, the scene of former sorrowful leave-takings. Between this and the next crescent (Heeren Gracht) there sprang up, on the east, the foreign quarter where the large Jewish population is located, and where Rembrandt lived (1640–1656) and Spinoza was born (1632). Beyond the Heeren Gracht lie the Keizer Gracht and the Prinsen Gracht respectively, and these three celebrated canals, with their tree-bordered quays and old-fashioned houses, form the principal thoroughfares of the city. West of the Prinsen Gracht lies the district called De Jordaan, a corruption of Le Jardin, for its streets are named after various flowers. It was formed by the settlement of French refugees after the revocation of the Edict of Nantes. The outermost crescent canal is called the Singel Gracht (girdle canal), and marks the boundary of the city at the end of the 17th century. The streets in old Amsterdam are narrow and irregular. The city's long connection with the sea produced its seamen, merchants and explorers. With the accumulation of mercantile wealth, coupled with a tradition of keenness of mind and action (enhanced by the arrival of refugees), the city became the home of artists, philosophers and religious leaders. Around the Dam are the Nieuwe Kerk and the palace. The palace, in classical style, was originally built as a town-hall in 1648–1655 by Van Kempen. Since 1768 it has been used as a royal residence. The exterior is beautifully decorated. The great hall is lined with white Italian marble, and in spite of its enormous dimensions the roof is unsupported by pillars. The Nieuwe Kerk (St. Catherine's) is a fine Gothic building dating from 1408. Internally it is remarkable for its remains of ancient stained glass, fine carvings and interesting monuments, including one to the famous Admiral de Ruyter (d. 1676). The new exchange (1901) lies between the Dam and the central station (1889). The Oude Kerk (St. Nicholaas), so called (*c.* 1300), contains some beautiful stained glass of the 16th and 17th centuries, by Pieter Aertsen of Amsterdam (1508–1575) and others. One window contains the arms of the burgomasters of Amsterdam from 1578 to 1767. The North church was the last work of the architect Hendrik de Keyser (1565–1621) of Utrecht. The Roman Catholic church of St. Nicholas (1886) replaced a common dwelling-house, now the Museum Amstelkring of ecclesiastical antiquities. Among the Jewish synagogues, the largest is that of the Portuguese Jews (1670). The St. Antonieswaag, built as a town gate (1488–1585), contains the city archives; and the Trippenhuis, the Royal Society of Science, Letters and Fine Arts. The Ryks, or State museum, is a finely situated building in the Dutch Renaissance style, erected in 1876–1885. It has a department of general antiquities and a large gallery of pictures of the Dutch and Flemish schools. Famous pictures in the Ryks museum are those from the Trippenhuis, the so-called "Night-watch" and the "Syndics of the Cloth Hall" by Rembrandt, and the "Banquet of the Civic Guard," by van der Helst. The Trippenhuis gallery consisted of the pictures brought from The Hague by Louis Bonaparte, king of Holland, and belonging to the collection of the Orange family dispersed during the Napoleonic period. The municipal museum contains a collection of furniture, paintings, etc. The Joseph Fodor museum (1860) contains modern French and Dutch pictures. The pictures collected by Burgomaster Jan. Six (d. 1702) are (with the exception of the family Rembrandts) in the Ryks museum. The Willet Holthuysen museum (1895) has exhibits of furniture and porcelain.



VIEW ALONG THE CANAL IN AMSTERDAM. IN THE BACKGROUND, THE ROMAN CATHOLIC CHURCH OF ST. NICHOLAS, BUILT IN 1886

Modern Amsterdam extends southward beyond the Singel Gracht. In the middle of this new region lies the Vondel park, named after the great national poet Joost van den Vondel (d. 1679), whose statue stands therein. The Willems park adjoining was added later. In the older part of the town the chief open space is the Zoological gardens in the north-east corner, set out by the *Natura Artis Magistra* Society in 1838, which are well known. There is attached a library and an ethnological and natural history museum. Nearby are the Botanical gardens. The public squares include the Sophiaplein, with the picturesque mint-tower; the Rembrandtplein, with a monument to the painter; the Thorbeckeplein, with monument, and the Leidscheplein, with the large theatre, rebuilt in 1890–94 after a fire. There are two universities, the Free university (1880), and the more ancient State university of Amsterdam, founded in 1632, but reconstructed in 1887. In addition to the numerous science laboratories the State university possesses a very fine library of about 100,000 volumes, including the Rosenthal collection of over 8,000 books on Jewish literature. The Society for Public Welfare (1785) promotes the education and improvement of all classes, and has branches all over Holland. Among other societies are the *Felix Meritis* (1776) and the *Arti et Amicitiae* (1839), whose art exhibitions are of a high order.

Harbour and Commerce.—The first attempt to overcome the evils wrought to trade by the slow formation of the Pampus sandbank, at the entrance to the Y from the Zuider Zee, was the construction of the North Holland canal to the Helder in 1825. The route was long and difficult, and in 1876 a larger and more direct canal was built across the isthmus to the North Sea at Ymuiden. The serious rivalry of Rotterdam, especially with regard to the transit trade, and the inadequacy of the Keulsche Vaart, which connected the city with the Rhine, led to the construction in 1892 of the Merwede canal to Gorinchem. Meanwhile a complete transformation took place on the Y to suit the new requirements of the city's trade. The three islands built out into the river serve to carry the railway across the front of the city, and form a long series of quays. On either side are the large East and West docks (1825–1834), and beyond these stretch the quays at which the ocean liners are berthed. On the west of the West dock is the timber dock, and east of the East dock is another series of islands joined together so as to form basins and quays, one of which is the State Marine dock (1790–1795), with the arsenal and admiralty offices. Opening out of one of the crescent canals which penetrate the city from the Y is the State Entrepôt dock (1900), the free harbour of Amsterdam, where the produce from the Dutch East Indies is stored. The trade with the East Indies increased enormously within the period 1910–25. On the north side of the Y are the dry docks and the petroleum dock. The principal imports are timber, coal, grain, ore, petroleum, tobacco, tea, coffee, cocoa, sugar, Peruvian bark and other drugs. Diamond-cutting has long been practised by the Jews and forms one of the most characteristic industries of the city. Other industries include sugar-refineries, soap, oil, glass, iron, dye and chemical works; distilleries, breweries, tanneries; tobacco and snuff factories; shipbuilding and the manufacture of machinery and stearine candles. The Amsterdam exchange is still of considerable importance. The celebrated Bank of Amsterdam (1609) was dissolved in 1796 and the present Bank of the Netherlands was established in 1814. The city suffered considerably during the World War from the loss of a great part of the former extensive financial business. The position continued bad until shipping on the Rhine increased after the German mark had been stabilized and conditions in the Ruhr had improved.

The total goods traffic of the port increased 50% between 1913 and 1924. The Coen harbour, on the south side of the Y, with 3,112ft of quays for seagoing ships and 2,000ft. for river craft, was opened in 1924, and plans were prepared for a new lock 1,292-ft. long at the entrance to the North Sea canal at Ymuiden. The canal itself was dredged to a depth of 33ft There is aeroplane service to London, Hamburg, Brussels and Paris.

See P. Scheltema, *Inventaris van het Amsterdamsche archief*, 3 vols. (1866–74). H. Brugmans and A. Loosjes, *Amsterdam in beeld* (1925).

AMSTERDAM, the only city of Montgomery county, N.Y., U.S.A., on the north bank of the Mohawk river, about 33m. N.W. of Albany. It is on the main line of the New York Central railroad, the State barge canal and the direct highway between New York and Buffalo; and is served also by the Fonda, Johnstown and Gloversville railroad, and (through south Amsterdam) by the West Shore railroad. Hills on both sides of the river command fine views of the Mohawk valley. The city has an area of 6·05 square miles. The population was 33,524 in 1920, of whom 9,807 were foreign-born whites (including Poles, Italians, Lithuanians and Germans); and 35,260 in 1925 (State census).

Amsterdam manufactures rugs, brooms, carpets, pearl buttons, silk gloves, silk and cotton hosiery, underwear (silk, rayon, cotton and woollen), sweaters, aprons, box board, box machinery, paper boxes, looms, boilers, linseed oil, oil cakes, "mendets," paper clips and novelties. The annual output of the 71 manufacturing establishments is valued at $57,000,000. The city has a large jobbing trade and is the retail trading centre for a territory covering more than 1,000 square miles. Outbound freight amounts to over 300,000 tons annually, and it is estimated that more than twice as much comes in. There is a breeding farm for race-horses on the outskirts of the city. The assessed valuation of property was $30,927,988 in 1927. A memorial has been erected to the 2,500 men from Amsterdam who served in the World War; and a system of memorial playgrounds and parks was completed in 1927. Three miles away, on a trolley line, is Fort Johnson, built by Sir William Johnson (*q.v.*). Amsterdam was settled about 1775, and was called Veedersburg until 1804, when its present name was adopted. It was incorporated as a village in 1830 and chartered as a city in 1885.

AMSTERDAM CANAL: *see* North Sea Canal.

AMSTERDAM ISLAND, an uninhabited island in the Indian ocean, in 37° 47′ S. and 77° 34′ E., about 40m. N of St. Paul island and approximately midway between the Cape of Good Hope and Tasmania. It is a nearly extinct volcano rising 2,989ft. from the sea. Exposed to the westerly winds and enshrouded in mists, the island possesses a vegetation of mosses and lichens and is the haunt of innumerable sea birds Fishing (cod and seal) is profitably carried on by fishermen from Réunion It was discovered by Anthony van Diemen in 1633 and annexed by France in 1893. In 1871, the British frigate "Megaera" was wrecked there and most of the 400 persons on board had to remain more than three months on the island. The *Mémoires* of a Frenchman, Captain François Péron (Paris, 1824), who was marooned three years on the island (1792–95), are of much interest

See Schenck, *Vergleichende Darstellung der Pflanzengeographie der Subantarktischen Inseln*, 2 vols. (Jena, 1905).

AMUCK, RUNNING (or more properly Amok), the native term for the homicidal mania which attacks Malays. A Malay will suddenly and apparently without reason rush into the street armed with a kris or other weapon, and slash and cut at everybody he meets till he is killed. These frenzies were formerly regarded as due to sudden insanity. It is now, however, certain that the typical *amok* is the result of circumstances, such as domestic jealousy or gambling losses, which render a Malay desperate and weary of his life. It is, in fact, the Malay equivalent of suicide "The act of running *amuck* is probably due to causes over which the culprit has some amount of control, as the custom has now died out in the British possessions in the peninsula, the offenders probably objecting to being caught and tried in cold blood" (W. W. Skeat). The word is widely used in a figurative sense.

Though so intimately associated with the Malay there is some ground for believing the word to have an Indian origin, and the act is certainly far from unknown in Indian history. Some notable cases have occurred among the Rajputs Thus, in 1634, the eldest son of the raja of Jodhpur ran amuck at the court of Shah Jahan, failing in his attack on the emperor, but killing five of his officials During the 18th century, again, at Hyderabad (Sind) two envoys, sent by the Jodhpur chief in regard to a quarrel between the two States, stabbed the prince and 26 of his suite before they themselves fell.

In Malabar there were certain professional assassins known to old travellers as *Amouchi* or *Amuco*. The nearest modern equivalent to these words would seem to be the Malayalim *amarkhan*, "a warrior" (from *amar*, "fight"). The Malayalim term *chaver* applied to these ruffians meant literally those "who devote themselves to death." In Malabar was a custom by which the zamorin or king of Calicut had to cut his throat in public when he had reigned 12 years. In the 17th century a variation in his fate was made. He had to take his seat, after a great feast lasting 12 days, at a national assembly, surrounded by his armed suite, and it was lawful for anyone to attack him, and if he succeeded in killing him the murderer himself became zamorin. (*See* Alex. Hamilton, "A New Account of the East Indies," in Pinkerton's *Voyages and Travels*, viii. 374.) In 1600 30 would-be assassins were killed in their attempts.

These men are called *amar-khan*, and it has been suggested that their action was "running amuck" in the true Malay sense. Another proposed derivation for *amouchi* is Sanskrit *amokshya*, "that cannot be loosed," suggesting that the murderer was bound by a vow, an explanation more than once advanced for the Malay *amuck;* and *amokshya* in such a sense is unknown in Malayalim.

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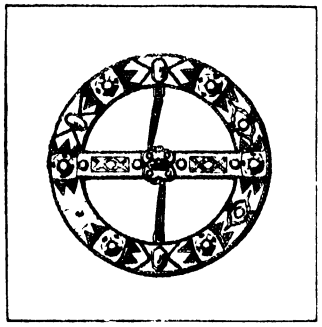
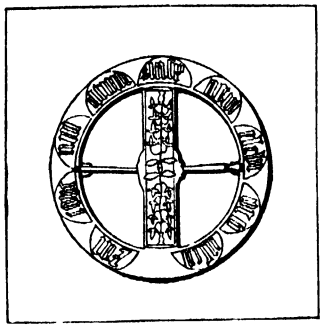
AMUL or **AMOL,** a town of Persia, in the province of Mazandaran, 23m. S.W. of Balfrush. Pop. about 10,000. It is situated on both banks of the Heraz river, and is an important "fall-line" town between the Elburz mountains of the south and the low shore-land of the Caspian sea. Around the present site are ruins that tell of Amul's former greatness. They include the mausoleum of King Seyed Kavvam Ud-Din (d. 1379) and a mosque dating from 793.

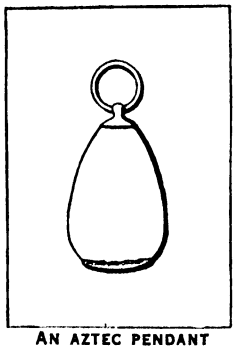
AMULET, a charm, generally, but not invariably, hung from the neck, to protect the wearer against witchcraft, sickness, accidents, etc. (Late Lat. *amuletum,* origin unknown). Amulets have been of many different kinds, and formed of different substances—stones, metals and strips of parchment being the most common, with or without characters or legends engraved or written on them. Gems have often been employed and greatly prized, serving for ornaments as well as for charms. Certain herbs, too, and animal preparations have been used in the same way. In setting them apart to their use as amulets, great precautions have been taken that fitting times be selected, stellar and other magic influences propitious, and everything avoided that might be supposed to destroy or weaken the force of the charm. The belief in the prevalence of occult evil influences engenders trust in amulets and similar preservatives against them. There are references to, and apparently correctives of, these customs in the Mosaic injunctions to bind portions of the law upon the hand and as frontlets between the eyes, as well as write them upon the door-posts and the gates.





BY COURTESY OF THE BRITISH MUSEUM

FRONT AND BACK VIEW OF THE 15TH-CENTURY GLENLYON BROOCH
Of Scottish workmanship, this amulet formerly belonged to the Campbells of Glenlyon. It is about 5½ in. in diameter, of heavy silver-gilt, set in front with pearls which stand about an inch above the flat surface, alternating with crystals and amethysts. The back is inscribed with the names Caspar, Melchior and Balthazar, followed by "Consumatum" ("It is finished") the last words of Christ on the cross



AN AZTEC PENDANT
Made of jasper and supposed to have magical powers in stanching blood

Amulets were much used by the ancient Egyptians, among the Greeks and Romans, and in the early Christian Church; hence the emphatic protests of Chrysostom, Augustine and others against them. *Talisman,* from the Arabic, is a word of similar use; but while talismans bring good luck or transmit qualities, amulets are preventive. A talisman, whose "virtues are still applied to for stopping blood and in cases of canine madness," gives name to one of Sir Walter Scott's novels.

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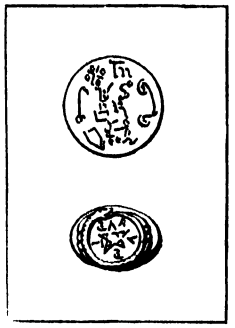
AMUN: *see* AMMON.

AMUNDSEN, ROALD (1872–1928), Norwegian explorer, was born July 16 1872, in Borge, a country district near Sarpsborg in south-eastern Norway. Educated at Christiania (now Oslo) he took his B.A. degree in 1890 and began to study medicine, but gave it up and went to sea in 1894. During the following nine years, Amundsen, with the tenacity of purpose which was one of his chief characteristics, prepared himself for his future career as an explorer, and in 1903–06 he led an expedition consisting of himself and six companions through the North-west Passage, on board the "Gjöa," a little sloop of 47 tons, and succeeded in fixing the position of the magnetic North Pole.

His next expedition, on board the "Fram," originally intended as a North Polar expedition, by a dramatic surprise, became a South Polar expedition (1910–12), and was the first actually to reach the South Pole. After his return in 1913 he resumed his preparations for a North Polar expedition but was stopped by the outbreak of the World War. He remained inactive until 1918 when he left Norway on board the "Maud," a new vessel, with the aim of drifting from the North Siberian Islands across the Pole. Baffled in this undertaking owing to the fact that the Polar stream did not prove to be constant, he decided to force the Polar basin in an aeroplane.

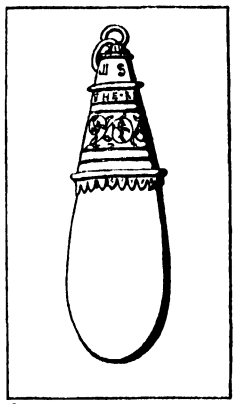


BY COURTESY OF THE BRITISH MUSEUM

RINGS WITH MAGICAL INSCRIPTIONS
The larger is of silver engraved with astrological characters. The smaller, of gold, has the form of a serpent with its tail in its mouth. It is inscribed ASLSV—Salus

On his fourth attempt he succeeded, using the semi-rigid dirigible "Norge," built in Italy. Starting with the American Ellsworth, from Spitsbergen, May 11 1926, he flew to the Pole, which he circled twice, thence across the unexplored Arctic basin to Point Barrow, Alaska, and finally landed, May 14, at Teller on Bering Sea. The total distance traversed was 2,700 m., the time occupied in the flight being only 71 hours (*see* POLAR EXPLORATION). When General Nobile's airship, "Italia," returning from the North Pole was wrecked on May 24, 1928, Amundsen chivalrously volunteered to go in search of him. He left Bergen for Spitsbergen in an aeroplane on June 17, and was not heard of again. *See* Roald Amundsen, *My Life as an Explorer* (1927).

AMUR, the chief river of Eastern Asia north of the Hwang-ho and about 3,000 miles in length. It traverses from west to east a series of tilted earth-blocks which present a steep face to the south-east and a gentle back-slope to the north-west. The course of the river is, therefore, alternately towards the north-east, when it flows parallel to the north-east to south-west trending ridges and towards the south-east, when it cuts across them. It is formed by the confluence of the Shilka, rising in Transbaikalia, and the Argun, rising on the back-slope of the Great Khingan, one of these earth-blocks. It receives its most important tributaries, the Sungari and the Ussuri, from the similar back-slope of the earth-block overlooking the Sea of Japan. Both tributaries enter from the south. Since the late 17th century, when the Chinese came into contact with the extending power of Russia, the Amur has had considerable political significance. The Argun head-stream was taken as part of the boundary between the two empires at the Treaty of Nerchinsk (1689), and the present boundary between Manchuria and Siberia follows the line of the Argun, Amur and Ussuri, thus forming one of the longest river frontiers in the world. The river is highest in summer, the season of rains, and then the Sungari, draining North Manchuria, has a greater volume of water than the Amur itself. In winter the river is frozen over and navigation is confined to the six months from May to October. For boats drawing four feet of water, the Amur is then navigable for over 2,000 miles up to Stretensk and the Sungari up to Kirin. But the fact that its outlet lies so far to the north deprives the Amur of much of its value and, moreover, it has as a competitor the Chinese Eastern railway which is linked with more southerly ports at Vladivostok and in South Manchuria.



A JADEITE CELT (ELIZABETHAN) AMULET
Mounted in silver, the shank is inscribed, "The right Elatrope, the speciall stone to staunche blooding and good against poyson."

AMUR PROVINCE, a part of the Far Eastern Area of the Russian S.F.S.R. Area 236,785sq.km. Pop. (1926) 394,000 (urban 75,588). Its boundaries are, on the south, the Amur river, on the west and north-west Zei Province, on the east and north-east Nikolaievsk Province and Khaborovsk Province. It includes the broad fertile plain which stretches from the junction of the rivers Zeya and Amur at Blagovyeschensk to the Bureya or Little Khingan mountains 250m. below. The river here is broad and slow-flowing; at Blagovyeschensk, 1,200m from its mouth, its elevation is less than 400ft. The climate is milder than that of the Lena basin though it has severe winters, the principal drawback being that the maximum rainfall is in July and August, too late to be of the best service to crops, though oats, wheat, buckwheat, barley and potatoes are successfully grown. The average temperature at Blagovyeschensk is 17°F. in January and 70° F. in July. Above Blagovyeschensk the river valley is narrow and there is little land available for cultivation. The mountain slopes are thickly forested and yield furs and timber, while the valley of the Zeya is noted for its gold mines. There are also deposits of iron-ore, coal, antimony and fluorspar. Horses, cattle, pigs, sheep and camels are reared. The Amur, Zeya and Bureya rivers furnish boat communication in summer and sledge in winter, but the province has developed markedly since the construction of the trans-Siberian railway through it, with its branch to Blagovyeschensk, which is an important trading and culture centre. The region was known to the Russians in the 17th century, and began to be settled by them in 1847. In 1858 China ceded to Russia the whole left bank of the Amur, and the right below the Ussuri confluence, and in 1860 the whole territory between the Ussuri and the Eastern sea.

AMURATH: *see* MURAD.

AMYGDALIN (Gr. ἀμυγδάλη, almond), a glucoside $C_{20}H_{27}NO_{11}$, was isolated from bitter almonds by H. E. Robiquet and A F. Boutron-Charlard in 1830, and subsequently investigated by Liebig and Wöhler, and others. It is extracted from almond cake by boiling alcohol; on evaporation of the solution and the addition of ether, amygdalin is precipitated as white minute crystals. It has been found to be a glucoside (*q.v.*) of formula $C_{20}H_{27}NO_{11}$, being a compound of *d*-glucose, benzaldehyde and hydrocyanic (prussic acid), into which it is decomposed by sulphuric acid. Hydrochloric acid gives mandelic acid, *d*-glucose and ammonia The enzyme maltase partially decomposes it, giving *d*-glucose and mandelic nitrile glucoside, $C_6H_5CH(CN)O{\cdot}C_6H_{11}O_5$. Emulsin, on the other hand, decomposes it into benzaldehyde, prussic acid and two molecules of glucose; this enzyme occurs in the bitter almond, and consequently the seeds invariably contain free prussic acid and benzaldehyde. (*See* GLUCOSIDES, NATURAL)

AMYGDALOID, a term meaning "almond-shaped," used in anatomy and geology.

AMYL ACETATE, a colourless, neutral, mobile liquid resembling jargonelle pears in odour. Hence its use as an essence in the manufacture of "peardrops." Owing to its solvent action in cellulose, cellulose esters (*q.v.*) etc., it is also used in photography, in the celluloid and varnish industries, in the preparation of "dope" for aeroplane construction, etc. Its chemical formula is $CH_3CO_2C_5H_{11}$. (*See* also ACETIC ACID.)

AMYL ALCOHOLS. There are eight of these alcohols theoretically possible. All are known, and the most important is *iso*butyl carbinol (or *iso*amyl alcohol), the chief constituent of fermentation amyl alcohol, and consequently present in fusel oil (*q.v.*). It can be extracted from fusel oil by shaking this with strong brine, discarding the brine layer and collecting the portion boiling between 125° and 140°C. By shaking this product with hot milk of lime, separating the oily layer, drying it with calcium chloride and collecting the fraction boiling between 128° and 132°C, a further degree of purification may be effected.

*Iso*amyl alcohol is a colourless liquid of specific gravity 0·8248 (0°C), boiling at 131·6°C, slightly soluble in water, easily soluble in alcohol, ether, chloroform, and benzene. It possesses a characteristic strong smell and a sharp burning taste. It is oxidized by chromic acid mixture to *iso*valerylaldehyde.

The eight amyl alcohols all have the general formula $C_5H_{11}OH$, the differences being due to the different ways in which the carbon atoms are linked together and to the hydrogen and oxygen atoms. In normal amyl alcohol, we have a "straight chain" primary alcohol, $CH_3{\cdot}CH_2{\cdot}CH_2{\cdot}CH_2{\cdot}CH_2OH$, which can be regarded as derived from the hydrocarbon *n*-pentane (normal pentane) by replacement of one end hydrogen atom with the alcoholic (hydroxyl) group. Methyl-*n*-propyl carbinol,

$$CH_3{\cdot}CH_2{\cdot}CH_2{\cdot}\overset{*}{C}HOH{\cdot}CH_3,$$

and di-ethyl carbinol, $C_2H_5{\cdot}CHOH{\cdot}C_2H_5$, are two secondary amyl alcohols, also derivable from *n*-pentane. From the hydrocarbon $(CH_3)_2CH{\cdot}CH_2\,CH_3$ can be derived *iso*butyl carbinol or *iso*amyl alcohol, $(CH_3)_2CH{\cdot}CH_2{\cdot}CH_2OH$, methyl *iso*propyl carbinol, $(CH_3)_2CH{\cdot}\overset{*}{C}HOH{\cdot}CH_3$, dimethyl ethyl carbinol,

$$(CH_3)_2COH\,C_2H_5,$$

and active amyl alcohol $CH_3{\cdot}\overset{*}{C}(CH_2OH)H{\cdot}CH_2{\cdot}CH_3$. And from the hydrocarbon $(CH_3)_4C$ can be derived tertiary butyl carbinol, $(CH_3)_3C{\cdot}CH_2OH$. Three of these contain "asymmetric carbonations" (marked *) and can therefore exist each in two optically active forms and one optically inactive form (*see* STEREO-CHEMISTRY); the amyl alcohols include four primary alcohols (containing the group $\cdot CH_2OH$), three secondary alcohols (containing the group :CHOH) and one tertiary alcohol (containing the group ;COH).

All the amyl alcohols can be obtained synthetically, *iso*amyl alcohol by the action of trioxy-methylene $(CH_2O)_3$, on *iso*butyl magnesium bromide, an example of Grignard's reaction The synthesis of tertiary butyl carbinol proved the most difficult and was finally achieved in 1891 by L. Tissier who reduced a mixture of trimethylacetic acid and trimethylacetyl chloride with sodium amalgam. It is a solid which melts at 48°–50°C and boils at 112 – 113°C.

AMYL NITRITE (*iso*amyl nitrite), a liquid which finds application in medicine, since it reduces blood pressure and retards the pulse. It is prepared by passing nitrous fumes (from starch and concentrated nitric acid) into warm *iso*amyl alcohol; or by distilling a mixture of 26 parts of potassium nitrite in 15 parts of water with 30 parts of *iso*amyl alcohol in 30 parts of sulphuric acid. It is a yellow-coloured liquid of specific gravity 0·877, boiling at about 95°–96° C, of characteristic penetrating odour, and having the composition $C_5H_{11}ONO$. It is insoluble in water, but dissolves readily in alcohol, ether, glacial acetic acid, chloroform or benzene. It is easily decomposed by nascent hydrogen, with the formation of ammonia and *iso*amyl alcohol; and on hydrolysis with caustic potash it forms potassium nitrite and *iso*amyl alcohol. When the liquid is dropped on to fused caustic potash, it forms potassium valerate.

AMYMONE, in ancient Greek legend, daughter of Danaüs. With her sisters, she had been sent to look for water, the district of Argos being then parched through the anger of Poseidon. Amymone having thrown her spear at a stag, missed it, but hit a satyr asleep in the brake. The satyr pursued her, and she called for help on Poseidon, who appeared and for love of her beauty caused a spring to well up, which received her name. Aeschylus wrote a satyric drama on the subject. By the god Amymone became the mother of Nauplius, the wrecker. Her meeting with Poseidon at the spring is frequently represented on ancient coins and gems.

See Apollodorus ii., 1, 4; Hyginus, *Fab.* 169; Propertius ii., 26.

AMYNTAS I., king of Macedonia (*c.* 540–498 B.C), was a tributary vassal of Darius Hystaspes and the first Macedonian ruler to have relations with other countries. He made an alliance with the Peisistratidae, and when Hippias was driven out of Athens he offered him the territory of Anthemus on the Thermaic gulf, hoping to turn the Greek party feuds to his own advantage (Herodotus v. 17, 94; Justin vii. 2; Thucydides ii. 100; Pausanias ix. 40). (*See* MACEDONIAN EMPIRE.)

AMYNTAS II. or III., King of Macedonia from 393 (or 389) to 369 B.C. He came to the throne after the ten years of confusion which followed the death of Archelaus, and showed the same taste for Greek culture and its representatives. In 383 B.C.

he was driven out by the Illyrians, but in the following year, with the aid of the Thessalians, he recovered his kingdom. He concluded a treaty with the Spartans, who helped him to reduce Olynthus (379 B.C.). He also entered into a league with Jason of Pherae, and cultivated the friendship of Athens. The youngest of his three sons was the famous Philip of Macedon.

See Diodorus xiv. 89, xv. 19, 60; Xenophon, *Hellenica*, v. 2; Justin vii. 4.

AMYOT, JACQUES (1513–1593), French writer, was born of poor parents, at Melun, on Oct. 30, 1513. He was educated at the University of Paris and then at Bourges, where he was made professor of Greek and Latin through the influence of Margaret of Valois. Here he translated *Théagène et Chariclée* from Heliodorus (1547 fol.), for which he was rewarded by Francis I. with the abbey of Bellozane. He was thus enabled to go to Italy to study the Vatican text of Plutarch, on the translation of whose *Lives* (1559; 1565) he had been some time engaged. On the way he turned aside on a mission to the Council of Trent. Returning home, he was appointed tutor to the sons of Henry II., by one of whom (Charles IX.) he was afterwards made grand almoner (1561) and by the other (Henry III.) was appointed, in spite of his plebeian origin, commander of the order of the Holy Ghost. Pius I. promoted him to the bishopric of Auxerre, and here he continued to live in comparative quiet, repairing his cathedral and perfecting his translations, for the rest of his days, though troubled towards the close by the insubordination and revolts of his clergy. He died on Feb. 6, 1593, bequeathing, it is said, 1,200 crowns to the hospital at Orleans for the twelve "deniers" he received there when "poor and naked" on his way to Paris. He translated seven books of Diodorus (1554), the *Daphnis et Chloe* of Longus (1559) and the *Opera Moralia* of Plutarch (1572). His lively and idiomatic version of Plutarch, *Vies des hommes illustres*, was translated into English by Sir Thomas North, and supplied Shakespeare with materials for his Roman plays. The translation of Plutarch was his magnum opus. His other translations were subsidiary. The version of Diodorus he did not publish, although the manuscript had been discovered by himself. Amyot took great pains to find and interpret correctly the best authorities, but the interest of his books lies in the simplicity and purity of language which won the praise of Montaigne. His translation reads like an original work. The personal method of Plutarch appealed to a generation addicted to memoirs. Amyot's book, therefore, obtained an immense popularity and exercised great influence over successive generations of French writers.

There is a good edition of the works of Amyot from the firm of Didot (25 vols., 1818–21). *See* also Auguste de Blignières, *Essai sur Amyot et les traducteurs français au xvie siècle* (1851).

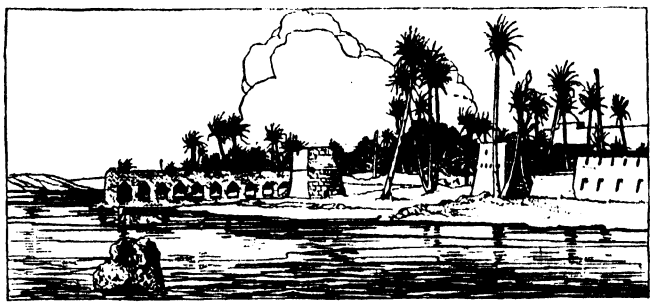
AMYRAUT, MOÏSE (1596–1664), also known as *Amyraldus*, French Protestant theologian and metaphysician, studied at Orleans, Poitiers, and then at Saumur under the famous Scottish Protestant teacher, John Cameron. He was made pastor of Saumur and professor of theology there. Amyraut and his colleagues, Louis Cappel and Josué de la Place, also Cameron's pupils, collaborated in the *Theses Salmurienses*, and in 1631 published his *Traité des religions*.

Amyraut was chosen by the national synod of 1631 to present to the king the complaint of the French Protestants against the revocation of the Edict of Nantes. His oration on this occasion is famous in the history of French Protestantism. Later he conferred with Richelieu, but without success, on the possibilities of reconciliation.

Amyraut held fast to Calvinism, but in his *Traité de la prédestination* he tried to mitigate its harsher features by his "universalismus hypotheticus"—that God predestines all men to happiness on condition of their having faith. For this doctrine he was thrice accused of heresy before the synod, but without success. His most important metaphysical work was *De l'élévation de la foy et de l'abaissement de la raison en la créance des mystères de la religion* (1641). But perhaps he is better remembered by his simpler works of devotion, which have remained fireside favourites of the French Protestant peasantry. Moïse Amyraut died Jan. 18, 1664.

See Edm. Saigey, *Moses Amyraut, sa vie et ses écrits* (1849); Alex. Schweizer in *Tüb. theol. Jahrb.*, pp. 155 *seq.* 41 *seq.* (1852); *Protestant Central-Dogmen* ii. 225 *seq.* (1854); and in Herzog-Hauck, *Realencyklopädie;* Bayle, *s.v.;* *Biog. Univ., s.v.;* John Quick's *Synod. in Gall. Reform.* pp. 352–357; *ibid. M.S. Icones Sacrae Gallicanae; Life of Cameron.*

ANA, a town on the Euphrates in 34°30′ N. and 42° E., 192m. below Deir, and 119 above Hit. The town has retained its name at least since the beginning of the 2nd millennium B.C., but the actual site seems to have changed slightly. The earlier writers describe it as being on an island, and even as late as the 16th



BY COURTESY OF THE MUSEUM OF THE UNIVERSITY OF PENNSYLVANIA

ANA ON THE EUPHRATES, FORMERLY A FLOURISHING TRADE STATION CONTROLLING THE WATER-WAY

century A.D. at least a part of the town was so situated. At this time, however, the greater part of the town already lay on the right bank of the Euphrates, to which it is confined to-day. The town is important as the end of the desert journey from Tadmor in the west, as a station controlling the Euphrates waterway, and as a point of contact and trade with the desert to the south-west. In the early 17th century A.D. at one of its most flourishing periods, the emir of Ana seems to have controlled the desert as far west as Tadmor; it was then the most flourishing Arab town on the Euphrates but since then it has fallen into decay, suffering inroads from the desert. It was formerly known for its wine, and, later on, for its palm groves; it is a region of great fertility.

To-day the population is 15,000 (a rather uncertain estimate) most of whom are Sunni Arabs. It is a centre of considerable trade along the valley road, and for trade with the Bedouins. It is also an agricultural oasis, growing mainly cereals, fruit and dates, the latter of which are traded, and its exports also include butter and wool. The modern motor route and aeroplane track to Damascus runs south of the old caravan route and leaves the Euphrates at Ramadi.

ANA, a Latin neuter plural termination appropriated to various collections of the observations and criticisms of eminent men, delivered in conversation and recorded by their friends, or discovered among their papers after their decease. Though the term Ana is of comparatively modern origin, the introduction of this species of composition is not of recent date. It appears, from d'Herbelot's *Bibliothèque Orientale*, that from the earliest periods the Eastern nations were in the habit of preserving the maxims of their sages. From them the practice passed to the Greeks and Romans. Plato and Xenophon treasured up and recorded the sayings of their master Socrates; and Arrian, in the concluding books of his *Enchiridion*, now lost, collected the casual observations of Epictetus. The numerous apophthegms scattered in Plutarch, Diogenes Laertius, and other writers, show that it was customary in Greece to preserve the colloquially expressed ideas of illustrious men. It appears that Julius Caesar compiled a book of apophthegms, in which he related the *bons mots* of Cicero.

But though vestiges of Ana may be traced in the classical ages, it is only in modern times that they have come to be regarded as constituting a distinct species of composition, comprising literary anecdotes, critical reflections, and historical incidents, mingled with the detail of *bons mots* and ludicrous tales. The term Ana seems to have been applied to such collections as far back as the beginning of the 15th century. Francesco Barbaro, in a letter to Poggio, says that the information and anecdotes which Poggio and Bartolommeo of Montepulciano had picked up during a literary excursion through Germany will be called *Ana*.

Poggio Bracciolini (*q.v.*) is the first eminent person of modern times whose jests and opinions have been transmitted to pos-

terity. During the pontificate of Martin V., Poggio and other members of the Roman chancery were in the habit of assembling in a common hall adjoining the Vatican, in order to converse freely on all subjects. The jests and stories which occurred in these unrestrained conversations were collected by Poggio and formed the chief materials of his *Facetiae*. This collection, which forms a principal part of the *Poggiana* printed at Amsterdam in 1720, is chiefly valuable as recording interesting anecdotes of eminent men of the 14th and 15th centuries. It also contains a number of quibbles or *jeux de mots*, and a still greater number of *facetiae*, idle and licentious stories.

Though Poggio was the first person whose remarks and *bons mots* were collected under the name of Ana, the *Scaligerana*, which contains the opinions of Joseph Scaliger, was the first work *published* under that appellation. There are two collections of Scaligerana—the *Prima* and *Secunda*. The first was compiled by a physician named François Vertunien, sieur de Lavau, who attended a family with whom Joseph Scaliger resided. It was published in 1669, under the title of *Prima Scaligerana, nusquam antehac edita*. The second work, known as *Secunda Scaligerana*, was collected by two brothers of the name of Vassan, students of the University of Leyden, of which Scaliger was one of the professors. Being particularly recommended to Scaliger, they were received in his house and enjoyed his conversation.

In imitation of the *Scaligerana*, a prodigious number of similar works appeared in France towards the end of the 17th and beginning of the 18th century. At first these collections were confined to what had fallen from eminent men in conversation; but they were afterwards made to embrace fragments found among their papers, and even passages extracted from their works and correspondence. Of those which merely record the conversations of eminent men, the best known and most valuable is the *Menagiana*. Gilles Ménage was a person of good sense, of various and extensive information and of a most communicative disposition. A collection of his oral opinions was published in 1693, soon after his death.

The *Perroniana*, which exhibits the opinions of Cardinal du Perron, was compiled from his conversation by C. Dupuy, and published by Vossius in 1666. The *Thuana*, or observations of the president de Thou, have usually been published along with the *Perroniana*, but first appeared in 1669.

The *Valesiana* is a collection of the literary opinions of the historiographer Adrien de Valois, published by his son.

The *Fureteriana* (1696) contains the *bons mots* of Antoine Furetière, the Academician, the stories which he was in the habit of telling, and a number of anecdotes and remarks found in his papers after his decease.

The *Chevraeana* (1697), so called from Urbain Chevreau, is more scholarly than most works of a similar description and probably more accurate, as it differs from the Ana proper, of which the works described above are instances, in having been published during the life of the author and revised by himself.

Parrhasiana (1699–1701) is the work of Jean le Clerc, a professor of Amsterdam, who bestowed this appellation on his miscellaneous productions with the view of discussing various topics of philosophy and politics with more freedom than he could have employed under his own name.

The *Huetiana* contains the detached thoughts and criticisms of P. D. Huet (1630–1722), bishop of Avranches, which he himself committed to writing when he was far advanced in life.

The *Casauboniana* presents us with the miscellaneous observations, chiefly philological, of the celebrated Isaac Casaubon.

Besides the above a great many works under the title of Ana appeared in France about the same period. Thus, the opinions and conversations of Charpentier, Colomesius and St. Evremond were recorded in the *Carpenteriana, Colomesiana* and *St. Evremoniana*; and those of Segrais in the *Segraisiana*—a collection formed by a person stationed behind the tapestry in a house where Segrais was accustomed to visit, of which Voltaire declared, "que de tous les Ana c'est celui qui mérite le plus d'être mis au rang des mensonges imprimés, et surtout des mensonges insipides." The Ana, indeed, from the popularity which they now enjoyed, were compiled in such numbers and with so little care that they became almost proverbial for inaccuracy.

Of the examples England has produced of this species of composition, perhaps the most interesting is the *Walpoliana*, a transcript of the literary conversation of Horace Walpole, earl of Orford. Most other works which in England have been published under the name of Ana, as *Baconiana, Atterburyana*, etc., are rather extracts from the writings and correspondence of eminent men than memorials of their conversation.

Of the productions which belong to the class, though they do not bear the name of Ana, the most celebrated are the *Colloquia Mensalia* of Luther and Selden's *Table-Talk*. The former, which comprehends the conversation of Luther with his friends and coadjutors in the great work of the Reformation, was first published in 1566. The *Table-Talk* of Selden contains a more genuine and undisguised expression of the sentiments of that eminent man than we find in his more studied productions. It was published after his death by Richard Milward, his amanuensis, who affirms that for 20 years he enjoyed the opportunity of daily hearing his discourse, and made it his practice faithfully to commit to writing "the excellent things that usually fell from him."

The most remarkable collection of Ana in the English language—and, indeed, in any language—is to be found in a work which does not correspond to the normal type either in the name or in form. In his *Life of Samuel Johnson, LL.D.*, Boswell relates that to his remark, *à propos* of French literature. "Their Ana are good," Johnson replied, "A few of them are good; but we have one book of that kind better than any of them—Selden's *Table-Talk*." Boswell's own work, however, is incomparably superior to all. Mrs. Thrale (who called her note-book "Thraliana") gave the world a volume in the orthodox Ana style in her *Anecdotes of the late Samuel Johnson, LL.D.* A good modern collection of Ana is Mountstuart Grant Duff's *Notes from a Diary* (1897–1905).

J. C. Wolf has given a history of the Ana in a preliminary discourse to his edition of the *Casauboniana*, published in 1710. In the *Répertoire de bibliographies spéciales, curieuses, et instructives*, by Peignot, there is a *Notice bibliographique* of these collections; but many of the books there enumerated consist of mere extracts from the writings of popular authors.

ANABAPTISTS, a name given by their enemies to various sects which denied the validity of infant baptism and for other reasons became prominent in Germany and elsewhere during the period of the Reformation. (Gr. ἀναβαπτίζω, rebaptize.) So used, the word is too well known to be discarded, though it describes these sects by one of the least important of their distinctive doctrines and practices. The Anabaptists of Germany are historically noteworthy, not because they insisted on rebaptism as a condition of admission to their community, but because the enthusiasm of the Reformation manifested itself in them in a form and manner altogether peculiar. Their views as to the true function of the church and its relation to the State, and the efforts which they made to realize these views, furnish a problem, partly theological, partly historical, of which a satisfactory solution is not easy. To one who looks merely at the extravagance and lawlessness which appear on the surface, fanaticism and madness, credulity and imposture may provide a sufficient explanation of the whole Anabaptist movement, but a deeper insight will find elements in it which are quite inconsistent with such a supposition.

Anabaptism, as a system, may be described as the Reformation doctrine carried to its extreme limit; the Anabaptists were the extreme left in the army of the Reformers. The hostility of the orthodox Reformers to them cannot conceal the fact that the most peculiar doctrines of the Anabaptists were to them only corollaries—illegitimately drawn, as the orthodox Reformers believed—from the fundamental principle common to both: the independence of the individual judgment, and the supreme importance of the subjective element, personal faith, in religion. The connection of this principle with their theory of the church and its relation to the State, their doctrine of the sacraments, and even their political risings, is evident.

The history of the Anabaptist movement in its outward development is brief but eventful. In 1521 their first rising took

place at Zwickau, under the leadership of Thomas Münzer, Lutheran pastor of that place. Compelled to leave Zwickau, Münzer visited Bohemia, resided two years at Alltstedt in Thuringia, and in 1524 spent some time in Switzerland. During this period he proclaimed his revolutionary doctrines in religion and politics with growing vehemence, and, so far as the lower orders were concerned, with growing success. The crisis came in the so-called Peasants' War in south Germany in 1525. In its origin a revolt against feudal oppression, it became, under the leadership of Münzer, a war against all constituted authorities, and an attempt to establish by force his ideal Christian commonwealth, with absolute equality and the community of goods. The total defeat of the insurgents at Frankenhausen (May 15 1525), followed as it was by the execution of Münzer and several other leaders, proved only a temporary check to the Anabaptist movement. Here and there throughout Germany, Switzerland and the Netherlands there were zealous propagandists, through whose teaching many were prepared to follow as soon as another leader should arise. A second and more determined attempt to establish a theocracy was made at Münster, in Westphalia (1532–35). Here the sect had gained considerable influence, through the adhesion of Rothmann, the Lutheran pastor, and several prominent citizens; and the leaders, Johann Matthyszoon or Matthiesen, a baker of Haarlem, and Johann Bockholdt, a tailor of Leyden, had little difficulty in obtaining possession of the town and deposing the magistrates. Vigorous preparations were at once made, not only to hold what had been gained, but to proceed from Münster, as a centre to the conquest of the world. The town being besieged by Francis of Waldeck, its expelled bishop (April 1534), Matthiesen, who was first in command, made a sally with only 30 followers, under the fanatical idea that he was a second Gideon, and was cut off with his entire band. Bockholdt, better known in history as John of Leyden, was now supreme. Giving himself out as the successor of David, he claimed royal honours and absolute power in the new "Zion." He justified the most arbitrary and extravagant measures by the authority of visions from heaven, as others have done in similar circumstances. With this pretended sanction he legalized polygamy, and himself took four wives, one of whom he beheaded with his own hand in the market-place in a fit of frenzy. As a natural consequence of such licence, Münster was for 12 months a scene of unbridled profligacy. After an obstinate resistance the town was taken by the besiegers on June 24, 1535, and in January 1536, Bockholdt and some of his more prominent followers, after being cruelly tortured, were executed in the market-place. The outbreak at Münster was the crisis of the Anabaptist movement. It never again had the opportunity of assuming political importance, the civil powers naturally adopting the most stringent measures to suppress an agitation whose avowed object was to suppress them. It is difficult to trace the subsequent history of the sect as a religious body. The fact that after the Münster insurrection the very name Anabaptist was proscribed in Europe, is a source of twofold confusion. The enforced adoption of new names makes it easy to lose the historical identity of many who really belonged to the Münster Anabaptists; but, on the other hand, has led to the classification of many with the Münster sect who had no connection with it. The latter mistake, it is to be noted, has been much more common than the former. The Mennonites, for example, have been identified with the earlier Anabaptists on the ground that they included among their number many of the fanatics of Münster. But the continuity of a sect is to be traced in its principles, and not in its adherents, and it must be remembered that Menno and his followers expressly repudiated the distinctive doctrines of the Münster Anabaptists. They have never aimed at any social or political revolution, and have been as remarkable for sobriety of conduct as the Münster sect was for its fanaticism (*see* MENNONITES). In English history frequent reference is made to the Anabaptists during the 16th and 17th centuries, but there is no evidence that any considerable number of native Englishmen ever adopted the principles of the Münster sect. Many of the followers of Münzer and Bockholdt seem to have fled from persecution in Germany and the Netherlands to be subjected to a persecution scarcely less severe in England. The excesses of John of Leyden, the Brigham Young of that age, cast an unjust stigma on the Baptists, of whom the vast majority were good, quiet people who merely carried out in practice the early Christian ideals of which their persecutors prated. Broadly speaking, the various branches of the Anabaptist movement held the following doctrines in common. (1) They taught that Jesus did not take the flesh from his mother, but either brought his body from heaven or had one made for him by the Word. The Anabaptists were accused of denying the incarnation of Christ: they did, but not in the sense that he was not divine; they rather denied him to be human. (2) They condemned oaths, and also the reference of disputes between believers to law-courts. (3) The believer must not bear arms or offer forcible resistance to wrongdoers, nor wield the sword. No Christian has the *ius gladii*. (4) Civil government belongs to the world, is Caesar. The believer who belongs to God's kingdom must not fill any office, nor hold any rank under government, which is to be passively obeyed. (5) Sinners or unfaithful ones are to be excommunicated and excluded from the sacraments and from intercourse with believers unless they repent, according to Matt. xviii. 15 *seq.*, but no force is to be used towards them. Some sects calling themselves *Spirituales*, *Pneumatici* or *Perfecti* also held that the baptized, or regenerate man, cannot sin, a very ancient tenet: though the outward man sinned, the inward man sinned not.

One of the most notable features of the early Anabaptists is that they regarded any true religious reform as involving social amelioration. The Socialism of the 16th century was necessarily Christian and Anabaptist. Lutheranism was more attractive to grand-ducal patriots and well-to-do burghers than to the poor and oppressed and disinherited. The Lutherans and Zwinglians never converted the Anabaptists. Those who yielded to stress of persecution fell back into Roman Catholicism and went to swell the tide of the Catholic reaction.

See Beard, *The Reformation in its relation to Modern Thought and Knowledge* (Hibbert lectures, 1883); Lindsay, *History of the Reformation* (1907), vol. ii.; Hastings, *Encyclopaedia of Religion and Ethics*, art. "Anabaptism" with references given there; and the general church histories of the period.

ANABASIS, the title given by Xenophon (*q.v.*) to his narrative of the expedition of Cyrus the younger against his brother, Artaxerxes of Persia, 401 B.C., and adopted by Arrian for his history of the expedition of Alexander the Great (Gr. ἀνάβασις, a march up country).

ANABOLISM, the biological term for the building up in an organism of more complex from simpler substances, constructive metabolism. (*See* BIOLOGY; PHYSIOLOGY.)

ANACHARSIS (*c.* 600 B.C.), a Scythian philosopher, the son of a chief of a nomadic tribe of the Euxine shores and a Greek woman. He went on an embassy to Athens about 589 B.C. and became acquainted with Solon, and it is said that he was initiated into the Eleusinian mysteries. After he had spent several years at Athens, he travelled through different countries and returned home filled with the desire of teaching his countrymen the laws and the religion of the Greeks. According to Herodotus he was killed by his brother. His simple and forcible language originated the proverbial expression "Scythian Eloquence," but his epigrams are as unauthentic as the letters which are often attributed to him.

See Herodotus iv. 76; Lucian, *Scytha;* Cicero, *Tusc. Disp.* v. 32; Diog. Laert. i. 101.

ANACHRONISM, a neglect or falsification, whether wilful or undesigned, of chronological relation (Gr. ἀνά, back, and χρόνος, time). Its commonest use is in the ante-dating of events, circumstances, or customs; *i.e.*, in the introduction, especially in works of imagination that rest on a historical basis, of details borrowed from a later age. Anachronisms may originate through ignorance of the progress of the arts and sciences and the other ascertained facts of history; artists on the stage and on canvas, in story and in song in all ages and all countries have been inclined to assimilate their *dramatis personae* to their own nationality and time.

ANACOLUTHON, a defectively constructed sentence which does not run on as a continuous whole. When a writer or speaker is full of his subject, or is carried rapidly along by the passion of the moment, such inconsequents are very apt to occur. Of Niebuhr it is told that his oral lectures consisted almost entirely of anacoluthic constructions. To this kind of licence some languages, as Greek and English, readily lend themselves; while the grammatical rigidity of others, as Latin and French, admits of it but sparingly. The following is an example:—"And he charged him to tell no man; *but go show thyself,*" etc. (Luke v. 14). The anacoluthon, as might be expected, is found several times in the plays of Shakespeare, *e.g.*,

> Keep your word, Phoebe, *that you'll marry me,*
> Or else, refusing me, *to wed this shepherd.*
> (*As You Like It,* Act v. 4.)

ANACONDA, a city of Montana, U.S.A., 26 m. N.W. of Butte, at an elevation of 5,300 ft.; the county seat of Deer Lodge county. The population in 1920 was 11,668. The Butte, Anaconda and Pacific (electric) railway connects the city with Butte and with the Northern Pacific, the Great Northern, the Oregon Short Line and the Chicago, Milwaukee, St. Paul and Pacific railways. Anaconda is a product of the Anaconda Mining Company, which in 1884 erected a plant on the north side of Warm Springs valley in order to treat locally the ore from its copper mines at Butte. This site was selected because there was no adequate water supply nearer. The first plant merely smelted the ore into matte which was sent to Swansea or to Baltimore for further reduction. In 1892 a full installation of converters was provided, and since then only metallic copper has been shipped from the district. In 1902 a new plant was erected one mile east of the city, increasing the capacity of the works to 17,000 tons of ore daily. The normal output of copper is 16% of the total produced in the United States, 9% of the world's production. Production of zinc and of manganese has been increasingly important since 1910 and 1918 respectively. The works employ 2,700 men, and use 20,000 electric horse-power from the water-power plants of the Montana Power Company, and 10,000 more that is developed in steam engines on the spot. It is the largest non-ferrous reduction plant in the world.

ANACONDA (*Eunectes murinus*), an aquatic boa, inhabiting the swamps and rivers of Brazil, northeastern Peru and the Guianas in South America. It is the largest of American snakes and rivals the reticulated python as the largest snake in the world. Exaggerated tales have been told by travellers of its size and swallowing capacity, but the largest known have rarely exceeded 30 ft. in length. There is very great dread of this snake among the natives, though authenticated cases of it having attacked man are few. The general colour of the anaconda is olive-brown, with large oval black spots arranged in two alternating rows along the back, and with smaller white-eyed spots along the sides. The belly is whitish, spotted with black. The head is elongate, flat, and very distinct from the neck. The top of the head is very dark and is separated from the paler sides by a black streak forming a point on the snout. An oblique streak is found on each side between the eyes. The nostrils are situated between three large shields. The anaconda feeds chiefly at night upon birds and other animals which it kills by constriction. In contrast to the boa, which rarely takes to the water, the anaconda spends most of its time there, lying entirely submerged, with only a small part of its head above the surface, waiting for any suitable prey. Only seldom does it establish itself in the branches of trees like the boa. It is ovoviviparous and the young are about 36 in. long when born

A smaller species of anaconda, *Eunectes notreus* inhabits Paraguay and the northern part of Argentina.

ANACONDA COPPER MINING COMPANY, an American company, incorporated in 1895 to succeed the Anaconda Mining Company; it has, through the acquisition of various mining and fabricating companies in the United States and elsewhere, developed into the world's premier company in the non-ferrous metal industry. Directly, or through its subsidiary and associated companies, it controls the annual production of more than 1,000,000,000 lbs. of copper, 500,000,000 lbs. of zinc, 150,000,000 lbs. of lead, and more than 5% of the world production of silver. In addition to almost the entire ownership of the Butte (Montana) mining district, "the richest hill on earth," it has large investments in fifteen other American states, as well as in Canada, Mexico, Chile and Poland. It is also a large producer of lumber, coal, gold, arsenic, sulphuric acid, superphosphate, zinc oxide and white lead, and has a large custom smelting and refining business, with plants situated at Anaconda and Great Falls, Montana; Tooele, Utah; Miami, Arizona; East Chicago, Indiana; and Perth Amboy, New Jersey. Through its copper wire and rod mill situated at Great Falls, Montana, and through the ownership of The American Brass Company, it is the world's largest user of copper and manufacturer of copper and brass products. Among its subsidiary and associated companies are: American Brass Company and subsidiaries; Anaconda Lead Products Company; Andes Copper Mining Company; Arizona Oil Company; Butte, Anaconda & Pacific Railway Company; Butte Water Company; Chile Copper Company and subsidiary companies; Diamond Coal and Coke Company; Greene Cananea Copper Company; Inspiration Consolidated Copper Company; International Smelting Company; International Lead Refining Company; North Lily Mining Company; Raritan Copper Works; Santiago Mining Company; Tooele Valley Railway Company; Utah-Delaware Mining Company; Walker Mining Company, and the Silesian Holding Company, which, through the Silesian-American Corporation, controls the Giesche Spolka Akcyjna, a Polish corporation, one of the largest producers of zinc and coal in Europe. In 1926 the outstanding capital stock was $150,000,000, and the total assets, $514,507,008. The net income was $14,231,219 and the surplus for the year, $5,226,203.

The principal office of the Company is at Anaconda, Montana, the executive offices being in New York City. (E. O. S)

ANACORTES, a city and a port of entry in Skagit county, Wash., U.S A., occupying the upper end of Fidalgo island, about 20m. S. by W. of Bellingham in a direct line. It is connected with the mainland by the Great Northern railway and the San Juan extension of the Pacific highway; with Vancouver island by an automobile ferry, which winds through enchanting scenery; with the ports on Puget sound by regular steamboat service, and with all parts of the San Juan archipelago by smaller steamers. The population in 1920 was 5,284

Anacortes has important fishing industries, and is a distributing point for the logs of fir, cedar, hemlock and spruce, brought down from British Columbia; and for the berries, the ginseng, goldenseal, and other medicinal plants, the cabbage seed, and other agricultural products of the region. It had the first glass factory of the North-west. There are large exporting lumber-mills and box-factories Box shooks are shipped to all parts of the world. Deception Pass State park is four miles away, on the southwestern end of Fidalgo island. The city was incorporated in 1889.

ANACREON, Greek lyric poet, was born about 560 B.C., at Teos, an Ionian city on the coast of Asia Minor. Little is known of his life, except a few scattered notices, not in all cases certainly authentic. He may have shared the voluntary exile of the mass of his fellow-townsmen, who, when Cyrus the Great was besieging the Greek cities of Asia (545), sailed to Abdera in Thrace, where they founded a colony. Anacreon seems to have taken part in the fighting, in which, on his own admission, he did not distinguish himself, but, like Alcaeus and Horace, threw away his shield and fled He is said to have acted as tutor to Polycrates of Samos; that he enjoyed the tyrant's confidence we learn on the authority of Herodotus (iii. 121), who represents the poet as sitting in the royal chamber when audience was given to the Persian herald. Anacreon wrote many complimentary odes upon his patron. Like his fellow-lyrist, Horace, who was one of his great admirers, and in many respects of a kindred spirit, Anacreon seems to have been made for the society of courts. On the death of Polycrates, Hipparchus, who was then in power at Athens and inherited the literary tastes of his father Peisistratus, sent a special embassy to fetch the popular poet to Athens in a galley of 50 oars. Here he became acquainted with the poet Simonides, and other members of the brilliant circle which had gathered round Hipparchus. When this

circle was broken up by the assassination of Hipparchus, Anacreon seems to have returned to his native town of Teos, where, according to a metrical epitaph ascribed to his friend Simonides, he died and was buried. According to others, before returning to Teos, he accompanied Simonides to the court of Echecrates, a Thessalian dynast of the house of the Aleuadae. Lucian (Macrob. 26) mentions Anacreon as having completed 85 years. If an anecdote given by Pliny (*Nat. Hist.* vii. 7) is to be trusted, he was choked at last by a grape-stone, but the story has an air of mythical adaptation to the poet's habits. Anacreon was for a long time popular at Athens, where his statue was to be seen on the Acropolis, together with that of his friend Xanthippus, the father of Pericles. On several coins of Teos he is represented, holding a lyre in his hand. A marble statue found in 1835 in the Sabine district, and now in the Villa Borghese, is said to represent Anacreon.



AFTER A CAST IN THE METROPOLITAN MUSEUM OF ART

ANACREON

Anacreon had a reputation as a composer of hymns, as well as of those bacchanalian and amatory lyrics which are commonly associated with his name. Two short hymns to Artemis and Dionysus, consisting of eight and 11 lines respectively, stand first amongst his few undisputed remains, as printed by recent editors; but pagan "hymns" and "Anacreontic" poetry are often not unlike. The tone of Anacreon's lyric effusions has probably led to an unjust estimate of the poet's character. The "triple worship" of the Muses, Wine, and Love, ascribed to him as his religion in an old Greek epigram (*Anthol.* iii. 25, 51), may have been as purely professional in the two last cases as in the first, and his private character on such points was probably neither much better nor worse than that of his contemporaries. Athenaeus remarks acutely that he seems at least to have been sober when he wrote; and he himself strongly repudiates, as Horace does, the brutal characteristics of intoxication as fit only for barbarians and Scythians (*Fr.* 64). Of the five books of lyrical pieces by Anacreon which Suidas and Athenaeus mention as extant in their time, we have now but the merest fragments, collected from the citations of later writers. Those graceful little poems (most of them first printed from the mss. by Henry Stephens in 1554), which long passed among the learned for the songs of Anacreon, and which are well known to many English readers in the translations of Cowley and Moore, are really of much later date, though possibly here and there genuine fragments of the poet are included. Modern critics, however, regard the entire collection as imitations belonging to different periods—the oldest probably to Alexandrian times, the most recent to the last days of paganism. They will always retain a certain popularity from their lightness and elegance, and some of them are fair copies of Anacreon's style. A strong argument against their genuineness lies in the fact that the peculiar forms of the Ionic Greek, in which Anacreon wrote, are not to be found in these reputed odes, while the fragments of his poems quoted by ancient writers are full of Ionicisms. Again, only one of the quotations from Anacreon in ancient writers is to be found in these poems, which further contain no references to contemporaries, whereas Strabo (xiv. p. 638) expressly states that Anacreon's poems included numerous allusions to Polycrates. The character of Love as a mischievous little boy is quite different from that given by Anacreon, who describes him as "striking with a mighty axe, like a smith."

The best edition of the genuine fragments of Anacreon, as well as of the Anacreontea, is by Bergk (*Poetae lyrici graeci*, 1882). He includes in an appendix a similar collection of imitations from the *Anecdota graeca* of P. Matranga (1850), which had their origin in the beginning of the middle ages and resemble the Christian anacreontics of Sophronius.

ANACREONTICS (from the name of the Greek poet Anacreon), the title given to short lyrical pieces, of an easy kind, dealing with love and wine. The English word appears to have been first used in 1656 by Abraham Cowley, who called a section of his poems "anacreontiques," because they were paraphrased out of the so-called writings of Anacreon into a familiar measure which was supposed to represent the metre of the Greek. Half a century later, when the form had been much cultivated, John Phillips (1631–1706) laid down the arbitrary rule that an anacreontic line "consists of seven syllables, without being tied to any certain law of quantity." In the 18th century, the antiquary William Oldys (1696–1761) was the author of a little piece which is the perfect type of an anacreontic: this begins:

Busy, curious, thirsty fly,
Drink with me, and drink as I;
Freely welcome to my cup,
Could'st thou sip and sip it up.
Make the most of life you may;
Life is short and wears away.

In 1800 Tom Moore published a collection of erotic anacreontics which are also typical in form; Moore speaks of the necessity of catching "the careless facility with which Anacreon appears to have trifled," as a reason why anacreontics are often tame and worthless. He dwells, moreover, on the absurdity of writing "pious anacreontics," a feat, however, which was performed by several of the Greek Christian poets, and in particular by Gregory of Nazianzus and John of Damascus. (E G)

ANADYOMENE, a common Greek epithet of Aphrodite (Venus), expressive of her having sprung from the foam of the sea (from the Greek *anaduomenē*, "rising"). In a famous picture by Apelles she was represented as having just emerged from the sea and in the act of wringing her tresses. This painting was executed for the temple of Asclepios at Cos, from which it was taken to Rome by Augustus in part payment of tribute, and set up in the temple of Caesar. In the time of Nero, owing to its dilapidated condition, it was replaced by a copy made by the painter Dorotheus

ANADYR, (1) a gulf, and (2) a river, in the extreme north-east of the Kamchatka province of the Far Eastern Area of the Russian S.F.S. Republics. The gulf extends from Cape Chukchi on the north to Cape Navarin on the south, forming part of the Bering sea. The river rises in the Stanovoi mountains as the Ivashki or Ivachno, about 67° N. and 173° E., flows through the Chukchi country, at first south-west and then east, and enters the Gulf of Anadyr after a course of about 500m. The country through which it passes is thinly populated, barren and desolate. For nine months of the year the ground is covered with snow. Reindeer, upon which the inhabitants subsist, are numerous.

ANAEMIA, a generic term for various forms of disease characterized by a defective constitution of the blood, or, more specifically, by a reduction in the oxygen-carrying power of the blood. This reduction is due, either to a decrease in the number of red blood corpuscles, or to a decrease in the amount of haemoglobin they contain, haemoglobin being that constituent of the red corpuscles which makes it possible for them to carry oxygen to the tissues and to play an important rôle in the transfer of carbon dioxide from the tissues to the lungs. The amount of haemoglobin that each red corpuscle contains is represented by a term known as the colour index, which is derived by dividing the percentage of haemoglobin by the percentage of red corpuscles.

Types of Anaemia.—The customary division is as follows: (*a*) the primary, those in which the cause is yet unknown; and (*b*) the secondary, those due to some known cause. Chlorosis and pernicious anaemia are primary anaemias. The anaemia caused by haemorrhage, malaria, chronic poisoning by known chemical and biological agents, parasites, malnutrition, malignant disease, etc., is secondary.

Symptoms.—Since the chief derangement in all anaemias is a reduction of the total amount of haemoglobin in the blood, the symptoms and pathological anatomy are quite similar in the dif-

ferent kinds of anaemia. Pallor of the skin and mucous membranes, shortness of the breath, palpitation, faintness, weakness, languor, headache, and usually gastro-intestinal disturbances, are the general symptoms. A special tendency to haemorrhage is frequently present. The physician frequently finds the heart to be dilated and hears systolic murmurs in the heart on auscultation. Anatomically the internal organs are pale, sometimes smaller than normal and atrophic, and their cells contain an excessive amount of fat. The spleen is enlarged in some anaemias and is usually denser than normal. The red bone-marrow, which forms the red corpuscles and haemoglobin, is increased in amount except in rare cases. The diagnosis depends on the clinical picture, the examination of the blood, and a number of other findings.

Causative Factors.—Obviously anaemia must be due to either one or a combination of the following factors: loss of blood, increased destruction of red corpuscles, or a disturbance of the red bone-marrow (erythroblastic tissue), leading to a decrease in the normal supply of red corpuscles or to a decrease in the amount of haemoglobin they contain. The red bone-marrow in health continually supplies the blood with red corpuscles which contain a constant amount of haemoglobin to take the place of those destroyed in the liver, spleen and other tissues; so that the number of red corpuscles and the total amount of haemoglobin in the blood remain constant.

If blood is lost, or if there is an increase in the destruction of red corpuscles, the red bone-marrow compensates by producing red corpuscles at a more rapid rate than normal. In such a case, especially if the loss, or destruction, is great, the red corpuscles so produced are frequently small, contain a subnormal amount of haemoglobin and may even contain a nucleus, which denotes that the cell is young. In the course of time these abnormal cells are replaced by normal cells and the red bone-marrow returns to a normal rate of production. But if the loss or destruction is continuous or intermittent, as in chronic anaemias, the blood contains more and more abnormal red corpuscles. The erythroblastic tissue further attempts to compensate for this continuous demand for red cells by invading and replacing the yellow marrow which does not form red corpuscles. If the demand is in excess of the capacity of the erythroblastic tissue to respond, the condition of the blood seen in the chronic anaemias develops, namely, a decrease in the number of red corpuscles, the presence of abnormal types of corpuscles, and a diminution of the total amount of haemoglobin in the blood.

In some of the anaemias it is possible to state definitely which of the above factors are concerned; in others opinion can be based only upon an interpretation of the known facts. In the anaemia that follows repeated haemorrhage, as occurs in ulcers of the gastro-intestinal tract, the obvious factor is the loss of blood. In the anaemias caused by haemolytic toxins, the destruction of red corpuscles is the chief factor concerned, although these toxins may also act on the erythroblasts or embryonic red corpuscles in the bone-marrow. In the anaemia secondary to malignant disease, *e.g.*, gastric cancer, the anaemia is due to a combination of several factors. First there is a toxaemic condition due to absorption of products of decomposition formed in the growth itself. But in addition there may be present loss of blood from haemorrhage; an increase in the destruction of red corpuscles in some cases; a disturbance of nutrition leading to a lack of proper food supply for the erythroblastic tissue; and the possible action of the autolytic products of the cancer cells which may inhibit the activity of the bone-marrow. The evidence of increased red corpuscle destruction can sometimes be obtained by examination of the spleen and liver, their cells containing a larger quantity of iron than normal, by examination of secretions or excretions, such as the bile and urine (haemoglobinuria), and by determining the fragility of the red corpuscles. The fragility of the red corpuscles is ascertained by determining their ability to withstand a hypotonic solution of sodium chloride without disintegrating, normal red corpuscles being able to resist a 0·4% solution, whereas "fragile corpuscles" will discharge their haemoglobin in a 0·5% solution. The evidence of disturbance of the red bone-marrow is obtained by detailed examination of the blood, the cellular constituents being markedly altered. In the chronic anaemias regeneration and destruction, or loss, occur simultaneously, so that the blood picture gives an idea more of the capacity of the erythroblastic tissue to respond than of the amount of destruction that is occurring. In aplastic anaemia, a rare condition, the red bone-marrow, does not respond, and as a result the anaemia runs a rapid and progressive course without remissions, contrary to the usual course of the chronic anaemias.

Chlorosis.—Chlorosis and pernicious anaemia are primary anaemias that deserve special discussion because of their common occurrence. Chlorosis occurs almost exclusively in females between the ages of 14 and 25, the most frequent ages of onset being 14 and 15 This disease is characterized by a pronounced haemoglobin deficiency without a proportional decrease in red corpuscles. It is rarely directly fatal and is fortunately very amenable to treatment with iron preparations, blood transfusions being required only in advanced and stubborn cases. The administration by mouth of bone-marrow and spleen is also beneficial. Recurrences of the disease are quite common. The cause of chlorosis is unknown. All evidence shows that a haemolytic agent is probably not responsible. The erythroblastic tissue is at fault, particularly in the formation of haemoglobin. The fact that iron is so beneficial suggests that iron starvation is in some way related to the primary cause, which is also related in some way to the age of puberty and the function of menstruation. Because of this latter factor, some believe that the glands of internal secretion, especially the ovary, are at fault; but no conclusive evidence is as yet available. An improper diet, overwork, worry and lack of fresh air are predisposing factors. Chlorosis does not occur frequently in country-bred girls, which is probably due to the greater exposure to sunshine and "outdoor life," which these girls enjoy. In towns, too, it is less common than formerly. The symptoms of chlorosis are in general those of anaemia.

Pernicious Anaemia.—Pernicious anaemia is a disease of middle life and is twice as common in males as in females. It is characterized by a progressive anaemia interrupted by periods of temporary improvement, and by a fatal termination almost without exception in from two to five years, the body being rarely emaciated. The onset of this disease is slow and insidious. The skin is pale and later takes on a lemon tint. Languor, weakness and breathlessness are not marked at first, but later become extreme. The heart palpitates readily. The mucous membrane of the mouth is glossy and appears bloodless; the tongue is sore. The appetite fails and quite early in the disease acid disappears from the gastric secretion. Attacks of diarrhoea and abdominal pain frequently occur. There is a tendency to bleed into the skin and serous surfaces. Some patients experience sensations of numbness and tingling and complain of neurotic pains.

The blood picture is much changed, the red corpuscles being greatly reduced in number and very abnormal in shape and size, as well as in other respects. The red corpuscles contain an abundance of haemoglobin, the colour index being greater than 1·0. The white blood corpuscles are generally normal or diminished in number, but frequently abnormal forms are present. On post-mortem examination the bone-marrow is red and hyperplastic, except in cases of aplastic anaemia; lesions of the spinal cord are found; the gastric mucosa is frequently atrophic; the internal organs show fatty degeneration; the lymph glands may be deepened in colour (haemolymph glands), and there is much iron pigment in the kidneys, liver and spleen.

In contrast to chlorosis, there appears to be no serious difficulty in the formation of haemoglobin in pernicious anaemia. Many evidences of excessive blood destruction are present, particularly the increased iron content of the organs, free haemoglobin in the blood serum and urine, the frequent occurrence of jaundice, and the increased fragility of the red corpuscles. A condition simulating pernicious anaemia occurs in continued poisoning with toluylendiamine and ricin and in patients infected with bothriocephalus, an intestinal parasite that produces a haemolytic agent.

Haemolytic substances are said to be present in the intestine of anaemic patients that have chronic intestinal disorders, and recently a condition similar to pernicious anaemia has been

observed to occur following intestinal stasis. B. aerogenes capsulatus, which frequently inhabits the intestine of man, produces a haemolytic agent, and it is reported that they occur in increased numbers in the intestines of patients that have pernicious anaemia and that their number decreases during the remissions. The feeding of these bacteria in large numbers, or the intravenous injection of their products, produces in animals a condition quite like pernicious anaemia in man. Buckman and Horrall report that an haemolytic substance is present in the serum of pernicious anaemia patients.

Some observers believe that the stomach is in some way related to the cause, because of the high incidence of absence of acid in the stomach (achlorhydria) of patients suffering with this disease and because this disease sometimes occurs after total removal of the stomach. The absence of the acid in the stomach is said to favour the growth of bacteria that produce haemolytic poisons. After total gastrectomy in dogs a grave anaemia is found, which, however, has been controlled by the administration of iron and cod-liver oil. Although the more recent evidence seems to show that the change in the stomach is primary, it is commonly held to be secondary, as are the changes in the bone-marrow and nervous system, to the action of a toxin, irrespective of its source.

(A. C. I.)

Treatment and Diet.—As regards treatment, Minot and Murphy of the Harvard Medical School showed in 1926 that very much may be done to stimulate blood-production and improve the patient's condition by feeding with liver. About half a pound of liver must be taken daily until the normal blood picture is restored which may be in a few weeks; subsequently the amount of liver may be reduced. In 1927 Cohn, Minot, Murphy and others found that a non-protein extract from liver containing the unknown factor could be used with equal success. These results have been confirmed in Great Britain, and in March 1928 the Medical Research Council, in a preliminary report, stated that extracts prepared by certain commercial drug firms had proved satisfactory. Certain other animal organs, as well as apricots, peaches and plums, are also of service. It has been debated whether iron must be in organic combination to be utilizable in blood regeneration or whether a simple organic salt (as ferrous carbonate) will suffice, but the evidence is that the form and quantity are not significant. Beef kidney and raspberries contain much more iron than do beef liver, apricots and peaches, but are much less effective in blood regeneration. Some unknown substance is supplied by the effective foods enabling the body to utilize the iron. Apricots, peaches and prunes are about as effective as bone marrow, pancreas and spleen; raisins and grapes rank lower, about on a par with brain tissue. The dried fruits are as effective as the fresh and in this connection are far superior to dairy products.

At the same time it may be noted that while diet may help, the liver treatment apparently affects the formation of blood alone and not the underlying condition on which the pernicious anaemia depends; the achlorhydria in particular is unaffected. Hence general measures must be undertaken besides the liver treatment. The source of the toxaemia should be looked for. Plenty of fresh air, sunlight and cod-liver oil are indicated. Dilute hydrochloric acid by mouth improves digestion. Removal of the spleen has been tried extensively, but without definite benefit. It is of great benefit, however, in splenic anaemia. Repeated blood transfusion is sometimes of great, though temporary value.

The benefits of liver diet for pernicious anaemia have been successfully demonstrated, both in America and Great Britain. The treatment was first suggested by G. R. Minot and W. P. Murphy of Harvard Medical school. Because a daily liver diet is intolerable to most patients, there have been extensive efforts to isolate the active principle in liver. As a result, liver extracts from the United States, Germany and Great Britain are now on the market. Since the extracts are soluble in water, a single dose, equivalent to nearly 30 oz. of whole liver, can be given a patient unable to take solid food. It has been demonstrated also that anaemics may obtain variety in apricots, peaches and prunes, either fresh or dried, and in certain other animal organs, such as brain tissue, bone-marrow, pancreas and spleen.

Other Forms of Anaemia.—There are other diseases of the blood and blood-forming organs, such as lymphosarcoma, Hodgkin's disease, chloroma, leucaemia and anaemia pseudoleucaemia of children, in which anaemia occurs. In these diseases the disturbance chiefly involves the white corpuscles, or leucocytes, and hence these diseases are not to be considered in a general discussion of anaemia. (X.)

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ANAESTHESIA and **ANAESTHETICS,** terms used in medicine to describe a state of local or general insensibility to external impressions, and the substances used for inducing this state. In diseases of the brain or spinal cord anaesthesia is an occasional symptom, but in such cases it is usually limited in extent, involving a limb or a definite area of the body's surface and depends upon interference with nerve tracts or centres. Complete anaesthesia occurs in a state of catalepsy or trance.

The artificial induction of anaesthesia holds a foremost place in modern medicine; in 1800 Sir **Humphry** Davy, while experimenting on nitrous oxide (the so-called "laughing gas"), discovered its anaesthetic properties, and described the effects it had on himself when inhaled with the view of relieving local pain. In 1818 Faraday showed that the inhalation of the vapour of ether produced anaesthetic effects similar to those of nitrous oxide; and this property of ether was also shown by the Americans, John D. Godman (1822), James Jackson (1833), Wood and Bache (1834).

These observations remained scientific curiosities until March 30, 1842, when Dr Crawford D. Long performed at Jefferson, Ga , an operation under ether His statue now stands in the statuary hall in the Capitol, Washington, D C. In December 1844, when Dr. Horace Wells, a dentist of Hartford (Conn), underwent in his own person the operation of tooth-extraction while rendered insensible by nitrous oxide. On Sept. 30, 1846, Dr. W. T. G. Morton, a dentist of Boston, following the suggestion of Dr. C. T. Jackson, employed the vapour of ether in private to procure general anaesthesia in a case of tooth-extraction, and thereafter administered it in cases requiring surgical operation with complete success. The first operation in public under ether was performed by Dr. J. C. Warren at the Massachusetts General Hospital on Oct. 16, 1846. On Dec. 19 of the same year Robinson, a dentist in London, and on the 21st Robert Liston, the eminent surgeon, operated on patients anaesthetized by ether; and the practice soon became general both in Great Britain and on the continent.

Sir James Simpson, in 1847, was the first to apply anaesthesia by ether to midwifery practice. On March 8, 1847, M. J. P. Flourens read a paper before the Académie des Sciences on the effect of chloroform on lower animals, and in November of the same year Simpson announced his discovery of the anaesthetic properties of chloroform. During the intervening period other drugs were found to possess anaesthetic properties. Of these ethyl chloride has come into prominence at the present time; nitrous oxide, too, which had been lost sight of, was reintroduced, to become the most popular anaesthetic in dental practice. Frequently, either alone or with oxygen, nitrous oxide is used in the preliminary stages of inducing ether anaesthesia.

The administration of the above-named drugs is by inhalation, and has to be continued throughout the operation, the reason being that all the drugs are as rapidly excreted as they are absorbed, especially by the lungs, and therefore no other method would be of any avail. On the other hand there are drugs which are sufficiently slowly eliminated to allow of an operation being performed between the moment of induction and that of recovery. The use of scopolamine and morphine in the production of "twilight sleep" for childbirth is an example. These drugs are injected with a hypodermic needle. Similarly, urethane produces a profound general anaesthesia but has only been used on the lower animals, as its

depressing effect on the respiratory centre contra-indicates its use in human beings.

Local Anaesthesia.—Much attention has been devoted to the discovery of methods by which the insensibility may be confined to the area of operation and the loss of consciousness avoided. But they have only lately been successfully applied to the severer operations. The earliest local anaesthetic was cold, produced by a mixture of ice and salt. The skin is now frozen by a fine spray of ether or ethyl chloride. The recovery, like that from any other frostbite, is very painful, and the time during which an operation can be done is very short; consequently this method has been very largely superseded by the use of drugs, particularly cocaine and its derivatives. Cocaine has by far the highest anaesthetic properties; it is, however, in certain individuals a most powerful cardiac depressant and has caused numerous fatalities. Eucaine has now largely taken its place, though its anaesthetic properties are less; it is, however, less toxic, and can be sterilized by heat.

Spinal Analgesia.—The method of inducing analgesia by injecting solutions into the sheath surrounding the spinal cord was devised by Bier in 1898, but was not adopted to any great extent, until Fourneau discovered *stovaine* in 1904. The substances injected, by virtue of their specific action on nervous tissues, cause loss of painful sensations in the lower limbs and for a variable distance up the trunk. The injection is followed, generally within three to five minutes, by the production of analgesia, which lasts for a period varying from half an hour to two hours. Various substances have been used for the purpose of which the following are the chief: tropacocaine, stovaine, novocaine, cocaine, eucaine and alypin. The chief points in favour of this method of producing analgesia are as follow: (*a*) The patient is not rendered unconscious, and is often able to assist at his own operation, such as by coughing or moving his limbs in any way as may be desired; (*b*) there are no troublesome after effects, such as nausea, vomiting and thirst; (*c*) surgical shock is considerably lessened, especially in such operations as amputations and severe abdominal emergencies; (*d*) the risk attending a general anaesthetic is avoided. The chief disadvantages are: (*a*) A severe form of headache may sometimes follow; (*b*) the paralysis of muscles. In a very few cases this has been permanent. The temporary paralysis of the muscles of respiration is apt to be a serious matter; (*c*) the uncertainty of the method, so that the analgesia is not always as complete as is desirable; (*d*) the analgesia for safety must be limited to a line below the level of the second rib in front. Finally, operations have been performed under a local anaesthesia produced by hypnotism (*q.v.*) but this is a method that can only be used on selected cases.

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ANAGNIA (mod. Anagni); pop. (1921), town 6,274, commune 10,504; an ancient town of the Hernici, on a hill (1,558ft.) above the valley of the Trerus and the Via Labicana. Its position in a fertile district soon gave it importance, and it became the seat of the assembly of the Hernican towns. In the war of 306 B.C. it lost its independence. It was besieged by the Saracens in 877, but in the 11th century was a place of considerable importance, the Conti and Caetani being the chief families; Pope Boniface VIII., a member of the latter, was there made prisoner in 1303. The ancient city walls, built of rectangular blocks of porous limestone, still stand, much restored in places. Within the city the only ancient remains are some massive substruction walls on the hillside. The cathedral, constructed in 1074 at the summit of the hill, is externally plain; it has a fine Gothic interior.

ANAGRAM, the result of transposing the letters of a word or words in such a manner as to produce other words that possess meaning (Gr. ἀνὰ back, and γράφειν, to write). The construction of anagrams is an amusement of great antiquity, its invention being ascribed without authority to the Jews, probably because the later Hebrew writers, particularly the Kabbalists, were fond of it, as serting that "secret mysteries are woven in the numbers of letters." Anagrams were known to the Greeks and also to the Romans, although the known Latin examples of words of more than one syllable are nearly all imperfect. They were popular throughout Europe during the middle ages and later, particularly in France, where a certain Thomas Billon was appointed "anagrammatist to the king" by Louis XIII. Dryden disdainfully called the pastime the "torturing of one poor word ten thousand ways," but many men and women of note have found amusement in it. A well-known anagram is the change of *Ave Maria, gratia plena, Dominus tecum* into *Virgo serena, pia, munda et immaculata.* Among others are the transposition of "Horatio Nelson" into "Honor est a Nilo"; and of "Florence Nightingale" into "Flit on, cheering angel." The pseudonyms adopted by authors are often transposed forms, more or less exact, of their names; the most remarkable pseudonym of this class is the name "Voltaire," which the celebrated philosopher assumed instead of his family name, "François Marie Arouet," and which is generally allowed to be an anagram of "A'ouet, l j.," that is, Arouet the younger Some of the astronomers of the 17th century embodied their discoveries in anagrams with the design apparently of avoiding the risk that, while they were engaged in further verification, the credit of what they had found out might be claimed by others.

Another species of anagram, called "palindrome," is a word or sentence which may be read backwards as well as forwards, letter by letter, while preserving the same meaning; for example, the word "tenet."

ANAHEIM, a city of Orange county, California, U.S.A., 25 m. S.E of Los Angeles. It is served by the Santa Fe, the Southern Pacific, and the Union Pacific railways, and by a network of highways. The population was 5,526 in 1920; and was estimated locally at 12,500 in 1925.

It lies in a fertile plain, irrigated from the Santa Ana river, which produces lemons and deciduous fruits, walnuts, berries, sugar beets, grain, and vegetables. The chief industrial products are dried and canned fruits, beet sugar, farm machinery, oil-well drilling supplies and denatured alcohol. Natural gas and crude oil are used for fuel.

Anaheim was the first of the settlements due to co-operative enterprise in Southern California. In 1857, 50 Germans organized an association in San Francisco, bought 1,165 acres of arid land, and prepared it for occupancy. The tract was then divided into 20-acre shares, which were distributed among the members by lot, with bonuses and rebates to equalize differences in value. This ended the co-operative aspect of the venture, except that the irrigating canal remained common property. The town was incorporated in 1870, and received a city charter in 1888. It has a city-manager form of government.

ANÁHUAC, a geographical district of Mexico, limited by the traditional and vaguely defined boundaries of an ancient Indian empire or confederation of that name previous to the Spanish conquest. The word signifies "country by the waters" in the old Aztec language; hence the theory that Anáhuac was located on the sea coast. Anáhuac has been described as all the plateau region of Mexico, with an area equal to three-fourths of the republic, and extending between the eastern and western coast ranges from Rio Grande to the Isthmus of Tehuantepec But it properly is the great plateau valley in which the city of Mexico is located, between 18° 40′ and 20° 30′ N. lat., about 200m. long by 75m. wide, with an average elevation of 7,500ft., and a mean temperature of 62°. The existence of the name in southern Utah, United States, and on the Gulf coast of Mexico, has given rise to theories of other locations and wider bounds for the old Indian empire.

ANAKRUSIS, from the Greek, meaning literally "up beat," has been defined in poetry as, "a syllable at the beginning of a verse before the just rhythm"; otherwise, an introductory weak accent preceding a strong one. In music the term is similarly applied to the notes on the weak beats of the bar, more especially to that on the last beat, preceding the strong one on the first beat

of the following bar, and constituting very frequently an apparently incomplete bar when occurring at the beginning of a composition.

ANALCIME, a common mineral of the zeolite group. It crystallizes in the cubic system, the common form being the icositetrahedron (211), either alone or in combination with the cube (100). The crystals are often perfectly colourless and transparent with a brilliant glassy lustre, but some are opaque and white or pinkish-white. The hardness is 5 to 5½, and the specific gravity 2·25. Chemically, analcime is a hydrated sodium and aluminium silicate, $NaAlSi_2O_6+H_2O$. Before the blowpipe the mineral readily fuses with intumescence to a colourless glass. It is decomposed by acids with separation of gelatinous silica. Analcime usually occurs, associated with other zeolitic minerals, lining amygdaloidal cavities in basic volcanic rocks such as basalt and melaphyre. The Tertiary basalts of the north of Ireland frequently contain cavities lined with small brilliant crystals of analcime. Larger crystals of the same kind are found in the basalt of the Cyclopean islands, Sicily. Large opaque crystals of the pinkish-white colour are found in cavities in melaphyre at the Seisser Alpe in southern Tirol.

ANALGESIA is the name given to the loss of the sensation of pain, and is due to an interruption of the nervous pathway between skin and brain. Different forms of sensation from one area of skin, such as touch, temperature, and pain, travel to the spinal cord by different nerve fibres in the same nerve bundle. Hence any injury or disease affecting such a nerve would abolish all forms of sensation in the area supplied by it. However, when the sensory nerves reach the spinal cord their fibres separate and pursue different courses on their way upward to the brain. Thus it is possible for certain forms of sensation to be lost, while others are preserved, in diseases which affect only certain areas in the spinal cord. Since the sensations of pain and temperature travel the same path, they are usually lost together. Diseases of the cord which may cause analgesia without loss of the sensation of touch are tabes dorsalis, syringomyelia and tumours of the cord. Analgesia may also be a manifestation of hysteria.

ANALOGY. Originally the general term *analogy* appears to have been used in the sense of "proportion," and so confined to quantitative relationships. Thus, for instance, the relation between three and four would be described as analogous to that between nine and 12; or, more generally, the relation between x and y would be described as analogous to that between nx and ny. Analogy in this sense could obviously serve as a basis for reliable inferences. In the solution of equations of many kinds it is usually possible to determine (that is, to infer) the value of an unknown quantity when its relation to a known quantity is given. Hence the early vogue of the expression "inference (or reasoning) from analogy." In mathematics, however, the term analogy has been displaced by the term proportion, except in the expression "Napier's Analogies" still used in spherical geometry.

Side by side with this *quantitative* application of the term *analogy* we find, already in Aristotle, a *qualitative* use of it. In its quantitative sense of "proportion," analogy designated similarity or identity of quantitative relationship between two pairs of terms; in its qualitative use the term analogy indicates similarity in *any kind* of (non-quantitative) relationship between two sets of terms. In this wider sense the term is very common, and the thought which it expresses is applied very extensively, especially in popular modes of thought and of expression. This is evident from the frequent use of metaphor, which is but one example of analogy. For instance, the metaphorical use of the term "sweet" in the phrase "a sweet melody" is an abridgment of the analogy that "this melody affects the ear in the same pleasing way as sweet things affect the palate." Similarly the expression "Mother Country" implies the analogy that "the relation of a country to its colonies is like that of a mother to her children." Another familiar group of analogies may be seen in the way in which people inflect new terms (or terms which are new to them) on the model of the known inflections of other terms—*e.g.*, "looped" is to "loop" as "looked" is to "look." Or, again, the names of certain organs of animals are often based on analogies—the so-called "wings" of butterflies are structurally very different from the wings of birds, but their function in relation to the butterfly (viz., in enabling it to fly) is essentially like that of the wings of birds, and so these otherwise different organs of butterflies and of birds are called "analogous organs." Similarly, all kinds of new inventions are frequently given names based on analogy—"airships," *e.g.*, are machines which do in the air what ships do in the water. And so on.

As appears already from the case of metaphors, from the case of "analogous organs" in biology, and analogous constructions in grammar, the *similarity of relationships* between pairs or sets of terms is apt to appear as a *similarity between the terms* or things themselves. And so the term "analogy" has come to be extended to *similarities* generally, excepting that close similarity which exists between members of the same recognized class of objects in respect of those qualities which are regarded as characteristic of that class. Thus, *e.g.*, one would not think of potatoes as being "analogous" to one another—they are too much like one another for that. Similarly with apples. But, as is evident from their French and German names, potatoes are regarded as "analogous" to apples.

The Psychology of Analogy.—Psychologically or educationally the importance of analogy lies in the fact that it is a very common form of apperception (*q.v.*), a way of assimilating new and strange objects to older and more familiar ones—a way of profiting from past experience for the proper apprehension and treatment of new situations. Any new thing or occurrence is apt to appear familiar, and so to become acceptable, as soon as it can be linked up in some way with the general store of our already acquired ideas and beliefs. The only safeguard against the evils of so-called "reasoning from analogy," or "analogical argument," is a correct insight into the real nature and function of analogy considered from a logical point of view.

The Logic of Analogy.—As was pointed out above *quantitative* analogy is a basis of valid inferences. *Qualitative* analogy (the only type with which we are now concerned) is also frequently made the ground of inference. In fact some thinkers regard analogical reasoning as one of the fundamental types of inference together with deductive and inductive inference Some, on the other hand, regard it as a species of deductive inference, and others as a variety of inductive inference. But at all events analogy is commonly accepted as a legitimate ground of inference when due care is taken. Now it is true that, as a matter of fact, people commonly do draw inferences from analogy. The real question, however, is whether such inferences can be regarded as conclusive or cogent. In other words, can reasoning from analogy ever be regarded as more than tentative, as equivalent to proof? This question must be answered in the negative for the following reasons. Reasoning from analogy usually assumes the following form: A certain phenomenon or a certain class of phenomena, say S, resembles a certain other phenomenon or class of phenomena, say Z, in some assignable respect, say M. Now Z is known to be P as well as M. It is accordingly inferred that S which resembles Z in respect of M also resembles it in respect of P; in other words, S is P. Now, strictly speaking, this conclusion could only be justified if it could be shown that M and P are connected by some law, either directly or indirectly. For unless M and P are so connected, the presence of M, in S or in anything else, may be entirely irrelevant to the question of the presence of P. That is why it is usually insisted that analogies or similarities must be *weighed,* not merely counted. For instance, the fact that light and sound resemble each other in respect of being transmitted through considerable distances is in itself no evidence that they also resemble each other in respect of having the same medium, or in respect of polarization, or even in respect of an undulatory form of transmission. If there is any connection between transmissibility and any of these other phenomena, it must be established independently. Now the question whether there is any connection betwen M and P, and if so, what it is, can only be decided by the usual methods of induction, not by mere analogy. The analogy may *suggest hypotheses* for inductive investigation; but it cannot *prove* anything. Analogy, in brief, is probably the most

fruitful source of suggestions, of hypotheses, that is, of *tentative inferences,* but it is not a type of *proof* at all. If an analogical inference is proved at all it is proved by inductive methods; if it is not proved or verified by inductive methods, it is not proved at all, and remains a mere suggestion, which may indeed be true, but is not yet established. In so far as an analogical suggestion proves fruitful it results in the inductive establishment of a connection between M and P, and so leads to the deductive application of this law of their connection to cases like S, etc. In other words, the analogy may eventually lead to both inductive and deductive proofs; but the analogy itself is neither inductive nor deductive, nor is it a proof at all; it is only an auxiliary to all these.

Of the value of analogy as an auxiliary to inductive investigation there can be no reasonable doubt. The history of science affords abundant evidence of this. A few illustrations may be adduced here. Descartes' perception of the analogy between algebraic and geometrical relationships has led to many important discoveries in modern mathematics. The observation of Jupiter and the Medicean satellites or moons led by analogy to the suggestion of the modern conception of the solar system. Newton's perception of the analogy between a falling apple and the moon led to the establishment of celestial gravitation. But analogy as such never goes beyond helpful *suggestion*—the actual results must be borne out by scientific methods. That is why in the more advanced sciences analogy plays a relatively unimportant part The finished results are supported by inductive evidence; the analogies by which they may have been first suggested are no part of the evidence, and are of interest only as incidents in the mental history of the discoverer, in the history of the builder rather than in the structure of the building. On the other hand, in the less developed sciences analogy may play a prominent rôle. Much of so-called biological sociology consists in the exploitation of analogies between the structures and functions of animals and those of societies. The reason for the conspicuous part played by analogy in the less developed sciences, or stages of a science, is this: The first problem to be attacked in the history of a science is that of classification—the most helpful (intellectual) grouping of the phenomena to be investigated. Now some phenomena are obviously similar or obviously different (though not always really so). Others are not so, and it may require a keen eye for analogies to bring together things that really belong together but not obviously. In this way analogy may be an early stage in the recognition of a new and somewhat complex class of facts. The history of terms like "boycott" or "Hobson's choice" furnishes popular illustrations of this process. Franklin's study of lightning, and his careful enumeration of the analogies between lightning and electricity, may serve as a scientific illustration of the help that may be rendered by analogy in the classificatory stage, as well as in the later stages, of a science. It should be noted, however, that Franklin did not stop at the analogies between lightning and electricity, but proceeded to test the suggestion experimentally by means of his famous kite. In comparatively simple cases the transition from analogy to a new class concept is easy. After considering a few cases analogous to that of Captain Boycott, or to that of Hobson, one may readily get at the idea of social ostracism, or of apparent without real choice, respectively. But in more complex instances there is the danger that some important feature may be overlooked in the general description or definition of the type as such. Hence probably the legal tendency to cite cases and follow precedents rather than formulate general laws or principles—flexible analogies being regarded as safer than rigid formulae in certain types of legal and similar problems.

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ANALYSIS, in general, the resolution of a whole into its component elements; opposed to synthesis, the combining of separate elements or minor wholes into an inclusive unity. Both analysis and synthesis may be either purely mental or physical. The analysis and synthesis carried out in psychology, for instance, are purely mental. But even in physics, chemistry, etc., where these processes can also be carried out physically, the mental analysis or synthesis generally precedes the physical in all well-planned experiments.

In grammar, analysis is the breaking up of a sentence into subject, predicate, object, etc. (an exercise introduced into English schools by J. D. Morell about 1852); so the analysis of a book or a lecture is a synopsis of the main points. The chief technical uses of the word, which retains practically the same meaning in all the sciences, are in (1) philosophy, (2) mathematics, (3) chemistry.

(1.) Logical analysis is the process of examining into the connotation of a concept or idea, and separating the attributes from the whole and each other. It, therefore, does not increase knowledge, but merely clarifies and tests it. In this sense Kant distinguished an analytic from a synthetic judgment, as one in which the predicate is involved in the essence of the subject. Such judgments are also known as verbal, as opposed to real or ampliative judgments. The processes of synthesis and analysis though formally contradictory are practically supplementary; thus to analyse the connotation is to synthesize the denotation of a term, and vice versa; the process of knowledge involves the two methods, analysis being the corrective of synthetic empiricism. In a wider sense the whole of formal logic is precisely the analysis of the laws of thought. Analytical psychology is distinguished from genetic and empirical psychology inasmuch as it proceeds by the method of introspective investigation of mental phenomena instead of by physiological or psycho-physical experiment. For the relation between analysis and synthesis on the one hand, and deduction and induction on the other, *see* INDUCTION.

(2.) In Greek mathematics the method of proving a proposition by resolving it into simpler statements already proved or else assumed as axiomatic. Pappus (*c.* 275), in his *Synagoge* or *Collection* (Bk. VII., "On the Treasury of Analysis"), gives the best extant Greek definition. "Analysis, then, takes that which is sought as if it were admitted and passes from it through its various consequences to something that is admitted as the result of synthesis." The process was probably used by the early Pythagoreans in the 5th century B.C., and was taught in Plato's school. Pappus speaks of it further as "a method which Plato, as they say, communicated to Leodamas, and by which the latter, too, is said to have discovered many things in geometry."

In the Renaissance period it came to be considered as the method of solving problems by means of equations, as in analytic geometry (*q.v.*). At present the word is used in a much more general way, being considered as including the theory of functions of real variables, infinite series, the differential and integral calculus, definite and multiple integrals, the calculus of variations, the theory of functions of complex variables, algebraic functions, elliptic and modular functions, special functions (Eulerian, Legendre's, Bessel's, hypergeometric, etc.), metrical and projective properties of quadric surfaces, algebraic curves and surfaces, algebraic configurations in general and infinitesimal and differential geometry. These topics are treated in various special articles, including CURVE; FUNCTIONS; FORMS; CALCULUS, DIFFERENTIAL AND INTEGRAL; and DIFFERENTIAL GEOMETRY.

(3.) In chemistry the word analysis was introduced by Robert Boyle to denote the determination of the composition of substances. (*See* CHEMISTRY: *Analytical.*)

BIBLIOGRAPHY.—For a detailed summary of the scope of modern analysis, with references to scientific literature *see* the *Catalogue of Scientific Papers* of the Royal Society of London, vol. i. pp 233–653 (1800–1900). For later material see the *Jahrbuch über die Fortschritte der Mathematik* (annual summary of publications) and the *Revue Semestrielle.*

ANALYSIS SITUS (POSITION ANALYSIS). In this branch of mathematics shape and size are unimportant. The important property may be said, roughly, to be *proximity;* to state it in precise terms, we must introduce the idea of *limit point.* Let *S* denote the collection of all points in the Euclidean plane (*i.e.,* the plane studied in Euclidean plane geometry). Then a point, *P,* is called a *limit point* of a collection of points *M* if every circle whose centre is at *P* encloses at least one point of *M* which is distinct from *P.* It is easily seen from this definition that every

point of S is a limit point of S. Also every point of a line is a limit point of the collection of all points on that line. Similar statements may be made for all the ordinary figures of plane geometry. In *Analysis situs* we are interested only in those properties of figures which can be expressed in terms of collections, or *sets*, of points and their limit points—such properties are called the *topological* properties of the figures. A geometrical figure is regarded more in the sense of being a *point set* than as being a "figure." (*See* POINT SETS.)

From another point of view it may be said that *Analysis situs* is interested only in those properties of figures or point sets which are not changed when the figures are subjected to continuous motion in a fluid medium. Thus, it is easy to conceive of a fluid motion carrying a circle into an ellipse and thence into a square, even though the areas enclosed by these figures differ greatly. From the standpoint of *Analysis situs*, then, there is no essential difference between these figures—the differences in their sizes and shapes are unimportant. However, the idea of continuous fluid motion is not precise enough for an exact characterization of *Analysis situs*. In order to make the idea implied by the illustration more exact, we introduce the idea of *homeomorphism*, and here we are led again to the idea of limit point.

Homeomorphism.—Two point sets, A and B, are said to be *homoeomorphic* if their points can be made to correspond in a one-to-one manner, those of A to those of B, so that if A_1 is any set of points in A having a point P_1 in A as a limit point, then the set, B_1, of corresponding points in B has the point P_2 of B which corresponds to P_1 as a limit point, and conversely. In figure 1 consider the sets A, B and C. In A the set of points consisting of a_1, a_3, a_5, ..., that is, all a's having odd subscripts, has a as a limit point (we suppose that there are infinitely many points in A, the subscripts of the a's running through the entire set of positive integers); similarly the set of a's with even subscripts has a as a limit point. It may be said that these two sets *converge to a* from two opposite directions. In B there are three sets of points, consisting of (1) b_1, b_4, b_7, ..., (2) b_2, b_5, b_8, ..., and (3) b_3, b_6, b_9, ..., converging to b from three different directions. The set C contains a set of points consisting of c_1, c_2, c_3, ..., which has two limit points, d_1 and d_2. Now A and B are homeomorphic, since by simply making every a_n correspond to the b_n of the same subscript, and a to b, the definition is satisfied. But neither A nor B is homeomorphic with C, for no correspondence can be set up between

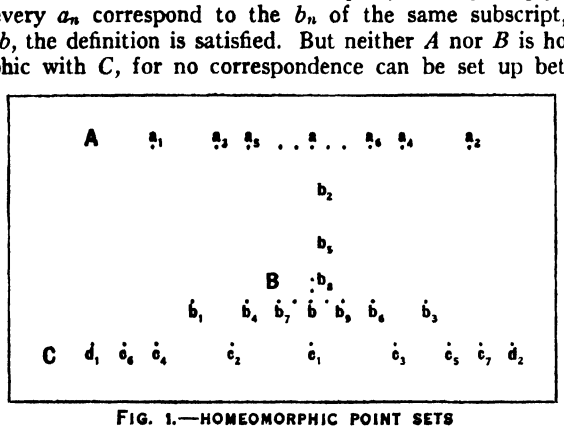

FIG. 1.—HOMEOMORPHIC POINT SETS

A and C, say, which will satisfy the definition. If both d_1 and d_2 were made to correspond to a, then the latter part of the definition would be satisfied, but then the correspondence would not be one-to-one.

It can be seen that squares, circles, ellipses, triangles and polygons are all equivalent in the sense that they are homeomorphic. And if we substitute the precise notion of homeomorphism for that of fluid motion, we can say that *Analysis situs* is interested only in those properties which are common to all figures that are homeomorphic. It might be asked, after observing that the geometric figures just mentioned do not have a common shape or a common size, and hence seem to have very little in common, just what properties are left to be studied? It may seem that there is very little left to be studied. To show that this is by no means the case, will be the purpose of the remainder of this article. We shall not attempt to cover all of the various aspects of *Analysis situs*, but take up only sufficient of the elementary notions to accomplish our purpose.

Connectedness.—A glance at the various familiar figures of plane geometry, such as the line, the triangle, the circle and the polygon, impresses one with a general property of such collections of points, namely their *connectedness*. Thus, a straight line, although it is made up of points, is somehow to be thought of as a connected thing, in the sense that if it were possible to pick up the line with one's hands it would not fall apart, but would hang together like a piece of twine. It was an early problem of *Analysis situs* to express in some precise way just what this connectedness of sets of points is. The most successful attempt at this is embodied in the so-called Lennes-Hausdorff definition (1) (2). A point set M is *connected* if it is impossible to separate it into two sets A and B such that A and B have no common points and such that neither A nor B contains a limit point of the other. It can be shown that all of the geometrical figures referred to above are connected according to this definition. Thus, no matter how we divide the set of all points on a line into two groups, at least one of these will contain at least one limit point of the other. It is easy to prove that if two point sets are homeomorphic and one of them is connected, then the other is connected; *i.e.*, connectedness is a common property of homeomorphic point sets.

Recent researches have demonstrated, however, that the connectedness implied by this definition is not as strong as the "connectedness" one has in mind when thinking of a line as the geometric analogue of a piece of twine. If a point is removed from a line, the remainder is separated into two portions each of which is itself connected. If we remove a point from a circle what is left is still connected; *i e*, no point of a circle *disconnects* the circle. But the existence has been established (3) (4) of certain sets of points in S, which, though they are connected according to the above definition, can be totally disconnected by the omission of single points. That is, there exists, in S, a connected point set M containing a certain point P which, if omitted from M, leaves no connected portion in M whatsoever.

Closed Sets and Continua.—However, the set of all points on a line has a property which the set of points M just referred to does not have; thus, if P is a limit point of the set, L, of all points on a straight line, then P must be a point of L. For if P were not a point of L, then, denoting by d the perpendicular distance from P to the line, clearly a circle with centre at P and radius equal to one-half of d would enclose no points of L and hence P could not be a limit point of L. The property of containing all limit points has been found to be an important one in *Analysis situs*, and is given a special name; if a set of points contains all of its limit points, it is said to be *closed*. A point set which is both closed and connected and which contains more than one point is called a *continuum*. All ordinary geometrical figures are therefore continua, and it is easy to show that if one of two homeomorphic point sets is a continuum, then the other is a continuum. The set M referred to in the preceding paragraph is not only not closed but fails to contain any continuum whatsoever.

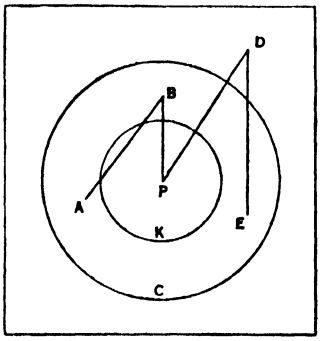

FIG 2.—LOCALLY CONNECTED POINT SETS

It is natural for the mathematician, having generalized from the figures of geometry to the continuum, to investigate the nature and possible structure of continua from a topological standpoint. Perhaps the simplest continuum is the *arc*, which is a set of points that is homeomorphic with a straight line interval. Another simple continuum is the *simple closed curve* which is a set of points that is homeomorphic with a circle. Both arcs and simple closed curves are special cases of *continuous curves*, which form a much more general class of continua. In order to characterize those continua which are continuous curves we introduce the idea of *local connectedness*.

Local Connectedness.—A set of points M is said to be *locally connected* at a point P provided that if C is any circle with centre at P there exists another circle, K, with centre at P, such that if Q is a point of M interior to K, then there is some connected set in M which contains both P and Q and lies wholly interior to C. In figure 2, let M be the set of all points on the broken line $ABPDE$, and C any circle with centre at P. The circle K can be so selected that it does not enclose any point of the straight-line interval DE, and hence if Q is any point of M within K, there is a connected portion of M joining P to Q without going outside of K. Hence M is locally connected at P.

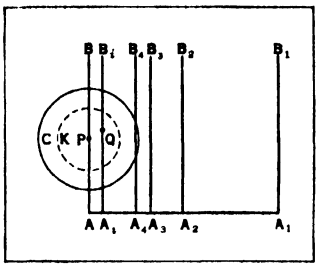

FIG. 3.—CONTINUA THAT ARE NOT CONTINUOUS CURVES

A continuous curve is a continuum which is locally connected at every one of its points. All of the figures studied in geometry are continuous curves. However, not all continua are continuous curves. In figure 3, let AA_1 be a straight line interval, whose length may be called 1 unit. Let A_2 be $\frac{1}{2}$ unit from A on AA_1, A_3 be $\frac{1}{3}$ unit from A on AA_1, and, in general, let A_n, where n is any positive integer, be at a distance $1/n$ unit from A and AA_1. At every such point, A_n, erect a perpendicular, A_nB_n, to AA_1, say 1 unit in length, and at A erect a perpendicular AB that is also 1 unit in length. Consider the set of points, M, consisting of all points on the straight line intervals AA_1, AB, and A_nB_n (for every n). The set M is a continuum. It is not a continuous curve, however, because it is not locally connected at all of its points. For let P be a point of AB not coincident with A. Let C be a circle of radius r less than the distance from A to P. Then, no matter what circle K is selected with centre P, that circle, K, will enclose a point, Q, of some A_nB_n, say A_1B_1, and there will be no connected portion of M containing both P and Q and lying wholly within C.

For references concerning continuous curves, as well as for a description of some of their properties, the reader is directed to reference (5) of the bibliography at the end of this article. Here we shall close our discussion of those properties of point sets that are studied in *Analysis situs*, having selected only a few of the fundamental ones by way of illustration.

Applications.—The topological theory of manifolds, which is considered in a separate article (*see* MANIFOLDS), has important applications to nearly every branch of mathematics. The topology of other types of point sets has been quite recently evolved, and hence its applications have not yet been very extensive. The methods of *Analysis situs* are applicable to any set of points, however it be defined, so long as the notion of limit point is introduced. That is, the space studied is not necessarily S—it may be the set of points on a sphere, or in three-dimensional space, or in a very general space which is characterized by some set of axioms. (*See*, for instance, the Hausdorff axioms for a "topological space," in reference [1] in Bibliography below, p. 213). An important recent result has been what seems to be a satisfactory definition of the word "dimension"—a definition which not only yields 2 as the dimension number of S, but attaches definite integral dimension numbers to very general spaces. (For bibliography and general discussion, *see* reference [6] below.) The space studied need not, indeed, be a set of points at all, but a set of any sort of elements, so long as the notion of limit element is introduced.

In physics, topological methods and properties of point sets have been used in connection with certain problems in dynamics, and in particular with the problem of showing the impossibility of a certain kind of gas system (7). It seems a possibility that physicists and astronomers of the future will make increasing use of topological ideas.

In a recent work (8) of a philosophical nature—a work which seems to contain much of value not only for the mathematician and physicist but for the scientist in general, and which discusses the relation between the world as it actually exists with the world as conceived by the physicist—it is interesting to note that the author has made use of quite recent results from the field of *Analysis situs*.

BIBLIOGRAPHY.—All works listed below, except (8), are technical in nature. (1) Felix Hausdorff, *Grundzuge der Mengenlehre* (1914), a book on the fundamentals of the theory of sets. (2) N. J. Lennes, "Curves in non-metrical *Analysis situs* with an application in the calculus of variations," *American Journal of Mathematics*, vol. xxxiii, pp. 287–326. Contains material concerning connectedness, arcs and simple closed curves (1911). (3) Bronislaw Knaster and Casimir Kuratovski, "Sur les ensembles connexes," *Fundamenta Mathematicae* (Warsaw), vol. ii., pp 206–255. A memoir devoted to the study of connected sets of points (1921). (4) Raymond Louis Wilder, "A point set which has no true quasi-components, and which becomes connected upon the addition of a single point," *Bulletin of the American Mathematical Society*, vol. xxxiii., pp. 423–427. Contains an example of a set of points M such as mentioned above under "Local Connectedness." (5) Robert Lee Moore, "Report on continuous curves from the view-point of *Analysis situs*," *Bulletin of the American Mathematical Society*, vol. xxix., pp. 289–302 (1923). A summary of the main discoveries (up to the time of its publication) concerning continuous curves. (6) Karl Menger, "Bericht über die Dimensionstheorie," *Jahresbericht der Deutschen Mathematiker-Vereinigung*, vol. xxxv., 5–8 Heft, pp. 113–150 (1926). Besides being an excellent summary of the main results in connection with dimension theory, this contains a good bibliography. (7) Artur Rosenthal, "Beweis der Unmoglichkeit ergodischer Gassysteme," *Annalen der Physik*, vol. xlii., pp. 796–806 (1913). (8) Bertrand Russell, *The Analysis of Matter* (1927). (R. L. WI.)

ANALYST, in modern times, a person who is professionally skilled in chemical analysis. He may be called upon in the discharge of his professional duties to analyse a very wide range of substances and report thereon with regard to their composition or their purity. Apart from private practitioners, analysts are employed by manufacturers, their duty being to exercise a constant watch over the processes of manufacture, to test the purity of raw materials used, and of the final product, and generally to engage in research work connected with the industry concerned. The services of analysts are constantly required in judicial enquiries, sometimes in purely criminal cases, sometimes in civil proceedings. In the case of criminal proceedings, the services of the local public analyst are usually employed, but in certain instances the official analyst of the British Home Office may be engaged. At the Government Laboratory, Clement's Inn Passage, London, W.C. a large staff of analysts examine foods, spirits, tobacco, etc , for import or excise duties and for other purposes. Under the Fertilisers and Feeding Stuffs Act, 1927, agricultural analysts are appointed by every county council, whose duty is the analysis of fertilisers and feeding stuffs.

A British public analyst is an analyst appointed by a local authority for the purposes of the administration of the Sale of Food and Drugs and closely allied Acts. He must be possessed of definite qualifications and be a competent authority on the microscopy and chemical analysis of all articles of food and drink. He must also have studied pharmacology and therapeutics.

The Society of Public Analysts was founded in 1874, and membership of the Society is open to any practising analytical chemist.

United States.—In the United States there are, in addition to numerous laboratories dealing exclusively with the control of plant operations, many consulting laboratories whose work is largely on analytical problems. Many of these laboratories deal in specialties, as foodstuffs, clinical, pathological and forensic analysis, fuel and water, and iron and steel A large share of the consulting work of university laboratories deals with analytical problems. The organization of the U.S. Bureau of Agriculture in 1862 (becoming a department represented in the cabinet in 1889) included a chemist. This branch developed through the Bureau of Chemistry (1900) into the Bureau of Food, Drug and Insecticide Investigation (1927), which is charged with the enforcement of the Food and Drugs Act (1906). A number of branch laboratories assist in this work. Other analytical work on foods, drugs, fertilizers, soils, etc., is fostered by the Bureau of Chemistry and Soils. The official methods of analysis are those of the Association of Official Agricultural Chemists, with the exception of official drugs, the methods for the analysis of which are found in

the U.S. Pharmacopoeia. Supplementing the Bureau of Food, Drug and Insecticide investigation are the analytical laboratories and consulting chemists sponsored by the food commissioners of the several States under authority of their dairy, food and drug legislation. Most of this legislation is modelled after the Federal Food and Drugs Act. Agricultural analysis began in the agricultural experiment stations, organized in conjunction with the land grant colleges which were fostered by the Morrill Act of 1862. The experiment stations were provided for further by the Hatch Act of 1887. Other analytical laboratories of full or semi-public standing are those of the customs service, public health service, and the geological survey and State and municipal boards of health. Associations dealing largely with problems of analytical chemistry include the Association of Official Agricultural Chemists, the American Society for Testing Materials, the Association of Cotton-oil Chemists, the American Association of Cereal Chemists and the American Leather Chemists' Association. The majority of associations of this type publish their own journals and proceedings. Among societies of broader scope in which analytical procedures are given prominent attention are the American Chemical Society, the American Society of Biological Chemists, the American Public Health Association and the American Pharmaceutical Association.

ANALYTIC, of or pertaining to analysis; the method of separating a whole into its parts, the opposite of synthetic For analytic *chemistry,* analytic *language,* etc, *see* the articles under the noun-headings. The title of *Analytics* was given by Aristotle to his treatises on logic.

ANALYTIC GEOMETRY. When Descartes first came upon the idea of co-ordinates, a link was made between the sciences of geometry and analysis. Now the connection has grown so close that the results of either can be passed over to the other by definite laws of interpretation. In what follows, a few leading ideas are set out in terms of plane geometry, most of which can be extended to three or more dimensions.

CARTESIAN CO-ORDINATES

Co-ordinates (*q.v*) are numbers measuring certain geometrical quantities and used to fix the position of a point, *e g*, latitude and longitude fix a place on a map. It is possible to build up a geometry, which is not analytical, on the ideas of order and incidence alone, without introducing measurement; but in analytic geometry we assume that we can measure such things as lengths and angles, and compare two different things of the same kind by measuring them in terms of a common unit. The value of a co-ordinate may depend on the choice of units; or it may be independent of them if it is defined as a ratio of two quantities of the same kind.

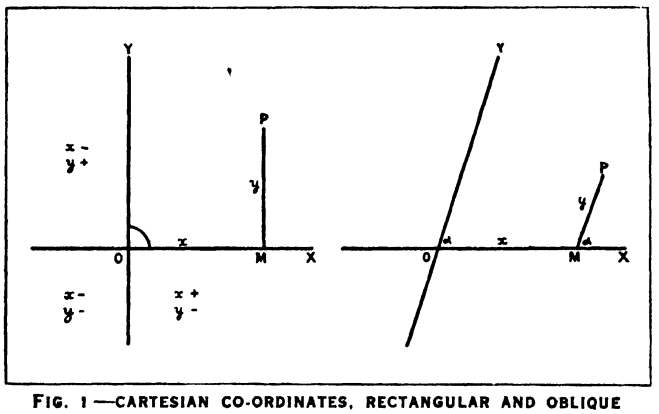

FIG. 1.—CARTESIAN CO-ORDINATES, RECTANGULAR AND OBLIQUE

The simplest plane co-ordinates are *rectangular cartesian.* Through a fixed point (*origin*) O, we take two lines (*axes*) OX, OY in fixed directions at right angles to each other. (In *oblique cartesian co-ordinates,* the axes are not rectangular, but inclined at a given angle α; the conditions of a problem often make this an advantage.) We reach any point P of the plane by going from O a certain distance $x=OM$ along OX, and then another distance $y=MP$ parallel to OY. The pair of numbers (x, y) are the co-ordinates of P. If x and y are positive, this procedure leads only to points in the first quadrant of the plane, bounded by the half-lines OX, OY. Points in the other three quadrants are reached by taking one or both of the steps OM, MP in the opposite direction; to these reversed steps we assign negative co-ordinates. A zero co-ordinate belongs to a point on one or other axis, and the co-ordinates of the origin are (o, o). Every point of the plane has a unique pair of real numbers as co-ordinates, and every pair of real numbers are the co-ordinates of a unique point.

Thus the point P, and its pair of co-ordinates (x, y) are equivalent data. Any length, or other geometrical quantity, that is fixed when the point P and the axes XOY are given, is fixed when x, y are given; thus, $OP^2=x^2+y^2$, and $\tan POM=y/x$. (If, instead of x, y, we are given $r\equiv OP=\sqrt{(x^2+y^2)}$ and $\theta\equiv\angle POM=\tan^{-1}y/x$, then, since $x=r\cos\theta$, $y=r\sin\theta$, both x and y are determined; thus r, θ, are data equivalent to x, y, and can serve just as well in determining P; they are called its *polar co-ordinates.*)

With any system of co-ordinates, the formula for the distance d between two given points P_1, P_2 is of great importance. Let the co-ordinates of P_1, P_2 have the suffixes 1, 2. Then, with rectangular cartesian co-ordinates,

$$d^2=(x_2-x_1)^2+(y_2-y_1)^2;$$

oblique cartesian co-ordinates,

$$d^2=(x_2-x_1)^2+(y_2-y_1)^2+2(x_2-x_1)(y_2-y_1)\cos\alpha;$$

polar co-ordinates,

$$d^2=r_1^2+r_2^2-2r_1r_2\cos(\theta_2-\theta_1).$$

The simplest analytic geometry of all is of one dimension; *e.g.,* when we deal with only one line and the points on it. Any point P can be specified by its distance $x=OP$, measured from a fixed origin O in terms of a fixed unit, which can be shown by marking the point A at unit distance from O, so that $OA=1$. Then x is the one co-ordinate of P.

By far the most important assumption is that of a single point with the co-ordinate ∞, at an infinite distance from O. This is required, for example, as the homologue of O in ordinary inversion, in which the point whose co-ordinate is x corresponds to the point whose co-ordinate is $1/x$.

Equations.—If we interpret the variables as the co-ordinates of a variable point P, an equation in x, y is a statement of the position of P. For example, the equation $x^2+y^2=a^2$ tells us that P is at a distance a from O, that is, P is some point on the circle centre O, radius a. This does not fix P, for one equation does not determine both x and y, but it relates x and y, and it limits P to lie on the curve. The equation holds between the co-ordinates of any point on the circle, and of no other point; it is called the *equation of the curve.*

Any geometrical property of the circle is a statement about P, true if, and only if, P lies on the circle; it has a corresponding equation in x, y which follows from the equation $x^2+y^2=a^2$. Suppose we want to prove that, if OX meets the circle in A, A', then $PM^2=A'M\cdot MA$. The expression of this desired result in terms of the co-ordinates is $y^2=(a+x)(a-x)$, which is a simple algebraic deduction from $x^2+y^2=a^2$. Thus, in general, any equation in x, y represents a curve, whose properties, when expressed in terms of the co-ordinates of a general point lying on it, are precisely the analytical consequences of this equation.

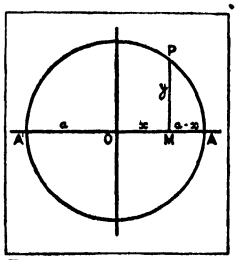

FIG. 2.—RECTANGLE OF SEGMENTS IN A CIRCLE

Since there is, as a general rule, a very much more certain and obvious way of verifying an analytical deduction than of devising a geometrical proof, the translation into equations introduces *method* and helps to turn geometry from an art into a science. One reason is that an algebraic expression has the property of *form,* which is more easily recognized than its geometrical equivalent. By the help of the conventions of the notation, the

expression is analysed, almost at first sight, into the components of its structure: variables and constants, terms, factors and indices.

The application of analysis to geometry saves effort by showing the direct way to success for soluble problems, and no less by showing certain others to be insoluble; it enables us to prove a negative. A particular figure may suggest wrongly that a certain property is true in general. In such a case, it is often quite hard to prove by pure geometry that the surmise does not always hold good. But when equations are written down expressing all the properties, both those given by hypothesis and those guessed from the figure, we can find out whether the second set can be deduced from the first or not. If they can, we may return more hopefully, and usually with some definite clue, to the search for a pure proof; if they are not deducible, we cease to waste our time on the matter. The classic example is the squaring of the circle by an Euclidean construction. For centuries, geometers were convinced that only a little more skill or luck was wanted for success, and no one was then in a position to assert that every conceivable attempt must fail. By the aid of analysis, that assertion is now proved. For this kind of special theorem, the analytical method is one of verification rather than discovery

It is sheer folly to keep the two methods apart. There are occasions for using either alone, but we gain most power by using pure, algebraic and infinitesimal ideas and notations alongside, keeping ever present the relation between them, and the interpretation of each in terms of the others. "Every equation has its little meaning" is a better motto than "shut your eyes and write down the equations." For example, analytic geometry could hardly get going at all without relying on the theorem of Pythagoras, as was done tacitly earlier in this article in writing down $OP^2=x^2+y^2$.

Algebraic Curves.—The most important elementary property of cartesian co-ordinates is that an equation of the first degree in x, y represents a line, and conversely every line has an equation of the first degree. Thus:—

$y=$constant	is a line parallel to OX,
$x=$constant	is a line parallel to OY,
$ax+by=0$	is a line through O,
$ax+by+c=0$	is a line parallel to the last, but does not pass through O if $c\neq 0$,
$x/a+y/b=1$	is the line cutting off lengths a, b from the axes,
$y-b=m(x-a)$	is the line through the point A whose co-ordinates are (a, b), making with OX the angle whose tangent is m.

For different values of m, this can represent any one of the set of lines through A. The co-ordinates of the point of intersection of two given lines satisfy both their equations. Two independent linear equations in x, y always have one and only one solution, provided we admit infinite values; *e.g.*, with the pair $ax+by=0$, $ax+by+c=0$. The corresponding geometrical convention is that two parallel lines intersect in one point at infinity.

A quadratic equation represents a *conic* (*see* CONIC SECTIONS), the simplest being the circle $x^2+y^2=a^2$. It illustrates the unity of mathematics that the same curves should be the first to present themselves naturally along the two lines of approach. The co-ordinates of the intersection of a line and conic satisfy a linear and a quadratic equation; their determination depends on the solution of the eliminant, a quadratic equation in one variable. Now a line may meet a conic in two different real points, or touch it at one point or pass clear of it. The conditions are the same as that the corresponding quadratic equation may have real and distinct, or equal or imaginary roots. It is therefore convenient to speak of the intersections of the line and conic as always two in number, being real or coincident or imaginary.

If the equation of a curve in cartesian co-ordinates is algebraic and not transcendental, its degree, in the co-ordinates jointly, is called the *degree of the curve*. The co-ordinates of the intersections of a curve of degree n and any line depend on an eliminant of degree n; there are n such intersections, real or imaginary, finite or coinciding with the one point at infinity on the line. The fundamental theorem about such curves is that two algebraic curves of degrees n_1, n_2 have n_1n_2 points of intersection; as we have just seen in the case when one is a line, $n_2=1$. Thus two conics meet in four points.

A common application of co-ordinates in subjects such as engineering or statistics is to show the variation of two connected quantities by means of a graph. This is not really analytic geometry, but rather its converse; not the use of analysis to increase our geometrical knowledge, but the use of geometry to illustrate some analytical knowledge. We can draw a graph whenever we can calculate one co-ordinate directly in terms of the other, and its equation has the form $y=f(x)$.

OTHER TYPES OF CO-ORDINATES

A co-ordinate need not be a distance. In one dimension, a point P of a line can also be specified, for example, by choosing two points of reference A, B, and determining P by the co-ordinate $\lambda=AP/PB$, which is a ratio of lengths, not a length itself. Points within the segment AB have positive co-ordinates, 1 being that of the midpoint, the points beyond A and beyond B have negative co-ordinates of absolute values <1 and >1 respectively, and the co-ordinates of A, B and the point at infinity are 0, ∞ and -1. Again, we can choose three points of reference A, B, C, and define P by the value of the cross ratio

$$\xi=\frac{AP}{PB}\Big/\frac{AC}{CB},$$

which is of advantage in dealing with projections

In plane problems not concerned with actual measurements, the most useful co-ordinates are *areal*. Instead of two independent co-ordinates, each point has three, connected by a simple identity. We refer to a fixed triangle ABC, and the co-ordinates of P are ratios of areas of triangles and are independent of the units of length and area:

$$x=PBC/ABC,\quad y=PCA/ABC,\quad z=PAB/ABC,$$

with the sign convention that x is positive or negative according as A and P are on the same side or opposite sides of BC. Wherever P lies, we have identically

$$x+y+z\equiv(PBC+PCA+PAB)/ABC\equiv 1.$$

The three co-ordinates are equivalent to two independent quantities only, which we could take to be x and y, but it is more convenient to leave them an unspecified pair of the ratios $x:y:z$, for the following reason. Since we may write $x+y+z$ for 1, we can alter the dimension, in x, y, z jointly, of any term without altering its value. We thus arrange that every equation is homogeneous in the three variables, then it alters none of the work if we replace x, y, z by three other quantities having the same ratios, say, ax, ay, az, and these can be taken to be the co-ordinates of P, instead of x, y, z. The sum of these new co-ordinates is a instead of 1, but this does not matter, since we need not use the identity again; the two independent ratios are the same as before. To this extent, the areal co-ordinates of a point are not unique, but each set of co-ordinates always determines a unique point.

The expression for distance in this co-ordinate system is complicated, involving the sides and angles of the triangle of reference, but it is still true that the equation of a line is of the first degree and conversely. If this is to hold without exception, the particular linear equation $x+y+z=0$, which contradicts the fundamental identity for the co-ordinates of a finite point, must be intrepreted as a line altogether at infinity, the locus of the points at infinity on each of the other lines of the plane. There are other systems of homogeneous co-ordinates, in which also linear equations represent lines, the line at infinity having a less simple form, for example, *trilinear co-ordinates*, which are the perpendicular distances of P from the sides of the triangle of reference.

The cartesian co-ordinates (a, b) of a point P can be regarded as specifying the two lines $x=a$ and $y=b$, intersecting at P,

selected from the two families of lines parallel to the axes OY, OX respectively. We have a more general type of co-ordinate, replacing these two families of lines by other curves; *e.g.*, two families of concentric circles, with fixed centres A_1, A_2 and varying radii. Then if P is given, it determines the values (ρ_1, ρ_2) of the radii for which the two circles, one from each family, intersect at P. These are *bipolar co-ordinates*. If ρ_1, ρ_2 are given, P

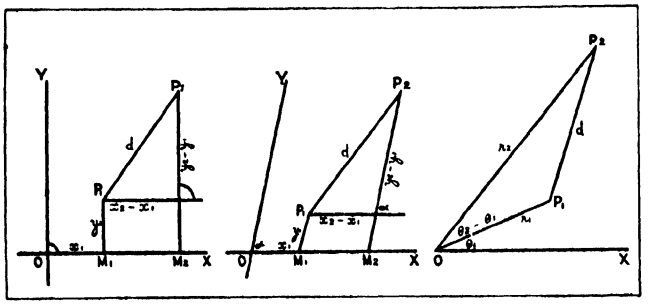

FIG. 3.—DISTANCE BETWEEN TWO POINTS IN RECTANGULAR, OBLIQUE, AND POLAR CO-ORDINATES

is not uniquely determined, for the two circles through P have another real intersection, the reflection of P in the line A_1A_2. In some connections, for example, if we are interested in one-half only of the plane, this is no bar to their use.

In each of these systems, all the co-ordinates are elements of the same kind. This is not essential; of the two polar co-ordinates, one is a length and one an angle. In other systems, the interpretation of a co-ordinate by itself is less simple than that of some combination. For example, one of the circles, which determine P in the bipolar system, has a cartesian equation of the form $x^2+y^2+2ax+2by=\lambda$, where a, b are constants depending on the fixed centre, and λ is a parameter which can serve instead of ρ_1 as a co-ordinate of P, since it determines the circle equally well. Here λ itself is the negative square of the tangent from the cartesian origin to the circle through P; whereas the combination $\sqrt{(a^2+b^2+\lambda)}$ is the radius ρ_1.

TRANSFORMATIONS

A co-ordinate is always measured with respect to a fixed origin or base or *frame of reference* of some sort. The analytical method gains by choosing the frame so as to simplify the treatment of the problem in hand, and in particular to take advantage of any symmetry. If there is one fixed point outstanding among the data, we may take this as cartesian origin If there is a pair of equal importance, we may put the origin midway between them, and take the axis of x to join them, so that their co-ordinates are $(a, 0)$, $(-a, 0)$. If the problem is descriptive and involves a triangle, areal co-ordinates are indicated, and so on. For example, the property of the existence of the centre of gravity of a triangle, where the medians concur, becomes the mere statement that there exists a point whose areal co-ordinates are $(1, 1, 1)$.

We often need to change the frame of reference in the middle of a piece of work, and to express, in terms of the new system, any result already obtained in terms of the old co-ordinates. We must find expressions to substitute for each of the old co-ordinates separately, that involve the new co-ordinates and the constants determining the new frame of reference in relation to the old, but that do not involve the other one of the old co-ordinates. Thus the change from cartesian to polar co-ordinates, with the same origin and axis, is effected by $x=r\cos\theta$, $y=r\sin\theta$; and the change back again by $r=\sqrt{(x^2+y^2)}$, $\theta=\tan^{-1}y/x$.

If we change from one rectangular frame of axes XOY to another $X'O'Y'$, we must know the co-ordinates $OA=a$, $AO'=b$ of the new origin O' referred to the old axes, and also the angle ϕ between the $O'X'$ and OX. Then if P is any point, and (x, y), (x', y') its two pairs of co-ordinates, we find:

$$x=a+x'\cos\phi-y'\sin\phi, \quad y=b+x'\sin\phi+y'\cos\phi;$$

and if, at a later point in the work, we wish to translate results involving x', y' into terms of the old co-ordinates we must use

$$x'=(x-a)\cos\phi+(y-b)\sin\phi,$$
$$y'=-(x-a)\sin\phi+(y-b)\cos\phi,$$

so as to eliminate the new co-ordinates.

If x', y' are point co-ordinates in a plane, π', and we make a substitution of the form

$$x'=f_1(x, y), \qquad y'=f_2(x, y), \tag{1}$$

and interpret x, y as point co-ordinates in another plane π, then to any point P of π there corresponds the particular point P' of π', homologue of P, whose co-ordinates are given by (1). If P moves and describes a curve k, then P' also moves and describes a curve k', which corresponds to k, and whose properties can be deduced from those in the other plane. If P' is a given point of π', there corresponds to it all the group of points whose co-ordinates satisfy (1), when in these equations we regard x', y' as known and x, y as unknown. If P' lies on k', in general only one of the group lies on k. Thus the two curves are transformed into one another so that each point of either corresponds to one and only one of the other. In particular, if (1) are such that they can be solved in the same form $x=f_1'(x', y')$, $y=f_2'(x', y')$, then there is a 1, 1 correspondence between all the points of the two planes, and not only between the points of the two curves.

The degree of a 1, 1 plane transformation is that of the curve in either plane which corresponds to a line in the other. If the two planes are identical, we have a transformation of the plane into itself. The simplest examples are translation, rotation, similarity and their combinations, which are all linear transformations, and inversion, which is quadratic. The last transforms P into the point P' of OP such that $OP\cdot OP'=\text{constant}$; it can be expressed by

$$x'=\frac{a^2x}{x^2+y^2}, \qquad y'=\frac{a^2y}{x^2+y^2},$$

and the reverse equations have the same form. Two different maps of the same region of the earth's surface are 1, 1 transformations of it and of each other. For example, one may show the whole world as a rectangle, and the other may show it as a pair of circles The shapes of Australia are quite different, but each spot within one map corresponds to one and only one within the other. This is not true of points on the boundaries, which are exceptional. (*See* CONFORMAL REPRESENTATION.)

So far we have considered co-ordinates of points only; but any variable geometrical object can have co-ordinates, for example, the lines or circles of the plane. If x, y are the cartesian co-ordinates of a point P, the equation of any line l can be taken in standard form $\alpha x+\beta y=1$, where α, β are the reciprocals of the intercepts which l makes on the axes. For different values of α, β, we can identify l with any given line: thus α, β may be taken as the *line co-ordinates* of l. If x, y are constants and α, β variable, the equation expresses that the variable line l passes through the fixed point P, and is the equation of the point in line co-ordinates. Just as any equation in point co-ordinates defines a continuous set of points lying on a locus, which is a line if the equation is of degree 1, so an equation in line co-ordinates defines a continuous set of lines all touching a curve, called an *envelope* from this point of view, which is a point if the equation is of degree 1. For this reason, line co-ordinates are often called *tangential co-ordinates*. In general, the degree of the envelope is the number of tangents, real or imaginary, which can be drawn to the curve from any given point. This number is called the *class* of the curve, and is equal to the degree n if $n=1$ or 2, but for $n\geqq 3$, the two are not generally the same.

Any piece of analysis, which has a geometrical meaning when a pair of variables are taken to be the co-ordinates of a point, has another meaning when the same variables are taken instead to be the co-ordinates of a line; and all such geometrical theorems occur in pairs, *dual* to each other. Corresponding to any plane figure built up from points and the lines joining them, there is a dual figure, built up in the same way from lines and their points of intersection. For any statement about the one, there is a statement about the other, exactly the same except that points

and lines are replaced by lines and points; and the analytical proofs are the same, except for the definitions of the symbols. The perpendicular distance of the line l from O is p where $1/p_1^2=\alpha^2+\beta^2$; the line equation $\alpha^2+\beta^2=1$ is satisfied by any line at unit distance from O and the envelope represented by this equation is the circle of unit radius centre O. The same equation

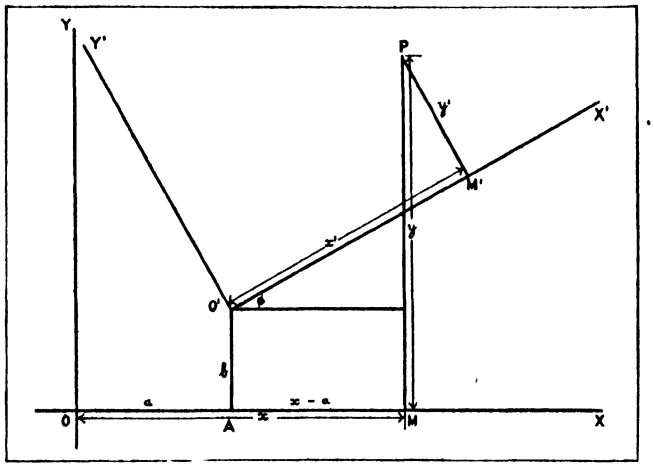

FIG. 4.—CHART SHOWING THE CHANGE OF RECTANGULAR AXES

in point co-ordinates represents the same circle, which is a self-dual figure.

THREE OR MORE DIMENSIONS

In three dimensions, a point requires three co-ordinates; a single equation between them represents a surface. For a curve, two equations at least are necessary; since each by itself gives a surface, the points whose co-ordinates satisfy both equations are those lying on both surfaces, and the curve represented is their complete intersection. If this total intersection breaks up into distinct curves, to represent one curve k apart from the other, we use the equation of another surface which passes through k but not through the residual curve. There may or may not exist two surfaces whose total intersection is k; if not, k cannot be represented by less than three equations. Thus the intersection of two quadrics can consist of a line and a twisted cubic curve. We can represent the line alone by the equations of two planes passing through it, for these have no other common curve; but to express the cubic we use the equation of a third quadric through it, meeting the first two in different residual lines

In space, the general bilinear equation in two sets of three variables $\alpha x+\beta y+\gamma z=1$, according to the way we interpret it, represents either a point or a plane, and these elements are dual to each other. A line may be regarded either as the intersection of two planes or as the join of two points, and, in either point or plane co-ordinates, can be represented by two linear equations. The whole set of lines in space is a fourfold infinity, and a line requires four independent or five homogeneous co-ordinates. It is more symmetrical and convenient to use a set of six homogeneous co-ordinates, which are connected by one quadratic identity, and whose ratios involve four independent quantities. If the line is defined as the intersection of two planes whose point equations are $\begin{matrix}a_1x+a_2y+a_3z+a_4=0,\\ b_1x+b_2y+b_3z+b_4=0,\end{matrix}$ the co-ordinates of the line are the six quantities p_{23}, p_{31}, p_{12}, p_{14}, p_{24}, p_{34}, where $p_{\alpha\beta}\equiv a_\alpha b_\beta-a_\beta b_\alpha$, connected by the identity:—

$$p_{23}p_{14}+p_{31}p_{24}+p_{12}p_{34}\equiv 0.$$

As far as the algebra is concerned, there is no essential difference, except in complexity, between three dimensions and any higher number. Most people's imagination can deal with line, plane and space, and stops short there; but analysis is more than imagination. With proper extensions, the ideas and language suitable to the lower dimensions, and partly supplied by everyday life, can be carried on. We agree to call a set of n numbers the co-ordinates of a *point* in a space of n dimensions, the series of sets satisfying one linear equation a *hyperplane*, and so on. This may seem to be geometry in name only; but properties of lower space suggest valid and interesting extensions in higher space, that retain their geometrical tinge, and, conversely, many results in ordinary space have been suggested, or their mutual relations illuminated, by work in higher dimensions, which, to a specialist imagination, is as geometrical as the lower ranges are to everybody. Moreover, though it is not easy to imagine a fourfold infinity of points, we are familiar with the higher orders of infinity in other objects, for example, all the lines of ordinary space, or all the conics in a plane. Thus the six homogeneous co-ordinates $p_{\alpha\beta}$ of a line in three dimensions may be interpreted as homogeneous co-ordinates of a point in space of five dimensions, lying on the quadric in that space whose equation is given by the quadratic identity satisfied by the p's.

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ANALYTIC JUDGMENT: *see* ANALYSIS.

ANALYTIC MECHANICS: *see* MECHANICS.

ANAMALAI HILLS (ANAIMALAI), a range of mountains in southern India, in the Coimbatore district of Madras, lying between 10° 13′ and 10° 31′ N., and between 76° 52′ and 77° 23′ E, forming a portion of the Western Ghats, south of the Palghat pass. They consist of a forest-clad and grassy tableland, with summits rising about 8,000ft.; Anaimudi peak (8,850ft.) is the highest in southern India. Their formation is metamorphic gneiss, veined with felspar and quartz, and interspersed with reddish porphyrite. The lower slopes yield valuable teak and other timber.

ANAMORPHOSIS (ăn″ă-mōr′fo̤-sĭs) [Gr.], a deformation or distortion of appearance in drawing, the representation of an object as seen; for instance, as altered by reflection in a mirror; in botany, e g., in the case of fungi or lichens, an abnormal change giving the appearance of a different species.

ʿANAN BEN DAVID, a Persian Jew of the 8th century, and founder within Judaism of the sect of Qaraites (Karaites) which set itself in opposition to the rabbinic tradition 'Anan ben David was an unsuccessful candidate for the dignity of Exilarch, and thus his opposition to the rabbanite Jews was political as well as theological. His secession occurred at a moment when the time was ripe for a reaction against rabbinism, and 'Anan became the rallying point for many opponents of tradition. (*See* QARAITES.)

ANANDA, one of the principal disciples of the Buddha (*q.v.*), known as the beloved disciple of the Buddhist story. According to the commentaries he was the son of Amitodana, an uncle of the Buddha, entered the order in the second year of the Buddha's ministry, and in the 25th year was appointed his permanent attendant. He attained enlightenment just before the first council, of which he was a member, and at which he repeated the *Suttapiṭaka*. From canonical passages we learn that he persuaded the Buddha to allow women to become nuns, and he is represented as being interlocutor in many discourses and the actual author of several. A collection of verses is ascribed to him in *Thera-gāthā*, 1,018 ff. In the time of Fa Hien (4th century A.D.) his relics were worshipped at Vesālī, and special devotion was shown by the nuns owing to his having obtained their admission to the order. (E. J. T.)

ANANIAS, the Greek form of Hananiah or Ananiah, a not uncommon name in the Bible. Best known are (1) A member of the first Christian community who, with his wife Sapphira, was punished by Peter with sudden death for falsehood (Acts v. 1–10; *cf.* Josh. vii.). (2) A disciple at Damascus in the story of the conversion and baptism of Paul (Acts ix. 10–17, xxii. 12–16). (3) Son of Nedebaios (Jos. *Ant.* xx. 5. 2), a high priest who presided during the trial of Paul at Jerusalem (Acts xxiii. 2, xxiv. 1–5). He was high priest A.D. 47–59, and being accused of acts of violence was sent to Rome for trial (A.D. 52), but was acquitted by the

emperor Claudius. As a friend of the Romans he was murdered by the people at the beginning of the Jewish war of revolt.

ANANKE ('Ανάγκη), Necessity or Fate personified. She is fairly prominent in posthomeric literature and theological speculation, particularly Orphic, but is definitely known to emerge into cult only at Corinth, where she was worshipped with *Bia* (Might, Force), *see* Pausanias, ii., 4, 6; there are one or two faint and dubious traces of her cult elsewhere. In literature, she is associated with *Adrasteia,* the *Moirai,* and similar deities. In Italy she does not appear to have been worshipped at all; the famous description of Necessitas (Ananke) in Horace, *Carm.* i., 35, 17, which makes her attendant on Tyche, is purely literary.

See Roscher's *Lexikon,* arts. Ananke, Necessitas.

ANANTAPUR, a town and district of India, in the Madras presidency. The town has a station on the Madras railway, 62m S.E. from Bellary. Pop. (1921) 11,452. The district of Anantapur was constituted in 1882 out of the unwieldy district of Bellary. It has an area of 6,722 sq m., and the north and centre form a high plateau, generally undulating, with large granite rocks or low hill ranges rising here and there above its surface. The south is more hilly, the plateau there rising to 2,600ft. above the sea. There is a remarkable fortress rock at Gooty, and a similar but larger rock at Penukonda, over 3,000ft. above the sea. Gooty fortress was a stronghold of the Mahrattas, but was taken from them by Hyder Ali. In 1789 it was ceded by Tippoo Sahib to the nizam, and in 1800 the nizam ceded the district of Anantapur with others to the British in payment for a subsidiary British force. The population in 1921 was 955,917. The principal crops are millet, rice, other food grains, pulse, oil seeds and cotton. There are factories for pressing cotton. Two railways traverse the district.

ANAPA, a port on the Black sea, north of Novorossisk, in the North Caucasian area of the R S F.S.R., 44° 58′ N. 37° 18′ E. It was formerly the scene of struggles between the Turks and Russians, until it became Russian in 1829. The fortifications were dismantled by the Russians during the Crimean war (1855). Pop. 13,320 (1926). The district has an experimental station for the encouragement of vine-growing and wine manufacture. Anapa is on the site of the ancient Gorgippia.

See M. I. Rostovtsev, *Iranians and Greeks in S. Russia,* with a bibl. (Oxford, 1922).

ANAPAEST, a metrical foot consisting of three syllables, the first two short and the third long (from Gr. *anapaistos,* beaten upwards). An anapaestic verse is one which contains only or mostly anapaests In Greek tragedy, a passage in this metre denotes a marching movement of the chorus or an actor.

ANAPHRODISIACS are agents used to allay sexual desire. In general mild sedatives may accomplish this effect, such as bromides or luminal. Avoidance of a diet rich in meats and spices, and especially of intoxicating beverages, is important. Epsom salts in the usual purgative doses may be of service. Failing benefit by such means the advice of a psychiatrist may be helpful.

ANAPHYLAXIS, the state of exaggerated susceptibility of an animal or man to a biologically foreign protein which may follow a first injection of that protein. Richet, who first used the term in 1893, found that after two properly spaced injections of an animal with eel serum, the second dose produced a toxic (often fatal) effect, much greater than did the first dose. He considered it to be the reverse of prophylaxis such as results from the use of bacterial vaccines. Theobald Smith, and later, Otto, extended these observations, using guinea-pigs and horse serum in their experiments.

The Anaphylactic Phenomenon.—If, for example, a guinea-pig be injected intravenously, subcutaneously or intraperitoneally with horse serum in an amount ordinarily not harmful, it becomes "sensitized" to horse serum, so that, if after ten to 14 days it be again injected with horse serum (*intoxicating dose*), there promptly result striking symptoms. The animal appears depressed and nervous, scratches its nose, shows a rapidly increasing difficulty in breathing, rapid pulse, and may die in a few minutes from respiratory failure. This symptom picture is called *Anaphylactic shock.* If the animal survive, it is for a time non-reactive to horse serum injections and is said to be *antianaphylactic.* After some weeks this refractory state wears off and the animal will again suffer shock if injected. Sensitivity may be transferred from one animal to another (*passive anaphylaxis*) and a similar passive transfer occurs from mother to offspring.

Anaphylactic sensitivity is strictly specific; a guinea-pig hypersensitive to horse serum is not shocked by sheep serum. One can even distinguish by an anaphylaxis experiment between two such closely related proteins as duck and hen egg-albumin. A single animal may be sensitized to a number of proteins. Animals vary widely in the ease with which they may be rendered sensitive; guinea-pigs are easiest to sensitize, 0·000 001gm. of horse serum at times sufficing as the sensitizing dose, and 0·000 000 1gm. as the intoxicating dose. Rats are most difficult to sensitize; man is moderately so. The symptoms of anaphylactic shock differ in various species but are always characteristic for that species. The basis of symptoms is in each instance the contraction of involuntary muscle and an increased permeability of the capillary blood-vessel walls.

The Sensitizing Substances and Their Operation.—The substances to which animals may be sensitized (*antigens*) are protein in nature, with a large molecule, and optically active in solution. If a protein be racemized (rendered optically inactive by heat or sodium hydroxide) it can no longer produce sensitization or shock.

The method whereby anaphylaxis occurs is probably as follows. The body normally protects itself against foreign protein in the intestinal tract where the digestive ferments break down the protein beyond the stage of intermediate (at times toxic) split-products. If an intact foreign protein reaches the blood in any way, the same digestion is carried out (rather slowly) by the ferments of the blood and tissues. But so abnormal is this, that the body's protective mechanism is stimulated to produce an excessive amount of a specific ferment (*antibody*) which can act on that particular protein. When a second dose of that protein gets into the blood, there is an intensely rapid combination of protein (*antigen*) and ferment (*antibody*) with the production, through partial digestion, of a poisonous substance (*anaphylatoxin*).

There are reasons to believe that the reaction occurs largely within the body cells. Thus, sensitized animals after perfusion with normal blood can still suffer shock, and a strip of uterus muscle from a sensitized guinea-pig, after being thoroughly washed so as to remove all traces of blood, still contracts when exposed to the protein. The intracellular site of the reaction probably accounts for its intensity. The poisonous substance was at first supposed to be derived wholly from the second dose of foreign protein, but there is adequate evidence to show that much or all of it is derived from the proteins of the shocked animal.

Anaphylaxis in Man.—Typical anaphylactic shock is in rare instances seen in man. It has followed a second injection of horse serum (diphtheria or tetanus antitoxin, immune sera for treating scarlet fever, epidemic meningitis, pneumonia, etc.) given at a suitable interval after the initial dose. The symptoms are a feeling of apprehension, sneezing, nettle-rash, tickling in the throat, swelling of the face or more generalized swellings, violent asthma, rapid weak pulse; occasionally convulsions; death may ensue in a few minutes or hours. *Serum Sickness,* the symptoms which often follow even the first injection of a foreign serum, is probably anaphylactic in nature.

The presence in an individual of hypersensitiveness to a substance, horse serum for example, may be determined by suitable tests (*see* below), and this hypersensitiveness can be temporarily lessened by frequently repeated injections of increasing amounts of serum, beginning with extremely small, non-toxic doses. The patient can then be given the needed diphtheria antitoxin or other type of serum treatment with safety. In the actual attack a hypodermic injection of adrenalin may be life-saving.

Phenomena in Man Allied to Anaphylaxis.—Ten per cent of Caucasians are hypersensitive to a wide range of substances, usually protein in nature, that may be ingested (*foods; e.g.,* egg, milk, shellfish, berries; *drugs; e.g.,* quinine) or inhaled (*pollens; animal emanations; e.g.,* feathers, hair, dandruff; *dusts* of organic origin; *e.g.,* flour, wood dusts, house dust). Even tiny

amounts of these substances, in susceptible subjects, provoke a variety of diseases (*q.v.*): asthma, hay fever, *Urticaria,* some forms of eczema, etc. Some of the phenomena of infections and parasitic infestations may be due to acquired hypersensitiveness to proteins of bacterial or parasitic origin (skin reactions to tuberculin and luetin, urticaria in *Ascaris* and *Echinococcus* infestations, etc.).

Hypersensitiveness of an individual to a protein may be demonstrated by applying the protein to an abrasion in the skin or injecting it in solution into the skin. swelling and redness at the site of contact indicate sensitiveness to that substance. Such *skin testing* is used in the diagnosis of suspected hypersensitiveness. The treatment of human hypersensitiveness is (1) Avoidance of the offending substance; *e g*, omission of a food from the diet; substituting a cotton pillow for the feathers to which the patient is sensitive; and (2) Creation of tolerance for the offending substance by repeated administration of increasing amounts of the substance, beginning with small non-toxic doses. Avoidance gives better results than does the second method.

Though human hypersensitiveness is probably closely allied to anaphylaxis, it differs therefrom by being usually a natural, not an acquired state; it tends to be hereditary, following the Mendelian law; it is not usually accompanied by presence of specific blood antibodies of the precipitin type (*see* IMMUNITY); it may exist towards non-protein as well as protein substances, etc.

The terminology of the entire subject is somewhat confusing The term *allergy* was introduced by von Pirquet to include all manifestations of human hypersensitiveness. The term *atopy* has been applied by Coca to the natural (inherited) type of human hypersensitiveness The term *anaphylaxis* is usually restricted to those instances of human hypersensitiveness which follow an initial sensitizing dose, and conform in other respects to hypersensitiveness as seen in laboratory animals

Detailed discussions of the subject will be found in the standard text-books on immunology, pathology and internal medicine.

(R A KN.)

ANARCHISM, the name given to a principle or theory of life and conduct under which society is conceived without government (from Gr ἀν- and ἀρχή, without authority)—harmony in such a society being obtained, not by submission to law, or by obedience to any authority, but by free agreements concluded between the various groups, territorial and professional, freely constituted for the sake of production and consumption, as also for the satisfaction of the infinite variety of needs and aspirations of a civilized being In a society developed on these lines, the voluntary associations which already now begin to cover all the fields of human activity would take a still greater extension so as to substitute themselves for the State in all its functions. They would represent an interwoven network, composed of an infinite variety of groups and federations of all sizes and degrees, local, regional, national and international—temporary or more or less permanent—for all possible purposes: production, consumption and exchange, communications, sanitary arrangements, education, mutual protection, defence of the territory, and so on; and, on the other side, for the satisfaction of an ever-increasing number of scientific, artistic, literary and sociable needs. Moreover, such a society would represent nothing immutable. On the contrary—as is seen in organic life at large—harmony would (it is contended) result from an ever-changing adjustment and readjustment of equilibrium between the multitude of forces and influences, and this adjustment would be the easier to obtain as none of the forces would enjoy a special protection from the State.

If, it is contended, society were organized on these principles, man would not be limited in the free exercise of his powers in productive work by a capitalist monopoly, maintained by the State; nor would he be limited in the exercise of his will by a fear of punishment, or by obedience towards individuals or metaphysical entities, which both lead to depression of initiative and servility of mind. He would be guided in his actions by his own understanding, which necessarily would bear the impression of a free action and reaction between his own self and the ethical conceptions of his surroundings. Man would thus be enabled to obtain the full development of all his faculties, intellectual, artistic and moral, without being hampered by overwork for the monopolists, or by the servility and inertia of mind of the great number. He would thus be able to reach full *individualization,* which is not possible either under the present system of *individualism,* or under any system of State Socialism in the so-called *Volkstaat* (popular State).

The Anarchist writers consider, moreover, that their conception is not a Utopia, constructed on the a priori method, after a few desiderata have been taken as postulates It is derived, they maintain, from an *analysis of tendencies* that are at work already, even though State Socialism may find a temporary favour with the reformers The progress of modern technics, which wonderfully simplifies the production of all the necessaries of life; the growing spirit of independence, and the rapid spread of free initiative and free understanding in all branches of activity—including those which formerly were considered as the proper attribution of Church and State—are steadily reinforcing the no-government tendency.

Anarchists and the State.—As to economical conceptions, the Anarchists, in common with all Socialists, of whom they constitute the left wing, maintain that the now prevailing system of private ownership in land, and our capitalist production for the sake of profits, represent a monopoly which runs against both the principles of justice and the dictates of utility. They are the main obstacle which prevents the successes of modern technics from being brought into the service of all, so as to produce general well-being The Anarchists consider the wage-system and capitalist production altogether as an obstacle to progress. But they point out also that the State was, and continues to be, the chief instrument for permitting the few to monopolize the land, and the capitalists to appropriate for themselves a quite disproportionate share of the yearly accumulated surplus of production Consequently, while combating the present monopolization of land, and capitalism altogether, the anarchists combat with the same energy the State, as the main support of that system, not this or that special form, but the State altogether, whether it be a monarchy or even a republic governed by means of the *referendum.*

The State organization, having always been, both in ancient and modern history (Macedonian empire, Roman empire, modern European States grown up on the ruins of the autonomous cities), the instrument for establishing monopolies in favour of the ruling minorities, cannot be made to work for the destruction of these monopolies The Anarchists consider, therefore, that to hand over to the State all the main sources of economical life—the land, the mines, the railways, banking, insurance, and so on—as also the management of all the main branches of industry, in addition to all the functions already accumulated in its hands (education, State-supported religions, defence of the territory, etc.), would mean to create a new instrument of tyranny State capitalism would only increase the powers of bureaucracy and capitalism True progress lies in the direction of decentralization, both *territorial* and *functional,* in the development of the spirit of local and personal initiative, and of free federation from the simple to the compound, in lieu of the present hierarchy from the centre to the periphery.

In common with most Socialists, the Anarchists recognize that, like all evolution in nature, the slow evolution of society is followed from time to time by periods of accelerated evolution which are called revolutions; and they think that the era of revolutions is not yet closed Periods of rapid changes will follow the periods of slow evolution, and these periods must be taken advantage of—not for increasing and widening the powers of the State, but for reducing them, through the organization in every township or commune of the local groups of producers and consumers, as also the regional, and eventually the international, federations of these groups.

In virtue of the above principles the anarchists refuse to be party to the present State organization and to support it by infusing fresh blood into it. They do not seek to constitute, and

invite the working men not to constitute, political parties in the parliaments. Accordingly, since the foundation of the first International Working Men's Association in 1864, they have endeavoured to promote their ideas directly amongst the labour organizations and to induce those unions to a direct struggle against capital, distrusting parliamentary legislation.

Historical Development of Anarchism.—The conception of society just sketched, and the tendency which is its dynamic expression, have always existed in mankind, in opposition to the governing hierarchic conception and tendency—now the one and now the other taking the upper hand at different periods of history. To the former tendency we owe the evolution, by the masses themselves, of those institutions—the clan, the village community, the guild, the free mediaeval city—by means of which the masses resisted the encroachments of the conquerors and the power-seeking minorities. The same tendency asserted itself with great energy in the great religious movements of mediaeval times, especially in the early movements of the reform and its forerunners. At the same time it evidently found its expression in the writings of some thinkers, since the times of Lao-tsze, although, owing to its non-scholastic and popular origin, it obviously found less sympathy among the scholars than the opposed tendency.

As has been pointed out by Prof. Adler in his *Geschichte des Sozialismus und Kommunismus,* Aristippus (b. *c.* 430 B.C), one of the founders of the Cyrenaic school, already taught that the wise must not give up their liberty to the State, and in reply to a question by Socrates he said that he did not desire to belong either to the governing or the governed class. Such an attitude, however, seems to have been dictated merely by an Epicurean attitude towards the life of the masses.

The best exponent of Anarchist philosophy in ancient Greece was Zeno (342–267 or 270 B C.), from Crete, the founder of the Stoic philosophy, who distinctly opposed his conception of a free community without government to the State Utopia of Plato He repudiated the omnipotence of the State, its intervention and regimentation, and proclaimed the sovereignty of the moral law of the individual—remarking already that, while the necessary instinct of self-preservation leads man to egotism, nature has supplied a corrective to it by providing man with another instinct—that of sociability. When men are reasonable enough to follow their natural instincts, they will unite across the frontiers and constitute the *Cosmos.* They will have no need of law-courts or police, will have no temples and no public worship, and use no money—free gifts taking the place of the exchanges. Unfortunately, the writings of Zeno have not reached us and are only known through fragmentary quotations. However, the fact that his very wording is similar to the wording now in use, shows how deeply is laid the tendency of human nature of which he was the mouthpiece.

In mediaeval times we find the same views on the State expressed by the illustrious bishop of Alba, Marco Girolamo Vida, in his first dialogue *De dignitate reipublicae* (Ferd Cavalli, in *Mem. dell' Istituto Veneto,* xiii.; Dr. E Nys, *Researches in the History of Economics*). But it is especially in several early Christian movements, beginning with the 9th century in Armenia, and in the preachings of the early Hussites, particularly Chojecki, and the early Anabaptists, especially Hans Denk (*cf.* Keller, *Ein Apostel der Wiedertäufer*), that one finds the same ideas forcibly expressed—special stress being laid of course on their moral aspects.

Rabelais and Fénelon, in their Utopias, have also expressed similar ideas, and they were also current in the 18th century amongst the French Encyclopaedists, as may be concluded from separate expressions occasionally met with in the writings of Rousseau, from Diderot's *Preface* to the *Voyage* of Bougainville, and so on. However, in all probability, such ideas could not be developed then, owing to the rigorous censorship of the Roman Catholic Church.

These ideas found their expression later during the great French Revolution. While the Jacobins did all in their power to centralize everything in the hands of the Government, it appears now, from recently published documents, that the masses of the people, in their municipalities and "sections," accomplished a considerable constructive work. They appropriated for themselves the election of the judges, the organization of supplies and equipment for the army, as also for the large cities work for the unemployed, the management of charities, and so on. They even tried to establish a direct correspondence between the 36,000 communes of France through the intermediary of a special board, outside the National Assembly (*cf.* Sigismund Lacroix, *Actes de la commune de Paris*).

It was W. Godwin, in his *Enquiry concerning Political Justice* (2 vols., 1793), who was first to formulate the political and economical conceptions of anarchism, even though he did not give that name to the ideas developed in his remarkable work. Laws, he wrote, are not a product of the wisdom of our ancestors: they are the product of their passions, their timidity, their jealousies and their ambition. The remedy they offer is worse than the evils they pretend to cure. If and only if all laws and courts were abolished, and the decisions in the arising contests were left to reasonable men chosen for that purpose, real justice would gradually be evolved. As to the State, Godwin frankly claimed its abolition. A society, he wrote, can perfectly well exist without any government: only the communities should be small and perfectly autonomous. Speaking of property, he stated that the rights of every one "to every substance capable of contributing to the benefit of a human being" must be regulated by justice alone: the substance must go "to him who most wants it." His conclusion was communism. Godwin, however, had not the courage to maintain his opinions He entirely rewrote later on his chapter on property and mitigated his Communist views in the second edition of *Political Justice* (8vo , 1796)

Proudhon Names Anarchy.—Proudhon was the first to use, in 1840 (*Qu'est-ce que la propriété?* first memoir), the name of anarchy with application to the no-government state of society. The name of "anarchists" had been freely applied during the French Revolution by the Girondists to those revolutionaries who did not consider that the task of the Revolution was accomplished with the overthrow of Louis XVI , and insisted upon a series of economical measures being taken (the abolition of feudal rights without redemption, the return to the village communities of the communal lands enclosed since 1669, the limitation of landed property to 120 acres, progressive income-tax, the national organization of exchanges on a just value basis, which already received a beginning of practical realization, and so on)

Now Proudhon advocated a society without government, and used the word anarchy to describe it. Proudhon repudiated, as is known, all schemes of Communism, according to which mankind would be driven into communistic monasteries or barracks, as also all the schemes of State or State-aided Socialism which were advocated by Louis Blanc and the collectivists . When he proclaimed in his first memoir on property that "Property is theft," he meant only property in its present, Roman law sense of "right of use and abuse"; in property rights, on the other hand, understood in the limited sense of *possession,* he saw the best protection against the encroachments of the State. At the same time he did not want violently to dispossess the present owners of land, dwelling-houses, mines, factories, and so on. He preferred to attain the same end by rendering capital incapable of earning interest; and this he proposed to obtain by means of a national bank, based on the mutual confidence of all those who are engaged in production, who would agree to exchange among themselves their products at cost-value, by means of labour cheques representing the hours of labour required to produce every given commodity. Under such a system, which Proudhon described as "Mutuellisme," all the exchanges of services would be strictly equivalent. Besides, such a bank would be enabled to lend money without interest, levying only something like 1%, or even less, for covering the cost of administration. Every one being thus enabled to borrow the money that would be required to buy a house, nobody would agree to pay any more a yearly rent for the use of it. A general "social liquidation" would thus be rendered easy, without violent expropriation. The same applied to mines. railways. factories. and so on.

In a society of this type the State would be useless. The chief relations between citizens would be based on free agreement and regulated by mere account keeping. The contests might be settled by arbitration. A penetrating criticism of the State and all possible forms of government, and a deep insight into all economic problems, were well-known characteristics of Proudhon's work.

It is worth noticing that French mutualism had its precursor in England, in William Thompson, who began by mutualism before he became a Communist, and in his followers John Gray (*A Lecture on Human Happiness*, 1825; *The Social System*, 1831) and J. F. Bray (*Labour's Wrongs and Labour's Remedy*, 1839). It had also its precursor in America. Josiah Warren, who was born in 1798 (*cf.* W. Bailie, *Josiah Warren, the First American Anarchist*, Boston, 1900), and belonged to Owen's "New Harmony," considered that the failure of this enterprise was chiefly due to the suppression of individuality and the lack of initiative and responsibility. These defects, he taught, were inherent to every scheme based upon authority and the community of goods. He advocated, therefore, complete individual liberty. In 1827 he opened in Cincinnati a little country store which was the first "Equity Store," and which the people called "Time Store," because it was based on labour being exchanged hour for hour in all sorts of produce. "Cost—the limit of price," and consequently "no interest," was the motto of his store, and later on of his "Equity Village," near New York, which was still in existence in 1865. Keith's "House of Equity" at Boston, founded in 1855, is also worthy of notice.

While the economical, and especially the mutual-banking, ideas of Proudhon found supporters and even a practical application in the United States, his political conception of anarchy found but little echo in France, where the Christian Socialism of Lamennais and the Fourierists, and the State Socialism of Louis Blanc and the followers of Saint-Simon, were dominating. These ideas found, however, some temporary support among the left-wing Hegelians in Germany, Moses Hess in 1843, and Karl Grün in 1845, who advocated anarchism Besides, the authoritarian Communism of Wilhelm Weitling having given origin to opposition amongst the Swiss working men, Wilhelm Marr gave expression to it in the '40s.

On the other side, individualist anarchism found, also in Germany, its fullest expression in Max Stirner (Kaspar Schmidt), whose remarkable works (*Der Einzige und sein Eigenthum* and articles contributed to the *Rheinische Zeitung*) remained quite overlooked until they were brought into prominence by John Henry Mackay.

Prof. V. Basch, in a very able introduction to his interesting book, *L'Individualisme anarchiste: Max Stirner* (1904), has shown how the development of the German philosophy from Kant to Hegel, and "the absolute" of Schelling and the *Geist* of Hegel, necessarily provoked, when the anti-Hegelian revolt began, the preaching of the same "absolute" in the camp of the rebels. This was done by Stirner, who advocated, not only a complete revolt against the State and against the servitude which authoritarian Communism would impose upon men, but also the full liberation of the individual from all social and moral bonds—the rehabilitation of the "I," the supremacy of the individual, complete "a-moralism" and the "association of the egotists." The final conclusion of that sort of individual anarchism has been indicated by Prof. Basch. It maintains that the aim of all superior civilization is, not to permit *all* members of the community to develop in a normal way, but to permit certain better endowed individuals "fully to develop," even at the cost of the happiness and the very existence of the mass of mankind. It is thus a return towards the most common individualism, advocated by all the would-be superior minorities, to which indeed man owes in his history precisely the State and the rest, which these individualists combat. Their individualism goes so far as to end in a negation of their own starting-point, to say nothing of the impossibility for the individual to attain a really full development in the conditions of oppression of the masses by the "beautiful aristocracies." His development would remain unilateral. This is why this direction of thought, notwithstanding its undoubtedly correct and useful advocacy of the full development of each individuality, finds a hearing only in limited artistic and literary circles.

Anarchism in the International Working Men's Association.—A general depression in the propaganda of all factions of Socialism followed, as is known, after the defeat of the uprising of the Paris working men in June 1848 and the fall of the republic. All the Socialist press was gagged during the reaction period, which lasted fully 20 years. Nevertheless, even anarchist thought began to make some progress, namely in the writings of Bellegarrique (*Coeurderoy*) and especially Joseph Déjacque (*Les Lazaréennes, L'Humanisphère*, an anarchist-Communist Utopia, lately discovered and reprinted). The Socialist movement revived only after 1864, when some French working men, all "mutualists," meeting in London during the Universal Exhibition with English followers of Robert Owen, founded the International Working Men's Association. This association developed very rapidly and adopted a policy of direct economical struggle against capitalism, without interfering in the political parliamentary agitation, and this policy was followed until 1871. However, after the Franco-German War, when the International Association was prohibited in France after the uprising of the Commune, the German working men who had received manhood suffrage for elections to the newly constituted imperial parliament, insisted upon modifying the tactics of the International, and began to build up a Social-Democratic political party. This soon led to a division in the Working Men's Association, and the Latin federations, Spanish, Italian, Belgian and Jurassic (France could not be represented), constituted among themselves a federal union which broke entirely with the Marxist general council of the International. Within these federations developed now what may be described as *modern anarchism*. After the names of "federalists" and "anti-authoritarians" had been used for some time by these federations the name of "anarchists," which their adversaries insisted upon applying to them prevailed, and finally it was revindicated.

Bakunin (*q.v.*) soon became the leading spirit among these Latin federations for the development of the principles of anarchism, which he did in a number of writings, pamphlets and letters. He demanded the complete abolition of the State, which —he wrote—is a product of religion, belongs to a lower state of civilization, represents the negation of liberty, and spoils even that which it undertakes to do for the sake of general well-being. The State was an historically necessary evil, but its complete extinction will be, sooner or later, equally necessary. Repudiating all legislation, even when issuing from universal suffrage, Bakunin claimed for each nation, each region and each commune, full autonomy, so long as it is not a menace to its neighbours, and full independence for the individual, adding that one becomes really free only when, and in proportion as, all others are free. Free federations of the communes would constitute free nations.

As to his economical conceptions, Bakunin described himself, in common with his federalist comrades of the International (Cesar De Paepe, James Guillaume, Schwitzguébel), a "collectivist anarchist"—not in the sense of Vidal and Pecqueur in the '40s, or of their modern Social-Democratic followers, but to express a state of things in which all necessaries for production are owned in common by the Labour groups and the free communes, while the ways of retribution of Labour, Communist or otherwise, would be settled by each group for itself. Social revolution, the near approach of which was foretold at that time by all Socialists, would be the means of bringing into life the new conditions.

Anarchism and Violence.—The Jurassic, the Spanish, and the Italian federation and sections of the International Working Men's Association, as also the French, the German and the American anarchist groups, were for the next years the chief centres of anarchist thought and propaganda. They refrained from any participation in parliamentary politics, and always kept in close contact with the Labour organizations. However, in the second half of the '80s and the early '90s of the 19th century, when the influence of the anarchists began to be felt in strikes, in May-

day demonstrations, where they promoted the idea of a general strike for an eight-hour day, and in the anti-militarist propaganda in the army, violent prosecutions were directed against them, especially in the Latin countries (including physical torture in the Barcelona castle) and the United States (the execution of five Chicago anarchists in 1887). Against these prosecutions the anarchists retaliated by acts of violence which in their turn were followed by more executions from above, and new acts of revenge from below. This created in the general public the impression that violence is the substance of anarchism, a view repudiated by its supporters, who hold that in reality violence is resorted to by all parties in proportion as their open action is obstructed by repression, and exceptional laws render them outlaws. (Cf, *Anarchism and Outrage,* by C. M. Wilson, and *Report of the Spanish Atrocities Committee,* in "Freedom Pamphlets"; *A Concise History of the Great Trial of the Chicago Anarchists,* by Dyer Lum (N.Y., 1886), *The Chicago Martyrs: Speeches,* etc)[1]

Anarchism continued to develop, partly in the direction of Proudhonian "Mutuellisme," but chiefly as Communist-anarchism, to which a third direction, Christian-anarchism, was added by Leo Tolstoi, and a fourth, which might be ascribed as literary-anarchism, began amongst some prominent modern writers.

The ideas of Proudhon, especially as regards mutual banking, corresponding with those of Josiah Warren, found a considerable following in the United States, creating quite a school, of which the main writers are Stephen Pearl Andrews, William Grene, Lysander Spooner (who began to write in 1850, and whose unfinished work, *Natural Law,* was full of promise) and several others, whose names will be found in Dr Nettlau's *Bibliographie de l'anarchie.*

[1]It is important to remember that the term "anarchist" is inevitably rather loosely used in public in connection with the authors of a certain class of murderous outrages, and that the same looseness of definition often applies to the professions of "anarchism" made by such persons. As stated above, a philosophic anarchist would repudiate the connection. And the general public view, which regards anarchist doctrines indiscriminately, is to that extent a confusion of terms. But the following *résumé* of the chief modern so-called "anarchist" incidents is appended for convenience in stating the facts under the heading where a reader would expect to find them.

Between 1882 and 1886 in France, Prince Kropotkin, Louise Michel and others were imprisoned. In England, Most, one of the German anarchist leaders, founded *Die Freiheit,* and, for defending in it the assassination of Alexander II. at St. Petersburg, was sentenced to 18 months' imprisonment with hard labour. After this he moved to the United States, and re-established his paper there in New York, in May 1886. During this period there were several anarchist congresses in the United States. In one at Albany, in 1878, the revolutionary element, led by Justus Schwab, broke away from the others; at Allegheny city, in 1879, again there was a rupture between the peaceful and the revolutionary sections. *The Voice of the People* at St. Louis, the *Arbeiter Zeitung* at Chicago, and the *Anarchist* at Boston, were the organs of the revolutionary element. In 1883, at Pittsburgh, a congress of 28 delegates, representing 22 towns, drew up an address to the working men of America. The programme it proposed was as follows —

First, Destruction of the existing class rule by all means; *i e,* energetic, relentless, revolutionary and international action.

Secondly, Establishment of a free society, based upon co-operative organization of production

Thirdly, Free exchange of equivalent products by and between the productive organizations, without commerce and profit-mongery.

Fourthly, Organization of education on a secular, scientific and equal basis for both sexes.

Fifthly, Equal rights for all, without distinction of sex or race.

Sixthly, Regulation of all public affairs by free contracts between the autonomous (independent) communes and associations, resting on a federalistic basis.

This, together with an appeal to the working men to organize, was published in Chicago, Nov. 1883, by a local committee of four, representing French, Bohemian, German and English sections, the head of the last being August Spies, who was hanged in 1887 for participation in the Haymarket affair in Chicago, May 4, 1886 This affair was the culmination of a series of encounters between the Chicago working men and the police, which had covered several years. The meeting of May 4 was called by Spies and others to protest against the action of the police, by whom several working men had been killed in collisions growing out of the efforts to introduce the eight-hour day. The mayor of the city attended the meeting, but, finding it peaceful, went home. The meeting was subsequently entered by the police and commanded to disperse. A bomb was thrown, several policemen being killed and a number wounded. For this crime eight men were tried in one panel and condemned, seven—Spies, Parsons, Engel, Fischer, Fielden, Schwab and Ling—to death, and one—Neebe—to imprisonment for 15 years. The sentences on Fielden and Schwab were commuted by Governor Oglesby to imprisonment for life, on the recommendation of the presiding judge and the prosecuting attorney. Ling committed suicide in gaol, and Spies, Parsons, Engel and Fischer were hanged, Nov. 11, 1887. On June 26, 1893, an unconditional pardon was granted the survivors, Fielden, Schwab and Neebe, by Governor Altgeld The reasons for the pardon were stated by the governor to be that, on an examination of the records he found that the jury had not been drawn in the usual manner, but by a special bailiff, who made his own selection and had summoned a "prejudiced jury"; that the "State had never discovered who it was that threw the bomb which killed the policemen, and the evidence does not show any connection whatever between the defendants and the man who did throw it," . . . or that this man "ever heard or read a word coming from the defendants, and consequently fails to show that he acted on any advice given by them" Judge Gary, the judge at the trial, published a defence of its procedure in the *Century Magazine,* vol. xxiii., p. 803.

A number of outbreaks in later years were attributed to the propaganda of reform by revolution, like those in Spain and France in 1892, in which Ravachol was a prominent figure. In 1893 a bomb was exploded in the French Chamber of Deputies by Vaillant. The spirit of these men is well illustrated by the reply which Vaillant made to the judge who reproached him for endangering the lives of innocent men and women: "There can be no innocent bourgeois." In 1894 there was an explosion in a Parisian café, and another in a theatre at Barcelona. For the latter outrage six men were executed. President Carnot of the French Republic was assassinated by an Italian at Lyons in the same year. The Empress Elizabeth of Austria was assassinated in Sept. 1898. These events, all associated by the public with "anarchism," led to the passage by the United States Congress of a law, in 1894, to keep out foreign anarchists, and to deport any who might be found in the country, and also to the assemblage of an international conference in Rome, in 1898, to agree upon some plan for dealing with these revolutionists. It was proposed that their offences should no longer be classed as political, but as common-law crimes, and be made subject to extradition. The suppression of the revolutionary press and the international co-operation of the police were also suggested. The results of the conference were not, however, published; and the question of how to deal with the campaign against society fell for a while into abeyance. The attempt made by the youth Sipido on the (then) prince of Wales at Brussels in 1900 recalled attention to the subject. The acquittal of Sipido, and the failure of the Belgian Government to see that justice was done in an affair of such international importance, excited considerable feeling in England, and was the occasion of a strongly-worded note from the British to the Belgian Government. The murder of King Humbert of Italy in July 1900 renewed the outcry against Italian anarchists. Even greater horror and indignation were excited by the assassination of President McKinley by Czolgosz on Sept. 6, 1901, at Buffalo, U S.A. and by an attempt made to blow up the young king and queen of Spain on their wedding-day in 1906. (Ed. *E.B.*)

A prominent position among the individualist anarchists in America has been occupied by Benjamin R. Tucker. His journal *Liberty* was started in 1881 and his conceptions are a combination of those of Proudhon with those of Herbert Spencer. Starting from the statement that anarchists are egotists, strictly speaking, and that every group of individuals, be it a secret league of a few persons, or the Congress of the United States, has the right to oppress all mankind, provided it has the power to do so, that equal liberty for all and absolute equality ought to be the law, and "mind every one your own business" is the unique moral law of anarchism, Tucker goes on to prove that a general and thorough application of these principles would be beneficial and would offer no danger, because the powers of every individual would be limited by the exercise of the equal rights of all others. He further indicated (following H. Spencer) the difference which exists between the encroachment on somebody's rights and resistance to such an encroachment, between domination and defence: the former being equally condemnable, whether it be encroachment of a criminal upon an individual, or the encroachment of one upon all others, or of all others upon one; while resistance to encroachment is defensible and necessary. For their self-defence, both the citizen and the group have the right to any violence including capital punishment. Violence is also justified for enforcing the duty of keeping an agreement. Tucker thus follows Spencer, and, like him, opens (in the present writer's opinion) the way for reconstituting under the heading of "defence" all the functions of the State. His criticism of the present State is very searching, and his defence of the rights of the individual very powerful. As regards his economical views B. R. Tucker follows Proudhon.

The individualist anarchism of the American Proudhonians finds, however, but little sympathy amongst the working masses. Those who profess it—they are chiefly "intellectuals"—soon realize that the *individualization* they so highly praise is not attainable by individual efforts, and either abandon the ranks of the anarchists, and are driven into the liberal individualism of the classical economists, or they retire into a sort of Epicurean a-moralism, or super-man-theory, similar to that of Stirner and Nietzsche. The great bulk of the anarchist working men prefer the anarchist-Communist ideas which have gradually evolved out of the anarchist collectivism of the International Working Men's Association. To this direction belong—to name only the better known exponents of anarchism—Elisée Reclus, Jean Grave, Sebastien Faure, Emile Pouget in France; Enrico Malatesta and Covelli in Italy; R. Mella, A. Lorenzo, and the mostly unknown authors of many excellent manifestos in Spain; John Most amongst the Germans; Spies, Parsons and their followers in the United States, and so on; while Domela Nieuwenhuis occupied an intermediate position in Holland. The chief anarchist papers which have been published since 1880 also belong to that direction; while a number of anarchists of this direction have joined the so-called syndicalist movement—the French name for the non-political Labour movement, devoted to direct struggle with capitalism, which has lately become so prominent in Europe.

Scientific Anarchist-Communism.—As one of the anarchist-Communist direction, the present writer for many years endeavoured to develop the following ideas: to show the intimate, logical connection which exists between the modern philosophy of natural sciences and anarchism; to put anarchism on a scientific basis by the study of the tendencies that are apparent now in society and may indicate its further evolution; and to work out the basis of anarchist ethics. As regards the substance of anarchism itself, it was Kropotkin's aim to prove that Communism—at least partial—has more chances of being established than collectivism, especially in communes taking the lead, and that free, or anarchist-Communism is the only form of Communism that has any chance of being accepted in civilized societies; Communism and anarchy are therefore two terms of evolution which complete each other, the one rendering the other possible and acceptable. He has tried, moreover, to indicate how, during a revolutionary period, a large city—if its inhabitants have accepted the idea—could organize itself on the lines of free Communism; the city guaranteeing to every inhabitant dwelling, food and clothing to an extent corresponding to the comfort now available to the middle classes only, in exchange for a half-day's or a five-hours' work; and how all those things which would be considered as luxuries might be obtained by every one if he joins for the other half of the day all sorts of free associations pursuing all possible aims—educational, literary, scientific, artistic, sports and so on. In order to prove the first of these assertions he has analysed the possibilities of agriculture and industrial work, both being combined with brain work. And in order to elucidate the main factors of human evolution he has analysed the part played in history by the popular constructive agencies of mutual aid and the historical rôle of the State.

Without naming himself an anarchist, Leo Tolstoi, like his predecessors in the popular religious movements of the 15th and 16th centuries, Chojecki, Denk and many others, took the anarchist position as regards the State and property rights, deducing his conclusions from the general spirit of the teachings of the Christ and from the necessary dictates of reason. With all the might of his talent he made (especially in *The Kingdom of God in Yourselves*) a powerful criticism of the church, the State and law altogether, and especially of the present property laws. He describes the State as the domination of the wicked ones, supported by brutal force. Robbers, he says, are far less dangerous than a well-organized Government. He makes a searching criticism of the prejudices which are current now concerning the benefits conferred upon men by the church, the State and the existing distribution of property, and from the teachings of the Christ he deduces the rule of non-resistance and the absolute condemnation of all wars. His religious arguments are, however, so well combined with arguments borrowed from a dispassionate observation of the present evils, that the anarchist portions of his works appeal to the religious and the non-religious reader alike.

It would be impossible to represent here, in a short sketch, the penetration, on the one hand, of anarchist ideas into modern literature, and the influence, on the other hand, which the libertarian ideas of the best contemporary writers have exercised upon the development of anarchism One ought to consult the ten big volumes of the *Supplement litteraire* to the paper *La révolte* and later the *Temps nouveaux,* which contain reproductions from the works of hundreds of modern authors expressing anarchist ideas, in order to realize how closely anarchism is connected with all the intellectual movement of our own times. J. S Mill's *Liberty,* Spencer's *Individual versus The State,* Marc Guyau's *Morality without Obligation or Sanction,* and Fouillée's *La morale, l'art et le religion,* the works of Multatuli (E. Douwes Dekker), Richard Wagner's *Art and Revolution,* the works of Nietzsche, Emerson, W. Lloyd Garrison, Thoreau, Alexander Herzen, Edward Carpenter and so on; and in the domain of fiction, the dramas of Ibsen, the poetry of Walt Whitman, Tolstoi's *War and Peace,* Zola's *Paris* and *Le travail,* the works of Merezhkovski and an infinity of works of less known authors,—are full of ideas which show how closely anarchism is interwoven with the work that is going on in modern thought in the same direction of enfranchisement of man from the bonds of the State as well as from those of capitalism (P. A. K)

Anarchism Since Kropotkin's Death.—Peter Kropotkin, the author of the foregoing article, died in 1921, at the age of 70 The son of a distinguished Russian family, he renounced the life of the soldier and courtier which opened to him to devote himself to the natural sciences. But the reading of Proudhon turned his mind to social questions, and he became an anarchist of the Proudhonian school. To the propagation of these ideas he devoted the last 60 years of his life; and after the death of Bakunin he was probably the best known anarchist of the last two generations. Imprisoned in both Russia and Switzerland for his activities, he ultimately settled in London, where he was the centre of a distinguished circle of liberal-minded writers and Russian exiles. He wrote prolifically, some of his works, especially *Memoirs of a Revolutionist* (1901), *Mutual Aid* (1904) and *The Conquest of Bread* (1906) exercising considerable influence; while his *History of the French Revolution* is one of the best analyses of its subject written from the angle of extreme hostility to the State. In 1917, the revolution of March permitted him to return to Russia, where he lived until his death. It cannot be said that his last years were happy. He had never sympathised with the Marxist system; and his own passion for anarchist federalism found no comfort in the rigorous and authoritarian centralization of which the Bolshevists were the sponsors. He was, however, honoured by the new régime as a great figure in the history of Russian revolutionary effort; and his house has been turned into a museum of social history.

It cannot be said, indeed, that anarchism has been other than a declining movement in recent years. It still has its groups of enthusiasts, especially in the Latin countries. Attention was drawn to it in 1909 by the execution, in the face of all the evidence, of the Spanish anarchist Francisco Ferrer, who had mainly been concerned with educational reform movements and was, on all the evidence, a man of the highest nobility of character. A wave of excitement in America in 1919 led to the deportation of certain well-known anarchists to Russia. Among these were Alexander Berkman and Emma Goldman, both of whom were well-known for their propaganda work. They found the new régime intolerable by reason of its sternly authoritarian character, and the constant imprisonment of their anarchist colleagues led them to leave Russia in disgust. Both published angry denunciations of the new system, of which *My Disillusionment in Russia* (1925), by Emma Goldman, is an interesting picture of the reaction of the Bolshevist State upon a mind strongly wedded to freedom America again became the centre of attention in the civilized world in the summer of 1927 when, after a delay of seven years, two Italian anarchists, Sacco and Vanzetti, were executed

for supposed participation in a crime of violence (*see* F. Frankfurter, *The Sacco-Vanzetti Case*, 1927). As with Ferrer, 20 years before, the public opinion of the world felt that the execution had taken place less upon the evidence than for the crime of holding extreme opinions.

While anarchism in its classic form has made little headway in recent years, it can, however, claim that its central doctrines have not been without considerable influence. In the form of Proudhonian federalism it has created something like a revival of federalism in France: and the traces of this revival are to be found in the most diverse quarters. Its most usual thesis has been the danger of the centralized State to individual liberty, and under the name of Proudhon, a movement for decentralization has assumed considerable proportions. (*See* Charles-Brun, *Le Regionalisme* [1911]; *Cahiers du Cercle Proudhon* [1913]; and the prefaces to the new complete edition of Proudhon now in course of publication in Paris.) Another neo-anarchist current of opinion in France derives from Stirner and is ably represented by H. L. Follin, M. L. Lefort and E. Armand. (*See* especially the latter's *Initiation individualiste-anarchiste* [1923] and, generally, G. Pirou, *Les Doctrines Economiques en France depuis 1870* [1925]).

In England there has been no important anarchist thinker for many years. But, as in France, the reaction against the sovereign State had led to the growth of a political pluralism in which the influence of anarchist theories is apparent. (*See*, for instance, Bertrand Russell, *Roads to Freedom* [3rd ed., 1920]; H. J. Laski, *A Grammar of Politics* [1925]. G. D. H. Cole, *Social Theory* [2nd ed., 1921]). Anarchist groups, of course, remain but there is no evidence to suggest that they are at all largely influential. (H. J. L.)

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ANASTASIUS, the name of four popes. ANASTASIUS I., pope from 399 to 401. He it was who condemned the writings of Origen shortly after their translation into Latin.

ANASTASIUS II., pope from 496 to 498. He lived in the time of the schism of Acacius of Constantinople. He showed some tendency towards conciliation, and thus brought upon himself the lively reproaches of the author of the *Liber pontificalis*. On the strength of this tradition, Dante has placed this pope in hell.

ANASTASIUS III., pope from 911 to 913, was a Roman by birth. Practically nothing is recorded of him, except that he took an active part in determining the ecclesiastical divisions of Germany, his pontificate falling in the period when Rome was in the power of the Roman nobles.

ANASTASIUS IV. was pope from 1153 to 1154. He was a Roman named Conrad, son of Benedictus, and at the time of his election, on July 9 1153, was cardinal bishop of Sabina. He had taken part in the double election of 1130, had been one of the most determined opponents of Anacletus II. and when Innocent II. fled to France had been left behind as his vicar in Italy. During his short pontificate, however, he played the part of peacemaker; he came to terms with the emperor Frederick I. in the vexed question of the appointment to the see of Magdeburg and closed the long quarrel, which had raged through four pontificates, about the appointment of William Fitzherbert (d. 1154)—commonly known as St. William of York—to the see of York, by sending him the pallium in spite of the continued opposition of the powerful Cistercian order. Anastasius died Dec. 3 1154, and was succeeded by Cardinal Nicholas of Albano (Nicholas Breakspear) as Adrian IV.

ANASTASIUS I. (*c.* 430–518), Roman emperor, was born at Dyrrhachium not later than A.D. 430. At the time of the death of Zeno (491), Anastasius, a palace official (*silentiarius*), bore a very high character, and was raised to the throne of the Roman empire of the East, through the choice of Ariadne, Zeno's widow, who married him shortly after his accession. His reign, though afterwards disturbed by foreign and intestine wars and religious distractions, commenced auspiciously. He gained popular favour by a judicious remission of taxation, and displayed great vigour and energy in administering the affairs of the empire. The principal wars in which Anastasius was engaged were those known as the Isaurian and the Persian wars. The former (492–496) was stirred up by the supporters of Longinus, the brother of Zeno. The victory of Cotyaeum in 493 "broke the back" of the revolt, but a guerilla warfare continued in the Isaurian mountains for some years longer. In the war with Persia (502–505), Theodosiopolis and Amida were captured by the enemy, but the Persian provinces also suffered severely and the Romans recovered Amida. Both adversaries were exhausted when peace was made (506) on the basis of *status quo*.

In 507 Anastasius built the strong fortress of Daras to hold Nisibis in check. The Balkan provinces were devastated by invasions of Slavs and Bulgarians; to protect Constantinople and its vicinity against them he built the "Anastasian Wall" in 512, extending from the Propontis to the Euxine. The emperor was a convinced Monophysite, but his ecclesiastical policy was moder-

ate; he endeavoured to maintain the principle of the *Henotikon* of Zeno and the peace of the church. It was the uncompromising attitude of the orthodox extremists, and the rebellious demonstrations of the Byzantine populace, that drove him in 512 to abandon this policy and adopt a monophysitic programme of religious unity in the East at the cost of Rome's hostility. His consequent unpopularity in the European provinces was utilized by an ambitious man, named Vitalian, to organize a dangerous rebellion, in which he was assisted by a horde of "Huns" (514–515); the rebellion was finally suppressed by a naval victory won by the general Marinus. The financial policy of Anastasius was so prudent and economical that it gained him a reputation for avarice and contributed to his unpopularity. He died July 9 518.

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ANASTASIUS II. (d. 721), Roman emperor in the East, whose original name was Artemius, was raised to the throne of Constantinople in A.D. 713, on the deposition of Philippicus, whom he had served in the capacity of secretary. Anastasius sent an army under Leo the Isaurian, afterwards emperor, to defend Syria against the Saracens; adopted wise and resolute measures for the defence of his capital; attempted to reorganize the discipline of the army; and equipped and despatched to Rhodes a formidable naval force. The troops of the Opsician province, resenting the emperor's strict measures, mutinied, slew the admiral, and proclaimed Theodosius emperor. After a six months' siege, Constantinople was taken by Theodosius; and Anastasius, who had fled to Nicaea, was compelled to submit to the new emperor and, retiring to Thessalonica, became a monk (716). In 721 he headed a revolt against Leo, who had succeeded Theodosius; but, though he besieged Constantinople, the enterprise failed and Anastasius, falling into Leo's hands, was put to death by his orders.

ANASTIGMAT, or anastigmatic lens, a photographic lens free from astigmatism (*q.v.*), and which is capable of forming a large sharp image in which a relatively great quantity of light is concentrated (*See* PHOTOGRAPHY: *Apparatus.*)

ANASTOMOSIS, the intercommunication between two vessels; a word used chiefly of blood-vessels and other tubes in anatomy for the communication between arteries and veins containing fluid, and also for the communication between the veins or branches of leaves, trees, insect-wings or river-connections, and by analogy in art-design.

ANATASE, one of the three mineral forms of titanium dioxide. It is always found as small, isolated and sharply developed crystals, and like rutile, a more commonly occurring modification of titanium dioxide, it crystallizes in the tetragonal system; but, although the degree of symmetry is the same for both, there is no relation between the interfacial angles of the two minerals, except, of course, in the prism-zone of 45° and 90°. There are also important differences between the physical characters of anatase and rutile; the former is not quite so hard (H.=5½–6) or dense (sp. gr.=3·9); it is optically negative, rutile being positive.

Two types or habits of anatase crystals may be distinguished. The commoner occurs as simple acute double pyramids with an indigo-blue to black colour and steely lustre. Crystals of this kind are abundant at Le Bourg d'Oisans in Dauphiné, where they are associated with rock-crystal, felspar and axinite in crevices in granite and mica-schist. Similar crystals, but of microscopic size, are widely distributed in sedimentary rocks, such as sandstones, clays and slates, from which they may be separated by washing away the lighter constituents of the powdered rock. Crystals of the second type have numerous pyramidal faces developed, and they are usually flatter or sometimes prismatic in habit; the colour is honey-yellow to brown. Such crystals occur attached to the walls of crevices in the gneisses of the Alps, the Binnenthal, Switzerland, being a well-known locality. Another common name for this mineral is octahedrite.

ANATHEMA, any curse, but especially one uttered by the Church for flagrant offences against faith or morals, and accompanied by exclusion from the community. Such exclusion was early practised in Judaism (*cf.* Ezra x. 8) and was developed into a formidable legal instrument by the rabbis (*cf.* "Ban" and "Anathema" in the *Jewish Encyclopedia*). Occasional complaints against the Jewish practice are heard from early Christians (*cf* John ix. 22, xii. 42, xvi. 2) but similar customs were early adopted by the Church (*cf.* 2 Thess. iii. 14; 1 Cor. v 5). 1 Cor xii 3, xvi. 22; Gal. i. 8, 9 are probably no more than private curses, but Rom. ix. 3 is a significant anticipation of later usage.

Instances of anathema in formulae of condemnation issued by councils are frequent, beginning with the 4th century, *e.g.*, a synod at Elvira (*c.* 300) issued an anathema against those who posted anti-Christian satires in churches and the Council of Nicea (325) anathematized Arianism. The formula, which later became regular and official appears in the canons of a council at Gangra (340?), "If any one (says such and such or behaves so and so), let him be anathema." A distinction between excommunication and anathema was drawn as early as the 6th century, and Pope John VIII. (878) defined "excommunication" as isolation from fellow Christians and "anathema" as separation from the body of Christ, *i.e.*, the Church. The Gratian Decree interprets this definition as implying exclusion from the sacraments. In spite of occasional uncertainty in usage, "anathema" has generally been reserved as a term for the gravest censure pronounced by the Church. In the *Corpus iuris canonici* (Rome, 1917), canon 2,257, it differs from excommunication only in the peculiarly solemn form in which it is pronounced.

The ecclesiastical legislation in canons 2,258–2,267 gives an excellent picture of the far-reaching effects of excommunication in Catholic society, even at the present day. Excommunicated persons are there divided into two classes, *vitandi* who have been publicly and by name denounced by the Apostolic see, and *tolerati* upon whom this sentence has not yet fallen. The society of *vitandi*, even in secular pursuits, is to be avoided except in special circumstances. Excommunicated persons may hear sermons but may not attend mass, and, although a *toleratus* attending mass need not be expelled from the church unless he attempt to take an active part in the service, a *vitandus* should be ejected or the service abandoned, if this can be managed without too great inconvenience. After formal condemnation no excommunicated person may receive sacraments or sacramentalia, or be buried in a Church cemetery, and he may not benefit by the indulgences, suffragia or public prayers of the Church, though private prayers and even masses may be offered on his behalf. In the case of *vitandi*, however, masses may only be said for their conversion. An excommunicated person ordinarily has no right to administer sacraments or sacramentalia, but may do so in the absence of clergy in good standing. Requests for sacraments and sacramentalia, however, should be made by the faithful to *vitandi* only in cases of extreme danger (in *solo mortis periculo*). No excommunicated person may take part in ecclesiastical transactions or procedure, except to appeal from the sentence of excommunication passed upon him, and should enjoy no ecclesiastical benefit or preferments. Ecclesiastical acts (*tam fori externi quam fori interni*) performed by excommunicated persons are, with few exceptions, illegal. For offences by which anathema may be incurred, *cf* canons 2,314 *seq.* and D. M Prummer O Pr., *Manuale iuris Ecclesiastici* (Friburg in Bresgau, 1920), pp 660 *seq.*

The ritual of anathema, now seldom used, is described in the *Pontificale Romanum* (ed. Joseph Catalan, Rome, 1740, iii. pp. 176 *seq.*). It is performed at the high altar, or in some other public place, by a bishop and 12 priests, all vested and carrying lighted tapers. The bishop recites a solemn formula describing the state of the condemned and the authority by which his excommunication is pronounced. It concludes, "*et (eum) a societate omnium Christianorum separamus, et a liminibus sanctae Matris Ecclesiae in coelo, et in terra excludimus, et excommunicatum, et anathematizatum esse decernimus, et damnatum cum diabolo, et angelis eius, et omnibus reprobis in ignem aeternum indicamus; donec a diaboli laqueis resipiscat, et ad emendationem, et poenitentiam*

redeat, et Ecclesiae Dei, quam laesit, satisfaciat; tradentes eum satanae in interitum carnis, ut spiritus eius salvus fiat in die iudicii." At this point all cry, "*Fiat, fiat, fiat,*" and dash their lighted candles to the ground. (R. P. C.)

ANATOLI, JACOB (*c.* 1194–1256), Hebrew translator from the Arabic. He was invited to Naples by Frederick II., and, in association with Michael Scot, made Arabic learning accessible to Western readers. Among his most important services were translations of works by Averroes.

ANATOLIA (Gr. ἀνατολή, sunrise, *i.e.*, eastern land), ancient geography, the country east of the Aegean, *i e.*, Asia Minor. It is now used by the Turks in the form *Anadolu* as the equivalent of the western part of Asia Minor (*q.v.*).

ANATOMY, literally dissection or cutting asunder, a term always used to denote the study of the structure of living things, animal or vegetable. Animal anatomy may include the study of the structure of different animals (*comparative anatomy* or *animal morphology*), or it may be limited to one animal only (*special anatomy*). From a utilitarian point of view the study of Man is the most important division of special anatomy, and this *human anatomy* may be approached from different points of view. From that of the medical man it consists of a knowledge of the exact form, position, size and relationship of the various structures of the human body in health (*descriptive* or *topographical human anatomy*). From the morphological point of view, human anatomy has for its object the discovery of the causes which have brought about the existing structure of Man, and needs a knowledge of the allied sciences of embryology or ontogeny, phylogeny and histology. Pathological or morbid anatomy is the study of diseased organs, while sections of normal anatomy, applied to various purposes, receive special names such as medical, surgical, gynaecological, artistic and superficial anatomy. The comparison of the anatomy of different races of mankind is part of the science of physical anthropology or anthropological anatomy.

In the present edition of this work the subject of anatomy is treated systematically rather than topographically. Each anatomical article contains first a description of the structures of an organ or system (such as nerves, arteries, heart, etc), as it is found in Man; and this is followed by an account of the development or embryology and comparative anatomy or morphology, as far as vertebrate animals are concerned.

The following separate anatomical articles will be found under their own headings.—

Alimentary canal.	Nerve.
Arteries.	Nervous system
Brain.	Olfactory system.
Coelom and serous membranes.	Pancreas.
Connective tissues.	Pharynx.
Diaphragm.	Placenta.
Ductless glands.	Reproductive system.
Ear.	Respiratory system.
Epithelial, endothelial and glandular tissues.	Scalp.
	Skeleton.
Eye.	Skin and Exoskeleton.
Heart.	Skull.
Joints.	Spinal cord.
Liver.	Teeth.
Lymphatic system.	Tongue.
Mammary gland.	Urinary system.
Mouth and salivary glands.	Vascular system.
Muscular system.	Veins.

From the year 1910 onwards the government authorities have not only supervised the administration of the Act, but also helped the schools to obtain an adequate supply of material to meet their needs. The immediate result has been an extension of sources of supply so as to improve considerably the state of affairs which prevailed previously in Great Britain.

NOMENCLATURE

There is still much confusion in the nomenclature of anatomy. This has arisen from an attempt to revise and improve the terminology which had previously been in common use. At present either the original or the new "Basle" terminology or a combination of both is employed, a manifest disadvantage. The most important recent advance has been the application of X-rays in the study of macroscopic anatomy, particularly of the living body—an advance which has proved of immense importance in the practice of medicine and surgery. Great improvements have been made in apparatus and technique and particularly in use of materials opaque to the rays for injections.

Osteology.—Advances in connection with the skeleton have been largely concerned with its development, and new views have been expressed as regards the origin, growth and fate of osteoblasts and osteoclasts. Important contributions have been made dealing with the human clavicle, ribs and bones of the face, with sexual differences in the human skull and sexual and racial characters of the human ilium and with the morphology of mammalian teeth and sternum.

Muscular System.—The investigations of Prof. Kulchitsky upon the innervation of muscle fibres, the suggestions of Prof. Hunter that muscle fibres are of two kinds with separate nerve supplies from the central and autonomic systems, and the actual designing of surgical measures for amelioration of muscle spasm based upon these ideas have not yet been sufficiently confirmed.

Nervous System.—C. W. Ariens Kappers has demonstrated that control is exercised upon the grouping of brain cells by forces, probably of a bio-electric character, emanating from the nerve tracts with which these are functionally associated. Attention has been given to the comparison of particular areas of the central nervous system in a series of vertebrates with a view to elucidating the evolutionary significance of these areas in man.

Organs of Sense—Investigations have been carried out by Karl Pearson, E. Nettleship and C. H. Usher on the subject of albinism in man, showing that eyes, hair and skin may alone show perfect albinism, and that perfect albinism in eyes may be accompanied by imperfect or wholly absent albinism in hair. Other recent publications of importance concern the eye and the ear.

Vascular System.—Recent additions to the knowledge of the vascular system have been chiefly in relation to function, to the blood supply of the valves, the muscular architecture and the development of the human heart, and to the arterial supply of the pons, medulla, and fore-brain, and the development and comparative anatomy of the arteries of the extremities.

Digestive System.—Particular attention has been paid to the teeth, the shape and size of the tonsils at different ages, the minute structure of the oesophagus in mammalia, the form and immediate relations of the abdominal viscera with special reference to their peritoneal attachments, their blood and nerve supply and lymphatic connections.

Respiratory System.—Papers have been written upon the human and comparative anatomy and development of this system with special reference to the lobes of the lungs and the nerve supply of the larynx. Knowledge has been acquired, by means of X-rays, regarding the position of the diaphragm and thoracic viscera.

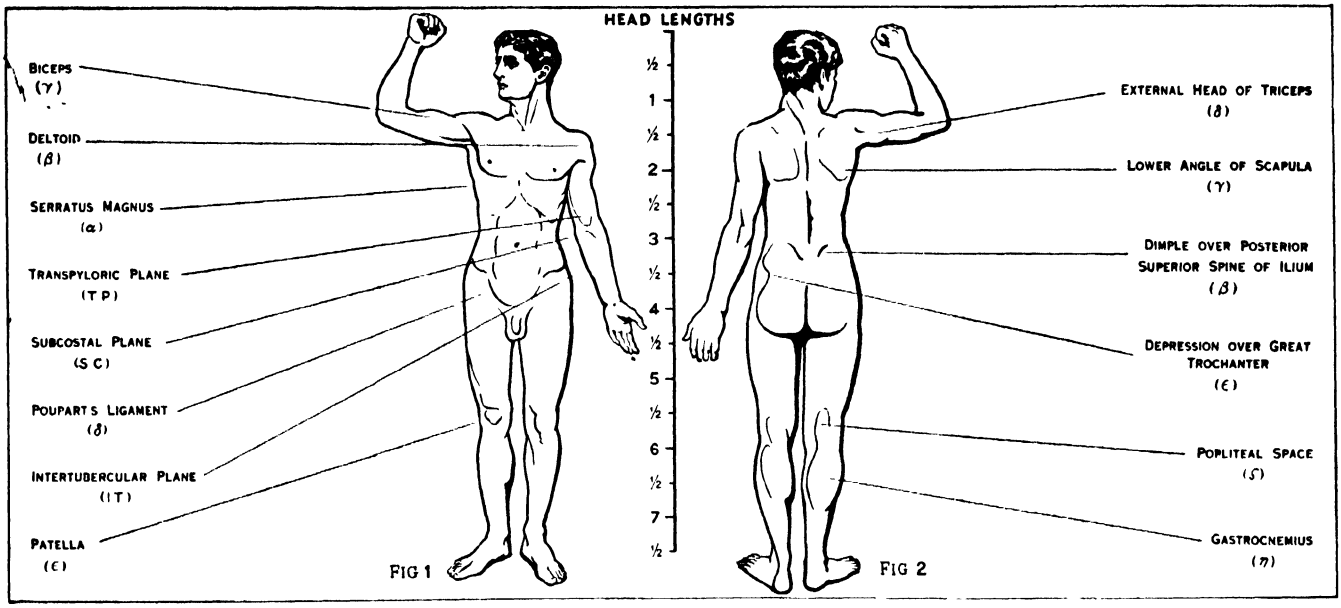
Genito-Urinary System.—Valuable additions have been made to our knowledge of the appearance of the urethra, bladder and ureter by the cystoscope, and of the kidney by radiography.

See Piersol, *Human anatomy* (6th ed. 1918); Testut, *Traité d'anatomie humaine* (7th ed. 1921–23); Cunningham, *Textbook of anatomy* (5th ed. 1922); Gray, *Anatomy descriptive and applied* (23rd ed. 1926). (F. G. P.; R. W. R.)

SUPERFICIAL AND ARTISTIC

The objects of the study of superficial anatomy are to show, first, the form and proportions of the human body and, second, the surface landmarks which correspond to deeper structures hidden from view. This study blends imperceptibly with others, such as physical anthropology, physiognomy, phrenology and palmistry, but whereas these deal chiefly with variations, superficial anatomy is concerned with the type.

With regard to the proportions of the body the artist and anatomist approach the subject from slightly different points of



A STUDY OF THE HUMAN BODY ACCORDING TO MEASUREMENTS SUGGESTED IN 1890 TO SERVE THE PURPOSE OF ANATOMIST AND ARTIST

Superficial anatomy has a two-fold object: to show the proportions of the human body and to mark the features on the surface which correspond to internal structures. To serve both these purposes the body is divided into 7½ head lengths. Four of these are above the fork and 3½ below. Two heads are allowed for the greatest width of shoulders; 1½ for greatest width of hips, one for narrowest part of waist, and ¾ for breadth of head on a level with the eyes

view. The former, by a process of artistic selection, seeks the ideal and adopts the proportions which give the most pleasing effect, while the latter desires to know only the mean of a large series of measurements

The scheme which Dr. Paul Richer suggested (*Anatomie artistique*, Paris, 1890), and Professor Arthur Thomson approves (*Anatomy for Art Students*, 1896), is to divide the whole body into head-lengths, of which seven and a half make up the stature. Four of these are above the fork and three and a half below (*see* figs. 1 and 2). Of the four above, one forms the head and face, the second reaches from the chin to the level of the nipples, the third from the nipples to the navel, and the fourth from there to the fork. By dividing these into half-heads other points can be determined; for instance the middle of the first head-length corresponds to the eyes, the middle of the second to the shoulder, of the fourth to the top of the hip-joint, and of the fifth to the knee-joint.

The elbow-joint, when the arms are by the side, is a little above the lower limit of the third head-length, while the wrist is opposite the very centre of the stature, three head-lengths and three-quarters from the crown or the soles. The tips of the fingers reach a little below the middle of the fifth head-length. (In fig. 1 the fingers are bent) By making the stature eight head-lengths instead of seven and a half the artistic effect is increased, as it is also by slightly lengthening the legs in proportion to the body. Approximate average breadth measurements are two heads for the greatest width of the shoulders, one and a half for the greatest width of the hips, one for the narrowest part of the waist, and three-quarters for the breadth of the head on a level with the eyes

The relation of superficial landmarks to deep structures cannot be treated here in full detail, but the chief points may be indicated. Certain parts of the head may easily be felt through the skin. If the finger is run along the upper margin of the orbit, the notch for the supraorbital nerve may usually be felt at the junction of the inner and middle thirds At the outer end of the margin is its junction with the malar bone, and this easily felt point is known as the external angular process. The junction of the frontal and nasal bones at the root of the nose is the nasion, while at the back of the skull the external occipital protuberance or inion is felt and marks the position of the torcular Herophili, where the venous sinuses meet. The zygoma may be felt running back from the malar bone to just in front of the ear, and two fingers' breadth above the middle of it marks the pterion, a very important point in the localization of intracranial structures. It corresponds to the anterior branch of the middle meningeal artery, to the Sylvian point where the three limbs of the fissure of Sylvius diverge, to the middle cerebral artery, the central lobe of the brain or island of Reil, and the anterior part of the corpus striatum. The fissure of Sylvius can be marked out by drawing a line from the external angular process back through the Sylvian point to the lower part of the parietal eminence. The position of the sulcus of Rolando is important because of the numerous cortical centres which lie close to it. It may be mapped out by taking the superior Rolandic point, ½ in behind the bisection of a line drawn from the nasion to the inion over the vault of the skull, and joining that to the inferior Rolandic point, which is just above the line of the fissure of Sylvius and 1 in behind the Sylvian point The external parieto-occipital fissure, which forms the boundary between the parietal and occipital lobes of the brain, is situated practically at the lambda, which is a hand's breadth (2¼ in) above the inion. The lateral sinus can be mapped out by joining the inion to the asterion, a point two-thirds of the distance from the lambda to the tip of the mastoid process, thence the sinus curves downward and forward toward the tip of the mastoid process. A point 1 in horizontally backward from the top of the external auditory meatus will always strike it

The Face.—On the front of the face a line drawn down from the supraorbital notch between the bicuspid teeth to the side of the chin will cut the exit of the second division of the fifth nerve from the infraorbital foramen, a quarter of an inch below the infraorbital margin, and also the exit of the third division of the fifth at the mental foramen, midway between the upper and lower margins of the body of the jaw. The angle of the mouth at rest usually corresponds to the interval between the bicuspid teeth. The skin of the eyelids is very thin, and is separated from the subjacent fibrous tarsal plates by the orbicularis palpebrarum muscle. On everting the lids the delicate conjunctival membrane is seen, and between this and the tarsal plates lie the meibomian glands, which can be faintly seen as yellowish streaks. From the free edges of the eyelids come the eyelashes, between which many large sweat-glands open, and when one of these is inflamed it causes a "stye." Internally the two eyelids form a little recess called the internal canthus, occupied by a small red eminence, the caruncula lachrymalis, just external to which a small vertical fold of conjunctiva may often be seen, called the plica semilunaris, representing the third eyelid of birds and many mammals. By gently drawing down the lower eyelid the lower punctum may

be seen close to the caruncula; it is the pinhole opening into the lower of the two canaliculi which carry away the tears to the lachrymal sac and duct. On the side of the face the facial artery may be felt pulsating about an inch in front of the angle of the jaw; it runs a tortuous course to near the angle of the mouth, the angle of the nose and the inner angle of the eye; in the greater part of its course its vein lies some distance behind it. The parotid gland lies between the ramus of the jaw and the mastoid process; anteriorly it overlaps the masseter to form the socia parotidis, and just below this its duct, the duct of Stensen, runs forward to pierce the buccinator and open into the mouth opposite the second upper molar tooth. The line of this duct may be marked out by joining the lower margin of the tragus to a point midway between the lower limit of the nose and the mouth. The facial or seventh nerve emerges from the skull at the stylo-mastoid foramen just in front of the root of the mastoid process; in the parotid gland it forms a network called the pes anserinus, after which it divides into six branches which radiate over the face to supply the muscles of expression.

The Neck.—In the middle line below the chin can be felt the body of the hyoid bone, just below which is the prominence of the thyroid cartilage called "Adam's apple," better marked in men than in women. Still lower the cricoid cartilage is easily felt, while between this and the suprasternal notch the trachea and isthmus of the thyroid gland may be made out. At the side the outline of the sterno-mastoid muscle is the most striking mark; it divides the anterior triangle of the neck from the posterior. The upper part of the former contains the submaxillary gland, which lies just below the posterior half of the body of the jaw. The line of the common and the external carotid arteries may be marked by joining the sterno-clavicular articulation to the angle of the jaw. The eleventh or spinal accessory nerve corresponds to a line drawn from a point midway between the angle of the jaw and the mastoid process to the middle of the posterior border of the sterno-mastoid muscle and thence across the posterior triangle to the deep surface of the trapezius. The external jugular vein can usually be seen through the skin; it runs in a line drawn from the angle of the jaw to the middle of the clavicle, and close to it are some small lymphatic glands. The anterior jugular vein is smaller, and runs down about half an inch from the middle line of the neck. The clavicle or collar-bone forms the lower limit of the neck, and laterally the outward slope of the neck to the shoulder is caused by the trapezius muscle.

The Chest.—It is important to realize that the shape of the chest does not correspond to that of the bony thorax which encloses the heart and lungs; all the breadth of the shoulders is due to the shoulder girdle, and contains the axilla and the head of the humerus. In the middle line the suprasternal notch is seen above, while about three fingers' breadth below it a transverse ridge can be felt, which is known as Ludovic's angle and marks the junction between the manubrium and gladiolus of the sternum. Level with this line the second ribs join the sternum, and when these are found the lower ribs may be easily counted in a moderately thin subject. At the lower part of the sternum, where the seventh or last true ribs join it, the ensiform cartilage begins, and over this there is often a depression popularly known as the pit of the stomach. The nipple in the male is situated in front of the fourth rib or a little below; vertically it lies a little external to a line drawn down from the middle of the clavicle; in the female it is not so constant. A little below it the lower limit of the great pectoral muscle is seen running upward and outward to the axilla; in the female this is obscured by the breast, which extends from the second to the sixth rib vertically and from the edge of the sternum to the mid-axillary line laterally. The female nipple is surrounded for half an inch by a more or less pigmented disc, the areola. The apex of a normal heart is in the fifth left intercostal space, three and a half inches from the mid-line.

The Abdomen.—In the mid-line a slight furrow extends from the ensiform cartilage above to the symphysis pubis below; this marks the linea alba in the abdominal wall, and about its middle point is the umbilicus or navel. On each side of it the broad recti muscles can be seen in muscular people. The outline of these muscles is interrupted by three or more transverse depressions indicating the lineae transversae in the recti; there is usually one about the ensiform cartilage, one at the umbilicus, and one between; sometimes a fourth is present below the umbilicus. The upper lateral limit of the abdomen is the subcostal margin formed by the cartilages of the false ribs (8, 9, 10) joining one another; the lower lateral limit is the anterior part of the crest of the ilium and Poupart's ligament running from the anterior superior spine of the ilium to the spine of the pubis (*see* fig. 1, δ); these lower limits are marked by definite grooves. Just above the pubic spine is the external abdominal ring, an opening in the muscular wall of the abdomen for the spermatic cord to emerge in the male. The most modern method of marking out the abdominal contents is to draw three horizontal and two vertical lines; the highest of the former is the transpyloric line of C. Addison (fig. 1, T P.), which is situated half-way between the suprasternal notch and the top of the symphysis pubis; it often cuts the pyloric opening of the stomach an inch to the right of the mid-line. The hilum of each kidney is a little below it, while its left end approximately touches the lower limit of the spleen. It corresponds to the first lumbar vertebra behind. The second line is the subcostal (fig. 1, S.C.), drawn from the lowest point of the subcostal arch (tenth rib); it corresponds to the upper part of the third lumbar vertebra, and is an inch or so above the umbilicus; it indicates roughly the transverse colon, the lower ends of the kidneys, and the upper limit of the transverse (3rd) part of the duodenum. The third line is called the intertubercular (fig. 1, I.T.), and runs across between the two rough tubercles, which can be felt on the outer lip of the crest of the ilium about two and a half inches from the anterior superior spine. This line corresponds to the body of the fifth lumbar vertebra, and passes through or just above the ileo-caecal valve where the small intestine joins the large. The two vertical or mid-Poupart lines are drawn from the point midway between the anterior superior spine and the pubic symphysis on each side vertically upward to the costal margin. The right one is the most valuable, as the ileo-caecal valve is situated where it cuts the intertubercular line, while the orifice of the vermiform appendix is an inch lower down. At its upper part it meets the transpyloric line at the lower margin of the ribs, usually the ninth, and here the gall-bladder is situated. The left mid-Poupart line corresponds in its upper three-quarters to the inner edge of the descending colon. The right subcostal margin corresponds to the lower limit of the liver, while the right nipple is about half an inch above the upper limit of this viscus.

The Back.—There is a well-marked furrow stretching down the middle line of the back from the external occipital protuberance to the cleft of the buttocks. In this the spinous processes of the vertebrae can be felt, especially if the model bend forward. The cervical spines are difficult to feel, except the seventh and sometimes the second, and although the former is called the vertebra prominens, its spine is less easily felt than is that of the first thoracic. In practice it is not very easy to identify any one spine with certainty: one method is to start from the prominent first thoracic and to count down; another is to join the lower angles of the two scapulae (fig. 2, γ) when the arms are hanging down, and to take the spine through which the line passes as the seventh.

The spinal furrow is caused by the prominence of the erector spinae muscles on each side; these become less well marked as they run upward. The outlines of the scapulae can be well seen; they cover the ribs from the second to the seventh inclusive. The scapular spine is quite subcutaneous, and can be followed upward and outward from the level of the third thoracic spine to the acromion, and so to the outer end of the clavicle. On the lower margin of the acromion is a little tubercle known as the metacromial process or acromial angle, which is very useful for taking measurements from. The tip of the twelfth rib may usually be felt about two inches above the middle of the iliac crest, but this rib is very variable in length. The highest point

of the iliac crest corresponds to the fourth lumbar spine, while the posterior superior iliac spine is on a level with the second sacral vertebra. This posterior superior spine is not easily felt, owing to the ligaments attached to it, but there is usually a little dimple in the skin over it (fig. 2, β). By drawing horizontal lines through the 1st, 3rd and 5th lumbar spines, the transpyloric, subcostal and intertubercular lines or planes may be reproduced behind and the same viscera localized.

The Arm.—Running downward and outward from the inner half of the clavicle, where that bone is convex forward, is the clavicular part of the pectoralis major, while from the outer third of the bone, where it is concave forward, is the clavicular part of the deltoid; between these two muscles is an elongated triangular gap with its base at the clavicle, and here the skin is somewhat depressed, while the cephalic vein sinks between the two muscles to join the axillary vein. The tip of the coracoid process is situated just under cover of the inner edge of the deltoid, one inch below the junction between the outer and middle thirds of the clavicle. The deltoid muscle (fig. 1, β) forms the prominence of the shoulder, and its convex outline is due to the presence of the head of the humerus deep to it; when this is dislocated the shoulder becomes flattened. The pectoralis major forms the anterior fold of the axilla or armpit, the posterior being formed by the latissimus dorsi and teres major muscles. The skin of the floor of this space is covered with hair in the adult, and contains many large sweat-glands. The axillary vessels and brachial plexus of nerves lie in the outer wall, while on the inner wall are the serrations of the serratus magnus muscle, the outlines of some of which are seen on the side of the thorax, through the skin, when the arm is raised (fig. 1, α). Below the edge of the pectoralis major, the swelling of the biceps (fig. 1, γ) begins to be visible, and this can easily be traced into its tendon of insertion, which reaches below the level of the elbow-joint. On each side of the biceps is the external and internal bicipital furrow, in the latter of which the brachial artery may be felt and compressed. The median nerve is here in close relation to the artery. At the bend of the elbow the two condyles of the humerus may be felt; the inner one projects beneath the skin, but the outer one is obscured by the rounded outline of the brachio-radialis muscle. The superficial veins at the bend of the elbow are very conspicuous; they vary a good deal, but the typical arrangement is an M, of which the radial and ulnar veins form the uprights, while the outer oblique bar is the median cephalic and the inner oblique the median basilic vein. At the divergence of these two the median vein comes up from the front of the forearm, while the two vertical limbs are continued up the arm as the cephalic and basilic, the former on the outer side, the latter on the inner. On the back of the arm the three heads of the triceps are distinguishable, the external forming a marked oblique swelling when the forearm is forcibly extended and internally rotated (fig. 2, δ). In the upper part of the front of the forearm the antecubital fossa or triangle is seen; its outer boundary is the brachio-radialis, its inner the pronator radii teres, and where these two join below is the apex. In this space are three vertical structures—externally the tendon of the biceps, just internal to this the brachial artery, and still more internally the median nerve. Coming from the inner side of the biceps tendon the semi-lunar fascia may be felt; it passes deep to the median basilic vein and superficial to the brachial artery, and in former days was a valuable protection to the artery when unskilful operators were bleeding from the median basilic vein. About the middle of the forearm the fleshy parts of the superficial flexor muscles cease, and only the tendons remain, so that the limb narrows rapidly. In front of the wrist there is a superficial plexus of veins, while deeper down two tendons can usually be made to start up if the wrist be forcibly flexed; the outer of these is the flexor carpi radialis, which is the physician's guide to the radial artery where the pulse is felt. If the finger is slipped to the outer side of this tendon, the artery, which here is very superficial, can be felt beating. The inner of the two tendons is the palmaris longus, though it is not always present. On cutting down between these two the median nerve is reached.

The wrist-joint may be marked out by feeling the styloid process of the radius on the outer side, and the styloid process of the ulna on the inner side behind, and joining these two by a line convex upward. The superficial appearance of the palm of the hand is described in the article on PALMISTRY; with regard to anatomical landmarks the superficial palmar arterial arch is situated in the line of the abducted thumb, while the deep arch is an inch nearer the wrist. The digital nerves correspond to lines drawn from the clefts of the fingers toward the wrist On the back of the forearm the olecranon process of the ulna is quite subcutaneous, and during extension of the elbow is in a line with the two condyles, while between it and the inner condyle lies the ulnar nerve, here known popularly as the "funny-bone." From the olecranon process the finger may be run down the posterior border of the ulna, which is subcutaneous as far as the styloid process at the lower end. When the thumb is extended, two tendons stand out very prominently; the outer of these is the tendon of the extensor brevis, the inner of the extensor longus pollicis. Situated deeply in the space is the radial artery, covered by the radial vein On the dorsum of the hand there is a plexus of veins, and deep to these the tendons of the extensor longus digitorum stand out when the wrist and fingers are extended.

The Leg.—Just below Poupart's ligament (fig. 1, δ), a triangular depression with its apex downward may be seen in muscular subjects; it corresponds to Scarpa's triangle, and its inner border is the tendon of the adductor longus, which is easily felt if the model forcibly adducts the thigh In this triangle the superficial inguinal glands may be made out. The head of the femur lies just below the centre of Poupart's ligament. The sartorius muscle forms the outer boundary of the triangle, and may be traced from the anterior superior spine obliquely downward and inward, across the front of the thigh, to the inner side of the knee. The two vasti muscles are well marked, the internal being the lower and forming with the sartorius the rounded bulging above the inner side of the knee. The internal saphenous vein runs superficially up the inner side of the th[illegible] from behind the internal condyle of the femur to the saphenous opening in the deep fascia, the top of which is an inch horizontally outward from the spine of the pubis. On the other side of the thigh a groove runs down which corresponds to the ilio-tibial band, a thickening of the fascia lata or deep fascia; the lower end of this leads to the head of the fibula. On the front of the thigh, below the sartorius, the rectus muscle makes a prominence which leads down to the patella, the outlines of which bone are very evident (fig. 1, ϵ). The only part of the femur besides the great trochanter which is superficial is the lower end, and this forms the two condyles for articulation with the tibia. If the posterior part of the inner condyle be joined to the mid-point between the anterior superior spine and the symphysis pubis, when the thigh is externally rotated, the line will correspond in its upper two-thirds to that of the common and superficial femoral arteries, the former occupying the upper inch and a half. The common femoral vein lies just internal to its artery, while the anterior crural nerve is a quarter of an inch external to the latter. The rounded mass of the buttock is formed by the gluteus maximus muscle covered by fat; the lower horizontal boundary is called the fold of the nates, and does not correspond exactly to the lower edge of the muscle At the side of the buttock is a depression (fig. 2, ϵ) where the great trochanter of the femur can be felt; a line, named after Nelaton, drawn from the anterior superior spine to the tuberosity of the ischium, passes through the top of this. On the back of the thigh the hamstrings form a distinct swelling; below the middle these separate to enclose the diamond-shaped popliteal space (fig. 2, ζ), the outer hamstrings or biceps being specially evident, while, on the inner side, the tendons of the semi-tendinosus and semi-membranosus can be distinguished

On the front of the leg, below the knee, the ligamentum patellae is evident, leading down from the patella (fig. 1, ϵ) to the tubercle of the tibia. From this point downward the anterior border of the tibia or shin is subcutaneous, as is also the internal surface

of the tibia. External to the shin is the fleshy mass made by the tibialis anticus and extensor longus digitorum muscles. At the inner side of the ankle the internal malleolus is subcutaneous, while on the outer side the tip of the external malleolus is rather lower and farther back. Both this malleolus and the lower quarter of the shaft of the fibula are subcutaneous, and this area, if traced upward, is continuous with a furrow on the outer side of the leg which separates the anterior tibial from the peroneal groups of muscles, and eventually leads to the subcutaneous head of the fibula. At the back of the leg the two heads of the gastrocnemius form the calf, the inner one (fig. 2, η) being larger than the outer. Between the two, in the mid-line of the calf, the external saphenous vein and nerve lie, while lower down they pass behind the external malleolus to the outer side of the foot. The internal saphenous vein and nerve lie just behind the internal border of the tibia, and below pass in front of the internal malleolus. At the level of the ankle-joint the tibialis posticus and flexor longus digitorum tendons lie just behind the internal malleolus, while the peroneus longus and brevis are behind the external. Running down to the heel is the tendo Achillis with the plantaris on its inner side. On the dorsum of the foot the musculo-cutaneous nerve may be seen through the skin in thin people when the toes are depressed; it runs from the anterior peroneal furrow, already described, to all the toes, except the cleft between the two inner ones. There is also a venous arch to be seen, the two extremities of which pass respectively into the external and internal saphenous veins. The long axis of the great toe, even in races unaccustomed to boots, runs forward and outward, away from the mid-line between the two feet, so that perfectly straight inner sides to boots are not really anatomical. The second toe in classical statues is often longer than the first, but this is seldom seen in Englishmen. On the outer side of the sole the skin is often in contact with the ground along, but on the inner side the arch is more marked, and, except in flat-footed people, there is an area in which the sole does not touch the ground at all.

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RADIOGRAPHY

The Skull.—An instructive radiogram of the skull is obtained by placing the tube generating the rays on one side of the head and by laying the photographic plate flat against the other. Fig. 1 on plate shows a lateral view of the head resting upon the upper part of the spinal column. A good view is obtained of the extent of the cavity which contains the brain. The orbital and nasal chambers with their accessory air sinuses (antrum of Highmore and sphenoidal air sinus) are well seen. Particularly there is noticeable, immediately behind the sphenoidal sinus, the saddle-shaped sella turcica for the lodgment of the pituitary gland.

Shoulder.—A front view of the shoulder and neighbouring part of the chest when the arm hangs by the side of the body, discloses the relative position of the bones of that region. The ribs pursue an obliquely downward course and their movements in life are well seen.

The clavicle passes outwards and slightly upwards toward the acromion process of the scapula, with it to form a bony arch overhanging the shoulder joint and thus helping to prevent upward displacement of the humerus at that joint. The body of the scapula rests on the ribs thickening at its axillary border and upper and outer angle where it expands to form the glenoid fossa for reception of the head of the humerus. The coracoid process which is swung by fibrous tissue to the clavicle in the recent state is very evident.

The ball and socket character of the shoulder-joint is so arranged as to allow of extensive movement of the arm at the joint, the socket (glenoid cavity) being small as compared with the large articulating surface of the ball. The upper extremity of the humerus with its articular surface and tuberosities are well seen.

Elbow.—A good picture of this region is obtained by taking a radiograph from its inner side with the elbow-joint slightly bent and the forearm in such a position that the palm of the hand is directed toward the median plane of the body. The lower end of the humerus shows the internal condyle with a ridge running upward and a groove behind for the passage of the ulnar nerve from the arm into the forearm. The upper end of the ulna shows the deep concavity by which it articulates with the pulley-shaped surface of the humerus and its helmet-shaped upward extension (olecranon process) for the attachment of the triceps muscle. The head of the radius supported upon its conical neck articulates with the humerus above and the ulna at the side. The whole picture emphasizes the hinge-like character of the elbow-joint and the pivot character of the joint between the bones of the forearm at the elbow.

Wrist and Hand.—Fig. 5 on plate shows the lower part of the forearm and hand viewed from the palmar aspect. The radius and ulna, the carpal, metacarpal and phalangeal bones form distinct shadows. The outline of the wrist-joint shows that the hand is supported mainly by the expanded lower end of the radius, the head of the ulna being separated from the carpus by an interval which in the recent state is filled up by a fibrocartilaginous pad.

The outlines of all the eight bones of the carpus can clearly be made out forming a group consisting of two rows of bones with an ∞-shaped joint between them. The os magnum is the largest bone of the group and lies with its long axis in line with the middle finger, the semi-lunar and the radius. Its rounded head fits into a cup formed by the scaphoid and semi-lunar; its body is flanked by the trapezoid and unciform, and its base supports the third and to a lesser degree the second and fourth metacarpal bones. The pisiform is rather indefinitely seen immediately below the ulna and in front of the cuneiform. The trapezium partially hides the trapezoid.

The four inner metacarpal bones lie close to one another, while the first or that of the thumb is separated from the second by a wide interval. A small sesamoid bone is seen lying upon the inside of its head

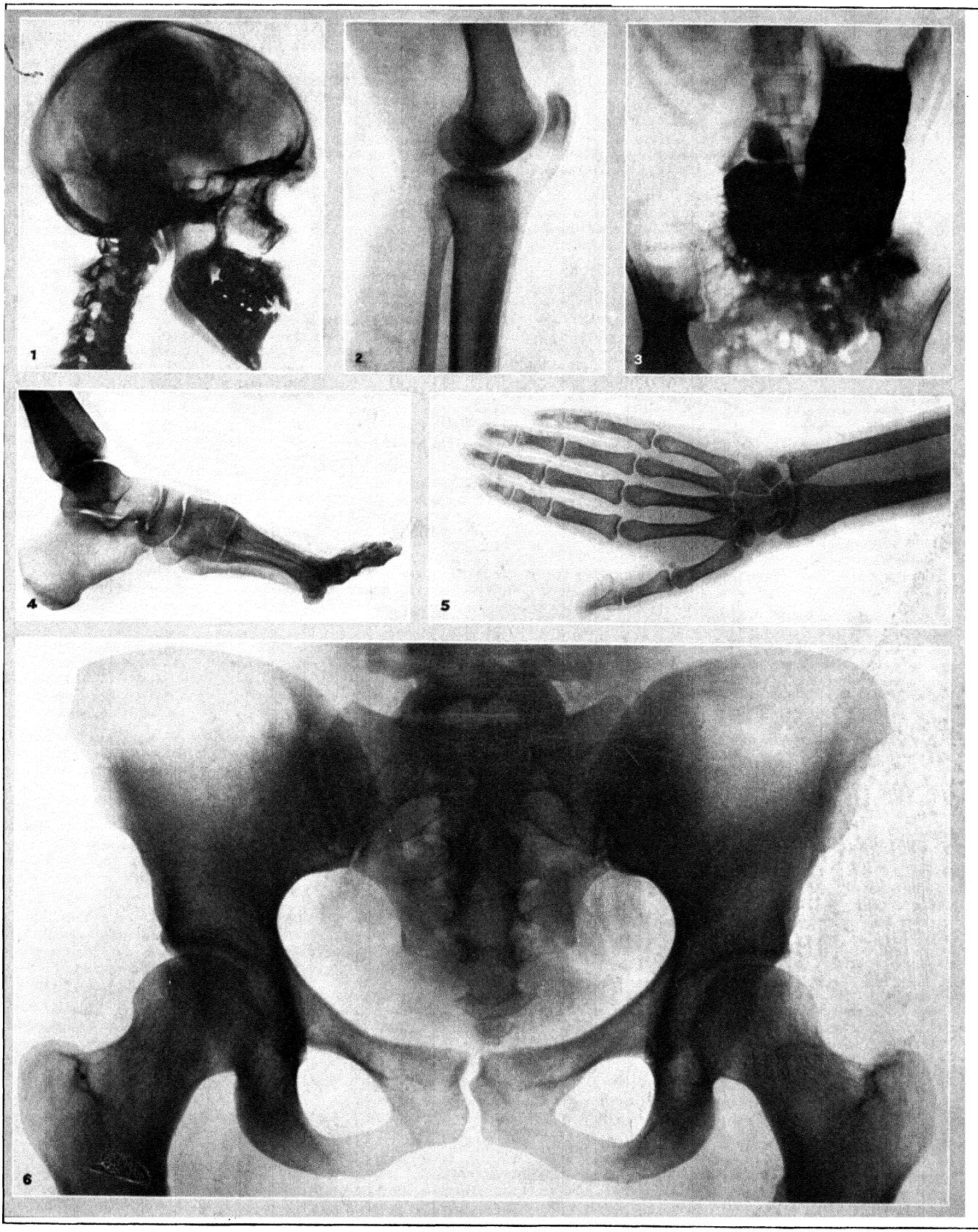
The phalanges of the fingers and thumb are shown very distinctly, and the ball and socket character of the metacarpophalangeal and the hinge-like nature of the inter-phalangeal joints are also manifest.

Pelvis and Hip-joint.—The architecture of the bony framework of the pelvis which transmits the weight of the trunk and upper extremities allowing at the same time room for viscera is well seen in fig. 6 on plate.

The relation of the wedge-shaped sacrum with its coccygeal appendage to the rest of the body girdle is apparent. The sacrum is seen to be interlocked between the ilia of the innominate bones, so as to form with them an arch transmitting the superincumbent weight either to the lower extremity in the erect position or to the ischial tuberosity in the sitting position. The tendency towards the spreading of the arch is prevented by the front portions of the pelvic girdle acting as tie beams, and there are three "buffers" which break shocks, one at the symphysis pubis in the middle of the front part of the girdle, and the other two at joints between the sacrum and ilia. The foramina for the exit of nerves from the spinal cord to supply the lower extremities and soft parts of pelvis are apparent. The general character of the female as compared with the male pelvis is well exemplified in fig. 6; *e.g.*, the widely spreading ilia, the great width of cavity below the ilia and the wide sub-pubic angle.

To get a good radiogram of the region of the hip-joint is a somewhat difficult matter. One taken from the front shows the thigh occupying its position in the erect posture, revealing the socket or acetabulum, the head of the femur with its pit for the round ligament, the oblique neck, and the upper part of the shaft with the great and small trochanters. The arrangement of the cancellous bone tissue is such as to bear the superincumbent weight in the best possible way.

Knee.—A good general idea of the region is obtained by taking



PARTS OF THE HUMAN ANATOMY PHOTOGRAPHED BY RADIOGRAPHY

1. Lateral view of the head of a living person
2. Radiogram showing a side view of the knee
3. Normal stomach after ingestion of a barium meal
4. The bone structure of the ankle and foot
5. Radiogram showing the thumb as opposable to the rest of the hand
6. The bone structure of the pelvis and hip-joint

a radiogram from the side (fig. 2 on plate). It shows the lower part of the femur with its condyles, upper part of the tibia with its spine, tuberosities and tubercle, and the upper part of the fibula with its head.

There is seen to be but little interlocking between the femur, tibia and patella, which enter into the formation of the knee-joint. The tibia articulates by a relatively small surface with the relatively large articular surface of the femur, the joint so formed being an example of a hinge joint with the pin of the hinge a movable one. The spine of the tibia is seen projecting upward between the condyles of the femur acting like the flange of a wheel and so helping to prevent lateral displacement of the tibia from the femur at the joint. The knee-cap, to which are attached the great extensor muscles of the leg, moves upward and downward on the femur only. The fibula is seen articulating with the tibia, the joint surface being oblique in direction in order to break shocks between the two bones.

Ankle and Foot.—In fig. 4 on plate a view of the skeleton of the lower part of the leg and of the foot is given from the inside The tibia and fibula of the leg, and the tarsal and metatarsal and some of the phalangeal bones are shown.

The tibia articulates with the astragalus at the ankle joint, and on close inspection the relative positions of the malleoli of both the tibia and fibula to the astragalus can be made out, the bones of the leg and the astragalus forming a hinge joint. The tip of the outer malleolus formed by the fibula reaches to a lower level than the tip of the inner malleolus, which belongs to the tibia.

The antero-posterior and to a less extent the transverse arch of the foot are shown, the pillars of the former consisting of the great tuberosity of the os calcis behind and of the heads of the metatarsal bones in front. The astragalus forms the keystone of the arch, and transmits the weight of the body from the tibia to the astragalus and os calcis behind, and to the scaphoid, cuboid, cuneiform and metatarsal bones in front. The spicules of the cancellous tissue in these bones are arranged so as to bear the weight of the body transmitted through them. The so-called tunnel of the tarsus and the mediotarsal joint across the foot between the astragalus and os calcis behind and the scaphoid and cuboid in front are very apparent, showing at the same time that the articulation between the os calcis and cuboid forms a separate joint. The front of the middle cuneiform is indicated by a narrow vertical shadow situated a little behind the shadow indicating the anterior border of the internal cuneiform.

The radiogram illustrates vividly the essential difference between the hand and the foot, in that the big toe is seen to be closely applied to the second toe and not opposable to the rest of the foot as the thumb is to the rest of the hand.

Ossification.—Ossification begins in each bone of the skeleton at one or more spots called "primary centres of ossification" Each appears before birth and by their spreading they form the main part of the bone. After birth "secondary centres of ossification" begin to show themselves independently of the main mass, form what are known as "epiphyses" and join it at various periods after birth to make the adult bone. Radiography, when applied to the living body, affords information as to the forms, times of first appearance and times of junction of the epiphyses with the main parts of bones to which they belong. It has shown that there is very great variability in the times, appearance and fusion of epiphyses in different individuals.

Thorax and its Contents.—Apart from revealing the skeleton of the thorax, radiography permits inspection of the position and contour of the heart and great vessels, the lungs and mediastinum.

Abdomen and its Contents.—Subsequent to the introduction of matter opaque to X-rays such as barium or bismuth salts into certain organs, radiography has played an important part in elucidating the anatomy of the alimentary canal and urinary tract.

Fig. 3 on plate shows a normal stomach and first part of the duodenum immediately after the ingestion of a barium meal. The clear area at the upper part indicates the air-containing portion of the cavity in the neighbourhood of the entrance of the oesophagus.

The writer of this article is indebted to Dr. Levack, Radiologist, Royal Infirmary, Aberdeen; Dr. Spriggs, Duff House, Ruthin Castle, North Wales; and Dr. Salmond, Radiologist, University College hospital, London, for the radiograms that are reproduced in Figs. 1 to 6.

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ANATOMY IN DRAWING: *see* DRAWING, ANATOMY.

ANATOMY OF PLANTS: *see* section *Anatomy* under PLANTS.

ANATTO, orange colouring matter derived from the outer layer of the seed-coat (testa) of the tropical American shrub *Bixa Orellana*, of the family Bixaceae. It was long ago introduced into India and Ceylon where it is now cultivated; it is naturalized also in parts of West Africa and Brazil. The commercial supply (some 250 to 400 tons annually) comes largely from India and the West Indies. Anatto contains a yellow colouring matter, bixin, $C_{16}H_{26}O_2$, and is used largely in colouring butter, cheese and other foodstuffs as well as certain varnishes. Alone or in conjunction with other dyes it is employed in the dyeing of silks and in calico printing. As *achiote* it is commonly used to colour rice, soups and other foods in Latin America

ANAU, site of an abandoned settlement 2om. E S E. from Ashkhabad in the Turkmenistan S S R. There are indications of four different cultures, the two earlier from a *kurgan* (mound) about a mile west of the ruins and ½ mile south of the Transcaspian railway and the two later from a *kurgan* about 1 mile further south. The earliest inhabitants were grain cultivators and had handmade pottery geometrically decorated Pumpelly, calculating from loess deposits, dated the cultures 8,000–6,000 B.C., but 3,900–3,300 B.C. seems more probable.

See R. Pumpelly, *Explorations in Turkestan*, 1908; H. Frankfort, *Studies in Early Pottery of the Near East*, pt. i. 1924, pt. ii. 1927; Peake and Fleure, *Corridors of Time, III. "Peasants and Potters,"* 1927.

ANAXAGORAS, Greek philosopher, born probably about 500 B.C (Apollodorus *ap.* Diog Laert. ii. 7) at Clazomenae in Asia Minor. He went to Athens, which was rapidly becoming the headquarters of Greek culture (*c.* 464–462 B C). There he is said to have remained for 30 years. Pericles learned to love and admire him and the poet Euripides derived from him an enthusiasm for science and humanity. Some authorities assert that even Socrates was among his disciples. His influence was due partly to his astronomical and mathematical eminence, but still more to the ascetic dignity of his nature and his superiority to ordinary weaknesses.

It was he who brought philosophy and the spirit of scientific inquiry from Ionia to Athens. His observations of the celestial bodies led him to form new theories of the universal order, and brought him into collision with the popular faith. He attempted to give a scientific account of eclipses, meteors, rainbows and the sun, which he described as a mass of blazing metal, larger than the Peloponnesus; the heavenly bodies, he said, were masses of stone torn from the earth and ignited by rapid rotation. The polytheism of the time could not tolerate such explanation, and the enemies of Pericles used the superstitions of their countrymen as a means of attacking him in the person of his friend

Anaxagoras was arrested on a charge of contravening the established dogmas of religion (some say the charge was one of Medism) and it required all the eloquence of Pericles to secure his acquittal. Even so he was forced to retire from Athens to Lampsacus (434–433 B.C.), where he died about 428 B C. Anaxagoras holds that all things have existed in a sort of way from the beginning. But originally they existed in infinitesimally small fragments of themselves, endless in number and inextricably combined throughout the universe.

All things existed in this mass, but in an indistinguishable form. There were the seeds (*σπέρματα*) of corn and flesh and gold in the mixture; but these parts, of like nature with their wholes (the *ὁμοιομερῆ* of Aristotle), had to be eliminated from the complex mass before they could receive a definite name and character.

The existing species of things having thus been transferred, with all their specialties, to the prehistoric stage, they were multiplied endlessly in number by reducing their size through continued subdivision; at the same time each thing is so connected with every other that the keenest analysis can never completely sever them. The work of arrangement, the segregation of like from unlike and the summation of the ὁμοιομερῆ ("simple substances") into totals of the same name, was the work of Mind or Reason. This peculiar thing called Mind (νοῦς), was no less illimitable than the chaotic mass, but, unlike the Intelligence of Heraclitus (*q.v.*), it stood pure and independent (μοῦνος ἐφ' ἑωυτοῦ), a thing of finer texture, and everywhere the same.

This agent, possessed of all knowledge and power, is especially seen ruling in all the forms of life. Its first appearance, and the only manifestation of it which Anaxagoras describes, is Motion. It originated a rotatory movement in the mass which, arising at one point, gradually extended till it gave distinctness to the aggregates of like parts. But even after it has done its best, the original intermixture is not wholly overcome. No one thing in the world is ever abruptly separated from the rest. The name given to it signifies merely that in that congeries of fragments the particular "seed" is preponderant. Every *a* of this present universe is only *a* by a majority, and is also in lesser number *b, c, d.* It is noteworthy that Aristotle accuses Anaxagoras of failing to differentiate between νοῦς and Ψυχή while Socrates (Plato, *Phaedo,* 98 B) objects that his νοῦς is merely a *deus ex machina* to which he refuses to attribute design and knowledge.

Anaxagoras gave some account of the process from original chaos to present arrangements. First came the division into cold mist and warm ether. With increasing cold, the former gave rise to water, earth and stones. The seeds of life in the air were carried down with the rains and produced vegetation. Animals, including man, sprang from the warm and moist clay. We seem to see things coming into being and passing from it; but reflection tells us that decease and growth only mean a new aggregation (σύγκρισις) and disruption (διάκρισις). Thus Anaxagoras distrusted the senses, and preferred the conclusions of reflection. Accordingly, he maintained that there must be blackness as well as whiteness in snow; how otherwise could it be turned into dark water?

With Anaxagoras speculation passed from the colonies of Greece to settle at Athens. His theory of minute constituents and mechanical processes paved the way for the atomic theory. On the other hand the conception of reason in the world passed from him to Aristotle, to whom it seemed the dawn of sober thought after a night of disordered dreams. From Aristotle it descended to his commentators, and under the influence of Averroes became the engrossing topic of speculation.

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On the date of the trial of Anaxagoras *see* Burnet, *Early Greek Philosophy,* ch. vi. (1908); A. E. Taylor, *Classical Quarterly,* XI. 1917.

ANAXIMANDER, the second of the physical philosophers of Ionia, was a citizen of Miletus and a companion or pupil of Thales. The computations of Apollodorus have fixed his birth in 611, and his death shortly after 547 B.C. He taught the obliquity of the ecliptic, is said to have introduced into Greece the gnomon (for determining the solstices) and the sundial, and to have made the first map. But his reputation is due mainly to his work on nature. From the few fragments which remain we learn that the first principle was a boundless mass (ἄπειρον), eternal and indestructible, from which all beings came, by the separating out of opposites, and to which they will return. From this primal body there sprung a central fiery mass enclosing the rings of sun, moon and stars, with the earth in the middle, cylindrical in shape, and held in place "because of its equal distance from everything." Living creatures arose from moisture evaporating in the sun. Man was supposed by Anaximander to have sprung from some other species of animals, probably aquatic, "for had he been originally as he is now he would never have survived."

See Histories of the Ionian School by Ritten, Mallet; Schleiermacher, "Dissert. sur la philosophie d'Anaximandre," in the *Mémoires de l'acad. des sciences de Berlin* (1815); J. Burnet, *Early Greek Philosophy* (1892); A. W. Benn, *Greek Philosophers* (1883 foll.); A. Fairbanks, *First Philosophers of Greece* (1898); Ritter and Preller, *Historia Phil.* §§ 17–22; Mullach, *Fragmenta Phil. Graec.* i. 237–240; Burnet, *Early Greek Philosophy* (1908), ch. i. § 2; Diels, *Fragmente der Vorsokratiker,* vol. i. (1912); and IONIAN SCHOOL OF PHILOSOPHY.

ANAXIMENES, of Lampsacus (*c.* 380–320 B.C.), Greek rhetorician and historian, was a favourite of Alexander the Great, whom he accompanied in his Persian campaigns. He wrote histories of Greece and of Philip, and an epic on Alexander (fragments in Müller, *Scriptores Rerum Alexandri Magni*). As a rhetorician, he was a determined opponent of Isocrates and his school. The *Rhetorica ad Alexandrum,* usually included among the works of Aristotle, is now generally admitted to be by Anaximenes, although some consider it a much later production (edition by Spengel, 1847).

See P. Wendland, *Anax. von Lampsakos* (1905); *see* also RHETORIC.

ANAXIMENES, of Miletus, Greek philosopher in the latter half of the 6th century, said to have been the "associate of Anaximander." He held that air is the primary substance; it expands with heat or contracts with cold, and by these changes of density is the source of all that exists. The earth is a flat disc floating in air, with the heavenly bodies rotating round it.

See Schmidt, *Dissertatio de Anaximensis psychologia* (Jena, 1869); Ritter and Preller, *Historia Phil.* §§ 23–27; A. Fairbanks, *First Philosophers of Greece* (1898); Mullach, *Fragmenta Phil. Graec.* i. 241–243; J. Burnet, *Early Greek Philosophy,* ch. i. § 3 (1920); also IONIAN SCHOOL OF PHILOSOPHY; EVOLUTION.

ANAZARBUS, an ancient Cilician city, situated in the Aleian plain about 10m. W. of the main stream of the Pyramus (Jihun) and near its tributary, the Sempas Su. A lofty isolated ridge formed its acropolis. Under the early Roman empire the place was known as *Caesarea,* and was the metropolis of Cilicia Secunda. Rebuilt by the emperor Justin after an earthquake, it became *Justinopolis* (A.D. 525); but the old native name persisted, and when Thoros I., king of Lesser Armenia, made it his capital early in the 12th century, it was known as Anazarva. Its great natural strength and situation not far from the mouth of the Sis pass, and near the great road which debouched from the Cilician gates, made Anazarbus play a considerable part in the struggles between the Byzantine empire and the early Muslim invaders. It had been rebuilt by Harun al-Rashid in A.D. 796, refortified at great expense by Saif addaula, the Hamdanid (10th century), and Saiked, and ruined by the crusaders.

The present wall of the lower city is of late construction, probably Armenian. It encloses a mass of ruins conspicuous in which are a fine triumphal arch, the colonnades of two streets, a gymnasium, etc. A stadium and a theatre lie outside.

ANBAR (originally Firuz Shapur or Perisopora), a ruined town on the left bank of the Euphrates in 33° 30′ N., 43° 50′ E., below the modern Ramadi (*q.v.*) and between 40 and 50m. from Baghdad. The town lies just south of the Sakhlawiye canal, the most northerly of the canals which link with the Tigris. It was originally founded in A.D. 350 by Shapur II., was destroyed by Julian, but rebuilt and became a Christian and Jewish centre; and it is said to have had 90,000 Jews at the time of its capture by Ali in A.D. 657. It was the original capital of the Abbasid caliphate until the founding of Baghdad. It continued to be an important centre and even had a Christian governor under Caliph Mu'tadid.

ANCACHS, a department of central Peru, between the Pacific and the valley of the Marañon, with the department of La Libertad on the north, and that of Lima on the south (area 14,705 sq.m., estimated population 428,703, doubtless somewhat below the actual figure). Lying partly on the arid coast, partly in the

high cordilleras, it has a variety of climates and products. Two lofty chains parallel with the coast, Cordillera Negra on the west, Cordillera Blanca on the east, include some of the highest peaks in Peru (Huascarán). They hem in a wide, fertile valley, that of the Santa or Huaráz, the largest coast stream. It is unique among the rivers of Peru as it rises east of the continental divide, flows from south to north in a longitudinal valley, cuts the western cordillera in a narrow gorge and empties into the Pacific. The climate of this valley is in general mild, with moderate rainfall. From south to north the principal crops are barley, potatoes, wheat and maize. Cattle and sheep are also raised. A series of towns, Recuay, Huaráz, Yungai, Caráz, Huailás, follow the stream. On the eastern slopes of the Cordillera Blanca tributaries of the Marañon flow east, while from western slopes of the Cordillera Negra, short streams cross the desert to the Pacific. In their valleys sugar-cane, cotton, rice and tropical fruits are grown. The chief ports, Chimbote, Samanco and Casma, each with a few hundred inhabitants, are situated on protected though shallow harbours. A road from Casma over the Cordillera Negra (pass 14,000ft) is the chief means of access to the capital, Huaráz (*q.v.*). The highly mineralized mountains are at present but little exploited; the largest establishment is in Ticapampa, at the south. The principal deposits are silver and lead, placer gold (Chuquicara), copper (Huari), tungsten (Pallasca), coal (Ancos and Caráz). Living conditions are still primitive owing to lack of transportation facilities. There are 426m. of finished roads in the department, and construction is actively going forward. One narrow-gauge State railway runs from Chimbote up the Santa valley to Huallaca, 85m. distant. Many interesting pre-Columbian remains can be seen both on the coast and in the mountains.

ANCAEUS, in Greek legend, son of Zeus or Poseidon, king of the Leleges of Samos. In the Argonautic expedition, after the death of Tiphys, helmsman of the "Argo," he took his place. It is said that, while planting a vineyard, he was told by a soothsayer that he would never drink of its wine. As soon as the grapes were ripe, he squeezed the juice into a cup, and, raising it to his lips, mocked the seer, who retorted with the words, Πολλὰ μεταξὺ πέλει κύλικος καὶ χείλεος ἀκροῦ ("there is many a slip between the cup and the lip") At that moment it was announced that a wild boar was ravaging the land. Ancaeus set down the cup, leaving the wine untasted, hurried out, and was killed by the boar.

ANCELOT, JACQUES ARSENE FRANÇOIS POLYCARPE (1794–1854), French dramatist and *littérateur,* was born at Havre, Feb. 9 1794, and died in Paris Sept. 7 1854 His best-known plays were *Louis IX.* (1819), *Le Maire du palais* (1825) and *Maria Padilla* (1838).

ANCESTOR-WORSHIP. In savage and barbarian belief, as in civilized sentiment, death does not make a person cease to belong to his social unit (family, clan, tribe, village, nation) Hence, since the living and the dead of any given community are as much one as any other two classes thereof—for instance, the older and the younger men—we might expect to find the dead treated much as are the older living members of the community, especially the dead who died at a ripe age, or at least after bearing or begetting offspring. For those who die immature are often treated as of less account, or as in some way different, while a common confusion of thought leads to conceiving all persons who died a long time ago as old. Now the aged are regarded in three different ways: (*a*) with contempt, owing to their physical weakness; hence they are not infrequently killed as *bouches inutiles;* (*b*) with fear, owing to their supposed magical powers; (*c*) with respect, as repositories of the traditional wisdom of their people, and often as more or less definite rulers; *e.g*, the elders of an Australian tribe. We find the dead regarded more or less in all these ways by various peoples, but the matter is complicated by the following considerations: (1) All dead, as such, are terrible, because death is contagious, and where one person has died (especially by violence) more deaths are apt to follow. (2) The dead cannot fend for themselves, cannot hunt or look for vegetable food, etc., but as they are beloved or venerated members of the community they should be provided with necessities, as a sick brother or a wise but feeble old medicine-man, tribal counsellor, or witch might be. (3) The dead or some of the dead (*e.g.,* chiefs or sorcerers) become more powerful than ever by reason of their death; they are now spirits able to help or harm, and should therefore be propitiated. This often blends with (1). (4) The dead, or some of them, return and are re-born into the community. (5) The older dead, if not quite forgotten, tend to become vague, idealized figures, often passing into gods.

Mere neglect of the dead, as of no account, is very rare; awe or fear, with or without affection as for kinsmen or fathers and mothers, is the prevailing attitude The ideas given under (2) lead rather to tendance of the dead (offerings of food, etc., at their graves, soul feasts, destruction of all or some of the dead man's property to be of use to him in the other world) than to actual worship. All the ideas numbered (1), (3), and (5) may and do lead to worship of one sort or another; (4) is somewhat more complicated in its results.

Clearly, if the dead can be re-born (*see* RE-INCARNATION), it is desirable to make sure that only the "good" dead shall thus re-enter the community. For persons unlucky, inefficient, scorners of law and justice, the survivors have no use whatever and do not want them back. Moreover, of the good dead, *i.e.,* those powerful, magically or materially efficient, observers of custom, some are so important that they will not condescend to become babies. Hence we get, among other things, a difference in funeral ceremonies; ordinary decent people are buried in one way, great chiefs in another; criminals, women dead in childbirth, men killed by wild beasts, etc , perhaps in a third (*see* DEAD, DISPOSAL OF THE). So far, no worship is necessarily implied, but we get prayers addressed to those of the dead who are expected to return. For instance, the Edo imagine that their normal dead will go to their heaven, *elimi,* stay there for a time, during which they can send blessings to the survivors, and finally return. "My father," one of their prayers runs, "tell Osa (God) to give you things when you come back." This touches ancestor-worship, at least at one point; for a time the dead man is a worshipful ghost whose favours may be sought; he can also confer a last favour by providing well for his own life on earth before he returns (*Journ. Roy. Anth. Inst ,* 1920, p. 380 ff). But it is not yet complete and typical.

Another practice very like ancestor-worship at first sight is the worship of what may be called the life-stream. The object of this cult is not any man, living or dead, but the power which enables the community to continue in existence by natural increase—a power which may be embodied for the time being in the head of the family or clan and worshipped by him and his dependents. The Roman *genius* (*q.v.*) in its earliest form is an example of this.

TYPES OF ANCESTOR-WORSHIP

But ancestor-worship pure and simple is directed towards ancestors possessing venerable powers of one sort or another, coupled with either a kindly interest in their descendants or at least the ability to do them harm if they neglect them. It may be of several kinds, according to the beliefs of the people practising it.

Communal Worship.—(I.) The dead may be worshipped *en masse* by the family, clan, or other community to which they belong; *i.e.,* of which, while alive, they were really or supposedly members. The best known instances of this come from ancient Italy. The cult of the *manes* (*q.v.*) at Rome was not a worship of any individuals; that of the *di parentes* or *parentum* was the cult or tendance of all the dead of a particular line. This fits the belief in the *genius* quite logically. The really worshipful thing, the life-force, is gone from the dead man and there is little or nothing left to give him individuality or importance. For the most part, the cult consisted in the provision of food, either solemnly given to the ghosts, as at the Lemuralia, etc , or in the form of a communal banquet, in which presumably the ghosts had their share. But that these ghosts were not without power, at least collectively, is shown to some extent by the story that once, when the rites of the *parentalia* in February were neglected, the result was a plague which lasted until they were restored (*cf.* [1], above; Ovid. *Fast.,* ii. 545–554), but more decisively (for

such tales may be the result of Ovid's or another's imagination) by the dates of the festivals, in early spring and early summer, just when the ghosts who live in the ground can help or harm the crops, and by the inclusion of the *di manes* in the formula of *devotio* (Livy, viii. 9, 6), from which it appears that they were strong at least to curse.

Individual Worship.—(II.) On the whole, however, the worship of individual ancestors is more common. This may, after a fashion, be combined with (I.), for a large number, or even the entire series of ancestors, so far as they are remembered, may receive collective cult. This is often the case in Africa. For instance, at the *adae* or ceremony of worship of ancestral spirits carried out by a queen-mother among the Ashanti, Capt. Rattray heard of seven stools, each belonging to one of the dead queen-mothers, having each an offering placed upon it (Rattray, *Ashanti,* p. 104). But these same people have many prayers in which the ancestral spirits (*samanfo*) are addressed collectively. Such things, however, are to be expected among a people believing in more than one supernatural being of any kind, for it is not always thought necessary to address each object of cult in a separate prayer or ceremony.

Grades of Ancestors.—(III.) For the reason given in (3) above, not all ancestors are equally worshipful. It is plain that since a commoner was of little importance in life he is not a very powerful ghost; consequently, while such minor spirits are tended only by their immediate relatives, or perhaps not at all, the ghosts of great men are singled out for much more elaborate cult by the whole community. Thus the spirit of a Samoan chief is "supposed to be nearer than the spirits of common people," and is consulted "on all important occasions" (Rev. G. Brown, *Melanesians and Polynesians,* p. 209). His magical power, of course, was far greater than that of a commoner in his lifetime; but the ghosts even of commoners count for something; they "are consulted also" by their own descendants (*ibid.*). This is much the same idea as that underlying Greek hero-cult. But it is not merely prominence, even magical prominence, in life which brings about promotion after death to the rank of a worshipful ancestor. Seniority also has much to do with it; we often find that the founder of a family continues to be worshipped by that family throughout an indefinite number of generations; this worship is, of course, not affected by the circumstance that the founder in question never had any real existence. We find this at all manner of stages in culture, from the reverence paid by Australian blacks of to-day to their mythical *alcheringa* (*see* FAMILY; ARUNTA), to the practice of the civilized Greeks, who not only described themselves as "sons or descendants of such a one" (*e.g.*, Iamidai, descended from the legendary seer, Iamus, son of Apollo) but also definitely worshipped their founder, honouring him above all the intervening ancestors. On the other hand, the older ghosts may be forgotten in time—the number of generations in a pedigree that can be remembered, while often considerable, is not without limits —and in that case the once worshipful ancestor fades vaguely into the mass of ghosts or disappears altogether, unless he becomes a god. A ghost who has shown himself formidable, or a person whose death was in some way strange, may quite well enjoy high rank among the venerated ancestors, even if he has been of little account in life. Again, the ancestor most worshipped may be the last person of importance to die: "their father whom they knew is the head by whom they begin and end in their prayer, for they know him best," says one of Callaway's Zulu witnesses (*Religious System of the Amazulu,* p. 144). It by no means always follows that the character of the ghost, venerated or not, will be identical with that of the living person: "perhaps he, too, who was good becomes bad when he is dead; and he who was bad, when he is dead, is good and becomes a good Itongo" (*ibid.,* p. 151).

Ancestors as Gods.—(IV.) Finally, some one ancestor may so combine in his own person all the worshipful qualities a good ancestral ghost should have, or show such pre-eminence in some one quality, that he is no longer treated as a ghost, however venerable, but receives the full honours due to a god. Among many peoples it is a matter of considerable doubt, both to themselves, when they give any thought to the matter, and to European investigators, whether they have any gods; *i.e.,* any beings supernatural and non-human from the start, or only more or less worshipful ghosts adored by a greater or smaller portion of the community. This confusion is illustrated by the classical case of Asclepius, who was worshipped in many parts of Greece as a god, but is also several times spoken of as a hero; *i.e.,* a worshipful ghost, with a clan, the *Asclepiadai,* called after him. It was an artificial clan, a guild of physicians; but this makes no difference. It is quite possible that a real man, renowned in his lifetime for his medical skill, lies behind the cult and myth of the god (*see* L. R. Farnell, *Greek Hero-Cults,* p. 234 ff). Practically any work on the Pacific cultures will give instances of the same confusion.

If we ask why ancestors are worshipped, apart from the desire to propitiate them and prevent them doing harm because they are neglected and angry, the answer varies almost indefinitely. Ghosts are often thought of as living in or just outside the house; thus the Zulu *amatongo* frequently enter houses in the form of snakes (Callaway, *op. cit*, p. 126 ff). A Greek house had frequently a house-hero (*ἥρως οἰκουρός*), originally no doubt the spirit of some ancestor, whose influence, if he was properly looked after by the inhabitants, was good. In particular, he might intervene to beget a much desired child on the housewife, taking the form of her husband for the purpose (*see* HERODOTUS, vi. 69; the hero Astrabacus, one of the ancient royal house, comes from his shrine in the form of King Ariston of Sparta and becomes by the latter's wife the father of Demaratos). Offspring is indeed a boon regularly expected from ancestors, who, even if they are not supposed themselves to return and be re-incarnated, naturally are interested in the continuance of the line which tends or worships them. For a like reason they are expected to protect it in various ways, averting illness, giving warning and advice in dreams, and so forth. Again, as ghosts often are supposed to live in the ground, the ancestors are commonly worshipped in hopes of getting good crops. Thus in Malabar, at the feast of Vishnu, (the beginning of the agricultural year) the celebrant prays: "May the gods on high, and the deceased ancestors, bless the seed. . . . May they also vouchsafe us a good crop." (C. Karunakara Menon in E Thurston's *Omens and Superstitions of Southern India,* p. 291). As they are thus associated with gods, they are often called upon to intercede with gods (*see* Sir J. G. Frazer, *Worship of Nature,* vol. i , p. 159); for they often live in the sky or some other abode of the deity or deities. But the above are only typical examples; there is almost nothing which an ancestral spirit may not be called upon to grant or to avert. Their relation to the gods is usually indeed that of inferior to superior; but they are commonly supposed to enjoy a larger share of divine favour than the dwellers on earth, if only because they live closer to the deities and so can act as "friends at court" for their worshippers. Usually, however, their ritual differs in kind as well as in degree from that of great gods, regularly preserving something of the methods supposed to be efficacious for securing the repose of a ghost

DIFFUSION OF ANCESTOR-WORSHIP

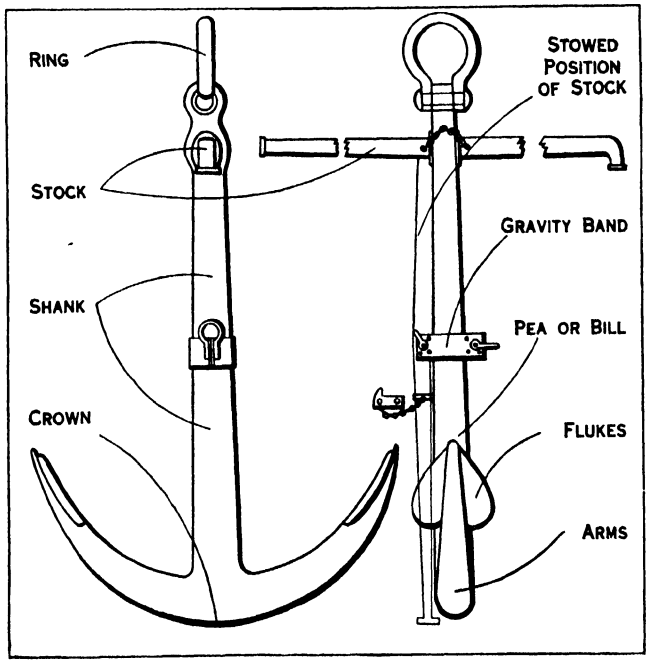
The custom is found among peoples very widely distributed, and in all grades of culture. It is not, however, so nearly universal as either the fear of ghosts or the cult of supernatural beings of some kind. Thus, the ancestors of totemic tribes are themselves totems; but it can hardly be said that the totem is worshipped; *i.e.,* made the object of prayer and other forms of cult. It is not a god, but rather a respected kinsman. The totemic ceremonies of North America, for instance, consist largely in mimetic dances in which the celebrants are assimilated to the totem, rather than in performances intended to please it, or as requests to it to send some blessing. Totemism may here and there develop into worship, but can hardly be said to be worship (*see* TOTEMISM and Sir J. G. Frazer, *Totemism and Exogamy,* ii. p. 18). Again, merely to care for the comfort of the dead ancestors is not necessarily to worship them; the Roman *parentalia* were quite as much tendance as worship proper. But examples of true ancestor-worship are very numerous, when all deductions have been made. Instances

have been quoted from Africa, Asia and the Pacific islands, in all three of which it flourishes. Of civilized races, the Greeks, Romans and Vedic Indians all had it in a more or less developed form, and it has been claimed as a common Indo-Germanic heritage. This is possible but not certain. Of existing cultured peoples, the Chinese and Japanese are the best-known examples (*see* CONFUCIUS; TAOISM). Where it has completely disappeared the reason is normally the adoption of a monotheistic religion, as Christianity, Judaism, or Islam; hence it is no longer found in Europe. It is not necessarily inconsistent with the existence of a very high form of religious or ethical belief, such for example as Confucianism.

BIBLIOGRAPHY.—No complete modern work dealing specifically with this subject exists. For the civilized races, *see* the literature of the articles GREEK RELIGION; ROMAN RELIGION, etc. Standard older works are Sir H. Maine, *Ancient Law;* Fustel de Coulanges, *La cité antique*. For uncivilized peoples, besides the works quoted in the text, *see* especially Ploss-Renz, *Das Kind,* chap. xlviii. (Leipzig, 1912); J. G. Frazer, *The Belief in Immortality* (1913–1924); L. Lévy-Bruhl, *La Mentalité primitive* (1922). (H. J. R)

ANCHISES, in Greek legend, son of Capys and Themis, grandson (according to Hyginus, son) of Assaracus, of the junior branch of the royal family of Troy, king of Dardanus on Mt Ida Here Aphrodite met him and, enamoured of his beauty, bore him Aeneas. For revealing the name of the child's mother, he was killed or struck blind by lightning (Hyginus, *Fab.,* 94). In more recent legend, adopted by Virgil in the *Aeneid,* he was conveyed out of Troy on the shoulders of his son Aeneas (q v) and died in Sicily.

ANCHOR. The most ancient anchors consisted of large stones, baskets full of stones, sacks filled with sand, or logs of wood loaded with lead. Of this kind were the anchors of the ancient Greeks; they held the vessel merely by their weight and by the friction along the bottom. When iron was introduced for the construction of anchors, an improvement was made by forming them with teeth or "flukes" to fasten themselves to the bottom.



FROM THE "MANUAL OF SEAMANSHIP," BY PERMISSION OF THE CONTROLLER OF H M STATIONERY OFFICE

FIG. 1.—FRONT AND SIDE VIEW OF AN ADMIRALTY PATTERN ANCHOR

Until the beginning of the 19th century anchors were of imperfect manufacture, the means of effecting good and efficient welding being absent and the iron poor, whilst the arms, being straight, generally parted at the crown when weighing from good holding-ground. A clerk in the Plymouth yard, named Pering, in the early part of that century (1813) introduced curved arms; and after 1852 the Admiralty anchor, under the direction of the Board, was supplied to H.M. ships. The present form of Admiralty pattern anchor, which is still used for light work and in boats, is shown in fig. 1. The parts of the anchor are known as: the shank, the ring, the stock, the crown, the arms, the flukes, the pea or bill, and the gravity band. It will be noted that, by removing the keep pin, the anchor can be "unstocked" for stowing The anchor must be "stocked" before letting go, to ensure that one of the flukes takes the ground.

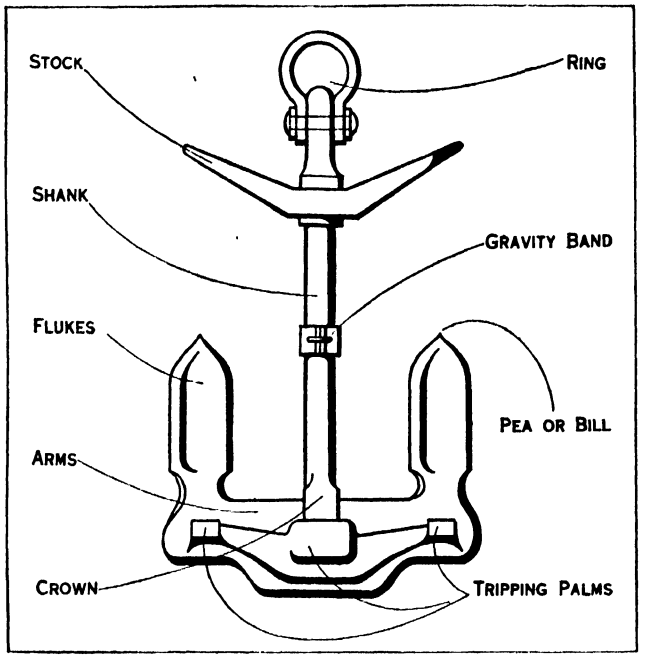


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FIG. 2.—FRONT VIEW OF MARTIN S CLOSE STOWING ANCHOR

Later came the self-canting and close-stowing Martin anchor, which, passing through successive improvements, became the improved Martin anchor (fig 2)

In this pattern the arms are in one plane and can turn through an angle of about 40° either side of the stock. Projections on the arms known as tripping palms (K) cause the arms to rotate, if the anchor is dragged along the bottom, when the flukes will catch in the ground It is superior to the Admiralty pattern because both flukes are holding the ship instead of only one. It is also much easier to stow.

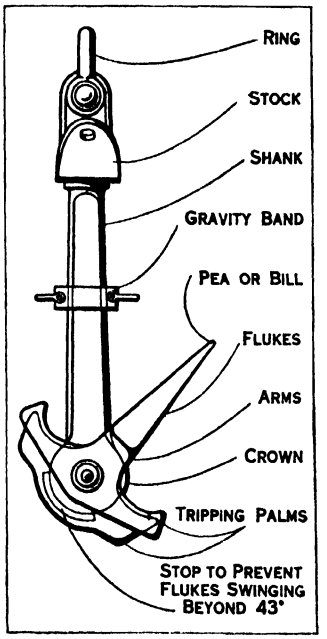

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FIG. 2B.—SIDE VIEW OF MARTIN'S CLOSE STOWING ANCHOR

To stow a stocked anchor on the anchor-bed it is hove up close to the forefoot, and by means of a ground chain (secured to a balancing or gravity band on the anchor), which is joined to a catting chain rove through a cat davit, the anchor is hove up horizontally and placed on its bed, where it is secured by chains passing over a rod fitted with a lever for "letting go"

Stockless anchors have now replaced the older pattern almost entirely for bow, sheet, and sometimes stern anchors. The latest type of this anchor is shown in fig 3

In 1903 they were adopted generally for the British Navy, after extensive anchor trials begun in 1885. Their advantages are. handiness combined with a saving of time and labour; absence of davits, anchor-beds and other gear, with a resulting reduction in

weight; and a clear forecastle for "right ahead" gun fire or for working ship. These more than make up for the disadvantage that bigger, and therefore heavier, hawse-pipes are required.

Fig. 4 shows how a stockless anchor stows in a modern warship.

Fig. 5 shows the general arrangement of the anchors and cables on the forecastle of a modern battleship. (*See* also CABLE.)

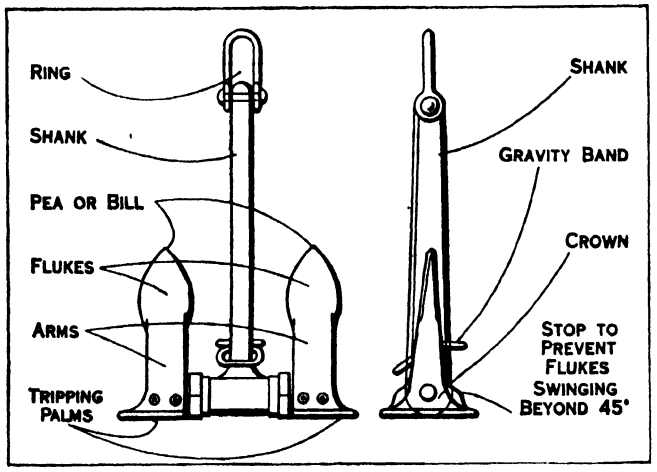

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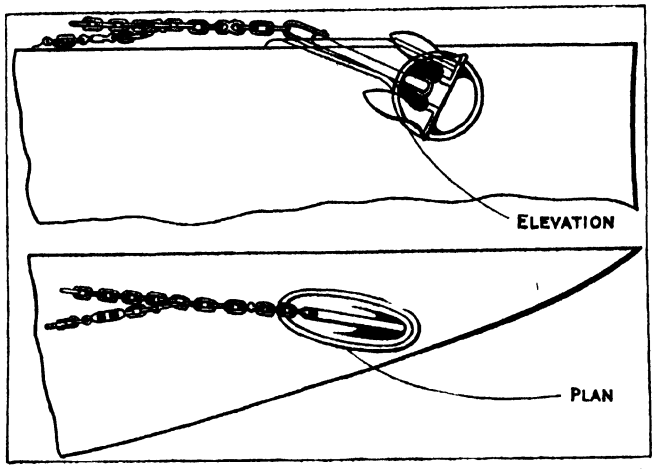
FIG. 3.—FRONT AND SIDE ELEVATION OF A STOCKLESS ANCHOR

The word "anchor" is derived from the Greek ἄγκυρα which Vossius considers is from ὄγκη, a crook or hook.

BIBLIOGRAPHY.—*Admiralty Manual of Seamanship*, vol. I. (H.M Stationery Office); *Lloyd's Register of British and Foreign Shipping*. (E. A.)

ANCHORITE, a hermit or recluse, one who has withdrawn himself from the world, usually for religious reasons. The name is specially used for the hermits of the East in the early Christian era.

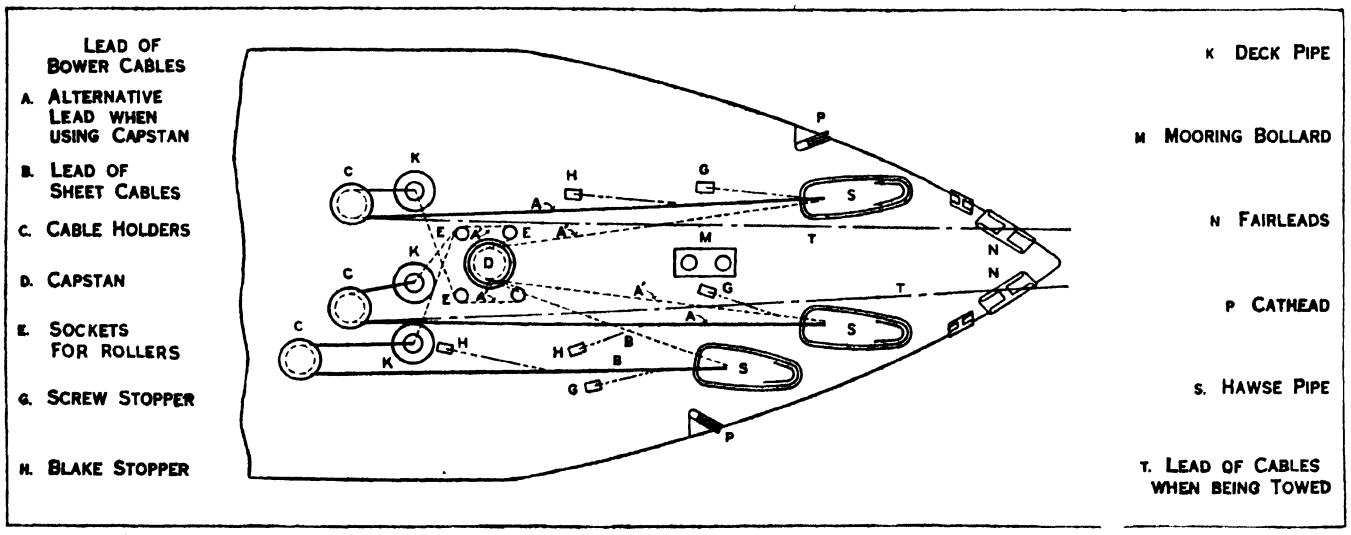
ANCHOVY (*Engraulis encrasicholus*), a fish of the herring family distinguished by its deeply cleft mouth, the angle of the gape being behind the eyes. The pointed snout extends beyond the lower jaw. The fish resembles a sprat in having a forked tail and a single dorsal fin, but the body is round and slender. The maximum length is 8¼ in. Anchovies are abundant in the Mediterranean, and are regularly caught on the coasts of Sicily, Italy, France and Spain. The range of the species also extends along the Atlantic coast of Europe to south Norway. In summer it enters the Zuider Zee in such numbers as to give rise to a regular and valuable fishery. It is also taken in the estuary of the Scheldt. The anchovies found at the western end of the English Channel in November and December are probably those which annually migrate from the Zuider Zee to the Atlantic in autumn, returning in the following spring. The shallow and landlocked waters of the Zuider Zee become raised to a higher temperature in summer than any part of the sea about the British coasts, and therefore anchovies are able to spawn in these waters. Spawning takes place in June and July. The eggs are buoyant and transparent but peculiar in having an elongated, sausage-like shape. They resemble those of the sprat and pilchard in having a segmented yolk and no oil globule. The larva hatches two or three days after fertilization and is very minute and transparent. The so-called "Norwegian anchovies" imported into England in little wooden kegs are sprats pickled in brine with bay-leaves and pepper.



FROM THE "MANUAL OF SEAMANSHIP," BY PERMISSION OF THE CONTROLLER OF H.M. STATIONERY OFFICE

FIG. 4.—METHOD OF STOWING THE STOCKLESS ANCHOR ON SHIPBOARD

ANCHOVY EGGS, a savoury dish. To make it, beat three eggs slightly and stir them over a fire, together with ¾ oz. of butter, a tablespoonful of milk, ½-teaspoonful of anchovy essence, pepper, salt, capers or other seasoning When the mixture thickens, pour it on to hot buttered toast and decorate it with capers and anchovies laid crosswise.



FROM THE "MANUAL OF SEAMANSHIP," BY PERMISSION OF THE CONTROLLER OF H M STATIONERY OFFICE

FIG. 5.—DIAGRAM OF THE FORECASTLE OF A MODERN BATTLESHIP

ANCHOVY PEAR (*Grias cauliflora*), the common name for a tall slender tree cultivated in the West Indies and belonging to the family Lecythidaceae. The russet-brown fruit, which is about 3in. long, is eaten pickled.

ANCHOVY TOAST, a pleasant savoury dish, best made as follows: Chop coarsely six boned anchovies, fry in butter with a finely chopped small onion and the yolk of an egg. Add, if desired, chopped parsley and cayenne pepper. When the mixture thickens, pour on to hot buttered toast.

ANCIEN RÉGIME, THE, a French phrase commonly used to denote the social and political system established in France under the old monarchy. (*See* FRANCE: *History.*)

ANCIENT or **ANTIENT,** old or in olden times. "Ancient history" is distinguished from mediaeval and modern, generally as meaning before the fall of the Western Roman empire. "The Ancient of days" is a Biblical phrase for God. In the London Inns of Court the senior barristers used to be called "ancients." From the 16th to the 18th century the word was also used, by confusion with "ensign," *i.e.,* standard-bearer, for that military title (*cf.* Shakespeare's "ancient Pistol"). (*See* also ANCIENT LIGHTS; DEMESNE.)

ANCIENT LIGHTS, a phrase in English law for a negative easement (*q.v.*) consisting in the right to prevent the owner or occupier of an adjoining tenement from building or placing on his own land anything which has the effect of illegally obstructing or obscuring the light of the dominant tenement. At common law a person who opens a window in his house has a natural right to receive the flow of light that passes through it. But his neighbour is not debarred thereby from building on his own land even though the effect of his action is to obstruct the flow of light thus obtained. Where, however, a window has been opened for so long a time as to constitute immemorial usage in law, the light becomes an "ancient light," which the law protects from disturbance. The Prescription Act, 1832, created a statutory prescription for light. It provided (s. 3) that "when the access and use of light to and for" (any building) "shall have been actually enjoyed therewith for the full period of 20 years without interruption, the right thereto shall be deemed absolute and indefeasible, any local usage or custom to the contrary notwithstanding, unless it shall appear that the same was enjoyed by some consent or agreement, expressly made or given for that purpose by deed or writing." Since under the statute an "interruption" in order to prevent the right accruing must be one of at least a year, the period of prescription is really only 19 years. But the right given by the statute is inchoate, unless and until the dominant owner's claim is decided by the court, and the period of prescription must be the years immediately preceding the action, raising the question. But in the meantime, however long the enjoyment may have been, the dominant owner's right is just the same, and the origin of his right is just the same as if the act had never been passed. These principles were laid down in 1904 by the House of Lords in the leading case of *Colls* v. *Home and Colonial Stores, Ltd.* (1904, A. C. 179). There has been much difference of judicial opinion as to what constitutes an actionable interference with "ancient lights." On the one hand, the test has been prescribed that if an angle of 45°—uninterrupted sky light—was left, the easement was not interfered with, and, while this is not a rule of law, it is a good rough working criterion. However, it has now been decided by the House of Lords in *Colls* v. *Home and Colonial Stores* (*supra*) that there must be a privation of light substantial enough to render the occupation of the house or building uncomfortable according to the ordinary notions of mankind and (in the case of business premises) to prevent the plaintiff from carrying on his business as beneficially as before. *See* also *Kine* v. *Jolly* (1905, 1 Ch. 480). The ordinary remedy for a disturbance of "ancient lights" is an injunction. Under the act commonly called Lord Cairns' Act, 1858, however, the court has power to grant damages in lieu of an injunction even before any damage has been done to the premises of the plaintiff (*Leeds Industrial Co-operative Society, Ltd* v *Slack,* 1924, A.C. 851). This jurisdiction is exercised only when the possible damage is certain to be small. (*See* EASEMENT.)

There is, in Scots law, no special doctrine as to "ancient lights." The servitude of light in Scotland is simply the Roman servitude *non officiendi luminibus vel prospectui.* (*See* EASEMENT and ROMAN LAW.) The same observation applies to the Code Civil and other European codes based on it. The doctrine as to ancient lights does not prevail generally in the United States. In a considerable number of the more important British dominions the acquisition of a prescriptive right to light and air has been abolished.

ANCILLARY (Lat. *ancilla,* a handmaid), an adjective meaning "subordinate to" or "merely helping," as opposed to "essential." Thackeray and some other writers have also employed it rather affectedly in its primary meaning of "pertaining to a maid-servant."

ANCILLON, CHARLES (1659–1715), one of a distinguished family of French Protestants, was born on July 28 1659, at Metz. His father, David Ancillon (1617–1692), was obliged to leave France on the revocation of the Edict of Nantes, and became pastor of the French Protestant community in Berlin. Charles Ancillon studied law at Marburg, Geneva and Paris, where he was called to the bar. In 1699 he succeeded Pufendorf as historiographer to the elector, and the same year replaced his uncle Joseph Ancillon as judge of all the French refugees in Brandenburg. He died on July 5 1715. Ancillon's chief claim to remembrance is the work that he did for education in Prussia, and the share he took, in co-operation with Leibnitz, in founding the Academy of Berlin. Of his works the only one still of value is the *Histoire de l'établissement des Français réfugiés dans les états de Brandebourg* (1690).

ANCILLON, JOHANN PETER FRIEDRICH (1766–1837), Prussian historian and statesman, great-grandson of Charles Ancillon, was born at Berlin, April 30 1766. He studied theology at Geneva, and after finishing his course was appointed minister to the French community at Berlin. Ancillon wrote a *Tableau des révolutions du système politique de l'Europe depuis le XVe siècle* (1803; new ed. 1824), which gained him the eulogium of the Institute of France, and admission to the Academy of Berlin. It was the first attempt to recognize psychological factors in historical movements, but otherwise its importance was exaggerated. In 1808 he was appointed tutor to the royal princes, in 1809 councillor of state in the department of religion, and in 1810 tutor of the Crown Prince (afterwards Frederick William IV.), on whose sensitive and dreamy nature he was to exercise a powerful but far from wholesome influence. In Oct. 1814, when his pupil came of age, Ancillon was included by Prince Hardenberg in the ministry, with a view to utilizing his supposed gifts as a philosophical historian in the preparation of the projected Prussian Constitution. But the practical difficulty of the constitutional problem gave the "court parson"—as Gneisenau had contemptuously called him—excuse enough for a change of front which, incidentally, would please his exalted patrons. He became the soul of the reactionary movement at the Berlin court, and the faithful henchman of Metternich in the general politics of Germany and of Europe.

In 1818 Ancillon became director of the political section of the ministry for foreign affairs under Count Bernstorff, and in the spring of 1832, on Bernstorff's retirement, succeeded him as head of the ministry. Ancillon had convinced himself that the rigid class distinctions of the Prussian system were the philosophically ideal basis of the State, and that representation "by estates" was the only sound constitutional principle; his last and indeed only act of importance as minister was his collaboration with Metternich in the Vienna Final Act of June 12 1834, the object of which was to rivet this system upon Germany forever. He died on April 19 1837, the last of his family. His historical importance lies neither in his writings nor in his political activity, but in his personal influence at the Prussian court, and especially in its lasting effect on the character of Frederick William IV.

See C. A. L. P. Varnhagen von Ense, *Blätter aus der preussischen Geschichte* (Leipzig, 1868–69); *ib. Tagebucher,* vol i. (Leipzig, 1861); H. O. Treitschke, *Deutsche Geschichte* (Leipzig, 1879–94), and essay on Ancillon in *Preussische Jahrbücher* for April 1872; *Allgemeine Deutsche Biographie, s.v.* (Leipzig, 1875).

ANCÓN, a small village and bathing-place on the coast of Peru, 22m. N. of Lima by rail. The bay is formed by two projecting headlands and is one of the best on the coast. It has a gently sloping beach of fine sand and has been a popular bathing-place since the time of President Balta, although the country behind it is arid and absolutely barren At some time previous to the discovery of America, Ancón had a large aboriginal population. Traces of terraces on the southern headland can still be seen,

and the sand-covered hills and slopes overlooking the bay contain extensive burial-grounds which were systematically explored in 1875 by W. Reiss and A. Stübel (*see* Reiss and Stübel's *The Necropolis of Ancón in Peru*). In modern times Ancón has been the scene of several important historical events. Its anchorage was used by Lord Cochrane in 1820 during his attacks on Callao; it was the landing-place of an invading Chilean army in 1838; was bombarded by the Chileans in 1880; and in 1883 it was the meeting-place of the Chilean and Peruvian commissioners who drew up the Treaty of Ancón, which ended the war between Chile and Peru.

ANCON, the anatomical name for "elbow" (from the Gr. ἀγκών); "ancones" in architecture are the projecting bosses left on stone blocks or on drums of columns, to allow of their being either hoisted aloft or rubbed backwards and forwards to obtain a fine joint; the term was also given to the trusses or console brackets on each side of the doorway of a Greek or Roman building. A particular sort of sheep, with short crooked forelegs, is called "ancon" sheep.

ANCONA, ALESSANDRO (1835–1914), Italian man of letters, was born at Pisa on Feb. 20 1835 and died at Florence on Nov. 8 1914. He acted as intermediary between Cavour and the Tuscan Liberals in 1855, and represented Tuscany in the Società Nazionale. In 1861 he was appointed professor of Italian literature at Pisa, and was made a senator in 1904.

His chief works are: *Opera di Tommaso Campanella* (Turin, 1854); *Sacre Rappresentazioni dei secoli* XIV., XV., e XVI. (Florence, 1872); *Origini del Teatro in Italia* (Florence, 1877); *La Poesia popolare italiana* (Livorno, 1878), besides several volumes of literary essays, editions of the works of Dante and other early Italian writers, etc.

ANCONA, the Marches, Italy, an episcopal see and capital of the province of Ancona, on the north-east coast of Italy, 185m. N.E. of Rome by rail and 132m. direct, and 127m. S E. of Bologna. Pop. (1921) 51,575 (town) 66,291 (commune). The town stands on and between the steep slopes of the two extremities of the promontory of Monte Conero, Monte Astagno to the south, occupied by the citadel, and Monte Guasco to the north, on which the cathedral stands (300ft.). The latter, dedicated to S. Ciriaco, is said to occupy the site of a temple of Venus, mentioned by Catullus and Juvenal as the tutelary deity of the place and 14 columns in the interior are attributed to it. It was consecrated in 1128 and completed in 1189. It is fine Romanesque in grey stone, in the form of a Greek cross, with a dodecagonal dome over the centre. The façade has a Gothic portal. The interior, with a crypt in each transept, preserves its original character. In the dilapidated episcopal palace Pope Pius II died in 1464. S. Maria della Pizza has an elaborate arcaded façade (1210). The Palazzo del Comune (twice restored) with lofty arched substructures at the back, was the work of Margaritone d'Arezzo (1270). Fine late Gothic buildings include churches of S. Francesco and S. Agostino, the Palazzo Benincasa, and the Loggia dei Mercanti, all by Giorgio Orsini, usually called da Sebenico and the prefecture, which has Renaissance additions. The portal of S. Maria della Misericordia is ornate early Renaissance. There is an important archaeological museum.

To the east of the town is the harbour, now an oval basin of 990 by 880 yards, which, though small, is the finest harbour on the south-west coast of the Adriatic, and one of the best in Italy; improvements are in progress. It was originally protected only by the promontory on the north from the elbow-like shape of which (Gr. ἀγκών) the ancient town, founded by Syracusan refugees about 390 B.C., took the name which it still holds. Greek merchants established a purple factory here (Sil. Ital. viii. 438). Even in Roman times it kept its own coinage and continued the use of the Greek language. When it became a Roman colony is doubtful. It was occupied as a naval station in the Illyrian War of 178 B.C. Caesar took possession of it immediately after crossing the Rubicon. Its harbour was of considerable importance in imperial times as the nearest to Dalmatia, and was enlarged by Trajan, who constructed the north quay. It was his starting point for his second expedition to Moesia and Dacia in A.D. 105. At the beginning of it stands the marble triumphal arch, erected in his honour in A.D. 115. Pope Clement II. prolonged the quay, and an inferior imitation of Trajan's arch was set up; he also erected a lazaretto at the south end of the harbour, now a tobacco warehouse, Vanvitelli being the architect-in-chief. The southern quay was built in 1884, and the harbour is now protected by forts on the heights. Steamers run regularly to Zara and Fiume and also to Gravosa. The imports and exports (but mainly the former) in 1921 amounted to 373,000 tons. There is a large sugar refinery and a shipbuilding yard. In 1926 the port dealt with 605,562 tons of merchandise, and 4,568 ships of tonnage 1,912,774, carrying 31,073 passengers.

Ancona was attacked by Goths, Lombards and Saracens, but recovered its importance. It was one of the cities of the Pentapolis under the exarchate of Ravenna, the other four being Fano, Pesaro, Senigallia and Rimini, and eventually became a semi-independent republic under papal protection until Gonzaga took possession for Clement VII. in 1532. From 1797 onwards, when the French took it, it frequently appears in history as an important fortress, until Lamoricière capitulated here on Sept. 29, 1860, eleven days after his defeat at Castelfidardo. It suffered some damage from bombardment by the Austrian fleet on May 24, 1915.

ANCONA, a variety of domestic fowl, very similar to the Leghorn. The Ancona originated in Port Ancona, Italy, and was imported into England about the middle of the last century, and thence to America. It lays a white-shelled egg, and is a non-broody breed. There are two varieties, the Single Comb and the Rose Comb Ancona which, apart from the type of comb, are identical in every respect. The general plumage colour is lustrous black above with certain of the feathers tipped with a v-shaped white tip and slate below. (*See* POULTRY.)

ANCREN RIWLE, a Middle English prose treatise written for a small community of three religious women and their servants. It is generally supposed to date from the first quarter of the 13th century, but E. Kölbing is inclined to place the Corpus Christi ms. about the middle of the 12th century. There are extant eight English mss. of the work (two fragmentary), four in Latin and one in French. One Latin ms., *Regula Anachoritarum sive de vita solitaria* (Magdalen college, Oxford, No. 67, fol. 50) has a prefatory note:—*Hic incipit prohemium venerabilis patris magistri Simonis de Gandavo, episcopi Sarum, in librum de vita solitaria, quem scripsit sororibus suis anachoritis apud Tarente.* But Bishop Simon of Ghent, who died in 1315, could not have written the book, though he may have been responsible for the Latin recension. It has been tentatively attributed to Richard Poor, bishop successively of Chichester, Salisbury and Durham; but the claim rests on slight foundation.

What was the original language of the *Ancren Riwle?* Morton held that it was English, but his view was challenged by E. E. Bramlette in *Anglia* (XV. 478–498), who argued in favour of a Latin original. Bramlette was, in his turn, challenged by G. C. Macaulay (*Modern Language Review,* IX, 70–78) who showed conclusively that the Latin was translated from English, and not vice versa; but after study of the French ms. (Cotton Vitellius F. vii) Macaulay argued that the English was translated from the French. But the evidence in favour of English cannot really be resisted. What is important, however, about the *Ancren Riwle,* is not the quantity of dispute it occasions, but the fact that it is a genuine contribution to English literature—almost the earliest English prose work that the ordinary person can read with pleasure. It combines religious sincerity with simple, affectionate charm in a singularly high degree.

Ancren Riwle was edited for the Camden Society by the Rev. James Morton in 1853 from the Cotton ms. (Nero A xiv.). A collation of this text with the ms. by E. Kölbing is printed in the *Jahrbuch für romanische u. engl. Spr. und Lit.* xv. 180 *seq.* (1876). The *Ancren Riwle* (ed. F. A. Gasquet, 1905) is available for the ordinary reader in *The King's Classics.* For specimens of texts and discussions of details *see,* in addition to works quoted, Kölbing in *Englische Studien,* lii. 535; Panes in *Englische Studien,* xxx. 344–346; McNabb in *Modern Language Review,* xi. 1–8, claiming a Dominican, Friar Robert Bacon, as author; Miss Hope Allen in *Publications of the Modern Language Association of America,* xxxiii., 538–546, suggesting that the work was written for three ladies of Kilburn; Miss Dorothy Dymes in *Essays and Studies by Members of the English Association,* Vol. ix.; R. W. Chambers and others in *Review of English Studies,* Jan. 1925, Jan. 1926, April 1926; and Joseph Hall, *Selections from Early Middle English.*

ANCRUM, a village on Ale or Alne Water, a tributary of the Teviot, Roxburghshire, Scotland. Pop. (1921) 912. The name has a Gaelic root and the village is of considerable antiquity; a Roman road forms the north-east boundary of the parish. Ancrum Moor, 2m. N.W., was the scene of a battle in 1545 in which the English were defeated by the Scots.

ANCUS MARCIUS (640–616 B.C.), fourth legendary king of Rome. Like Numa, his reputed grandfather, he was a friend of peace and religion, but was obliged to make war to defend his territories. He conquered the Latins, and some of them whom he settled on the Aventine formed the origin of the Plebeians. He fortified the Janiculum, threw a wooden bridge across the Tiber, founded the port of Ostia, established salt-works and built a prison.

See Livy i. 32, 33; Dion Halic. iii. 36–45; Cicero, *De Republica,* ii. 18.

ANCYLOPODA or **CHALICOTHEROIDEA,** a group of extinct large-bodied herbivorous mammals distinguished by the combination of large claws on the feet with herbivorous molar teeth of the type technically known as buno-lopho-selenodont (cone-ridge-crescent tooth). The first known remains of these animals consisted of a large claw-like bone found in the Upper Miocene formation near Eppelsheim, Germany. This was pronounced by Cuvier in 1825 to represent *"un pangolin gigantesque."* Similarly, in North America the claw-like bones now known to pertain to *Moropus* (*see* below) were at first believed to have belonged to edentates, but the entire group is now known to consist of strangely modified hoofed mammals belonging to the order Perissodactyla (*q v.*).

Through recent discoveries the best known member of the group is *Moropus elatus,* nearly complete skeletons of which, from the Lower Miocene of western Nebraska, are exhibited in the natural history museums of New York and Pittsburgh. This animal stood about 6ft. high at the shoulders. In general appearance it somewhat resembled a large horse, especially in the head and neck; but the feet were short, each ending below in three clawed digits, the claw on the inner side of the forefoot (corresponding to the nail of the second finger of the human hand) being greatly enlarged. Very possibly these claws (which represent highly modified hoofs rather than true claws) were used in scraping the ground in search of food or water. The front teeth or incisors were small and the canine teeth reduced. In the upper molar teeth the crown pattern exhibited a combination of crests and hillocks across which the U-shaped lower molars moved The skull and dentition exhibit a curious combination of characters found elsewhere separately among the horses and earlier titanotheres, to both of which families the chalicotheres are remotely related. The earliest known member of the group (*Eomoropus*) occurs in the middle Eocene of Wyoming. It was about as large as a sheep. Its skull and teeth, while clearly foreshadowing those of *Moropus,* also indicate its derivation from still older and more primitive perissodactyls. Among the later members of the group *Macrotherium magnum* was a beast of elephantine bulk The known range of the group was from the middle Eocene of Wyoming to the Pliocene of China

See H F. Osborn, *"Eomoropus,* an American Eocene Chalicothere," *Bull. Amer. Mus. Nat. Hist.,* vol. xxxii., p. 261 (1913); W. J. Holland and O. A. Peterson, "The Osteology of the Chalicotheroidea," *Memoirs of the Carnegie Museum,* vol. iii., No. 2 (1914).

(W. K. G.)

ANCYRA, an ancient city of Galatia (mod. *Angora,* q v), in Asia Minor, on a tributary of the Sangarius. Originally a prosperous Phrygian city, Ancyra became the centre of the Tectosages, one of the three Gaulish tribes that settled in Galatia about 232 B.C. In 189 B.C. Ancyra was occupied by Cn. Manlius Vulso, who made it his headquarters in his operations against the tribe. In 63 B.C. Pompey placed it (together with the Tectosagan territory) under one chief, and it continued under native rule till it became the capital of the Roman province of Galatia in 25 B.C. Inscriptions and coins show that its civilization in the 1st century A.D. consisted of a layer of Roman ideas and customs super-imposed on Celtic tribal characteristics, and that not until about A.D. 150 did the true Hellenic spirit begin to appear. Christianity was introduced (from the north or north-west) perhaps as early as the 1st century, but there is no shred of evidence that the Ancyran Church (first mentioned A.D. 192) was founded by St. Paul or that he ever visited northern Galatia. The real greatness of the town dates from the time when Constantinople became the Roman metropolis, when its situation gave it an importance which it retained throughout the middle ages. *See* further ANGORA (1). An important ecclesiastical synod was held here in A.D. 314.

The modern town contains many remains of Roman and Byzantine periods. The most important monument is the *Augusteum,* a temple of white marble erected to "Rome and Augustus" during the lifetime of that emperor by the common council or diet of the three Galatian tribes. The temple was afterwards converted into a church, and in the 16th century a fine mosque was built against its south face. On the walls of the temple is engraved the famous *Monumentum Ancyranum,* a long inscription in Latin and Greek describing the *Res gestae divi Augusti* The inscription is a grave and majestic narrative of the public life and work of Augustus. The original was written by the emperor in his 76th year (A D. 13–14) to be engraved on two bronze tablets placed in front of his mausoleum in Rome.

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ANCYRANUM, MONUMENTUM, the tablets recording the deeds of Augustus, found on the walls of a temple at Ancyra (Angora). These tablets were copies of the *index rerum a se gestarum* (record of his deeds) set up by the emperor in Rome The first section deals with the "deeds," largely military, between 44 and 28 B C.; the second with domestic matters, such as honorific titles and constitutional changes; the third with finance; and the fourth with general political and diplomatic matters It is one of our most important historical sources for this period

See the editions by Th. Mommsen (1883) and E. G. Hardy (1923).

ANDALUSIA (Span Andalucía), one of the old provinces of Spain, broken up in 1833 into the eight modern provinces of Almería, Cadiz, Cordova, Granada, Huelva, Jaén, Malaga and Seville (*q.v.*).

The Arab name al-Andalus designated the entire peninsula, but was used also specifically for the Muslim area and especially for the four kingdoms of Seville, Cordova, Jaén and Granada. It has been referred to a hypothetical form Vandalīcia, the name either of Baetica when occupied by the Vandals or of the port by which the Vandals passed to Africa. The alternative "Land of the West" seems not to be considered seriously by modern Arabic scholars. In popular speech, however, Andalusia begins, not with the northern boundaries of the provinces of Cordova and Seville, but with the descent from the Sierra Morena to the Guadalquivir lowlands. Here is one of the abrupt changes characteristic of Spain; everything changes—climate, vegetation and people—in the drop of 1,500 to 2,000ft. from the plateau to the lowlands. These wide and undulating lowlands are the essential Andalusia; the foothills of the Cordillera which separates them from the Mediterranean, and the Cordillera itself are known in distinction as Upper Andalusia. (Nevertheless, the terms Upper and Lower Andalusia are used also to distinguish between the lowlands lying respectively along the upper and lower courses of the Guadalquivir.) Lower Andalusia opens out gradually in a funnel as it descends towards the Atlantic, at the same time it slopes gently towards the Guadalquivir, which on the north clings to the Morena foot. It is the upheaved bottom of the sea-straits which formerly separated the Spanish plateau from the Cordillera to the south, at that time still connected across the present Straits of Gibraltar with the African continent. The movement of upheaval, which led to the steady westward growth of the land, had many oscillations, so that deposits of widely differing kinds were laid down on the ocean margin as defined from time to time Moreover, the older levels which appear at the surface where these latter deposits have been worn away often contain gypsum and salt. Thus the soils of Lower Andalusia vary widely from the fertile

marls, which are best known in the famous olive-groves of the *Ajaraque*, west of Seville, and in the vineyards of Jeréz, de la Frontera to the waterless, infertile soils of the wide pasture tracts (*dehesas*). To the west Lower Andalusia rises into the highly mineralized plateau leading to Portugal; to the east the lowlands, and with them the name, disappear in the narrows of the old straits, now limestone highlands leading to Murcia; in this direction the esparto and saline steppes increasingly dominate the landscape.

The excessive heat and almost absolute drought of the summer months and the mildness of winter differentiate the climate of Lower Andalusia from that of the other arid districts of Spain. The amazingly fertile "black earths," which cover large tracts south of the Guadalquivir below Cordova and the La Janda depression east of Cape Trafalgar, have no reference to present climatic conditions; they are residual soils from an earlier, pluviose phase. The present climate is reflected in the wide extension of the olive, in the restricted extension of the orange from the coast to Palma del Río, but more especially in the frequent hedges of prickly-pear, and the varieties of cactus. The towns of Lower Andalusia lie on the rivers, usually at points where these may be suitably bridged (Seville, Ećija, Cordova), or on elevations rising from the plain (Carmona, Marchena, Baena), or in commanding positions on the borders of the foothills (Morón, Osuna, Lucena). Cadiz, however, lies on the coast on a narrow-necked peninsula. Between the Rio Tinto and the Guadalquivir a large area of marsh-lands, fringed with dunes along the coast, is practically uninhabited.

Upper Andalusia rises somewhat abruptly from the south side of the Guadalquivir lowlands, but as these rise towards the narrows its boundary becomes less distinct. The sierras of Upper Andalusia are aligned roughly in a cordillera, for the origin and structure of which *see* general article SPAIN, under heading *Geology*. They culminate in the Sierra Nevada (*q.v.*). A series of structural depressions, aligned with the sierras, provides most of the flat ground in this mountainous country, and the cities and towns are situated to command these (Granada, Antequera, Guadia and Baza), or on the coastal plains at the mouths of the short rivers of the Mediterranean slope (Malaga, Matril, etc). The *vegas*, or fertile flats, of this area are thus unusually important. The climates of Upper Andalusia are altitudinal variants of that of Lower Andalusia. The towns of the mountain and of the coast are both, for different reasons, tolerable in summer. The coastal strips are notable for the mildest winter climate in Europe; here are to be found the sugar-cane, the plantain, the cherimoya, even the coffee-plant, and cotton is now being re-introduced experimentally under Government control. Between the sub-tropical coastal district and the Nevada summits, lying some 500 or 600ft. below the theoretical snow-line, there is a great range of climates and vegetations, which are brought into close superposition in the Alpujarras (*q.v.*). Nowhere, however, is there significant rainfall in summer; the only advantage possessed by Upper Andalusia over the lowlands is the availability of water for irrigation.

The accessibility of the interior by the waterways of the Guadalquivir (the only important river of Spain for navigation) and, to a lesser extent, of the Odiel and Rio Tinto, together with the mineral wealth of the Sierra Morena and of the plateau leading to Portugal, contributed to the early advance of civilization in Andalusia and to early contact with the outside world. The kingdom of Tartessus, perhaps the Biblical Tarṣhish, flourished here in the latter half of the second millennium B.C, and its port, of the same name, on the Atlantic front served both as depot for the ore of Andalusia and as *entrepôt* for the tin of northern lands, brought here in Tartessian ships. The Phoenicians, who may have been preceded here by the Cretans, established about 1100 B.C. a colony, Gadir, the earliest Cadiz, on a small coastal islet at some distance south, and also tapped the resources of Andalusia at points on the Mediterranean coast (Malaga, Adra). The Phoenicians were followed—after an interval during which the Phocaean Greeks controlled the trade with Tartessus—by the Carthaginians, who destroyed the Tartessian kingdom and finally established themselves firmly in southern Spain. Andalusia did not blossom again until, as the senatorial province of Baetica (which extended, however, farther north and reached east only to the Linares district), it became integrally Roman. The brief occupation by the Vandals in the 5th century A.D., and the failure of the Eastern empire to hold Andalusia as an outlier of the imperial territory in Africa, seem to illustrate the untenability of Andalusia by a power not firmly established on the central plateau of Spain. The Muslim period, beginning in 711, brought Lower Andalusia to the highwater mark of its history. Cordova, more conveniently situated with respect to the Morena passes than the other Andalusian towns, became under the Umaiyads the chief centre of authority in the peninsula and a world-centre of culture. But the disadvantages, for control of the peninsula, of an administrative centre in Andalusia required to be counteracted by the energy of an Abderrahman III. or an Almanzor, and with the death of the latter effective control from Cordova and, for the time, from Andalusia ceased. In the succeeding period superior local advantages of site contributed to make Seville outstanding among the numerous small Muslim states of Spain. When, after the defeat at Las Navas de Tolosa in 1212, the Muslims lost control of the Despeñaperros pass, and their Guadiana states, now outflanked, fell to the Christians, Lower Andalusia ceased to be tenable.

The Muslim concentration in Upper Andalusia from 1257 onwards brought that region in turn to the zenith of its historical destiny. Granada, dominating the Genil depression, the most central of the Cordillera, became the centre of authority for a kingdom extending from Algeciras to the neighbourhood of Aguilas. To the loose coherence of the kingdom of Granada, regarded as ending Arab civilization, the physical isolation of the local administrative centres of Malaga, Almeria, Guadix, Baza, etc., and the lack of continuous lines of easy communication contributed obviously.

It has been suggested, particularly by Dr. Vaughan Cornish, that an important mistake was made by the Catholic sovereigns at the close of the reconquest in failing to recognize the suitability of Seville to be the capital of reunited Spain (*see* article SPAIN). With the discovery of the New World the water-front of Andalusia rose to a new importance. First Seville, and later Cadiz, controlled the American trade. The tedious navigation of the lowest reaches of the Guadalquivir and the isolated position of Cadiz contributed to the decline of this trade in Andalusia when the monopoly was withdrawn from these cities. Canalization and other improvements effected on the Guadalquivir have revived the foreign trade of Seville during the last 40 years; the outlook to the ocean is again an important factor in the life of Lower Andalusia. The 19th century mining revival, under foreign concessionaire companies, has brought into play again another traditional factor. In Upper Andalusia modern development is largely a question of communications; the proposed railway from Granada to Motril will stimulate development in the heart of this region.

The long period of Muslim domination in Andalusia has left behind four great monuments—the Giralda and Alcázar of Seville, the Mosque of Cordova and the Alhambra at Granada. Though the buildings which survive from that period are few, the impress of the Muslim is still clear in the plan of cities and towns where, as in Cordova, later economic currents have not been sufficiently strong to modify it seriously, and is everywhere traceable. The internal arrangement of the house is derived by evolution from the Arab interior. The influence of Arabic in the everyday language of the common people is obvious, but it is not possible to assess the relative parts played by physical environment and the successive immigrations in determining the "Gascon" temperament of the people, the physical type—dark complexioned, handsome, graceful, and the clipped speech and phonetic peculiarity of the *seses*, or sibilation of the lisped Castilian *c* and *z*. The extension of the *seses* in the New World is a testimony to the part played by Andalusia in its settlement.

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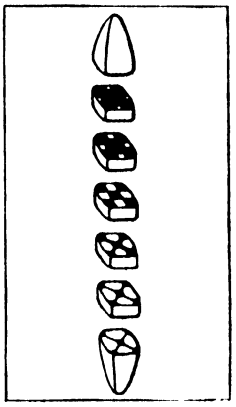
for the XIVth International Geological Congress (Madrid, 1926); H. Pacheco and Puiz de la Bellacasa, *Guide Géologique de Despeñaperros* (Madrid, 1926); D. Orueta and E. Rubio, *The Mountain Ranges of Ronda* (Madrid, 1926); H. Pacheco, *La Sierra Morena et La Plaine bétique (Synthèse géologique)* (Madrid, 1926); *De Sierra Morena a Sierra Nevada* by various authors (Madrid, 1926). A. F. Calvert, *Moorish Remains in Spain* (undated); Théophile Gautier, *Voyage en Espagne,* trans. under the title, *A Romantic in Spain* (1926).

ANDALUSIA, a city of southern Alabama, U.S.A, on the Central of Georgia and the Louisville and Nashville railways; the county seat of Covington county, and the commercial centre of a farming and lumbering region. The population was 551 in 1900; 4,023 in 1920 (25% negroes). The city's manufactures include sashes and doors, paint, pickles and turpentine.

ANDALUSITE, a mineral with the same chemical composition as kyanite and sillimanite, being aluminium silicate, Al_2SiO_5 As in sillimanite, its crystalline form is referable to the orthorhombic system. Crystals of andalusite have the form of almost square prisms, the prism-angle being 89° 12′. As a rule the crystals are roughly developed and rude columnar masses are common, these being frequently partially altered to kaolin or mica. Such crystals, opaque and of a greyish or brownish colour, occur abundantly in the mica-schist of the Lisens Alp near Innsbruck in Tirol, and in Andalusia, from which place it derives its name. The unaltered mineral is found as transparent pebbles with topaz in the gem-gravels of the Minas Novas district, in Minas Geraes, Brazil. These pebbles are usually green but sometimes reddish-brown in colour and are remarkable for their very strong dichroism, the same pebble appearing green or reddish-brown according to the direction in which it is viewed. Such specimens make very effective gem-stones, the degree of hardness of the mineral (H = 7½) being quite sufficient for this purpose



TRANSVERSE SECTION OF A CRYSTAL OF CHIASTOLITE

A variety of andalusite with black inclusions. The crystal sections, when polished, are worn as amulets or charms

A curious variety of andalusite known as chiastolite is specially characteristic of clay-slates near a contact with granite. The elongated prismatic crystals enclose symmetrically arranged wedges of carbonaceous material, and in cross-section (*see* fig) show a black cross on a greyish ground. Cross-sections of such crystals are polished and worn as amulets or charms. Crystals of a size suitable for this purpose are found in Brittany and the Pyrenees, while still larger specimens have been found recently in South Australia.

ANDAMANESE. The Andaman islands in the Bay of Bengal are inhabited by a pigmy stock. The men average 4ft. 10½in., the women, 4ft. 6in. They are markedly round headed, broad nosed, with hair generally sooty black or yellowish brown. The skin varies in colour from an intense sheeny black to reddish brown on the unexposed parts.

There are two main divisions, coast and inland people, each divided into minor local groups with definite linguistic and cultural characteristics. There are no clans or exogamic units. There is no organized government or hereditary chief. Conduct is regulated by public opinion, the direct pressure of which, in small nomadic, hunting, food-collecting groups, is effective. The stages of life are marked by a series of rites centring on food taboos. Marriage rites consist simply of publicly placing the bride on the bridegroom's lap. The encampment has separate huts for the unmarried—girls and boys apart, and for married couples. Four modes of burial are practised, tree burial being employed for those who are specially honoured Dancing is practised, and singing, individual and collective, is cultivated. Religious beliefs are associated with the seasonal variations, the monsoon being the prominent and regulating feature. Legends display local variations. Religious ritual is not organized. Men have visions or dreams and gain reputation as in contact with the world of spirits. Though ignorant of methods of making fire, they preserve it carefully, cook by it and make pottery.

Language.—The languages of the ten tribes of the Great Andaman form a linguistic group distinct from that constituted by the languages of the Little Andaman and the Jarawa of the South Andaman. The vocabularies differ conspicuously, but the identities of grammatical structure show that all are derived from a common source. The phonetic system is imperfectly known, but there is no *s, z, sh* or *zh*. Vowel and consonantal changes follow regularly in the several languages. The language is built up of stems and affixes. Simple stems are generally nouns, names of simple independently existing objects. Compound stems have a prefix, which is a separable element. The prefixes show that the object is a part of, or intimately associated with, some other object. A pig is an independent object. It is a simple stem. The head of a pig is not a simple object. A class prefix is therefore required. Such objects belong to someone; a head belongs to someone. A possessory prefix is therefore required. The class prefixes also modify the meaning of the stem. Adjectives do not require a possessory prefix but do require a class prefix. Simple verbs consist of a stem and a radical prefix and must be preceded by a personal pronoun. Compound words contain more than one stem. The elements may be (1) two simple stems, (2) two compound stems, (3) simple stem plus compound stem, (4) compound stem plus simple stem. It is recorded that many words could not be analysed so that the methods of word formation may include methods not stated above. The use of specific terms to describe details regarded by them as important is carried very far. Words for one and two are known. Finger counting is employed. Ten or both hands mean all, which is also used when five is reached by fingers. The grammatical construction proceeds on logical lines. There is as yet no convincing proof of any relationship with other languages.

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ANDAMAN ISLANDS, a group of islands in the Bay of Bengal. Large and small, they number 204, and lie 590m. from the mouth of the Hugli, 120m. from Cape Negrais in Burma, the nearest point of the mainland, and 340m. from the northern extremity of Sumatra. The extreme length of the Andaman group is 219m. with an extreme width of 32 miles. The main part of it consists of a band of five chief islands, so closely adjoining and overlapping each other that they have long been known collectively as "the Great Andaman." Four narrow straits part these islands. Attached to the chief islands are, on the extreme north, Landfall Islands; Interview Island, off the west coast of the Middle Andaman; the Labyrinth Island off the south-west coast of the South Andaman; Ritchie's (or the Andaman) archipelago off the east coast of the South Andaman and Baratang. Little Andaman, roughly 26m. by 16, forms the southern extremity of the whole group and lies 31m. south of Rutland Island across Duncan Passage, in which lie the Cinque and other islands, forming Manners Strait, the main commercial highway between the Andamans and the Madras coast. Besides these are a great number of islets lying off the shores of the main islands. The land area of the Andaman Islands is 2,508 sq. miles.

Topography.—The islands forming Great Andaman consist of a mass of hills enclosing very narrow valleys, the whole covered by an exceedingly dense tropical jungle. The hills rise, especially on the east coast, to a considerable elevation; the highest being Saddle Peak (2,400ft.) in the North Andaman. Little Andaman, with the exception of the extreme north, is practically flat There are no rivers and few perennial streams in the islands. The scenery is everywhere strikingly beautiful and varied, and the coral beds of the more secluded bays in its harbours are conspicuous for their exquisite colouring. The coasts of the Andamans are deeply indented, giving existence to a number of safe harbours and tidal creeks, often surrounded by mangrove swamps. The chief of several capacious harbours is Port Blair in South Andaman: and there are a number of good anchorages along the coast.

Geology.—The Andaman islands form part of a lofty range of submarine mountains, 700m. long, running from Cape Negrais in the Arakan Yoma range of Burma, to Achin head in Sumatra. This range separates the Bay of Bengal from the Andaman sea; and it contains much that is geologically characteristic of the Arakan Yoma, and formations common also to the Nicobars and to Sumatra and the adjacent islands. The older rocks are Early Tertiary or Late Cretaceous, but there are no fossils to indicate age. The newer rocks, common also to the Nicobars and Sumatra, are chiefly in Ritchie's archipelago and contain radiolarians and foraminifera.

Climate.—Rarely affected by a cyclone, though within the influence of practically every one that blows in the Bay of Bengal, the Andamans are of the greatest importance because of the accurate information relating to the direction and intensity of storms which can be communicated from them better than from any other point in the bay, to the vast amount of shipping in this part of the Indian ocean. A well-appointed meteorological station has been established at Port Blair since 1868. Speaking generally, the climate of the Andamans themselves may be described as normal for tropical islands of similar latitude. It is warm always, but tempered by pleasant sea-breezes; very hot when the sun is northing; irregular rainfall, but usually dry during the north-east, and very wet during the south-west monsoon.

Flora and Fauna.—A section of the Forest Department of India has been established in the Andamans since 1883, and in the neighbourhood of Port Blair 156 sq.m. have been set apart for regular forest operations which are carried on by convict labour. The chief timber of indigenous growth is padouk (*Pterocarpus dalbergioides*), used for buildings, boats, furniture, fine joinery and all purposes to which teak, mahogany, hickory, oak and ash are applied. This tree is widely spread and forms a valuable export to European markets. Other first-class timbers are koko (*Albizzia Lebbek*), white chuglam (*Terminalia bialata*), black chuglam (*Myristica irya*), marble or zebra wood (*Diospyros kurzii*) and satin wood (*Murraya exotica*), which differs from the satin-wood of Ceylon (*Chloroxylon Swietenia*). All of these timbers are used for furniture and similar purposes. Among the imported flora are tea, Siberian coffee, cocoa, Ceara rubber (which has not done well), Manila hemp, teak, cocoanut and a number of ornamental trees, fruit-trees, vegetables and garden plants. The general character of the forests is Burmese with an admixture of Malay types. Great mangrove swamps supply unlimited firewood of the best quality.

Animal life is generally deficient throughout the Andamans, especially as regards mammalia, of which there are only nineteen separate species in all, twelve of these being peculiar to the islands. There is a small pig (*Sus andamanensis*), important to the food of the people, and a carnivore (*Paradoxurus tytleri*); but the bats and rats constitute nearly three-fourths of the known mammals. This paucity of animal life seems inconsistent with the theory that the islands were once connected with the mainland. Moreover, the Andaman species differ from those of the adjacent Nicobar islands. Each group has its distinct harrier-eagle, red-cheeked paroquet, oriole, sun-bird and bulbul. Fish are very numerous and many species are peculiar to the Andaman seas. Turtles are abundant and supply the Calcutta market.

The People.—The Andaman islands are the abode of savages as low in civilization as almost any known on earth. Our earliest notice of them is in a remarkable collection of early Arab notes on India and China (A.D. 851), which describes the islanders as cannibals who massacre ship-wrecked crews. The traditional charge of cannibalism has been very persistent; but it is entirely denied by the islanders themselves, and is now and probably always has been untrue. Of their massacres of shipwrecked crews, even in quite modern times, there is no doubt. The Andamanese are probably the relics of a pigmy race that once inhabited the south-east portion of Asia and its outlying islands, representatives of which are also still to be found in the Malay Peninsula and the Philippines. Their antiquity and their stagnation are attested by the remains found in their kitchen-middens, which lead to the belief that the Andamans were settled by their present inhabitants some time during the Pleistocene period, and certainly no later than the Neolithic age. Though all descended from one stock, there are twelve distinct tribes, each with its own clearly-defined locality, its own distinct variety of the one fundamental language and to a certain extent its own separate habits. Every tribe is divided into septs fairly well defined. The average height of males is 4ft. 10½in.; of females, 4ft. 6in. The skin varies in colour from an intense sheeny black to a reddish-brown on the collarbones, cheeks and other parts of the body. The hair varies from a sooty black to dark and light brown and red. It grows in small rings, which give it the appearance of growing in tufts, though it is really closely and evenly distributed over the whole scalp. The figures of the men are muscular and well-formed and generally pleasing; but the women have a tendency to stoutness and ungainliness of figure, and sometimes to pronounced prognathism. The women's heads are shaved entirely and the men's into fantastic patterns. Yellow and red ochre mixed with grease are coarsely smeared over the bodies, grey in coarse patterns and white in fine patterns resembling tattoo marks. Tattooing is of two distinct varieties In the south the body is slightly cut by women with small flakes of glass or quartz in zigzag or lineal patterns downwards. In the north it is deeply cut by men with pig-arrows in lines across the body. The male matures when about fifteen years of age, marries when about twenty-six, begins to age when about forty, and lives on to sixty or sixty-five if he reaches old age Except as to the marrying age, these figures fairly apply to women.

The Andamanese are bright and merry companions, keen sportsmen, but when angered, cruel, jealous, treacherous and vindictive and always unstable—in fact, a people to like but not to trust. There is no idea of government, but in each sept there is a head, who has attained that position by degrees on account of some tacitly admitted superiority and commands a limited respect and some obedience. The young are deferential to their elders. Offences are punished by the aggrieved party. Property is communal and theft is recognized only as to things of absolute necessity, such as arrows, pigs' flesh and fire. Fire is the one thing they are really careful about, not knowing how to renew it. The religion consists of fear of the spirits of the wood, the sea, disease and ancestors, and of avoidance of acts traditionally displeasing to them. There is neither worship nor propitiation. Honour is shown to an adult when he dies by wrapping him in a cloth and placing him on a platform in a tree instead of burying him. At such a time the encampment is deserted for three months. The only known weapons are bows, which differ altogether with each group, but the same two kinds of arrows are in general use: (1) long and ordinary for fishing and other purposes; (2) short with a detachable head fastened to the shaft by a thong, which quickly brings pigs up short when shot in the thick jungle. Bark provides material for string, while baskets and mats are neatly and stoutly made from canes and buckets out of bamboo and wood. None of the tribes ever ventures out of sight of land, and they have no idea of steering by sun or stars. The Andaman languages are extremely interesting from the philological standpoint. They are agglutinative in nature, show hardly any signs of syntactical growth though every indication of long etymological growth, give expression to only the most direct and the simplest thought, and are purely colloquial and wanting in the modifications always necessary for communications by writing. The sense is largely eked out by manner and action.

For many years the Andamans have been the scene of a highly organized penal settlement to which life convicts and long-term convicts from India were sent; this was the "transportation" of the Indian penal code. The capital of the settlement is Port Blair, where a chief commissioner resides, in charge of the islands and also of the Nicobar group. He has a staff of assistants and overseers, mostly Europeans, and security is ensured by a small garrison of British and Indian troops and a battalion of Indian military police. The purpose of the settlement is largely reformative. After a period of graduated labour, the well-behaved convict is given a ticket-of-leave and becomes self-supporting. He can live in one of the villages comprised in the settlement, farm, keep cattle, marry if he is single, or send to India for his family; but he must not leave the settlement or be idle. His children

receive elementary education; and there is ample hospital accommodation throughout the settlement. With approved conduct he may be released and sent home after 20 to 25 years of total "transportation"; and throughout that time a quasi-judicial procedure controls any punishments inflicted on him, and he is as sure of justice as if he were free. The total convict population of all grades used to be in the neighbourhood of 12,000. Since 1921, however, transportation has ceased; and the gradual abandonment of the settlement has been decided upon. In 1926 the convict population had fallen to just under 8,000. The many self-supporting convicts cannot well be transferred to imprisonment in India; and there is also a large free-born population who have made the islands their home; so that the policy is to extend the occupation of the islands for agricultural purposes on a voluntary basis. Good-conduct prisoners in the Indian jails will be allowed to transfer to the Andamans and take their families with them. A number of returned emigrants from Natal have elected to settle in the islands; and a batch of Karens have come over for forest work. The ticket-of-leave system has been extended, and grants of land with occupancy rights are being given. The area under cultivation has more than doubled since 1921, and exceeded 72,000ac. in 1926. There are 18 schools in the settlement, and the attendance in 1926 included 228 children of convict parents.

HISTORY

Andaman first appears distinctly in the Arab notices of the 9th century. But it seems possible that the *Agathou daimonos nēsos* (Good Spirit Island) of Ptolemy was really a misunderstanding of some form like *Agdamán.* The islands are briefly noticed by Marco Polo (who probably saw without visiting them), under the name *Angamanain,* seemingly an Arabic dual, "The two Angamans," with the exaggerated but not unnatural picture of the natives, long current, as dog-faced Anthropophagi Another notice occurs in the story of Nicolo Conti (*c.* 1440), who explains the name to mean "Island of Gold," and speaks of a lake with peculiar virtues as existing in it. The name is probably derived from the Malay *Handuman,* coming from the ancient *Hanuman* (monkey). Later travellers repeat the stories, too well founded, of the ferocious hostility of the people In Sept 1789 Captain Blair, acting under instructions from the Government of Bengal, established a penal colony, associated with a harbour of refuge on Chatham Island, in the south-east bay of the Great Andaman, now called Port Blair, but then Port Cornwallis Two years later, urged by Admiral Cornwallis, the Government transferred the colony—together with its name of Port Cornwallis—to the north-east part of Great Andaman, where a naval arsenal was to be established. But the scheme did ill; and in 1796 the Government put an end to it In 1839, Dr. Helfer, a German savant employed by the Indian Government, was attacked and killed in the islands In 1844 the troop-ships "Briton" and "Runnymede" were driven ashore there. The natives showed their usual hostility, killing all stragglers. Outrages on shipwrecked crews continued so frequent that the question of occupation was revived, and in 1855 a project was formed for a settlement and a convict establishment. This scheme was interrupted by the Indian Mutiny of 1857, but as soon as the revolt was broken, it became more than ever urgent to provide such a resource, on account of the great number of prisoners falling into British hands. Lord Canning, therefore, despatched in Nov. 1857 a commission, headed by Dr. F. Mouat, to examine and report. The commission reported favourably, selecting as a site Blair's *original* Port Cornwallis, but avoiding the vicinity of a salt swamp which seemed to have been pernicious to the old colony. To avoid confusion, the name of *Port Blair* was given to the new settlement, which was established in the beginning of 1858. For some time sickness and mortality were excessively large, but the reclamation of swamp and clearance of jungle on an extensive scale by Col. Henry Man (1868–70) was ultimately successful. The Andaman colony obtained a tragic notoriety from the murder, by a Mohammedan convict, of the viceroy, the earl of Mayo, when on a visit to the settlement on Feb. 8, 1872. In the same year the two groups, Andaman and Nicobar—the occupation of the latter having been forced on the British Government in 1869 by the continued outrages upon vessels—were united under a chief commissioner residing at Port Blair. Since that time the Islands have been continuously used as a convict settlement. The penal settlement however is being gradually discontinued, the islands being left to develop on free lines.

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ANDAMENTO (Ital.), a musical term signifying the longer and more extended type of fugal subject, as distinguished from that of the shorter and more compact kind, or soggetto, consisting of a single brief theme. By German writers however the term is more often applied, not to a fugue's subject matter, but to its episodes—another instance of the confusion of practice so often prevailing in the case of musical terminology

ANDANTE, a musical term to indicate pace, coming between *adagio* and *allegro;* it is also used of an independent piece of music or of the slow movement in a sonata, symphony, etc. The diminutive form *andantino* is used, confusingly enough, to signify both less slow and less fast.

ANDAQUIAN, a small independent linguistic stock of South American Indians, so called from the Andaquis, its most important tribe. The Andaquis live on the eastern slope of the Cordillera Oriental in southern Colombia, on the Fragua and Orteguaza rivers, which form the sources of the Caqueta They are said to have formerly lived on the western slope of the range, on the headwaters of the Magdalena and between it and the Suaza In this region the remarkable ruins of San Augustin are located The Andaquis are a warlike folk, and are but little known

See M. M. Albis, *Los Indios del Andaqui* (Popayan, 1855).

ANDERIDA, an ancient Roman fort at Pevensey, near Eastbourne in Sussex (England), built about A.D. 300 as part of a scheme of land-defence against Saxon pirates; repaired probably by Stilicho, about A.D. 400; and utilized by William the Conqueror for a Norman castle. Its massive Roman enceinte still stands but little damaged.

ANDERMATT, a Swiss health resort and centre for winter sports, lying at a height of 4,700ft at the foot of the Gurschen, in the Urseren valley. The settlement is first mentioned in the 14th century, but remained unimportant until the opening of the St. Gotthard railway from Lucerne to Milan in 1882 It now ranks among the most famous Alpine resorts. Andermatt is also the chief military station of the St. Gotthard pass in one of the most elaborately fortified valleys in Europe.

ANDERNACH, a town in Rhenish Prussia, Germany, on the left bank of the Rhine, 10m. N.W. of Coblenz. Pop. (1925), 10,790. *Antunnacum,* the Roman frontier station, was founded by Drusus. In 1109, Andernach received civic rights; in 1253 it joined the confederation of the Rhine cities, and was the most southern member of the Hanseatic league. In 1794, Andernach passed to France, but in 1815 was ceded, together with the left bank of the Rhine, to Prussia. It possesses old walls, a Romanesque parish church (12th century), a watch tower on the river and a Renaissance town hall. A famous crane, for lading merchandise, dates from 1554. Mat-making is one of the chief industries, and millstones of the local lava and tufa are exported. This product was much used by the Dutch in the construction of their dykes.

ANDERSEN, HANS CHRISTIAN (1805–1875), Danish poet and fabulist, was born at Odense, in Fünen, on April 2, 1805. He was the son of a sickly young shoemaker of 22 and his still younger wife; the whole family lived and slept in one little room. Andersen very early showed signs of imaginative temperament, which was fostered by the indulgence and superstition of his parents. In 1816 the shoemaker died and the child was left entirely to his own devices. He ceased to go to school; he built himself a little toy-theatre and sat at home making clothes for

his puppets and reading all the plays that he could borrow; among them were those of Holberg and Shakespeare. At Easter 1819 he was confirmed at the church of St. Knud, Odense, and began to turn his thoughts to the future. It was thought that he was best fitted to be a tailor; but as nothing was settled, and as Andersen wished to be an opera-singer, he took matters into his own hand and started for Copenhagen in Sept. 1819. There he was taken for a lunatic, snubbed at the theatres, and nearly reduced to starvation; but he was befriended by the musicians Christoph Weyse and Siboni, and afterwards by the poet Frederik Hoëgh Guldberg (1771–1852). His voice failed, but he was admitted as a dancing pupil at the Royal Theatre. He grew idle and lost the favour of Guldberg, but a new patron appeared in the person of Jonas Collin, the director of the Royal Theatre, who became Andersen's life-long friend. King Frederick VI. was interested in the strange boy and sent him for some years, free of charge, to the great grammar-school at Slagelse. Before he started for school he published his first volume, *The Ghost at Palnatoke's Grave* (1822). Andersen, a very backward and unwilling pupil, actually remained at Slagelse and at another school in Elsinore until 1827; these years, he said, were the darkest and bitterest in his life. Collin at length consented to consider him educated, and Andersen came to Copenhagen. In 1829 he made an appreciable success with a fantastic volume entitled *A Journey on Foot from Holman's Canal to the East Point of Amager,* and he published in the same season a farce and a book of poems. He thus suddenly came into request at the moment when his friends had decided that no good thing would ever come out of his early eccentricity and vivacity. He made little further progress, however, until 1833, when he received a small travelling stipend from the king and made the first of his long European journeys. At Le Locle, in the Jura, he wrote *Agnate and the Merman;* and in Oct. 1834 he arrived in Rome. Early in 1835 Andersen's novel, *The Improvisatore,* appeared and achieved a real success; the poet's troubles were at an end at last. In the same year, 1835, the earliest instalment of Andersen's immortal *Fairy Tales* (Eventyr) was published in Copenhagen. Other parts, completing the first volume, appeared in 1836 and 1837. The value of these stories was not at first perceived, and they sold slowly. Andersen was more successful for the time being with a novel, *O.T.,* and a volume of sketches, *In Sweden;* in 1837 he produced the best of his romances, *Only a Fiddler.* He then turned his attention, with but ephemeral success, to the theatre, but was recalled to his true genius in the charming miscellanies of 1840 and 1842, the *Picture-Book without Pictures* and *A Poet's Bazaar.* Meanwhile the fame of his *Fairy Tales* had been steadily rising; a second series began in 1838, a third in 1845. Andersen was celebrated throughout Europe, although in Denmark itself there was still some resistance to his pretensions. In June 1847 he paid his first visit to England and enjoyed a triumphal social success; when he left, Charles Dickens saw him off from Ramsgate pier. After this Andersen continued to publish much; he still desired to excel as a novelist and a dramatist, which he could not do, and he still disdained the enchanting *Fairy Tales,* in the composition of which his unique genius lay. Nevertheless, he continued to write them, and in 1847 and 1848 two fresh volumes appeared. After a long silence Andersen published in 1857 another romance, *To be or not to be.* In 1863, after a very interesting journey, he issued one of the best of his travel-books, *In Spain.* His *Fairy Tales* continued to appear, in instalments, until 1872, when, at Christmas, the last stories were published. In the spring of that year Andersen had an awkward accident, falling out of bed and severely hurting himself. He was never again quite well, but he lived till Aug. 4, 1875, when he died very peacefully in the house called Rolighed, near Copenhagen.

BIBLIOGRAPHY.—Collected editions of Andersen's works were published in Copenhagen in 33 vols. (1854–79) and in 15 vols. (1876–80). The fairy tales were translated into nearly every European language, and the English editions are very numerous. For his life, *see* his autobiography, *The Story of My Life* (1855; Eng. trans., 1871), and R. N. Bain, *Hans Christian Andersen, a Biography* (1895). (E. G.)

ANDERSEN, HANS NIELS (1852–), Danish shipowner and merchant, was born at Nakskov in poor circumstances. He went to sea and in 1884, having gained experience by trading with the East, he founded the business of Andersen and Co., at Bangkok, opening in 1894 a branch house in Copenhagen. In 1897 he established at Copenhagen Det Oestasiatiske Kompagni (The East Asiatic Company) which soon became the largest commercial enterprise in Denmark and one of the few Danish undertakings of world-wide renown. In 1912 at Copenhagen, the company launched the first large motor-ship. Owing to his powers of administration and his extensive connections throughout the world he rendered important services to his country during the World War.

See A. Fraenkel, *Verden med dansk Maal eller Danmark med Verdensmaal* (1916).

ANDERSON, ADAM (1692–1765), Scottish economist, was born in 1692, and died in London on Jan. 10 1765. He was a clerk for 40 years in the South Sea House, where he published a work entitled *Historical and Chronological Deduction of the Origin of Commerce from the Earliest Accounts to the Present Time, containing a History of the Great Commercial Interests of the British Empire* (1762).

ANDERSON, ALEXANDER (*c.* 1582–1620?), Scottish mathematician, was selected by the executors of Franciscus Vieta to revise and edit his manuscript works.

ANDERSON, ALEXANDER (1775–1870), pioneer American wood engraver, was born in New York city on April 21, 1775, the son of a printer. At the age of 12 he made his first attempts at engraving without instruction by observing the work of jewellers and other artisans. Among his earliest efforts were copies of anatomical figures in medical works cut with a pocket-knife in plates made by rolling out pennies. In 1789, in compliance with his father's desire, he began the study of medicine and continued until he graduated at the medical department of Columbia college in 1796. But throughout this period he maintained an active interest in engraving. In 1793, upon seeing wood engravings by Thomas Bewick (*q.v.*), he obtained boxwood blocks, designed his own tools, and produced the first wood engravings made in the United States. In 1794 he illustrated with wood engravings the book entitled *Looking Glass for the Mind.* Upon the loss of his entire family from yellow fever in 1798, he withdrew from medical practice and devoted himself entirely to engraving. At first he used both metal and wood, but after 1820 he confined his work almost exclusively to wood engravings. He illustrated numerous books, chiefly after English originals, and produced during his long life an enormous volume of work. At the age of 93 he cut a series of pictures for Barker's *Historical Collection of New Jersey.* He was also a skilled miniature painter and executed numerous portraits. Among his most widely known productions are the illustrations for Webster's *Elementary Spelling Book;* engravings for Shakespeare's plays; Holbein's *Dance of Death,* published as *Emblems of Mortality,* and some 300 cuts for Bewick's *Quadrupeds.* Entirely self-taught, he became the "father of wood engraving in the United States." He died in Jersey City, N.J., on Jan. 18, 1870.

See B. J. Lossing, *Memorial Address on Alexander Anderson* (1872), and F. M. Burr, *Life and Works of Alexander Anderson* (1893).

ANDERSON, SIR EDMUND (1530–1605), English lawyer, descended from a Scottish family settled in Lincolnshire, was born in 1530 at Flixborough or Broughton in that county. He took part in all the leading state trials which agitated England during the latter years of Elizabeth's reign. Though a great lawyer and thoroughly impartial in civil cases, he was notorious for his excessive severity and harshness when presiding over the trials of catholics and nonconformists; especially in those of Sir John Perrot, Sir Walter Raleigh, and John Udall the puritan minister. Anderson was also one of the commissioners appointed to try Mary queen of Scots in 1586. He died on Aug. 1, 1605, at Eyworth, Bedfordshire.

ANDERSON, ELIZABETH GARRETT (1836–1917), English physician, and pioneer in the professional education of Englishwomen, daughter of Newson Garrett, of Aldeburgh, Suffolk. She was born in 1836, and was educated at home and at a private school. In 1860 she resolved to study medicine, an un-

heard-of procedure for a woman in those days, and one which was regarded by old-fashioned people as almost indecent. Miss Garrett managed to obtain some more or less irregular instruction at the Middlesex hospital, London, but was refused admission as a full student there and at many other schools to which she applied. Finally she studied anatomy privately at the London hospital, as well as with some of the professors at St. Andrews University, and at the Edinburgh Extra-Mural school. She had no less difficulty in gaining a qualifying diploma to practise medicine. London University, the Royal Colleges of Physicians and Surgeons and many other examining bodies refused to admit her to their examinations; but in the end the Society of Apothecaries, London, allowed her to enter for the License of Apothecaries' Hall, which she obtained in 1865. In 1866 she was appointed general medical attendant to St. Mary's dispensary, a London institution started to enable poor women to obtain medical help from qualified practitioners of their own sex.

The dispensary soon developed into the New Hospital for Women, and there she worked for more than 20 years. In 1870 she obtained the Paris degree of M D. In 1871 she married J. G. S. Anderson (d. 1907), a London shipowner, but did not give up practice. She worked steadily at the development of the New Hospital, and also from 1874 at the creation of a complete school of medicine for women in London. London University admitted women to the medical degrees from 1877 onwards. Both institutions have since been suitably housed and equipped, the New Hospital, now the Elizabeth Garrett Anderson Hospital, being worked entirely by medical women, and the schools (in Hunter street, W C.). In 1897 E. Garrett Anderson was elected president of the East Anglian branch of the British Medical Association. In 1908 she was elected (the first woman) mayor of Aldeburgh. The movement for the admission of women to the medical profession, of which she was the indefatigable pioneer in England, has extended to every civilized country. She died at Aldeburgh, Suffolk, Dec. 17 1917. Her son, Sir Alan Garrett Anderson (b. 1877), shipowner, has been a director of the Bank of England and vice-president of the International Chamber of Commerce. Her daughter, Dr. Louisa Garrett Anderson (b. 1873), continued her mother's work for the advancement of women. She took an active part in the suffrage movement. During the war she was joint organizer of the Women's Hospital Corps and (1915–18) chief surgeon of the military hospital at Endell street.

There is an excellent account of Mrs. Garrett Anderson's early struggles to secure a place in the medical profession in Barbara Stephen's *Emily Davies and Girton College* (1927), in which many of Miss Garrett's letters are given. But the most important source is her sister Dame Millicent Fawcett's autobiography, *What I remember* (1924).

ANDERSON, JAMES (1662–1728), Scottish genealogist, antiquary and historian, was born at Edinburgh on Aug. 5, 1662. Just before the union the Scottish parliament commissioned him to prepare for publication what remained of the public records of the kingdom. The work was not completed at his death in 1728. The book was published posthumously in 1739, edited by Thomas Ruddiman, under the title *Selectus Diplomatum et Numismatum Scotiae Thesaurus*. Soon after his death, the numerous plates, engraved by Sturt, were sold for £530. These plates are now lost and the book has become exceedingly scarce. Anderson died on April 3, 1728

ANDERSON, JOHN (1726–1796), Scottish natural philosopher, born at Roseneath, Dumbartonshire, was a professor of natural philosophy in the University of Glasgow. He devoted himself particularly to the application of science to industry, instituting courses of lectures intended especially for artisans, and he bequeathed his property for the foundation of Anderson's College, now merged in the Glasgow and West of Scotland Technical College. He died in Glasgow on Jan. 13 1796. His *Institutes of Physics,* published in 1786, went through five editions in ten years.

ANDERSON, MARY (1859–), American actress, was born in Sacramento (Calif.), on July 28, 1859. Her father, an officer in the Confederate service in the Civil War died in 1863. She was educated in various Roman Catholic institutions, and at the age of 15, with the advice of Charlotte Cushman, began to study for the stage, making her first appearance, at the age of 16, in Louisville (Ky.) as Juliet, in 1875. Her remarkable beauty created an immediate success, and she played in all the large cities of the United States with increasing popularity. Between 1883 and 1889 she had several seasons in London, and was the Rosalind in the performance of *As You Like It* which opened the Shakespeare Memorial theatre at Stratford-on-Avon. Among her chief parts were Galatea (in W. S. Gilbert's *Pygmalion and Galatea*), Clarice (in his *Comedy and Tragedy,* written for her), Hermione, Perdita, Lady Macbeth and Ion (in Noon Talfourd's *Ion*). In 1889 she retired from the stage and in 1890 married Antonio de Navarro, and settled in England.

See William Winter's *Stage Life of Mary Anderson* (1886), and her own *A Few Memories* (1896).

ANDERSON, RICHARD HENRY (1821–1879), American soldier, was born in South Carolina on Oct. 7, 1821. He graduated at West Point in 1842, and won the brevet of first lieutenant in the Mexican War, becoming first lieutenant in 1848 and captain in 1855, and took part in the following year in the Kansas troubles. At the outbreak of the Civil War in 1861 he entered the Confederate service as a brigadier general, being promoted major general in August 1862 and lieutenant general in May 1864. Except for a few months spent with the army under Bragg in 1862, Anderson's service was wholly in the Army of Northern Virginia. Under Lee and Longstreet he served as a divisional commander in nearly every battle from 1862 to 1864, winning special distinction at Chancellorsville and Gettysburg. When Longstreet was wounded at the battle of the Wilderness, Anderson succeeded him in command of the 1st corps, which he led thereafter. His services at the battle of Spottsylvania (*q.v.*) were most important. He remained with the army as a corps commander to the close of the war, after which he retired into private life. He died at Beaufort (S.C.), on June 26, 1879.

ANDERSON, ROBERT (1750–1830), Scottish author and critic, was born at Carnwath, Lanarkshire, Jan. 7 1750, and died at Edinburgh Feb. 20 1830. His principal work was his edition of *The Works of the British Poets, with Prefaces Biographical and Critical* (1792–1807).

ANDERSON, SIR ROBERT ROWAND (1834–1921), British architect, was born at Forres in 1834, the son of a solicitor. He died in Edinburgh on June 1 1921. He was educated at Edinburgh and entered the Royal Engineers, where he received his first training as a draughtsman. His first important work was his successful design for the Edinburgh Medical Schools (1875), and this was followed by a succession of important commissions, including the Conservative club, Edinburgh (1883), the dome of Edinburgh University (1886) and the Scottish National Portrait Gallery (1886–88) He also successfully carried out a series of restorations of Scottish cathedrals, including those of Dunblane cathedral, Paisley abbey, Culross abbey and the interior of Dunfermline abbey. In 1901 he was selected to superintend the alterations which were being carried out at Balmoral Castle; in 1902 he was knighted.

ANDERSON, SHERWOOD (1876–), American author, was born in Camden, O , Sept. 13 1876 His family was poor and his education meagre. After trying various occupations he went to Chicago, where he worked with an advertising agency. His first novel was *Windy McPherson's Son* (1916). In 1921 he was awarded the *Dial* prize of $2,000. He has since published several novels, *Marching Men* (1917), *Poor White* (1920), *Many Marriages* (1922) and *Dark Laughter* (1925); short story collections, *Winesburg, Ohio* (1919), *The Triumph of the Egg* (1921) and *Horses and Men* (1923); a book of Whitmanesque verse, *Mid-American Chants* (1918); the autobiographical *Tar—A Mid-West Childhood* (1926) and *A Story Teller's Story* (1924); and *Sherwood Anderson's Notebook* (1926). After devoting himself for a number of years solely to creative writing he bought several country papers in Virginia and became an editor.

Mr. Anderson's fiction, psychological in interest and sombre

in tone, is striking as an attempt to express the evolution and inarticulate longings of industrial America.

BIBLIOGRAPHY.—*See* biographical and critical articles by Paul Rosenfeld and R. M. Lovett in the *Dial*, Jan. 1922, and "Sherwood Anderson, Corn-Fed Mystic, Historian of the Middle Age of Man," in Harry Hansen's *Mid-West Portraits* (1923).

ANDERSON, a city in the north-western part of South Carolina, U.S.A.; the county seat of Anderson county. It is on four transcontinental highways, and is served by the Blue Ridge, the Charleston and Western Carolina, and the Piedmont and Northern (electric) railways. Between 1900 and 1910 the population increased from 5,498 to 10,570, of whom 3,030 were negroes. Anderson is the centre of important cotton manufactures. Hydro-electric power is available in practically unlimited amounts. In the city and county there are 20 textile plants, representing an investment of $25,000,000; with an aggregate of about 700,000 spindles and 15,000 looms; manufacturing print cloths, sheets, outing flannels, dress goods, pyjama checks, lawns, ducks, shirtings, drills, twills, fine combed and coarse yarns. The city has in addition 50 or 60 diversified manufacturing plants.

Anderson was settled in 1827. Anderson college for women, a Baptist institution, was established in 1910. About 16m. N.W. is Clemson agricultural college, on the Fort Hill homestead of John C. Calhoun, which, with other property, was bequeathed to the State for the purpose by Thomas G. Clemson (1807–88), the husband of Calhoun's daughter, Anna Maria. The college was opened in 1893; in 1926–27 it had an enrollment of 1,180. The students live in barracks, under military discipline, and wear a uniform. An infantry unit of the Reserve Officers' Training Corps is maintained by the war department.

ANDERSON, a city of Indiana, U.S.A., on the west fork of the White river, about 38 m. N.E. of Indianapolis, in a rich wheat and corn-producing region; the county seat of Madison county. It is served by the Big Four and the Pennsylvania railways, by the Central Indiana (for freight only) and by the Union Traction Company of Indiana (electric). The population (95% native white) was 29,767 in 1920: estimated locally at 41,000 in 1927.

Its importance as a manufacturing centre dates from the discovery of natural gas in the vicinity in 1887. In 1927 it had about 100 factories, manufacturing 140 different products. One plant has 6,800 employés. The principal manufactures are automobile generators, starters and horns; playground equipment; corrugated boxes and shipping cartons; nails, wire, files, shovels, wire fencing, floor tile, asphalt roofing, stoves, oil engines, bed and auto-seat springs; silicate of soda; house dresses, aprons and lodge regalia. Large quantities of religious literature are issued by a publishing company. The property valuation is $33,290,275. Over 9,000 families own their homes. Anderson was founded in 1812 on the site of an Indian village. It was incorporated in 1865.

ANDERSONVILLE, a village of Sumter county, Georgia, U.S.A., on the Central of Georgia railway, about 6om. S.W. of Macon. The population in 1920 was 196. From Nov. 1863 until the close of the Civil War a Confederate military prison was maintained in an open stockade of 26½ac. near the village. The sufferings of the prisoners—from congestion, insufficient food, exposure, pollution of the water supply, and disease—were terrible. Of the 49,485 prisoners received during the war, about 13,000 died. After the war the superintendent, Henry Wirz, was tried by a court-martial and hanged (Nov. 10, 1865). The prisoners' burial ground was made a national cemetery. It contains 13,737 graves, of which 1,040 are marked "unknown."

There is an impartial account of the Andersonville prison in James F. Rhodes, *History of the United States* (1904), vol. v. The partisan accounts are numerous; *see*, for instance, A. C. Hamlin, *Martyria; or, Andersonville Prison* (Boston, 1866); and R. R. Stevenson, *The Southern Side; or Andersonville Prison* (Baltimore, 1876).

ANDES, the name applied to the great mountain system which extends the full length of the western part of South America. The origin of the name is obscure. It has been suggested that it is derived from *anti*, the *Quechua* word for east, a name applied by the Quechua Indians to the range east of Cuzco. Other suggested origins of the name are the Quechua words *antasuya*, region of metal, or *anta*, copper. The term "Cordillera of the Andes" is sometimes erroneously used as a name for the whole Andean system, and in South American nomenclature is often applied to the most important range of a given section of the system. From its original form, "Las Cordilleras de los Andes," a term applied by the Spanish conquerors to the series of parallel ranges of which the Andes appeared to be composed, is derived the present widespread use of the word "cordillera," meaning an extensive mountain range or system of ranges.

The Andes are narrowest at the southern end and broadest in the central or Bolivian section and at their northern end, where they divide into four distinct ranges. In Tierra del Fuego their trend is nearly east and west; on the mainland the trend is north and south as far north as Lat. 18° S., where, in one of its two broadest sections, the system turns westward to form an almost semi-circular curve convex to the west and follows the configuration of the west coast as far north as southern Colombia. There it spreads out into three distinct ranges, the easternmost of which again divides into two ranges, one of which forms the northern section of the Venezuela-Colombia boundary while the other crosses the boundary south of Lake Maracaibo and extends northeastward toward the Caribbean sea.

The Patagonian Andes.—Until recently the dominating feature of the entire Andean system was pictured as a great mountain barrier, with a well-defined crest line of lofty peaks which coincided with the water-divide between the Pacific and Atlantic drainage systems, and effectively separated them from each other. As late as 1881, when the Governments of Chile and the Argentine republic signed a treaty in which their common boundary was defined, they described it as following the highest crest of the Andes, which formed the water-divide between the Atlantic and Pacific oceans. When the demarcation of this boundary was undertaken it was found that throughout the greater part of the cordillera the topography did not correspond to the conception of it on which the treaty was based. South of lat. 38° S. the Andes were found to be, not a simple ridge, but a broad zone, from 25 to 40m. wide, of mountain chains and narrow valleys. The higher summits shift back and forth from one chain to another and do not, except in a general way, mark the water-divide. These summits rise above a broad base, represented by high valleys and broad passes, to an average elevation of about 6,500 feet. Few are lower than this average altitude, and only individual peaks exceed



AFTER AN ENGRAVING FROM A CONFEDERATE PHOTOGRAPH IN "MARTYRIA," 1866

ANDERSONVILLE PRISON WITH THE QUAGMIRE AND CROWDS OF HUTS AND MEN BEYOND. OWING TO THE TERRIBLE CONDITIONS PREVAILING THERE 13,000 OF THE 49,000 PRISONERS ADMITTED DURING THE CIVIL WAR DIED OF HUNGER, EXPOSURE AND DISEASE

7,500 feet. Those which have a fairly uniform altitude have been carved by erosion from the older Andean rocks of the plateau-like base. The higher peaks are volcanic cones built up on the plateau. The eastern side of this part of the Andes is divided into two sections—a northern from Lake Aluminé to Lake Nahuel Huapi, and a southern from Lake Nahuel Huapi southward, which includes the island of Tierra del Fuego. Both sections are characterized by a succession of glacier-fed lakes which stretch back like fiords into the heart of the cordillera, and by valleys cut from west to east across the Patagonian tableland through which, at one time, the lakes drained toward the Atlantic.

In the northern section high transverse ridges separate the lake basins and more or less effectively obstruct passage from one to another. These ridges connect the mountain zone with the Patagonian tableland, and all but one of the streams of this section rise in the westernmost range and flow eastward to the Colloncura and Limay rivers. Lake Lacar now discharges across the western range to the Chilean lake region, but there is evidence that it, too, once drained to the Atlantic.

In the southern section the tableland is separated from the cordillera by a longitudinal depression which marks the line of contact between the folded cordillera and the flat tableland and extends southward from the low pass between Lake Nahuel Huapi and Lake Bariloche and is continued beyond the mainland by the Canal Ancho of the Straits of Magellan, Useless bay, and Whiteside and Admiralty sounds. The continuity of this depression has, however, been frequently exaggerated. It is really divided into several compartments by masses of different kinds of rocks and by granite ridges. Between Lake Argentina and Lake Buenos Aires it is interrupted by the tableland which rises to a height of 5,000ft and butts against the cordillera. Similarly between Lake Buenos Aires and Lake General Paz there is no great difference in level between the tableland and the depression.

Most of the lake basins here, as well as in the northern section, are continued eastward across the Patagonian tableland as distinct valleys. This is the case even in the submerged southern end of the depression, where the east end of the Straits is a submerged valley on the axis of Otway Water and Useless bay and is continued eastward across northern Tierra del Fuego by the depression which ends in the Bay of San Sebastian. The valleys are now, however, with few exceptions, dead valleys, for the drainage is mostly west to the Pacific by way of narrow canyons in the cordillera and the interoceanic water-divide follows the terminal moraines of the old glaciers which confine the lakes on the east.

On the Pacific side of the cordillera a great longitudinal plain extends from the Chacabuco range, by which the basin of the Aconcagua river is enclosed on the south, southward to the Gulf of Ancud. The northern part of this region is narrow and irregular and is cut by ridges into small, almost completely separated valleys, and interrupted by isolated hills. At about lat. 36° S it widens out to a width of 20 to 40 miles. A line of recent volcanoes begins a little south of Santiago and is alined on the cordillera to about 35° S. lat., where it gradually departs from the cordillera until in the south it stands well out in the central plain and forms a less continuous but higher chain west of the cordillera proper. The northern part of the plain is filled with recent geological deposits and forms the fertile "Vale of Chile." South of lat. 39° S. it is sown with glacial lakes or depressions formerly occupied by lakes. Not only because of the greater precipitation on the west side of the cordillera in the belt of the westerly winds south of lat. 39° S, but also because of the great condensation of moisture caused by the line of volcanoes in front of the cordillera, the glaciers of the Glacial period advanced much farther from the water-divide on the western slope than on the eastern, with the result that the glacial lakes on the Chilean side of the cordillera are at a much lower level than those on the Argentine side, and part of them, as, for instance, Ranco and Lanquihue, lie completely separated from the cordillera.

The cordillera of Patagonia is divided into a series of massifs separated by longitudinal and transverse depressions. Some of these depressions cut completely through the cordillera and are occupied by rivers which drain lakes on the Argentine side, or by fiords which extend through to the Argentine side. Between 41° and 46° S. lat. the altitude of these massifs is from 6,500 to 8,000ft., only Troncador (11,000ft.) attaining a higher altitude. Between 46° and 50° the cordillera reaches altitudes of from 10,000 to 13,000 feet. It is lower and broken up between Smith channel and the Straits of Magellan, but again rises to more than 6,500ft. on Tierra del Fuego.

South Chilian Andes.—Northward from lat. 39° S. to lat. 30° S. the character of the Andes is greatly simplified. It consists of a double line of crests, the westernmost of which carries the Argentine-Chile boundary. The high valleys between the crests are at an altitude of from 10,000 to 13,000 feet. The passes to the east and west in the northern part are between 13,000 and 15,000ft. in altitude. South of lat. 31° S. they are somewhat lower. Isolated summits rise from 5,000 to 7,000ft. above the high valleys, and between 32° and 34° S. lat. include three of the highest peaks of the Andes: Mecedario (21,870ft), Aconcagua (22,830ft), Tupungato (21,810ft). The interior valleys have a direction slightly oblique to the general trend of the cordillera and corresponding to the direction of the folds. The whole section has effective drainage of normal type. The water-divide which the boundary follows shifts back and forth from one ridge to another, and the boundary pillars, which are located, in general, on high passes between headwaters, follow a tortuous line Eruptions from the chain of recent volcanoes which appears a little south of the latitude of Santiago and extends southward on the Pacific side of the main axis of the cordillera to the Gulf of Ancud have greatly complicated the topography of the cordillera by filling up high valleys or damming up lakes.

East of the cordillera in this section a continuous depression extends northward from the Mendoza river for more than 160m. between the cordillera and the pre-cordillera (a series of short ranges reaching out into the Argentine plain and formed by a north-south alinement of narrow crests of Silurian limestones between sandstones and metamorphosed Devonian schists). The pre-cordillera continues south of the Mendoza river to about latitude 36° S. It attains heights of 13,000ft in the latitude of San Juan and 11,000 on the Paramillo plateau above Mendoza. In spite of their narrow width the Andes in this section offer serious obstacles to movement from one side to the other because of their elevation and covering of snow. They have no mineral wealth and the few routes across them, which include the Transandine railway between Santiago and Mendoza, are solely for the purpose of crossing the cordillera and not for exploiting its subsoil. The high valleys furnish some summer pasture and the rivers and lakes afford water for irrigation Settlements lie not in the mountains but on their border, and the location of the more important of those on the Argentine side has been influenced by the position of the most practicable passes, since it is to cattle and goods trade with Chile that they owe their origin and growth.

The Puna de Atacama.—North of lat. 30° S. the Andes again lose their simple character. The mountain belt widens and long extensions of it reach out south-eastward to the Argentine plain, enclosing in the depressions between them long embayments of the plain At about the 28th parallel the main range divides into a western and an eastern range, with a belt of very high and extremely cold and desolate country between them (called the Puna de Atacama), made up of mountain chains, isolated peaks, and basins of salt deposits known as salars, arranged along dominating north-south lines. The average height of the basin floors of the Puna is between 11,000 and 13,000ft, with the interior peaks and ridges rising only from 1,000 to 5,000ft. higher. The range which forms the western border of the Puna is known as the Cordillera de Los Andes or Maritime cordillera and consists chiefly of a line of high volcanoes with lava flows between them. The passes in the Maritime cordillera average about 15,000ft. while the peaks reach 20,000 to 23,000 feet. In the range which forms the eastern border of the Puna the passes are from 16,500 to 17,000ft. high, but the peaks average only from 18,000 to 20,000 feet. In contrast with the western cordillera in which the volcanic cones are high and have been built up on a lower basement of lava, the cones of the eastern cordillera are low and have been built up on broad beds of lava. West of the western cordillera is a line of depressions between 3,000 and 4,000ft. lower than the average level of the Puna and enclosed on the west by the Cordillera Domeyko which contains a number of salars, among them the Salar de Atacama and the Salar de Punta Negra.

East of the eastern border of the Puna, the Andes of the Argentine provinces of Jujuy, Salta and Tucuman form a broad belt of ridges oriented from north to south and separated by deep depressions. Their altitudes diminish as they extend eastward into the Argentine plains, and their summits, as well as those of

the secondary ranges along the main mountains, exhibit an older aspect than their ravined borders. The tops and high upper slopes are covered with grass. The steep headwater slopes and narrow declivities of the ravines, cut into them as the result of recent uplift, are youthful features in contrast to the lawn-like high-level slopes which they are gradually invading.

The Central Andes.—The northern limit of the Puna de Atacama is a transverse range of high snow-capped peaks and ridges at about the 23rd parallel, which separates it from the drainage basin of the Salar de Uyuni. The high plateau continues northward as the *altiplano* or *altoplanicie* of Bolivia. This *altiplano* has no outlet to the sea, and is therefore one of the world's great basins of interior drainage. It is about 500m. long by 100m. wide, and slopes gently from a little over 12,500ft. at Lake Titicaca to slightly more than 12,000ft. at Lake Poopo, and a little lower at the Salar de Uyuni. It differs from most interior drainage basins in that it contains a large body of fresh water (Lake Titicaca) and an important river drainage (the Desaguadero river). Lake Titicaca is the highest large body of navigable water in the world and has a length of about 125 miles. It owes its existence to a deep tectonic depression in close proximity to a high snow-capped mountain range (the Cordillera Real) that keeps it supplied with water. Farther south the *altiplano* becomes more and more like other interior semi-deserts, for the windward mountains become lower, so that they condense less moisture, and broader, so that the precipitation is more widely distributed. As it flows southward, the Desaguadero river, the outlet of Lake Titicaca, grows smaller and smaller until Lake Poopo, into which it empties, is a shallow pond with only a small overflow to the nearby salt lake or marsh called Coïpasa. The *altiplano* lies between two great table-lands with superimposed peaks and ranges. Its eastern edge is particularly well-defined by the sharp rise and straight form of the eastern cordillera. The western edge is less clearly defined because of the volcanic debris that has encroached upon it from the western or Maritime cordillera, forming hilly districts of irregular outline. Between the Salar de Coïpasa and the Salar de Uyuni, the *altiplano* is divided into two interior drainage basins by a line of volcanoes and hills which extend from the western cordillera nearly across to the eastern. North of Lake Titicaca the bordering scarps converge in the Nudo de Vilcanota at about 14° S. Lat., and enclose the *altiplano* on the north.

The western cordillera descends by relatively smooth slopes to the coastal deserts of Tarapacá and Atacama, famous for their nitrate deposits, and the desert region of southern Peru. In the rare cases in which its streams permanently reach the piedmont, they furnish water to small but important fields of vegetables and alfalfa. Viewed from the west, the cordillera presents, for long distances a strikingly even skyline, generally the line along which the uplifted peneplane has been warped up to form the highlands, broken only by the summits of the highest volcanoes which stand back toward the *altiplano* or, in places, by volcanoes like El Misti and Tacora, which rise on the western edge of the cordillera. The most recent of these volcanoes, such as El Misti, Tacora and Sajama, are symmetrical cones surmounted by craters; but the greater number are much older than these, and have more or less lost their original form by erosion.

The eastern cordillera, where it borders the *altiplano,* falls into two sections of quite different physiographic aspect. In the northern section the character of the uplifted peneplane has been almost completely destroyed because the concentration of the rainfall in a narrow belt in this region and the relatively steep gradient of the rivers have combined to enable the streams to cut the old surface to pieces, leaving only the lofty snow-clad Cordillera Real standing on a narrow base. The Cordillera Real is a central core of resistant rocks whose superior hardness and greater initial elevation have preserved it from the effects of great denudation recognizable all around it. The Cordillera Real is cut between the Nevado de Illimani and the Nevado de Quimza Cruz by the chasm of the La Paz river, a tributary of the Madeira river of the Amazon system, which, by virtue of the enormous condensation of moisture on the eastward slope of the eastern cordillera, has been able to break through this great barrier to the *altiplano;* but the axis of the Cordillera Real extends southward across the La Paz valley through the Nevados de Araca, Quimza Cruz and Vera Cruz, forming a line of heights as definite in trend and structure as the Cordillera Real and continuing its features southward nearly 50 miles.

Northward from Lake Titicaca the western range turns northwestward, while the eastern range, which has already in the Cordillera Real taken a north-westerly trend, turns still further to the west and cuts off the *altiplano* by merging with the western range in a rough mountain mass known as the Nudo de Vilcanota. The Eastern Cordillera, here called the Cordillera de Carabaya, is a lofty snow-capped range separated from the Cordillera Real by a narrow and relatively low divide between the headwaters of the Mapiri river (a tributary of the Beni) and the Lake Titicaca drainage. On the west flank of the Cordillera de Carabaya is a group of glacial lakes in narrow depressions between the spurs of the range. There is no record of any soundings having been made in them, but from descriptions of their deep colouring and the character of the depressions in which they lie, they appear to be among the deepest of the high glacial-fed lakes of the Andes. The Cordillera of Carabaya lowers very rapidly to the north-east to the Amazon plain, and larger tributaries of the Beni cut directly across the lines of low ranges which front it on the east. Farther north, however, the valleys of the tributaries of the Madre de Dios have a longitudinal trend and have cut deep troughs oriented from south-east to north-west like the ridges which separate them.

The Peruvian Plateau.—The Andes of Peru, north from the Nudo de Vilcanota, are usually described as three distinct ranges which merge in the Nudo de Pasco and then continue north again as separate ranges. Recent studies show that they are a single broad plateau from 13,000 to 15,000 ft. high, on which narrow cordilleras rise to 18,000 and 21,000 feet; and that the *nudos* or knots are only gigantic erosion remnants. The Amazon tributaries have cut deep gorges almost to the western edge of the plateau, while the numerous streams of the arid Pacific slope are short and, with the exception of the Rimac and Santa rivers, carry little water as far as the ocean.

The Andes are divided into three natural regions—the *montaña,* the eastern slopes of the Amazon forest; the *sierra,* the temperate regions of the slopes and secondary valleys of the plateau; and the *puna,* cold, monotonous regions in the cordilleras, of vast extent at altitudes of from 10,000 to 15,000 feet. In isolated sections above the *puna* are areas known as *jalcas* which resemble the *paramos* of Colombia and Ecuador. They are covered with a dense, steppe-like vegetation that varies but little from season to season. North-west of the Nudo de Vilcanota is a narrow trough sunk below the level of the plateau to an elevation of 11,000ft., known as the Cuzco valley, from the City of Cuzco which lies at its upper end, on the site of the ancient Inca capital. The trough is 19m. long and is divided into three basins of flat-lying land arranged like the links of a chain. Its bordering rims have an average altitude of 13,500ft, with peaks exceeding 14,500ft, and are cut through in many places by streams leading to the Urubamba and Apurimac rivers. The valley itself is drained by the Huantaney river which flows through the chain of basins and joins the Urubamba through a broad pass in the mountain wall. The most broken section of the Peruvian Andes is between Abancay and Huancayo where the Apurimac, Pachachaca, Pampas and Mantaro rivers have cut deep gorges 6,000ft. and more below the surface of the *puna.* The zone of the interoceanic water-divide is here a gently undulating plateau, with lakes of glacial origin which the recently eroded valleys have not yet reached. The many secondary valleys, such as those of Ayacucho and Lircay, have long been centres of grain cultivation.

From the Huancayo to Cerro de Pasco the plateau is chiefly the basin of the upper Mantaro river. In the Cordillera de Huarochiri through which the Central railway from Lima to Oroya cuts, at an altitude of nearly 16,000ft., on red porphyritic sandstones between crests of dark andesites, the divide rises to elevations of over 17,000 feet. On the western slopes of the Cordillera de Huarochiri are many glacial cirques, and immediately north of the route of the Central railway as it enters the cordillera is a great

cluster of lakes at different levels, still fed by glaciers, which drain into the Rimac river close to the edge of the plateau. East of the crest a network of glaciated valleys with many lakes descends in steps to the Mantaro river. East of the Mantaro a little known range, whose snow-capped summits approach 16,500ft., cuts off the horizon north-east of the plain of Jauja. Its altitude diminishes to the north-west, and north of Tarma no longer carries permanent snow.

The Mantaro river rises at an altitude of about 15,000ft., near the mining town of Cerro de Pasco, in a marshy plain with many shallow lakes. Most of these are only small ponds, but Lake Junin, the largest of them, is about 20m. long. A group of partially glacier-fed lakes close to the main divide, of which Lake Punrún (15m. long) is the largest, also drains to the Mantaro river near the outlet of Lake Junin. The Mantaro flows southeastward in a long limestone gorge to the plains of Jauja and Huancayo. These plains stand at 12,500ft. and 11,600ft. respectively, and together form a depression, 25m. long by 6 to 8m. wide, bordered on both sides by rows of bare hills behind which rise snow-capped ranges. The Mantaro leaves the depression in a deep gorge and swings round in a great bend to the Amazon plain about 80m. below Huancayo. The Cerro de Pasco region, north of the plain of Junin, has been given great importance in descriptions of the Peruvian Andes as a mountain knot in which are merged three distinct cordilleras. In reality it does not exceed the altitude of the *puna* and is only a fragment of the continuous plateau of sandstones and limestones, with occasional crests of andesite, which extends north of the plain of Junin and south between the plains of Junin and Jauja.

From Cerro de Pasco to the Pongo de Manseriche the plateau forms the drainage basin of the Huallaga and the upper Marañón rivers. North-west of Cerro de Pasco the Cordillera de Huayhuash forms the interoceanic divide. The Marañón river flows from a chain of glacier-fed lakes on its north-east flank, while on the same slope, a short distance to the south, are the sources of the Huallaga river. The Huallaga valley is fairly wide as far as the gorge east of Huánuco in which it turns northward toward the Amazon and the valley floors of both the main streams and its tributaries in the plateau are well-irrigated and have a considerable population. Below the Huánuco the Huallaga is a swift-flowing stream, with many rapids and gorges, and flows in a northerly direction through the foothills and low ranges for 180m. before it finally breaks through to the Amazon plain in the gorge or *pongo* of Aguirre, at lat. 6° 30′ S. The Marañón flows in a deep trench and has only a sparse population of Indian communities, which occupy the upper basins of its affluents and occasional sugar plantations at the mouth of the larger tributaries or at rare points where the valley widens.

The Cordillera Blanca, north of the Cordillera de Huayhuash has the same south-east to north-west trend as the latter but stands slightly to the west of its axis. These are both lofty snow-capped ranges with elevations that may be classed among the highest of the whole Andean highland, Cerro Carnicero in the Cordillera de Huayhuash being 21,760ft. high, and Cerro Huascarón in the Cordillera Blanca 22,180 feet. The valley of the Santa river (known as the Callejón de Huaylas) which separates the Cordillera Blanca from the Cordillera Negra (so-called because its crests do not exceed 16,500ft. and, therefore, bear no permanent snow) is the most densely populated district of this section of the Andes. The river has its source in Lake Conococha in the high *puna*; flows, with a descent of 6,500ft. in 60m., through a string of lacustrine basins of rich alluvial soil; and carries a large permanent stream through a gorge across the Cordillera Negra to the Pacific ocean.

Ecuador.—North of the Peru-Ecuador boundary the plateau is higher, rising to altitudes of over 10,000ft., but the interoceanic divide continues narrow as far north as lat. 3° S. From there northward to the Nudo de Pasto, in southern Colombia, the Andes appear to be a single broad plateau, the top of which is in places 40m. wide, surmounted by irregularly distributed volcanic masses which rise to elevations from 11,000 to 12,000ft. above the plateau, and divide it into a number of separate basins (*hoyas*) at an average elevation of from 7,500 to 9,000 feet. It has been the custom to describe this section of the Andes as consisting of two parallel cordilleras (a western cordillera and an eastern cordillera, or Cordillera Real) with a high plateau between them which is divided into separate basins by cross ranges from the main cordilleras. Our present knowledge does not support this description, and it seems to be only the rather general north and south alinement of some of the outstanding volcanoes on the east and west borders of the basins and, particularly, of the Quito and Latacunga-Riobamba basins themselves, that has given rise to such a characterization. In the interior basins is concentrated the population of the plateau. Their rich volcanic soil and temperate climate had permitted their Indian inhabitants to attain, long before the conquest, a state of civilization far above the savage. They are in the rain-shadow of the mountain masses which enclose them on the east and west, and have, at the most, only moderate rainfall and, in some cases, require irrigation. By contrast, both outer slopes have very heavy rainfall at about the level of the basins and are covered with luxuriant vegetation, while above 10,000 to 11,000ft. they have very heavy rainfall on both sides. These high regions of heavy rainfall are the regions of the *páramos*, cold, desolate areas on both the slopes of the cordilleras and on the cross ranges, with a covering of moss and other bog growths and enshrouded in almost perpetual mist.



ONE OF THE MANY WAYSIDE SHRINES THAT TOP THE HIGH RIDGES OF THE ANDES

The Cuenca basin, in the south, and the Latacunga-Ambato and Riobamba basins, in the central plateau, drain to the Amazon; while the Alausi basin, north of the Cuenca basin, and the Quito and Ibarra basins in the north, drain to the Pacific. The Andes in this section slope steeply to both the Pacific and the Amazon plains. The streams from the basins have, therefore, steep gradients. Because of this and the steady supply of water from the adjoining mountaintop *páramos*, the streams have eroded deep beds and few lakes remain, of which San Pablo, in the Ibarra basin, is the only one of considerable area. Erosion is slight at the parts of the basins farthest from the outlet through the mountains, but deepens rapidly as the outlet is approached. In the case of the Guaillabamba river, which drains the Quito basin, the total depth is over 3,000ft., of which 1,200 is a steep-sided canyon.

An essential characteristic of the northern half of the Andes of Ecuador is the volcanoes which not only border the western side of the interior basins, from Chimborazo to the Nudo de Pasto in southern Colombia, and the eastern side from nearly lat. 2° S. to the Equator, but are grouped in many places between the basins and, in places, stand completely in them. They really owe more than half their height to the base of ancient rocks on which they stand, but so impressive are they that even conscientious observers have frequently exaggerated the steepness of their slopes. The principal volcanoes of the more westerly line of volcanoes are Chimborazo (20,700ft), Canhuairazo (16,784), Quilatos (15,715), Iliniza (17,405), Pichincha (15,718), Catacachi (16,292), Cimbal (15,715), Chiles (15,682); of the eastern, Altar (17,729), Tunguragua (16,689), Cotopaxi (19,498), Antisana (18,851), Cayambe (19,062). Sangay (17,470) lies still farther to the east, and Sumaco (12,700), which is believed to be a volcanic cone, lies far out on the eastern slope east of the Cordillera Guacamayo.

The eastern slopes of the Andes of Ecuador are little-known. Recent explorers have described the Amazon lowland as joining the base of the plateau at elevations averaging between 3,600 and 4,000ft., and sloping gently eastward with a descent of 1,000ft. in the first 70 miles. There has been no exploration of the southern part of the lowland. North of the Napo river recent explorations have revealed a number of short ranges and mountain masses of moderate elevation rising above the general level. Among these are the Cordillera Guacamayo and the Cordillera Galeras, with elevations reaching 8,000ft. and 6,000ft. respectively, and the

cone-shaped Sumaco (12,700ft.). Still farther north a short range on the Equator called the Cordillera Lumbaki and two high mountain masses north-west of Sumaco have recently been discovered.

The Cordilleras of Colombia.—In southern Colombia the Andes divide into three separate ranges: the western cordillera, or Cordillera de Choco; the central cordillera, or Cordillera del Quindío; and the eastern cordillera, or Cordillera de Bogotá. The valley of the Magdalena river which separates the eastern cordillera from the central and part, at least, of the Patía and Cauca valley between the central and western cordilleras are not narrow, eroded trenches, but broad tectonic depressions with a deep alluvial cover. The western cordillera forms the coast range of Colombia in the south and, to the north, extends on the east side of the valleys of the San Juan and Atrato rivers to the Caribbean coast. It is the lowest of the cordilleras, with elevations varying, in the southern section, from a little over 5,000ft on the Pacific railway between Buenaventura and Cali, to 7,200ft. west of Cartago and 10,000ft. west of Popayán, and rising to elevations of 11,000 and 13,000ft. in the west and northwest of the province of Antioquia. The southern 250m. of the depression between the western and central cordilleras is occupied by a series of three broad longitudinal plains. The southernmost is drained by the Patía river to the Pacific ocean, while the northernmost, with a length equal to the combined length of the other two, is the famous Cauca valley and drains to the Magdalena by the Cauca river. The central plain, in which is the city of Popayán, contains the low divide between these two drainage basins Its elevation (6,000ft.) is 3,000ft. higher than those of the Cauca and Patía plains, and its northern and southern borders are, therefore, deeply trenched. The Cauca plain has many aspects of an old lake basin filled with detritus. The city of Cali stands slightly above the level of the plain on a gently sloping alluvial fan. North of the Cauca plain the Cauca river flows by a series of gorges through a region of hills and valleys between the western and central cordilleras. Its lower plain is bordered by gradually disappearing spurs until it finally merges in the plains of the lower Magdalena river.

The central cordillera is the highest of the cordilleras of Colombia and the shortest, its last spurs disappearing south of the junction of the Cauca river with the Magdalena, 170m. from the Caribbean. It contains the only recent volcanoes in the Colombian Andes Of these, Tolima (18,400ft.) and Ruiz (18,400ft.) are the most important. At lat. 5° 30′ N. the cordillera widens to form the plateau of Antioquia, whose last spurs extend as far as lat. 8° N, where they are lost in the plains of the Magdalena. This plateau appears to be a block of ancient crystalline rocks with intrusions of diorites and diabases divided into two parts by the deep trench of the Porce and Nechi rivers The groups of highlands on both sides of the Porce river preserve, in their gently broken surfaces, traces of a very ancient cycle of erosion. The larger of these covers an area of about 1,200 sq m. N. of Medellin and has an average elevation of 8,500ft., with diminishing heights toward the north-east. The other extends south-east of Medellin, and contains the upper valley of the Nare or Negro river. Medellin, the second city of Colombia, occupies an advantageous position in the Porce valley, where it widens out for a distance of about 8m. into a fertile alluvial plain.

The eastern cordillera is somewhat analogous to the Andes of Ecuador in that its most marked characteristic is a series of high intermontane plains or *savannas*, at a nearly uniform elevation of 8,000 to 9,000ft., of which the most important are at the headwaters of the Bogotá, Suarez and Sogamoso rivers on the eastern border of the Magdalena basin. Their subsoil is formed of beds of fine gravels and clays, with some beds of peat, and the majority contain shallow lagoons and bogs which are partly submerged during the rainy season. Most of them have areas in their centres too wet for cultivation, so that the population is grouped about their edges. These high *savannas* were the centre of the pre-colonial Chibcha civilization and now contain a third of the entire population of Colombia. The Savanna de Bogotá is the largest and most densely populated of them, and has only a narrow strip of useless bog land in its centre. Bogotá is built on its eastern edge.

East of Girardot and Honda the cordillera is a series of parallel ranges, running from south-south-west to north-north-east, of which only the easternmost, the Sierra de Cocuy (17,500ft.), reaches the level of permanent snow. North of the Sogamoso river the ranges have a north-south direction and in the latitude of Bucaramanga are united in a broad block. Farther north the central ranges stop and the western and eastern continue on, diverging toward the north and north-east as the Cordillera de Ocaña, of which the Sierra de Perija forms the boundary between Colombia and Venezuela, west of Lake Maracaibo. North-east of the delta of the Magdalena river, the Sierra Nevada de Santa Marta, a triangular massif with steep slopes to the north and west, rises abruptly from the Caribbean coast to snowy summits 17,000ft. high. It is separated from the Sierra de Perija by the valleys of the Cesar and Rancheria rivers.

A great many lakes exist in the cordillera east of Bogotá and on both sides of the upper Sogamoso, but the *páramos* have usually gentle forms and show traces of a long erosion period. It is, however, only on the high plains and the *páramos* that the streams of the interior now meander. They are rapidly cutting the greater part of their courses and upon leaving the *savannas* they flow through deep canyons. The falls of Tequendama south-west of Bogotá are the most striking example of the manner in which these streams have dissected the borders of the high plains, but the Suarez and Sogamoso rivers exhibit the same characteristics. Tributaries of the Orinoco river have cut through the eastern range to the neighbourhood of the *savannas* at points south of the Sogamoso and Tunja rivers. South of Bogotá the eastern cordillera is narrow. The Páramo de Sumapaz reaches elevations of 14,000ft , and snow remains there throughout most of the year, but farther south the range is much lower. In the Sierra de Perija, which forms its northern extremity, the cordillera narrows to about 16m., and its highest crests do not exceed 8,000 feet.

Venezuela.—The Andes of Venezuela are separated from the eastern cordillera of Colombia by a depression of about 4,600ft. altitude, between the Tachira and Torbes rivers, and extend north-east and east for about 500m., across the northern part of the country. Transverse valleys cut them into three sections, the area and altitude of which decrease from west to east. The westernmost section, from the sources of the Torbes river to the sources of the Tocuyo river is known as the Cordillera de Merida It is about 160m. long and 30 to 50m. wide. Its snow-capped summits are all above 10,000ft , and in the Sierra de Santo Domingo and the Sierra Nevada de Merida exceed 14,500 feet. In the Andes of Venezuela the coastal sierras have a west to east direction, and are separated from a second line of much lower mountains by a depression in which are the basins of Lake Valencia and the Tuy river. Eastward from Puerto Cabello the range rises steeply from the coast. Its western end is only a little over 5,000ft. high near Nirgua, but it reaches 9,000ft. on the Silla de Caracas north-east of Caracas, and falls to 7,500ft. west of Cape Codera. The Caracas valley, in which is the city of Caracas at an altitude of 2,600ft., is only 6m. from the sea, and is not a part of the central depression It appears to be, rather, a subsided local block covered with alluvial soil.

East of Cape Codera the Gulf of Barcelona interrupts the mountain zone for a distance of 80 miles. Only a narrow line of sandstones and limestones continues eastward from the interior range along the flat coast. Its altitude lowers rapidly from 4,000ft. to 1,600ft., and it is completely interrupted by the Unari and Aragua rivers, which drain a part of the llanos to the Gulf of Barcelona. The Sierra de Cumana extends for 80m. between the Aragua river and the Gulf of Paria. Its interior is a massif of sandstones and folded limestones which rises to 7,500ft. in the Cerro Turumiquire. The double peninsula of Araya and Paria is a narrow belt of crystalline schists, with an altitude of 1,300ft. west of the town of Carupano and a little over 3,000ft. at its eastern end near the Boca del Dragón, beyond which it is continued as the northern range of Trinidad island.

Geology.—The beds of the Primary series are found in the Andes in a longitudinal zone on the eastern side of the cordillera. They form the eastern part of the plateaus of Bolivia and northern Argentina, where the high anticlinal ranges are of Cambrian

quartzites, while Silurian schists, surrounding the recent granite crests of the Cordillera Real, cut by deep valleys, and overlapped in the synclines by Devonian and Secondary red sandstones, form the base of the series. They are found, also as Silurian sandstones, schists and Devonian sandstones on the eastern side of the Chile-Argentine cordillera as far south as lat. 35° S. and in the pre-cordillera.

The zone of the Secondary beds is of much greater length. Breccias and porphyritic conglomerates are the most common formation, forming almost the whole of the western part of the Andean system. In Peru they are succeeded to the east by gray limestones, which cover the greater part of the plateau. Still farther east, on the Marañón and upper Huallaga rivers, the ridges are of Secondary sandstones above Silurian schists. In Ecuador the Secondary conglomerates of the western side of the plateau rest directly upon the Andean gneisses and mica-schists, of which the eastern part is composed. In Colombia the central cordillera is formed of mica-schists, with almost no trace of sedimentary covering; while, in the eastern cordillera, even on the border of the plains of the Orinoco, the conditions which prevail farther south are completely reversed and the Secondary beds have their greatest development. The importance of the Secondary marine deposits in the Andes, especially in the Jurassic and Cretaceous series, seems to indicate that, during the Secondary period the region of the Andes was a geosyncline inundated by the sea between two continental masses, one of which occupied the place of the present Pacific ocean. The relations between the Andes and the *vorland* to the east is obscured by an enormous development of alluvial forms which partly cover the zone of contact between the lowlands and the cordilleras. It has been suggested that it is a rigid zone against which were exerted the forces to which the folding of the geosynclinal Andes was due.

The beginning of the folding of the Andes dates from the upper Cretaceous and continued during a part, at least, of the Tertiary. Tertiary marine forms are, therefore, lacking in the interior of the cordillera and are known only in eastern Patagonia, on the extreme edge of the cordillera. The Tertiary is represented in the greater part of the Andes by continental deposits without fossils, which furnish no precise information on the age of the folding. North of the Patagonian Andes as far as lat. 4° S. the western ranges contain Jurassic rocks and porphyritic rocks of similar age folded together. Both are of interest, the Jurassic because they are the only marine sediments of that age south of the Equator, the porphyritics because they are the most important evidence we have of volcanic activity in Mesozoic times. North of lat. 4° S the Jurassic and porphyritic rocks are comparatively rare and the Primary rocks are absent. The majority of geological cross-sections which have been made in the Andes indicate foldings of the simple Jura type rather than the complex type of the Alps. The cross-sections are, however, still comparatively few, and greater complexity may be revealed by further studies.

Evidence of the uplift of the Andes is found not only in the existence of Tertiary and Quaternary marine deposits on the Pacific coast and many examples of uplifted shore-lines, but also in the frequent occurrence throughout the cordillera of surfaces which could only have been formed at an altitude near sea-level. These areas are found even in the more humid parts, where the contrast between them and the deep ravines of the headwater streams which are now invading them is most striking. The peneplane has been most completely conserved, however, in the desertic Maritime cordillera of northern Chile and southern Bolivia. In the terracing of the valleys, particularly on the eastern side of the cordillera, there is evidence of a succession of vertical movements, interrupted by periods of rest; while in the coastal terraces all the way from Paita to Antofagasta we find evidence not only of periods of rest but also of at least one subsidence followed by an uplift, which is still in progress at the present time. In fact, along the entire western seaboard the region has suffered enormous disturbances in the past, while the frequent earthquakes that have occurred in recent years in many parts of the coastal region and the cordillera are evidence that these disturbances are still going on. The abrupt transition from high tableland to abysmal ocean depths that is characteristic of the entire coast indicates the remarkably unstable condition of the region. In addition to the general or regional movements of uplift and subsidence, the existence of drop-faulting has been noted throughout the whole length of the cordillera. The upper Magdalena valley, the Cuzco basin, the Iglesia and Calingasta valleys between the cordillera and the pre-cordilleras of the Argentine republic, and the central valleys of Chile have all been thus explained.

The volcanoes of the Andes occur in three notable groups, southern Colombia and northern Ecuador, southern Peru and northern Chile, and the group of central Chile, Neuquen and Patagonia All types are present, from ancient volcanoes almost completely destroyed by erosion and extinct volcanoes, with or without craters, but still fresh in form, to active volcanoes. They have played an important part in the levelling of the interior basins Fluid lavas exposed appear only on the Patagonian plateau. Elsewhere the lavas are chiefly of the viscous acidic type and, although accumulated to great depths in many places (as much as 1½m. deep in the Cordillera de Vilca pampa in southern Peru), have not been removed far from the craters. The volcanic ash, however, has been carried away by erosion in such quantities that they have overcharged the streams and filled depressions and valleys to a great depth.

Climate.—It is not on the Equator but between lat. 15° and 20° S that the highest temperatures of the Andes are found, and we must go south of the Tropics to find mean annual temperatures comparable to those on the Equator The abnormal depression of temperatures in the equatorial Andes is due to the heavy rainfall, and it is the lack of rainfall that raises the temperatures to the south. The effect of the higher temperatures of the drier Andes is to elevate the upper limit of agriculture and human occupation. In Colombia the highest agricultural zone is between 6,500 and 1,000ft, while on the moister portions of the Bolivia *altiplano* agriculture is carried on over 3,000ft. higher. The rich agricultural basins of Cuzco and Jauja, if they lay at the same elevation in the humid equatorial Andes, would not belong to the agricultural regions at all. The lower limit of the colder agricultural zone is not, however, parallel to the upper limit, and as one leaves the Equator frosts occur at lower and lower levels. As a result, sugar cane, which grows at a level of 6,500ft. and more in Ecuador and Colombia, does not reach above 3,000ft. in northern Argentina.

The lower limit of perpetual snow in the tropical Andes is between 15,000 and 16,000 feet. On account of the increasing aridity, it rises rapidly south of the equatorial region to 17,000ft. on the western ranges of the Peruvian Andes, above Lima, and to 18,000 and 20,000ft. in the summits which border the Puna de Atacama, to the north-east. South of the Puna de Atacama it lowers again to 18,000ft. in the Famatina ranges, and to between 14,500 and 16,500ft in the ranges of Juan and Mendoza. From these it falls rapidly to 6,500ft. at lat. 37° S., 5,000ft. at lat. 40° S, and 2,300ft. on Tierra del Fuego. In the tropical and subtropical sections of the Andes the present glaciers rarely extend beyond the snow line. South of lat. 40° S, however, they have more extensive fields of supply, and come well down into the valleys. South of lat. 46° S the ice-fields, though only a shrunken remnant of the ice-fields of the Glacial period, still form a continuous cap over the entire central zone of the cordillera. Throughout the Andes there have been recognized, in front of the present glaciers and in regions to-day free of ice, glacial moraines, cirques, outwash plains and lakes confined behind glacial dams, that are proofs of several periods of extensive Quaternary glaciation.

Mining is an important industry in all of the Andean countries. In Chile and Bolivia it far exceeds all other industries in the value of its products. The most important mineral deposits are those of the younger igneous rocks which include the gold quartz lodes of Colombia, the silver-bearing copper deposits of Peru and Chile, and the tin-silver-bismuth deposits of Bolivia. The copper deposits, which are found in many sections of the Andes, but are particularly abundant in Chile and Peru and, to a lesser degree, in Bolivia, differ greatly in their geological occurrence and characteristics. They occur most frequently as replacements of rock

near intrusions of igneous material. At Portrerillos, Chile, they have replaced the easily soluble limestone. At the Braden mines, near Rancagua, Chile, and the Cuquicamata mines, the copper minerals have filled cracks and openings in less soluble rocks with little or no replacement. In many places, as at Cerro de Pasco, Peru, rich silver ores at the surface give place to copper ores at lower levels. The tin deposits of Bolivia are true fissure veins or disseminations filled by products of igneous intrusives. The only gems occurring in the younger igneous rocks are the emeralds of Colombia. Of the ores which occur mainly in association with the ancient crystalline rocks, gold-bearing and silver-bearing veins in the pre-Cambrian schists, gneisses and granites, in many places in the cordilleras, and iron ore, chiefly magnetite, in Chile, are the most important. Mineral deposits of economic value in the sedimentary rocks are not extensive. Chile, Peru and Colombia have extensive coal deposits, but they are of inferior quality as compared with foreign coals, and except in Chile, are so inaccessible that they have been worked but little, except for local use. Petroleum resources have been studied intensively, and indications of oil-bearing strata have been reported on the eastern border of the Andes all the way from Venezuela to Tierra del Fuego. The areas which are at present yielding the most valuable flows are the Maracaibo basin, in Venezuela, the basin of the Sogamoso river on the western border of the eastern cordillera of Colombia, and the coastal region of northern Peru at Talara. Of the placer minerals, gold is the most important, and the extensive placer operations have of recent years been mainly confined to Colombia, particularly in the Choco district, where they yield considerable platinum.

From the standpoint of human occupation, the Andes are divided into three sections—an unpopulated section extending north to the Puna de Atacama; an arid central section from the Puna de Atacama to northern Peru, where mining is the chief industry; and a humid northern section, of which the chief industry is agriculture. The southernmost section has little mineral or agricultural resources, and the population is, therefore, not in the mountain zone but on its borders; concentrated in irrigated districts on the eastern side and more uniformly distributed in the central valleys of Chile on the western side. In the Puna de Atacama there is a sparse population of shepherds, and a still smaller element engaged in collecting salt from the salars for sale in the settlements on the mountain border. From there north to the Caribbean sea, however, the greater part of the population of the west coast and Caribbean republics, and, with few exceptions, the chief cities, are on the plateau This populated section of the Andes contains a third of the whole population of South America. It consists of two sections of distinctly different character. The southern and more arid section is a region in which mining is the dominant industry, and practically the only source of export. All other industries are maintained for the purpose of supplying it with food, clothing and means of transportation. Railways which penetrate into the cordillera from the Pacific coast are constructed solely to transport the products of the mines to the nearest ports. The influence of the mining industry, since the mining districts are mainly on the high *páramos*, has combined with climatic conditions to elevate the altitudinal limits of human habitation to levels which are among the highest in the world. Since before the conquest the characteristic of this section of the Andes has been the establishment of small agricultural communities on the alluvial floors of high, sheltered valleys in close proximity to the mining centres which form the sole market for their produce. In the more humid Andes of Ecuador, Colombia and Venezuela mining is of secondary importance, the chief industries are agricultural and the chief exports the products of the tropical levels—cacao in Ecuador; coffee, in Colombia and Venezuela. Here the internal trade is not the supplying of agricultural products to a dominant industry but an exchange of products between zones at different levels and, therefore, of different climates.

Throughout the populated sections of the Andes, transportation between different parts of the plateau, between the plateau and the eastern lowlands, and, to a considerable extent, between the plateau and the Pacific coast, is still chiefly by pack-trail. The mule has come to be the principal pack-animal, largely supplanting the llama of pre-conquest times, although the latter is still used locally in large numbers. In parts of Colombia the ox is still used for long trips with bulky commodities such as coffee and tobacco, while in the *montañas* of the eastern slopes and in the Choco region of Colombia, transportation is still dependent upon Indian bearers. Everywhere the *arrieros*, or muleteers, are an important element of the population. Often they are grouped in villages or particular districts where their work is the chief source of income. In Colombia it is estimated that they form a third of the population. Whereas the railway has supplanted the pack-train on most of the long routes from the plateau to the Pacific coast, the number of *arrieros* in the Andes as a whole has probably not been decreased, since the penetration of the railways into the plateau has increased the demand for foreign goods and, consequently, for means of distributing them from the railheads.

Except in the broad central plateau of Bolivia, the Andes offer such obstacles to road and railway construction that the west coast republics between Chile and Colombia are effectively divided into two lowland regions separated by the cordilleras. From the point of view of Government administration and national solidarity, railways across the Andes to connect the two lowland regions are of much importance; but so great would be the cost of construction and maintenance that, unless the economic interdependence of the two regions develops to a point where the cost is justified, it is probable that few of the many lines proposed will be constructed. Such rail connections as the mountain zone now has are short lines built to connect important mining or agricultural districts with the nearest seaports. Only two railway routes cross the Andes. The most famous of these is the railway opened in 1911 between Los Andes, Chile and Mendoza, Argentine republic, which crosses the Chile-Argentine boundary by a tunnel 10,000ft. long and 10,500ft. above sea-level, and affords direct rail connection between Buenos Aires and Valparaiso. The recently completed railway from the Bolivia-Argentine boundary to Uyuni connects on the Bolivian *altiplano* with three railways to the Pacific coast, and gives through routes from Buenos Aires to Antofagasta and Arica by rail, and by rail and steamer on Lake Titicaca, to Mollendo. (For railway lines eastward from the *altiplano* of Bolivia *see* BOLIVIA. For railways which penetrate the Andes in Peru, Ecuador, Colombia and Venezuela, *see* articles on these countries.) (R. R. P.)

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ANDESINE (named by W. H. Abich in allusion to its occurrence in the Andes mountains), a mineral of the plagioclase group of felspars (*q.v.*) and occupying a position about midway in the isomorphous series, albite-anorthite. In petrology the name is arbitrarily restricted to solid solutions between $Ab_{70}An_{30}$ and $Ab_{50}An_{50}$. Andesine is an essential constituent of the intermediate igneous rocks, as diorite, porphyrite and andesite.

ANDESITE, a name first applied by C. L. von Buch to a series of lavas, investigated by him, from the Andes, which has passed into general acceptance as the designation of a great family of rocks playing an important part in the geology of most of the volcanic areas of the globe. Not only the Andes but most of the Cordillera of Central and North America consist very largely of andesites; they occur also in great numbers in Hungary, Japan, the Philippines, Java, and New Zealand. They belong to all geological epochs and are frequent among the Ordovician and Devonian rocks of Britain, forming the ranges of the Cheviots, Ochils, Breidden hills, and part of the Lake district. The well-known volcanoes, Montagne Pelée, the Soufrière of St. Vincent, Krakatoa, Tarawera, and Bandaisan have within recent years emitted great quantities of andesitic rocks with disastrous violence.

They are typical intermediate rocks, containing on an average about 60% of silica, but showing a considerable range of composition. Most of them correspond to the plutonic diorites, but others more nearly represent the gabbros. Their essential distinguishing features are mineralogical and consist in the presence of much soda-lime felspar (ranging from oligoclase to acid labradorite, though phenocrysts may occasionally be still more basic), along with one or more of the ferro-magnesian minerals, biotite, hornblende, augite, and hypersthene. Both olivine and quartz are typically absent, though in some varieties one or other may occur in small quantity. Orthoclase may be present in small amount. In trachyandesites orthoclase and plagioclase are more or less equally developed. These rocks are conspicuously represented in the igneous fields of the Auvergne, Siebengebirge, Canary islands, etc. The andesites have mostly a porphyritic structure and the larger felspars and ferro-magnesian minerals are often visible to the naked eye, lying in a finer ground-mass, usually crystalline, but sometimes to a large extent vitreous. When very fresh they are dark-coloured if they contain much glass, but paler in colour, red, grey, or pinkish when more thoroughly crystallized

The older (pre-Tertiary) andesites are grouped together by many German and, formerly, by British petrologists under the term porphyrites, but are distinguished only by being, as a rule, in a less fresh condition. Apart from this there are three great subdivisions of this family of rocks, the quartz-andesites or dacites, the hornblende- and biotite-andesites, and the augite- and hypersthene-andesites (or pyroxene-andesites). The dacites, a term first applied by Karl Heinrich Hektor Guido Stache (b. 1833) to quartz-bearing andesites of Transylvania or Dacia, contain primary quartz and are the most siliceous members of the family; their quartz may appear in small blebs (or phenocrysts), or may occur only as minute interstitial grains in the ground-mass; other dacites are very vitreous (dacite-pitchstones). In many of their structural peculiarities they closely simulate the rhyolites, from which they differ in containing less potash and more soda, and in consequence less orthoclase felspar and more plagioclase. The hornblende- and biotite-andesites, like the dacites, have in most cases a pale colour (pink, yellow, or grey), being comparatively rich in felspar. They resemble the trachytes both in appearance and in structure, but their felspar is mostly plagioclase, not sanidine. The biotite and hornblende have much the same characters in both of these groups of rocks and are often surrounded by black borders, produced by corrosion and partial resorption by the magma. Augite is common in these andesites, but bronzite or hypersthene is comparatively rare. The pyroxene-andesites are darker, more basic rocks, with a higher specific gravity, and approach closely to the basalts and dolerites, especially when they contain a small amount of olivine. They are probably the commonest types of andesite, both at the present time and in former geological periods.

In addition to the accessory minerals, zircon, apatite, and iron oxides, which are practically never absent, certain others occur which, on account of their rarity and importance, are of special interest. Sharply-formed little crystals of cordierite are occasionally found in andesites (Japan, Spain, St. Vincent, Cumberland); they seem to depend on more or less complete digestion of fragments of aluminous rocks in the molten lava. Garnet and sapphire have also been found in andesites, and perhaps have the same signification; a rose-red variety of epidote (withamite) is known as a secondary product in certain andesites (Glencoe, Scotland), and the famous red porphyry (*porfido rosso*) of the ancients is a rock of this type. Ore deposits very frequently occur in connection with andesitic rocks (Nevada, California, Hungary, Borneo, etc.), especially those of gold and silver. They have been laid down in fissures as veins of quartz, and the surrounding igneous rocks are frequently altered and decomposed in a peculiar way by the hot ascending metalliferous solutions. Andesites affected in this manner are known as propylites. (J. S. F.)

ANDIJAN. (1) A province in Uzbek S.S.R. Area 7,314 sq.km. Pop. (1926) 792,297 (144,718 urban); (2) a town, the administrative centre of the province. Lat. 40° 55′ N. Long. 72° 16′ E.; alt. 1,630ft. It is the terminus of the Transcaspian Railway, on the left bank of the upper Syr-Darya. It is in an earthquake area and was destroyed in 1902, but re-built. It is a centre of the cotton trade and has cotton factories (hence the name *Andijani* for merchants in Central Asia). It has gardens and a large park and was formerly the residence of the Khans of Khokand. The province is fertile and is watered by the Syr-Darya. It produces rice, cotton, millet, winter and spring wheat, potatoes, grapes and silk.

AND INTEREST, a term used in the bond market meaning that upon the sale of a bond the quoted price must be supplemented by the payment of an amount equal to the accrued interest to date of sale (*see* ACCRUED INTEREST).

ANDIRON (older form *anderne*), one of a pair of horizontal iron bars upon which logs are laid for burning in an open fireplace.

Andirons stand upon short legs and are usually connected with an upright guard, giving the grotesque appearance of a dog (hence *fire-dogs, q.v.*). This guard, being a very conspicuous fixture, is often elaborately designed with figures, grotesque animals, emblems and the like. Andirons with little or no ornament were also used in kitchens, with ratcheted uprights for the spits.

ANDKHUI, northern khanate in Afghan Turkistan, allotted to Afghanistan by the Russo-Afghan boundary commission (1885). Also the chief town of the khanate, 100m. W. of Balkh on the edge of the low Turkoman desert, said to have been founded by Alexander the Great. Having been for a while subject to Bukhara, it was taken and ruined by Mahmud Khan in 1820, and its khan thereupon sought the help of the Afghans. The population has been estimated at 15,000 and includes Turkomans, some Uzbegs and a few Tajiks. The climate is unhealthy, but the soil fertile, the water is brackish, and flies and scorpions abound.

ANDOCIDES, one of the "ten" Attic orators, was born about 440 B.C. Implicated in the mutilation of the Hermae (415), although he saved his life by turning informer (*see* Thuc. VI. 27, 60) he was condemned to partial loss of civil rights and went into exile. He became a merchant, and after two unsuccessful attempts returned to Athens under the general amnesty that followed the restoration of the democracy (403), and filled some important offices. In 391 he was one of the ambassadors sent to Sparta to discuss peace terms.

Speeches extant:—*De Reditu,* plea for his return and removal of civil disabilities, *De Mysterus,* defence against the charge of impiety in attending the Eleusinian mysteries; *De Pace,* advocating peace with Sparta; *Contra Alcibiadem,* generally considered spurious. Text:—Blass, 1880, Lipsius, 1888; *De Myst.,* with notes by Hickie, 1885; *De Red.* and *De Myst,* with notes by Marchant, 1889; *see* Jebb, *Attic Orators;* L. L. Forman, *Index Andocideus,* 1897.

ANDORRA, a small autonomous and semi-independent State on the Franco-Spanish frontier between the central and eastern Pyrenees. Pop. about 5,200. Area, 191sq m.; with greatest length about 18m., east to west, and greatest breadth 17m. It is a cluster of mountain valleys, uniting to form the Valira, a tributary of the Segre, itself a feeder of the Ebro, surrounded, on all sides save the south-west, by peaks which rise between 5,000 and 10,000ft. No part of the valley is below 3,000ft.; the main Pyrenean crest line, to the north and east is over 8,000 ft. The valleys end in steep *cirques* which give no passage through the mountain wall. The *ports* (passes) of Salud, Fraymiquel and Soldeú are open for a part of the year only; while the defile of the Valira below San-Julia-de-Loria offers little easier, if more permanent, passage for communications with Spain. The climate is severe at all levels, and, above 4,500ft., drought becomes a serious factor, and though most of the valleys are within sub-alpine zones, coniferous forest does not flourish, partly for this reason. Irrigation is thus indispensable to the high meadows, but in the lower valleys large-scale irrigation dates only from 1884. All cultivable areas vary in value according to their exposure to the sun which melts the snows in spring. In the lower valleys torrential activity limits cultivable soil; the widest stretches are about Andorra-la-Vieja. The lateral valleys are in better case, but their alluvial meadows are often too high to be cultivable. The most fertile soil is on artificial terraced slopes. Forests are poor, and have been destroyed by animals and by man for firewood, charcoal, etc. The evergreen oak grows on the sunny slopes around Andorra-la-Vieja, but the olive is nowhere found. At the limits of cultivation bad weather often prevents the ripening of the barley, here sown before or soon after the harvest time. Higher still, in the Alpine zone, are great stretches of summer pasture which provide food for many more sheep than Andorra itself can support through the winter. When the land was first peopled is unknown. At various times the high valleys have doubtless served as refuges for peoples pressed up from the plain, as in the Caucasus, and it is known that French and Spanish deserters have frequently retired there. The Andorran, however, is stubborn and independent, and mistrusts intruders. Pastoral life is naturally well-developed, and the inhabitants of the groups of valleys hold the high pastures in common; a fact which tended towards autonomy in many mountain valleys of the Pyrenees, particularly in the middle ages. The richest soil is given up to tobacco culture, the crop constituting the main wealth of the country. Exported (mainly contraband) tobacco is found for a great distance around, both in Spain and in the Ariège basin. The need of hay for winter fodder for the sheep further limits cereal culture. Meadowland is highly prized and tends to extend at the expense of the cultivated soil; and even the potato, the introduction of which meant much to most regions of the Pyrenees, forms with barley only a poor supplement to pastoral products. Climate and soil alike are unfavourable to wheat.

Besides the local movement to high pastures in summer there is well developed *transhumance* in the migration of vast flocks of sheep from the distant plains of the lower Segre (Llanos del Urgel) and the Ariège, the total summer flocks of Andorra being estimated at about 30,000 head. In most parts the frontier against France lies in areas which form natural regions, so that treaties, *lies ou paceries,* for peaceful exploitation, regardless of national or political considerations, are of long standing. Against Spain, on the east, the frontier sometimes descends beyond the crests to include the head-waters of opposing streams. Lower down the slopes, herds of horses, mules and cattle find sustenance, while the goat also plays an important part in Andorran life. For all animals, however, the problem is lack of winter food, and the autumnal fairs, visited by Catalan dealers, are very important and are held both in Andorra and over the Spanish border. Industry, apart from the half-dozen tobacco "factories," is merely domestic, and lack of capital and initiative, remoteness and poorness of communications prevent development Mineral deposits include silver, lead and in particular iron ores, which were formerly worked and reduced with charcoal, as several ruined forges testify. The only roads are bridle-paths, and a municipal road over the Spanish frontier to Seo de Urgel, along which a motor-omnibus service operates. In 1904 France and Spain agreed to build a railway from Ax to Ripoll, which would greatly facilitate traffic, but little progress has been made.

There are two contrasted types of settlement, the permanent and the temporary village, but the houses are grouped together in both cases. The former, extending up to the limit of 6,000ft , are generally on slopes facing south. The largest agglomerations are in the plains about Andorra-la-Vieja and Encamp. The temporary (summer) habitations generally occur between 5,200 and 6,500ft.; but "migration" here is sometimes on a small scale, although in some districts the peasants spend nine months of the year at the high villages (*cortals*). The limited resources of the high valleys necessitate emigration.

The independence of Andorra is traditionally ascribed to Charlemagne, like many other Pyrenean anomalies. Since 1278 the principality has been under the joint suzerainty of the French State (which inherited the rights of the Counts of Foix) and the Spanish bishops of Urgel, and the two powers, who receive annual dues of 960 francs and 460 pesetas respectively, have mutually checked innovations in a land where mediaeval usages naturally persist. Thus Andorra is not a republic; its official title is "les Vallées et Suzerainetés." It is governed by a Council General of 24 members, elected for four years by the heads of families in each of the six parishes of Andorra-la-Vieja, Encamp, La Massana, Ordino, Canillo and San-Julia-de-Loria. A First Syndic, chosen by the Council constitutes the supreme executive; and a Second Syndic serves as deputy. In civil matters the judicial power is exercised in the first instance by two civil judges (*Bayles*) appointed by France and by the bishop respectively. There is a Court of Appeal and also a Supreme Court at Perpignan. The final appeal is either to the supreme court or to the Ecclesiastical Court at Urgel. For criminal suits two magistrates (*Viguiers*) preside at Andorra-la-Vieja, the capital, a village of some 600 inhabitants. In the "government house" here the Council General meets. A permanent delegate, the prefect of the department of Pyrénées Orientales, has charge of the interests of France. Spain has shown herself jealous of French encroachments, and some resentment has been shown by the Andorrans themselves, *e.g.,* in 1928. Catalan is the language spoken, and French and Spanish currency are both in use.

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ANDOVER, municipal borough, Hampshire, England, situated among low chalk hills on the river Anton, a tributary of the Test. Population (1921) 8,572. The neighbourhood is rich in prehistoric earthworks and *tumuli.* The importance of the Saxon village (Andefeian, Andieura, Andever) is probably related to the proximity of the Roman road from Silchester to Old Sarum. The witenagemot met here, and it is the traditional scene of meeting of Aethelred and Olaf the Dane. Andover existed as a borough before 1176, and Henry II. exempted its inhabitants from toll and passage. The corporation was reconstituted in 1599 and again in 1682. The town possessed an iron market and a prosperous wool trade in the 14th century; it is the centre of a large agricultural district, and also profits from various Army undertakings on the Downs. The November sheep-fair dates from the 13th century. The cattle and corn markets are both ancient institutions. Malting is carried on, and there is a large iron foundry. Extinct industries are the manufactures of silk and parchment. The borough is now in the Basingstoke parliamentary division of Hampshire. The corporation consists of a mayor, four aldermen and 12 councillors. Area 8,663 acres There is a station on the main S.R. from London to Exeter.

ANDOVER, a town of Essex county, Massachusetts, U.S A, situated on the south side of the Merrimac Valley. The population was 10,291 according to the State census of 1925. The Shawsheen river supplies power for a considerable manufacturing industry. Twine, woollens and rubber goods are produced in Andover, Ballardville, Frye and Shawsheen, a "model" community created by the American Woolen Company. Andover, the principal village, is about 23m. N. of Boston and is served by the Boston and Maine railway and interurban electric lines. The town is noteworthy for its educational institutions. Abbot academy, opened in 1829, was the earliest incorporated school for girls in New England, Phillips academy, opened in 1778 (incorporated in 1780), the first incorporated academy of the State, was founded through the efforts of Samuel Phillips (1752–1802) by his father, Samuel Phillips (1715–90), and his uncle, John Phillips (1719–95), "for the purpose of instructing youth, not only in English and Latin grammar, writing, arithmetic and those sciences wherein they are commonly taught, but more especially to learn them the great end and real business of living." An archaeological department with an important collection in American archaeology, was founded by Robert S. Peabody, and his wife in 1901. The academy grounds include those occupied 1808–1908 by the Andover theological seminary before its removal to Cambridge. Andover was settled about 1643 and incorporated in 1646. It was named after the English town of Andover, Hampshire, the home of some of the chief settlers North Andover was separated from it in 1855. Elizabeth Stuart Phelps-Ward was born and lived for many years in Andover, and Harriet Beecher Stowe, who resided from 1852 to 1864, is buried there.

ANDRADA E SYLVA, BONIFACIO JOZÉ D' (1765–1838), Brazilian statesman and naturalist, was born at Villa de Santos, near Rio de Janeiro. In 1800 he was appointed professor of geology at Coimbra, and soon after inspector-general of the Portuguese mines; in 1812 he was made perpetual secretary of the Academy of Lisbon. Returning to Brazil in 1819, he urged Dom Pedro to resist the recall of the Lisbon court, and was appointed one of his ministers in 1821. When the independence of Brazil was declared, Andrada was made minister of the interior and of foreign affairs; and when it was established he was again elected by the Constituent Assembly, but his democratic principles resulted in his dismissal from office, July 1823. On the dissolution of the Assembly in November, he was banished to France, where he lived near Bordeaux till, in 1829, he was permitted to return to Brazil. But being again arrested in 1833, and tried for intriguing on behalf of Dom Pedro I., he remained in retirement till he died at Nictheroy in 1838.

ANDRÁSSY, JULIUS, COUNT (1860–), Hungarian statesman, was born June 30, 1860, the son of Count Julius Andrássy. He was elected deputy in 1885, and in 1906 became Minister of the Interior, in the so-called Coalition Cabinet. At the collapse of this Ministry in 1910, he refused to join the Khuen-Héderváry Government but declared that he would not actively oppose it, and dissolved the constitutional party, of which he was leader. In 1913 he delivered three speeches in the Hungarian Delegation against the conduct of foreign affairs, advocating a policy of European *détente,* and in parliament he opposed the plan for the centralisation of the internal administration of Hungary. At the outbreak of the World War he supported the Tisza Ministry, but opposed Burian on the Polish and Italian questions In 1915 he pleaded for peace, and urged a wide extension of the franchise. Upon the resignation of Burian in Oct. 1918, he became foreign minister in Vienna and, in a note to President Wilson, made a last attempt to conclude a separate peace He then retired from office, but in Jan. 1920 was returned for Miskolcz to the Hungarian National Assembly and later became leader of the Christian National party. In Oct. 1921, at King Charles's second attempt to regain his throne, he was taken prisoner with the king and was imprisoned for several months. In 1922 he was returned to the Nationalist Assembly as a Legitimist deputy.

His works include—*Ungarns Ausgleich mit Österreich vom Jahre 1867* (1897); *Die Ursachen des Bestandes des Ungarischen Staates und dessen verfassungsmassiger Freiheit* (Budapest, 1901–11); *The Development of Hungarian Constitutional Liberty* (1908); *Wer hat den Krieg verbrochen?* (Leipzig, 1915, Eng. trans by E. J Euphrat; New York, 1915), *Interessensolidaritat des Deutschtums und Ungartums* (Munich, 1916); *Diplomatie und Weltkrieg* (1920, Eng. trans. by J. H. Reece, 1921), and *The Antecedents of the World War,* vol. i., Hungarian (1925).

ANDRÁSSY, JULIUS (GYULA), COUNT (1823–1890), Hungarian statesman, the son of Count Károly Andrássy and Etelka Szapáry, was born at Kočiře, Slovakia (then in north Hungary) on March 3, 1823. In 1846 he attracted attention by his bitter articles against the Government in Kossuth's paper, the *Pesti Hirlap,* and was returned as one of the Radical candidates to the diet of 1847–48. He was one of the leaders in the Constitutional agitation in Hungary, but when Jellačić (*q v*) marched into Hungary, Andrássy took command of a Honvéd battalion and served at the battles of Pákozd and Schwechat. In May 1849 Kossuth sent him to Constantinople, in the hope of persuading the Porte to declare war against Austria and Russia. After the catastrophe of Vilagós he migrated first to London and then to Paris. On Sept. 21, 1851, he was hanged in effigy by the Austrian Government for his share in the Hungarian revolt. In 1856 he married Countess Katinka Kendeffy, and in the following year asked for and obtained an amnesty, without, however, expressing regret for the part he had played in the past. In 1858 he returned to Hungary. Here he supported Deák in his demand for the restitution of the Hungarian Constitution of 1848, and worked strongly for reconciliation, both between the monarch and the Hungarian nation, and the conflicting political parties in Hungary.

On Dec. 21, 1865, he was chosen vice-president of the diet, and in March 1866, president of the sub-committee appointed by the parliamentary commission to draw up the Composition (commonly known as the *Ausgleich*) between Austria and Hungary, of which the central idea, that of the "Delegations," originated with him. After Koniggrätz he was formally consulted by the emperor for the first time. He advised the re-establishment of the constitution and the appointment of a responsible ministry.

On Feb. 17, 1867, the king appointed him the first constitutional Hungarian premier, and he took over the departments of war and foreign affairs.

It was he who, in the face of extraordinary opposition, secured for Hungary the recognition of a national militia (Honvéd), organized that force, and arranged for the "provincialization" of the Military Frontier (*q.v.*).

On Nov 6, 1871, Beust, the Austro-Hungarian foreign minister, who had urged revenge on Prussia for the war of 1866 and a Franco-Austrian alliance, left office, and Andrássy took his place.

He had resolutely opposed the "policy of revenge," notably in his speech of July 28, 1870, and under his guidance Austria-Hungary established that firm friendship with Germany which was the most essential factor in European politics up to 1914. Andrássy was a Magyar, and a man of world-wide outlook; for both reasons he saw in Germany the only trustworthy support of his country and his nation against Russian aggression and the encroachments of the Slavonic nationalities in the dual monarchy and in the Balkans.

Ultimately, Andrássy saw in Russia his most dangerous enemy, but he was able to preserve good relations, and even to secure the signature of an agreement between Franz Joseph and Alexander II. to act together to maintain the peace of Europe (June 6, 1873). Meanwhile his wise and active policy restored Austria-Hungary's fallen international prestige. She was no longer isolated; friendly relations were cultivated with Germany and Russia, and with Great Britain and Italy. The preservation of the Ottoman empire was most desirable for Andrássy's policy; but, should this prove impossible, he did not propose to let Russia's influence eclipse that of Austria-Hungary in the Balkans. At the same time, when court and military circles in Vienna were hoping for an acquisition of territory in the Balkans, Andrássy, fearing the effects on Hungary of an increase of the Slav population in the dual monarchy, resolutely opposed any territorial aggrandisement. Thus, when serious disturbances broke out in Bosnia in 1875, Andrássy, in his famous note of Dec. 30, 1875, urged the introduction of reforms which should leave the authority of the Porte intact, while ameliorating the lot of the Christians. The maintenance of the *status quo* proved impossible; and at the Congress of Berlin, Andrássy, who was present as Austro-Hungarian plenipotentiary, accepted for his country a mandate over Bosnia and Hercegovina far more for defensive, than for offensive, reasons. Nevertheless, the occupation was intensely unpopular in Hungary, as also in German Austria; and on Oct. 8, 1879, Andrássy resigned. The offensive-defensive alliance with Germany, which placed the foreign relations of Austria-Hungary once more on a stable footing, was his work, though it was signed by Haymele.

After his retirement Andrássy continued to take an active part in public affairs both in the Delegations and in the upper house as a moderate Constitutionalist and defender of the *Ausgleich* of 1867. In the last years of his life he regained his popularity, and his death on Feb. 18, 1890, was universally mourned as a national calamity. He was the first Magyar statesman who, for centuries, had occupied a European position. Breadth of view, swift resourcefulness, and an intimate knowledge of men and things were his distinguishing qualities as a statesman. Personally he was the most amiable of men; he united in himself the Magyar magnate and the modern gentleman. If Deák was the architect, Andrássy certainly was the master-builder of the modern Hungarian state.

Count Andrássy left two sons and one daughter, Ilona (b. 1859), who married Count Lajos Batthyány. The elder son, Tivador (Theodore) Andreas (b. July 10, 1857), was elected vice-president of the lower house of the Hungarian parliament in 1890. The younger, Gyula (Julius) is noticed above.

See Andrássy's *Speeches* (Hung.) edited by Béla Lederer (1891); *Memoir* (Hung.) by Benjamin Kállay (1891); *Recollections of Count Andrássy* (Hung.) by Máno Kónyi (1891). *Graf Julius Andrássy: sein Leben und seine Zeit*, by E. von Wertheimer (Stuttgart, 1913).

"ANDRÁSSY NOTE, THE," a declaration drawn up by Count Andrássy on behalf of Russia, Austria and Germany, and presented to the Porte, after the adherence of France and Great Britain, on Jan. 31, 1876. Serious insurrections had broken out in Bosnia and Hercegovina. The Andrássy note was an attempt at conciliation: it urged the equality before the law of Christian and Muslim subjects, the abolition of the system of farming taxes, and the erection of an administrative local assembly representing both religions. Neither the Andrássy note nor the subsequent Berlin memorandum (to which Great Britain refused any support) was successful. Serbia and Montenegro declared war. The "Bulgarian atrocities" followed, precipitating the Russo-Turkish War, which was closed by the treaties of San Stefano and Berlin, 1878 (*qq.v.*). (*See* also EASTERN QUESTION.)

ANDRÉ, JOHN (1751–1780), British soldier, was born in London in 1751 of Genevese parents. Accident brought him in 1769 to Lichfield, where, in the house of the Rev. Thomas Seward, he met the beautiful Miss Honora Sneyd. A strong attachment sprang up between the two, but Miss Sneyd's family refused their consent to marriage. André travelled for some time in Germany, and eventually joined the 7th Royal Fusiliers in



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MAJOR JOHN ANDRÉ, BRITISH SOLDIER AND PATRIOT, WHO WAS HANGED AS A SPY DURING THE AMERICAN REVOLUTION. FROM A SKETCH MADE BY ANDRÉ ON THE MORNING OF THE DAY FIXED FOR HIS EXECUTION

Canada. Honora married in 1773 R. L. Edgeworth, the father of Maria Edgeworth, but André remained faithful. In a letter to Anna Seward, written shortly after being taken prisoner by the Americans at the capitulation of St. John's on Nov. 3 1775, he states that he has been "stripped of everything except the picture of Honora, which I concealed in my mouth. Preserving this I yet think myself fortunate." Exchanged towards the close of 1776, André received rapid promotion, and Sir Henry Clinton appointed him adjutant-general of the forces in 1778.

Early in 1780 the American general, Benedict Arnold (q.v.), made overtures to the British to betray to them the fortress of West Point on the Hudson river. Major André was appointed to negotiate with Arnold. For this purpose he landed from a vessel bearing a flag of truce and saw Arnold, who gave him full particulars and plans of the fortress of West Point, and arranged to co-operate with the British during an attack which was to be made in a few days. Unfortunately for André, the British vessel was fired on before the negotiations were finished and obliged to drop down the river. André was compelled to pass the night within the American lines. Exchanging his uniform for a civilian disguise, he set out next day by land for New York, provided by Arnold with a passport. When all danger of being recognized seemed past, André was stopped by three American militiamen who searched him and discovered in his boots the proofs of his negotiations for the betrayal of West Point. Washington, although admitting that André was "more unfortunate than criminal," sent him before a court-martial, by which, he was, in consequence of his own admissions, condemned to death as a spy. He was hanged at Tappan on Oct. 2 1780. Arnold escaped by flight. The justice of André's execution has been much discussed, but he undoubtedly acted as a spy, although under orders and entirely contrary to his own feelings. Washington's apparent harshness in refusing the condemned man a soldier's death by shooting has also been censured.

Major André showed considerable poetic talent in his humorous *Cow-chase*, a parody on *Chevy-chase*, which appeared in three successive parts in New York, the last on the very day of his capture. His fate excited universal sympathy, and the whole British army went into mourning for him. A mural tablet to his memory was placed in Westminster Abbey by the British Government; and a memorial has been erected to him by Americans on the spot where he was taken. André's military journal of the

British movements in America from June 1777 to the close of 1778, was taken to England in 1782 by General Grey, whose descendant, Earl Grey, discovered it in 1902.

BIBLIOGRAPHY.—*See* Sargent-Winthrop, *The Life and Career of Major John André, etc.*, (new ed., New York, 1902); *André's Journal* (Boston, Mass., The Bibliophile Society, 1904).

ANDRÉ LE CHAPELAIN (ANDREAS CAPELLANUS), mediaeval French writer and chaplain at the French court (whence his surname), was born in the second half of the 12th century, and probably held his office under Philip Augustus (1180–1223). His famous treatise, *Liber de Arte honeste amandi et de Reprobatione inhonesti Amoris*, written in Latin at the beginning of the 13th century and translated twice into French during the century, is an interesting source of information concerning mediaeval manners and morals, and the "court of love" in particular. There are 12 mss. extant, of which the most important are: the 13th century ms in the Vatican, coll. Ottobonianae, no. 1463; the 14th century ms. in the Bibliothèque Nationale, no. 8758; and the 15th century ms. in the Ambrosian Library, A. no. 136. The work has also been translated into German and Italian The most widespread edition is that of D. Mühler, *Erotica seu Amatoria Andrei Capellani regii* (Dortmund, 1610); other editions are by E. Trojel, *Andreae Capellani regii Francorum De Amore libri tres* (Copenhagen, 1892); and by H. M. Elster, a German translation, *3 Bücher über die Liebe . . .* (1924).

ANDREA, GIOVANNI (1275–1348), professor of canon law at Bologna, where he is said to have died of plague. Curious stories are told of him, *e g.*, that by way of self-mortification he lay every night for 20 years on the bare ground with only a bear's skin for a covering; that in an audience he had with Pope Boniface VIII. his extraordinary shortness of stature led the pope to believe he was kneeling, and to ask him three times to rise, to the immense merriment of the cardinals, and that he had a daughter, Novella, so accomplished in law as to be able to read her father's lectures in his absence, and so beautiful that she had to read behind a curtain lest her face should distract the attention of the students.

ANDREA DEL SARTO (1486–1531), Italian painter, was born in Florence on July 16, 1486. There were four other children. His surname has been given as Vanucchi, his name "del Sarto" was given him because his father, Agnolo, was a tailor. In 1494 Andrea was put to work under a goldsmith. He took to drawing from his master's models and was soon transferred to a skilful woodcarver and inferior painter named Gian Barile, with whom he remained until 1498. Barile recommended him to Piero di Cosimo as draughtsman and colourist. Piero retained Andrea for some years, allowing him to study from the famous cartoons of Leonardo da Vinci and Michelangelo. Finally Andrea agreed with his friend Franciabigio, who was somewhat his senior, that they would open a shop conjointly; at a date not defined they took a lodging together in the Piazza del Grano. Their first work in partnership may probably have been the "Baptism of Christ," for the Florentine Compagnia dello Scalzo. Soon afterwards the partnership was dissolved From 1509 to 1514 the brotherhood of the Servites employed Andrea, as well as Franciabigio and Andrea Feltrini, the first-named undertaking in the portico of the Annunziata three frescoes illustrating the life of the Servite saint Filippo Benizzi (d. 1285). The subjects are the saint sharing his cloak with a leper, cursing some gamblers, and restoring a girl possessed with a devil. The second and third works excel the first, and are impulsive and able performances. These paintings gained for their author the pre-eminent title "Andrea senza errori" (Andrew the unerring). Andrea went on to the Death of S. Filippo and the Children cured by touching his Garment—all the five works being completed before the close of 1510. The youth of 23 was already, in technique, about the best fresco-painter of central Italy, barely rivalled by Raphael, who was the elder by four years. Michelangelo's Sixtine frescoes were then only in a preliminary stage. Andrea always worked in the simplest, most typical, and most trying method of fresco—that of painting the thing once and for all, without any subsequent dry-touching. He now received many commissions. The brotherhood of the Servites engaged him to do two more frescoes in the Annunziata at a higher price; he also painted, towards 1512, an Annunciation in the monastery of S. Gallo.

The "Tailor's Andrew" appears to have been an easy-going plebeian, to whom a modest position in life and scanty gains were no grievances. As an artist he must have known his own value; but he probably rested content in the sense of his superlative powers as an executant, and did not aspire to the rank of a great inventor or leader, for which, indeed, he had no vocation. He led a social sort of life among his compeers of the art, was intimate with the sculptor Rustici, and joined a jolly dining-club at his house named the Company of the Kettle, also a second club named the Trowel. At one time, Franciabigio being then the chairman of the Kettle-men, Andrea recited, and is by some regarded as having composed, a comic epic, "The Battle of the Frogs and Mice"—a rechauffé, as one may surmise, of the Greek *Batrachomyomachia*. He fell in love with Lucrezia (del Fede), wife of a hatter named Carlo Recanati; the hatter dying opportunely, on Sept. 1, 1516, Andrea married her. She was a very handsome woman and has come down to us treated with great suavity in many a picture of her lover-husband, who constantly painted her as a Madonna and otherwise; and even in painting other women he made them resemble Lucrezia in general type. Vasari, who was at one time a pupil of Andrea, describes her as faithless, jealous, overbearing, and vixenish with the apprentices. She lived to a great age, surviving her husband 40 years.

By 1514 Andrea had finished his last two frescoes in the court of the Servites, the "Nativity of the Virgin," which shows the influence of Leonardo, Domenico Ghirlandajo, and Fra Bartolommeo in effective fusion, and the "Procession of the Magi," intended as an amplification of a work by Baldovinetti; in this fresco is a portrait of Andrea himself. He also executed at some date a much-praised head of Christ over the high altar. By Nov. 1515 he had finished at the Scalzo the allegory of Justice, and the "Baptist preaching in the desert"—followed in 1517 by "John baptizing" and other subjects. Before the end of 1516 a "Pietà" of his composition and afterwards a Madonna were sent to the French court. At the invitation of Francis I. Andrea went in June 1518 to Paris, where, for the first and only time in his life he was handsomely remunerated. Lucrezia, however, wrote urging his return to Italy. The king assented on the understanding that his absence from France was to be short; and he gave Andrea a sum of money to be expended in purchasing works of art for his royal patron. Andrea spent the king's money and some of his own in building a house for himself in Florence.

In 1520 he resumed work in Florence, and executed the "Faith" and "Charity" in the cloister of the Scalzo. These were succeeded by the "Dance of the Daughter of Herodias," the "Beheading of the Baptist," the "Presentation of his head to Herod," an allegory of Hope, the "Apparition of the Angel to Zacharias" (1523), and the monochrome of the Visitation (1524). In 1525 he painted the very famous fresco named the "Madonna del Sacco," a lunette in the cloisters of the Servites, generally accounted his masterpiece. His final work at the Scalzo was the "Birth of the Baptist" (1526), executed with some enhanced elevation of style after Andrea had studied Michelangelo's figures in the sacristy of S. Lorenzo. In the following year he completed at S. Salvi, near Florence, a celebrated "Last Supper," in which all the personages seem to be portraits. This also is a very fine example of his style, though the conception of the subject is not exalted. It is the last monumental work of importance which Andrea del Sarto lived to execute. He caught the plague at Florence, and died on Jan. 22, 1531, at the comparatively early age of 43. He was buried in the church of the Servites.

Of the various portraits by Andrea said, though with doubtful reason, to represent himself, one, an admirable half-figure is in the National Gallery, London; others are in the gallery at Panshanger, in the Uffizi Gallery and the Pitti Palace. Other of his works are: in the Uffizi, the "Madonna di S. Francesco," or "Madonna delle Arpie," from certain figures of harpies which are decoratively introduced, *c.* 1517, and the altar-piece painted for the monastery of S. Gallo, the "Fathers disputing on the doctrine of the Trinity," *c.* 1517; in the Louvre, "Charity," perhaps the

only painting which Andrea executed while in France; in the Belvedere of Vienna, "The Pietà"; at Poggio a Caiano—a celebrated fresco (1521), completed by Alessandro Allori, representing Julius Caesar receiving tribute—various figures bringing animals from foreign lands; in the Pitti Gallery two separate compositions of the "Assumption of the Virgin," also a fine "Pietà"; in the Madrid museum the "Virgin and Child"; in the Louvre the "Holy Family," the Baptist pointing upwards; in Berlin a portrait of his wife; and in Panshanger a fine portrait named "Laura." The Uffizi and the Louvre possess many fine drawings from nature by his hand.

In 1523 Andrea del Sarto produced at the request of Ottaviano de' Medici a copy of the portrait group of Leo X. by Raphael; it is now in the Naples museum, the original being in the Pitti Gallery. Even Giulio Romano, who had himself manipulated the original to some extent, was misled.

Andrea had true pictorial style, a very high standard of correctness and an enviable balance of executive endowments. The point of technique in which he excelled least was perhaps that of discriminating the varying textures of different objects and surfaces. There is not much elevation or ideality in his works—much more of reality. His chiaroscuro is not carried out according to strict rule, but is adjusted to his liking for harmony of colour and fused tone and transparence; in fresco more especially his predilection for varied tints appears excessive. It may be broadly said that his taste in colouring was derived mainly from Fra Bartolommeo, and in form from Michelangelo; and his style partakes of the Venetian and Lombard, as well as the Florentine and Roman—some of his figures are even adapted from Albert Dürer. In one way or other he continued improving to the last. It is in his portraits that Andrea ranks among the greatest.

In this account of Andrea del Sarto the main lines of the narrative of Crowe and Cavalcaselle, supplemented by Vasari, Lanzi, and others, have been followed.

See H. Guinness, *Andrea del Sarto* (1899); F. Knapp, *Andrea del Sarto* (Beilefeld and Leipzig, 1907); C. Pfeiffer, *Les Madones d'Andrea del Sarto Étude Critique* (1913).

ANDREANI, ANDREA, Italian engraver on wood, in chiaroscuro, was born at Mantua about 1540 (Brulliot says 1560) and died at Rome in 1623. His engravings are scarce and valuable, and are chiefly copies of Mantegna, Dürer, and Titian.

ANDREE, KARL (1808–1875), German geographer, was born at Brunswick on Oct. 20, 1808, and died at Wildungen on Aug. 10, 1875. He was educated at Jena, Göttingen, and Berlin. From 1855 he devoted himself entirely to geography and ethnography, working successively at Leipzig and at Dresden. In 1862 he founded the important geographical periodical *Globus*. His works include *Nordamerika in geographischen und geschichtlichen Umrissen* (Brunswick, 1854), *Geographische Wanderungen* (Dresden, 1859), and an important *Geographie des Welthandels* (Stuttgart, 1867–72).

His son RICHARD (1835–1912) devoted himself especially to ethnography, but he also had a chief share in the production of the *Physikalisch-statistische Atlas des deutschen Reiches* (Leipzig, 1877), *Allgemeine Handatlas* (1st ed. 1881), and other atlases; and he continued the editorship of the *Globus*.

ANDRÉE, SALOMON AUGUST (1854–1897?), Swedish engineer, was born at Grenna, on Lake Vetter, Oct. 18 1854. After education at the Stockholm technical college, he studied aeronautics, and in 1895 elaborated a plan for crossing the north polar region by a balloon which should be in some degree dirigible by sails and trailing ropes. After an abortive effort in 1896, the winds being contrary, Andrée started with two companions from Danes Island, Spitsbergen, on July 11 1897. They were never seen again. Of several expeditions sent in search of them, the first started in Nov. 1897, on the strength of a report of cries of distress heard by shipwrecked sailors at Spitzbergen; in 1898 and 1899 parties searched the north Asiatic coast and the New Siberia Islands; and in May 1899 Dr. Nathorst headed an expedition to eastern Greenland. None was successful, and only scanty information was obtained from the discovery of a few buoys (on the west of Spitsbergen, northern Norway, Iceland, etc.) which the balloonists had arranged to drop, and a message taken from a carrier pigeon despatched from the balloon two days after its ascent. There were also messages in two of the buoys, but they dated only from the day of the ascent. The others were empty.

ANDREINI (ahn″drą-ē′nē), **FRANCESCO,** Italian actor, was born at Pistoia in the latter half of the 16th century. He was a member of the company of the *Gelosi* which Henry IV. summoned to Paris to please his bride, Marie de' Medici. His wife ISABELLA ANDREINI (1562–1604) was a distinguished actress, and also a minor poet. Her books included a pastoral, *Mirtilla* (Verona, 1588), a volume of songs, sonnets and other poems (Milan, 1601), and a collection of letters, published after her death. Her distinguished son GIAMBATTISTA ANDREINI (1578–1650), actor and playwright, was born in Florence, and acted in Paris under the name of Leylio. Italian writers have surmised that one of his plays, *L'Adamo* (Milan, 1613), suggested to Milton the idea of *Paradise Lost*.

ANDRÉOSSY, ANTOINE-FRANÇOIS, COUNT (1761–1828), French artillery officer and diplomatist, was born March 6 1761. He served in the French Revolutionary wars on the Rhine, in Italy and in Egypt, and took part in the *coup d'état* of the 18th Brumaire. During the short peace which followed the treaties of Amiens and Lunéville he was ambassador to England, but his repeated warnings to Napoleon that the British Government desired to maintain peace, but must be treated with consideration, were disregarded. Later Napoleon sent Andréossy as ambassador in 1808 to Vienna and in 1812 to Constantinople. After his recall by Louis XVIII. in 1814 he retired into private life, and wrote works on military history and scientific memoirs. He died at Montauban in 1828.

See Marion, *Notice nécrologique sur le Lt.-Général Comte Andréossy*.

ANDRES, JUAN (1740–1817), Spanish Jesuit, wrote on science, music, etc., but his chief work was *Dell'origine, progressi, e stato attuale d'ogni Letteratura* (Parma, 1782–99). A Spanish translation was made by his brother Carlos (Madrid, 1784–1806), and an abridgment in French (1838–46) was compiled by Alexis Nerbonne.

See C. Sommervogel, *Bibliothèque de la compagnie de Jésus, première partie* (Brussels and Paris), vol. i. col. 342–350.

ANDREW, ST., the Apostle (*see* APOSTLE).

ANDREW II. (1175–1235), king of Hungary, son of Bela III., succeeded his nephew, the infant Ladislas III., in 1205. By his reckless generosity Andrew impoverished the crown, and made the monarchy dependent on the great feudatories, who reduced Hungary to a state bordering on anarchy. His first wife, Gertrude of Meran, was murdered (Sept. 24 1213) by rebellious nobles. In 1217 Andrew set out for the Holy Land with an army of 15,000 men, about 10,000 of whom sailed from Venice to Acre. The expedition failed, and on Andrew's return the barons extorted from him the Golden Bull which has been called the Hungarian *Magna Carta*. Andrew was thrice married. St. Elizabeth of Hungary was his daughter by his first wife, Gertrude.

BIBLIOGRAPHY.—No special monograph for the whole reign exists, but there is a good description of Andrew's crusade in Reinhold Roehricht, *Geschichte des Königreiches Jerusalem* (Innsbruck, 1898). The best account of Andrew's government is in László Szalay's *History of Hungary* (Hung.), vol. i. (Leipzig and Budapest, 1851–62).

ANDREW, JOHN ALBION (1818–1867), American political leader, "war governor" of Massachusetts, was born at Windham, Me., on May 31, 1818. He graduated at Bowdoin college in 1837, studied law in Boston, was admitted to the Suffolk bar in 1840, and practised his profession in Boston. He also took a deep interest in religious matters, was a prominent Unitarian and was assistant editor for some time of *The Christian World*. With ardent anti-slavery principles, he entered political life as a "Young Whig" opposed to the Mexican War; he became an active Free-Soiler in 1848, and in 1854 took part in the organization in Massachusetts of the new Republican party. He served one term, in 1858, in the State house of representatives. In 1859 he took such an active part in raising funds to defend John Brown, then on trial in Virginia, that he aroused the suspicions of a senatorial committee investigating Brown's raid, and was sum-

moned to Washington to tell what he knew of the affair. In 1860 he was chairman of the Massachusetts delegation to the Republican national convention at Chicago, which nominated Lincoln for the presidency; and from 1861 to January 1866, throughout the trying period of the Civil War, he was governor of Massachusetts, becoming known as one of the ablest, most patriotic and most energetic of the remarkable group of "war governors" in the North.

Immediately after his inauguration he began filling the militia regiments with young men ready for active service, saw that they were well drilled and supplied them with good modern rifles. As a result, Massachusetts was the only northern State in any way prepared for war when the Confederates fired on Fort Sumter; and her troops began to muster in Boston on April 16, the very day after President Lincoln's call for volunteers. On the next day the 6th Massachusetts Volunteer Infantry started south for the defence of Washington, and was the first fully armed and equipped volunteer regiment to reach the capital. Within six days after the call, nearly 4,000 Massachusetts volunteers had departed for Washington. In 1863, at Governor Andrew's own request, the secretary of war authorized him to raise several regiments of negro troops, with white commissioned officers, and the 54th Massachusetts Infantry was the first regiment of free negroes raised in the North Governor Andrew's example was quickly followed in other States, and before the end of the year 36,000 negroes had been enrolled in the Union armies. When the War Department ruled that the negro troops were entitled to pay only as "labourers" and not as soldiers, Governor Andrew used all his influence with the president and the secretary of war to secure for them the same pay as white troops, and was finally successful. Notwithstanding his loyal support of the administration during the struggle, he did not fully approve of its conduct of the war, which he deemed shifting and timid; and it was with great reluctance that he supported Lincoln in 1864 for a second term.

In 1865 Andrew rejected the more radical views of his party as to the treatment to be accorded to the late Confederate States, opposed the immediate and unconditional enfranchisement of freedmen, and, though not accepting President Johnson's views in their entirety, he urged the people of Massachusetts to give the new president their support. On retiring from the governor's office he resumed the practice of law, at once achieving great success. In 1865 he presided at the first national convention of the Unitarian Church. He died suddenly of apoplexy, at Boston, on Oct. 30, 1867.

See Henry G. Pearson, *Life of John A Andrew* (Boston and New York, 1904).

ANDREWES, LANCELOT (1555–1626), bishop of Winchester, was born in London. His family was an ancient Suffolk one; his father, Thomas, became master of Trinity House. Lancelot was educated at Merchant Taylors' school and at Pembroke Hall, Cambridge, and became a fellow of his college in 1576. He took orders in 1580, and his preferment was rapid. He was vicar of St. Giles's, Cripplegate (1588), prebendary of St. Paul's (1589), of Southwell (1589–1609), dean of Westminster (1601), bishop of Chichester (1605), of Ely (1609), and of Winchester from 1618 until his death, Sept. 26 1626. He was one of those who prepared the authorized version of the Bible (1611).

Two generations later, Richard Crashaw caught up the universal sentiment, when, in his lines "Upon Bishop Andrewes' Picture before his Sermons," he exclaims:—

> "This reverend shadow cast that setting sun,
> Whose glorious course through our horizon run,
> Left the dim face of this dull hemisphere,
> All one great eye, all drown'd in one great teare."

Andrewes was distinguished in many fields. At court, though no trifler or flatterer, he was a favourite counsellor in three successive reigns, but he never meddled much in civil or temporal affairs. His learning made him the equal and the friend of Grotius, and of the foremost contemporary scholars. His preaching was a unique combination of rhetorical splendour and scholarly richness; his piety that of an ancient saint, semi-ascetic and unearthly in its self-denial. As a churchman he is typically Anglican, equally removed from the Puritan and the Roman positions. He stands in true succession to Richard Hooker in working out the principles of the English Reformation, though while Hooker argued mainly against Puritanism, Andrewes chiefly combated Romanism. A good summary of his position is found in his *First Answer to Cardinal Perron,* who had challenged James I.'s use of the title "Catholic." His position in regard to the Eucharist is naturally more mature than that of the first reformers. "As to the Real Presence we are agreed; our controversy is as to the *mode* of it. As to the mode we define nothing rashly, nor anxiously investigate, any more than in the Incarnation of Christ we ask how the human is united to the divine nature in One Person. There is a real change in the elements—we allow *ut panis iam consecratus non sit panis quem natura formavit; sed, quem benedictio consecravit, et consecrando etiam immutavit*" (*Responsio,* p 263). Adoration is permitted, and the use of the terms "sacrifice" and "altar" maintained as being consonant with scripture and antiquity. Christ is "a sacrifice—so, to be slain; a propitiatory sacrifice—so, to be eaten" (*Sermons,* vol. ii. p. 296). "By the same rules that the Passover was, by the same may ours be termed a sacrifice. In rigour of speech, neither of them; for to speak after the exact manner of divinity, there is but one only sacrifice, *veri nominis,* that is Christ's death. And that sacrifice but once actually performed at His death, but ever before represented in figure, from the beginning; and ever since repeated in memory to the world's end. That only absolute, all else relative to it, representative of it, operative by it. . . . Hence it is that what names theirs carried, ours do the like, and the Fathers make no scruple at it—no more need we" (*Sermons,* vol. ii p 300). As to reservation, "it needeth not: the intent is had without it," since an invalid may always have his private communion. Andrewes declares against the invocation of saints, the apparent examples in patristic literature are "rhetorical outbursts, not theological definitions." His services to his church have been summed up thus. (1) he has a keen sense of the proportion of the faith and maintains a clear distinction between what is fundamental, needing ecclesiastical commands, and subsidiary, needing only ecclesiastical guidance and suggestion; (2) as distinguished from the earlier protesting standpoint, *e g* of the 39 Articles, he emphasized a positive and constructive statement of the Anglican position.

LITERATURE—Of his works the *Manual of Private Devotions* is the best known, for it appeals to Christians of every church. One of the many good modern editions is that by Alex. Whyte (1900). Andrewes's other works occupy eight volumes in the Library of Anglo-Catholic Theology (1841–54). Of biographies we have those by H. Isaacson (1650), A. T. Russell (1863), R. L. Ottley (1891), and Dean Church's essay in *Masters in English Theology. See* also W. H. Frere, *Lancelot Andrewes as a Representative of Anglican Principles* (1898; Church Hist. Soc. Publications, No. 44).

ANDREW OF LONGJUMEAU (Longumeau, Lonjumel, etc.), a French Dominican, explorer and diplomatist. He accompanied the mission under Friar Ascelin, sent by Pope Innocent IV. to the Mongols in 1247; at the Tartar camp near Kars he met a certain David, who next year (1248) appeared at the court of King Louis IX. of France in Cyprus. Andrew, who was now with St. Louis, interpreted to the king David's message, a real or pretended offer of alliance from the Mongol general, Ilchikdai (Ilchikadai), and a proposal of a joint attack upon the Islamic powers for the conquest of Syria. In reply the French sovereign despatched Andrew as his ambassador to the great Khan Kuyuk; with Longjumeau went his brother, a monk, and several others—John Godericke, John of Carcassonne, Herbert "le sommelier," Gerbert of Sens, Robert a clerk, a certain William, and an unnamed clerk of Poissy.

The party set out about Feb. 16 1249, with letters from King Louis and the papal legate, and rich presents, including a chapel-tent, lined with scarlet cloth and embroidered with sacred pictures. From Cyprus they went to the port of Antioch in Syria, and thence travelled for a year to the khan's court, going ten leagues a day. Their route led them through Persia, along the

southern and eastern shores of the Caspian (whose inland character, unconnected with the outer ocean, their journey helped to demonstrate), and probably through Talas, N.E. of Tashkent. On arrival at the supreme Mongol court—either that on the Imyl river (near Lake Ala-kul and the present Russo-Chinese frontier in the Altai), or more probably at or near Karakorum itself, S.W. of Lake Baikal—Andrew found Kuyuk Khan dead, poisoned, as the envoy supposed, by Batu's agents. The regent-mother, Ogul Gaimish (the "Camus" of Rubruquis), seems to have received and dismissed him with presents and a letter for Louis IX., the latter a fine specimen of Mongol insolence. But it is certain that before the friar had quitted "Tartary," Mangu Khan, Kuyuk's successor, had been elected.

Andrew's report to his sovereign, whom he rejoined in 1251 at Caesarea in Palestine, appears to have been a mixture of history and fable; the latter affects his narrative of the Mongols' rise to greatness, and the struggles of their leader, evidently Jenghiz Khan, with Prester John; it is still more evident in the position assigned to the Tartar homeland, close to the prison of Gog and Magog. On the other hand, the envoy's account of Tartar manners is fairly accurate, and his statements about Mongol Christianity and its prosperity, though perhaps exaggerated (*e.g.*, as to the 800 chapels on wheels in the nomadic host), are based on fact. Mounds of bones marked his road, witnesses of devastations which other historians record in detail; he found Christian prisoners from Germany in the heart of "Tartary" (at Talas); the ceremony of passing between two fires he was compelled to observe, as a bringer of gifts to a dead khan, gifts which were of course treated by the Mongols as evidence of submission.

We only know of Andrew through references in other writers; *see* especially William of Rubruquis in *Recueil de voyages*, iv. (Paris, 1839), pp. 261, 265, 279, 296, 310, 353, 363, 370; Joinville, ed. Francisque Michel (1858, etc.), pp. 142, etc.; Jean Pierre Sarrasin, in same vol., pp. 254–5; William of Nangis in *Recueil des historiens des Gaules*, xx. 359–67; Rémusat, *Mémoires sur les relations politiques des princes chrétiens . . . avec les . . . Mongols* (1822, etc.), p. 52.

(C. R. B.)

ANDREWS, CHARLES MC LEAN (1863–), American educator and historian, was born in Weathersfield, Conn., on Feb. 22, 1863. He was educated at Trinity college, Hartford, Conn., graduating in 1884, and at Johns Hopkins university he received the degree of doctor of philosophy in 1889. He was associate professor and professor of history in Bryn Mawr college from 1889 to 1907 and professor of history in Johns Hopkins university from 1907 to 1910 when he became professor of American history in Yale university. He has been actively associated with many historical societies and has contributed numerous articles to reviews and historical journals.

Among his extensive historical writings are: *The River Towns of Connecticut* (1889); *The Old English Manor* (1892); *The Historical Development of Modern Europe* (1896–98); *Contemporary Europe, Asia and Africa, 1871–1901* (1902); *A History of England*, a text-book (1903); "Colonial Self-Government, 1652–1689," vol. v. of *The American Nation, a History* (1904); *British Commissions, Councils and Committees, 1622–1675* (1908); *A Short History of England* (1912); *The Colonial Period of American History* (1912); *The British Merchants and the Non-Importation Movement* (1917); *Fathers of New England* and *Colonial Folkways* (in "Chronicles of America" Series, 1919); *The Colonial Background of the American Revolution* (1924).

ANDREWS, ELISHA BENJAMIN (1844–1917), American educator, was born in Hinsdale, N.H., on Jan. 10, 1844. At the outbreak of the Civil War he entered the Union army and was wounded, losing an eye, at Petersburg, in 1864. He graduated from Brown university in 1870 and from Newton theological institution, Newton Centre, Mass., in 1874 From 1875 to 1879 he was president of Denison university, Granville, Ohio. In 1879–82 he was professor of homiletics in Newton theological institution and from 1882 to 1888 he was professor of history and political economy in Brown university He became professor of political economy at Cornell university in 1888, and in 1889 was made president of Brown university. In 1897, because of criticism by the trustees of his advocacy of free silver, he resigned, but soon withdrew his resignation. He served as superintendent of the public schools of Chicago from 1898 to 1900, when he was chosen chancellor of the University of Nebraska, from which he retired as chancellor emeritus in 1909. He died at Interlaken, Fla., on Oct. 30, 1917.

In addition to text-books on history and economics, his published works include *An Honest Dollar* (1889); *Wealth and Moral Law* (1894); *History of the United States* (1894); and *The History of the Last Quarter Century in the United States, 1870–95* (1896), revised as *The United States in Our Own Time* (1903).

ANDREWS, JAMES PETTIT (*c.* 1737–1797), English historian and antiquary, was born at Shaw House, Newbury, Berkshire, and died in London on Aug. 6, 1797. He was one of the magistrates at the police court in Queen Square, Westminster, from 1792 to his death. His chief work was a *History of Great Britain connected with the Chronology of Europe from Caesar's Invasion to Accession of Edward VI.* (1794–95).

ANDREWS, ROY CHAPMAN (1884–), American naturalist and explorer, was born at Beloit, Wis., on Jan. 26, 1884. Immediately after his graduation from Beloit college in 1906 he entered the American Museum of Natural History, New York, and went to Alaska on his first exploring trip in 1908. In 1909–10 he accompanied, as a naturalist, the "U S S. Albatross" on its voyage to the Dutch East Indies, Borneo and Celebes; in 1911–12 he explored northern Korea; and in 1913 was with the Borden Alaska expedition. The same year he received the degree of M A. from Columbia university.

Until 1914 he specialized in the study of whales and other water mammals. From that date he devoted himself, as chief of the division of Asiatic exploration of the American Museum of Natural History, to the exploration of the lesser known portions of Central Asia, China and Borneo, also serving in the U.S. Intelligence service in China, in 1918 The expeditions under his leadership explored successively, Tibet, southwest China, Burma, North China, Mongolia and Central Asia. In Mongolia they found some of the richest fossil fields known to the world The fruits of the expeditions which he led in 1921–22 and 1925 into Central Asia included the discovery of new geological formations, large fossil fields, dinosaur eggs, and the skull and other parts of the *Baluchitherium*—the largest known land mammal.

The expeditions discovered the oldest known mammals and extensive evidence of primitive human life on the Central Asian plateau. Evidence was discovered also pointing to Central Asia as a place of origin and centre of distribution for much of the reptilian and mammalian life of the world. The expeditions continued work in Central Asia until 1929.

He has written *Whale Hunting with Gun and Camera* (1916), *Camps and Trails in China*, with Yvette Borup Andrews (1918), *Across Mongolian Plains* (1921), *On the Trail of Ancient Man* (1926–27) and numerous monographs and scientific bulletins of the American Museum of Natural History and other scientific institutions.

ANDREWS, THOMAS (1813–1885), Irish chemist and physicist, was born on Dec. 19, 1813, at Belfast, where his father was a linen merchant. In 1845 he was appointed vice-president of the newly established Queen's college, Belfast, and professor of chemistry, offices which he held till 1879, when failing health compelled his retirement. He died on Nov. 26, 1885. The work on which his reputation mainly rests, and which best displayed his skill and resourcefulness in experiment, was concerned with the liquefaction of gases. He carried out a very complete enquiry into the laws expressing the relations of pressure, temperature and volume in carbonic dioxide, in particular establishing the conceptions of critical temperature and critical pressure, and showing that the gas passes from the gaseous to the liquid state without any breach of continuity.

His scientific papers were published in a collected form in 1889 with a memoir by Profs. Tait and Crum Brown.

ANDREYEV, LEONID NICOLAIEVICH (1871–1919), Russian novelist, was born in Orel on June 18 1871. He was educated at the government school. Poverty and an unhappy heredity drove him, in 1894, to an attempt on his own life, as a result of which he suffered from a weak heart, which ultimately caused his death. He became a reporter on *The Courier*. Then, in 1899, his story *They Lived* appeared in the monthly *Zhizn*

("Life") and attracted universal attention. It is the only work of Andreyev which contains a happy love-story.

In 1901, when the first series of his stories appeared in a separate edition, N. K. Michailovsky, the most influential critic of the time, paid a high tribute to the genius of the young author. This series included the stories *The Grand Slam, The Tocsin, The Wall,* in which Andreyev's creative genius and its characteristics were clearly visible. His subsequent works, *The Story of Serguey Petrovitch, Thought, In the Mist, The Life of Father Vassili Fiveisky, Ghosts,* etc., are similar to his first work in spirit and philosophical outlook.

His works are permeated by horror of life, which appeared to Andreyev, as to James Thomson, a "City of Dreadful Night." His manner is original and he follows the great precept that "in literary works, there should be little room for words and large space for ideas." The same terror of life is expressed in Andreyev's plays *The Life of Man* (1907), *King Hunger, Anathema* (1909). He was not a morbid pessimist who derided the misery of mankind, but a mournful humanist. He pities the sufferers and is filled with scorn for those who add nightmare to nightmare. Andreyev's best-known works reflect this attitude: his protest against war, *The Red Laugh* (trans. 1905); against capital punishment, *The Seven That Were Hanged* (trans. 1909), which appeared during the reign of the White Terror in 1909; and the passionate *S. O. S.* (1919), directed against the Red Terror.

Andreyev refused to follow Gorki's example and to recognize the Bolshevik régime, declined the honours offered by the Bolsheviks and fled to Finland. He thus lost the fortune he had accumulated by his writings, and during the last years of his life he once again experienced poverty and even want. *S. O. S.*, one of the most remarkable works of Russian literature, and Andreyev's swan-song, was published in Finland. He died at his villa at Kuokkala, Finland, Sept. 12, 1919. (I. W. S.)

ANDRIA, a town and episcopal see of Apulia, Italy, in the province of Bari; 35m. W. of the town of Bari by steam tramway and 6m. S.E. of Barletta. Pop. (1921) 55,786 (town); 58,895 (commune). It was founded probably about 1046 by Peter, the first Norman count of Andria. It was a favourite residence of the emperor Frederick II., whose second and third wives, Iolanthe and Isabella of England, were buried in the cathedral dedicated to St. Richard, who is believed to have come from England in 492. There are several other fine churches of the 13th century The Castel del Monte, 9½m. S. of Andria, was constructed by Frederick II., who frequently resided there. Despite its massive and imposing exterior, its details are fine.

ANDRIEU, BERTRAND (1761–1822), French engraver of medals, was born at Bordeaux. He is considered to have restored the art in France, which had declined after the time of Louis XIV.; and during the last 20 years of his life he was entrusted by the French Government with the execution of every work of importance. Many of his medals are figured in the *Medallic History of Napoleon.*

ANDRIEUX, FRANÇOIS GUILLAUME JEAN STANISLAS (1759–1833), French man of letters, was born at Strasbourg on May 6, 1759, and died in Paris on May 9, 1833. He was educated for the bar, and under the Convention was a civil judge in the court of cassation. He became president of the *Tribunat,* but was displaced because of his irreconcilable opposition to the civil code. In his retirement he returned to dramatic writing. He had made a hit in 1788 with *Les Étourdis* and he now produced *Molière avec ses amis* (1804). Among his later plays were *La Comédienne* (1816) and *Lucius Junius Brutus* (1830). As professor of literature at the Collège de France, he maintained the classical tradition and opposed the growing romantic school. In 1829 he became perpetual secretary to the Academy, and worked hard at the completion of the Dictionary.

See also A. H. Taillandier, *Notice sur la vie et les ouvrages d'Andrieux* (1850); Sainte-Beuve, *Portraits littéraires,* vol. i.

ANDRISCUS, "pseudo-Philip," a fuller of Adramyttium, claimed to be a son of Perseus, last king of Macedonia. He seized the Macedonian throne in 149 B.C., after defeating the Roman praetor, and his conquest of Thessaly and alliance with Carthage made the situation dangerous. In 148 he was defeated by Q Caecilius Metellus and given up to Rome. After this Macedonia was formally reduced to a province.

See Velleius Paterculus i. 11; Florus ii. 14; Livy, *Epit.* 49, 50, 52; Diod. Sic. xxxii. 9.

ANDROCLES, more correctly ANDROCLUS, a Roman slave, who lived about the time of Tiberius. He is the hero of a story by Aulus Gellius (v. 14), which tells that Androclus had taken refuge from the cruelties of his master in a cave in Africa, when a lion entered the cave and showed him his swollen paw, from which Androclus extracted a large thorn. The grateful animal subsequently recognized him when he had been captured and thrown to the wild beasts in the circus, and, instead of attacking him, began to caress him; he was then set free. (Aelian, *De Nat. An.,* vii. 48.) The story is the subject of the play, *Androcles and the Lion,* by G. Bernard Shaw.

ANDROIDES: *see* AUTOMATON.

ANDROMACHE, in Greek legend, the daughter of Eëtion, prince of Thebes in Mysia, and wife of Hector (*q.v.*). All her relations perished in or shortly after the taking of the town by Achilles (*Iliad,* vi. 414). After the capture of Troy her son Astyanax (or Scamandrius) was hurled from the battlements (Eurip. *Troades,* 720). When the captives were allotted, Andromache fell to Neoptolemus (Pyrrhus), the son of Achilles, whom she accompanied to Epirus, and to whom she bore three sons. When Neoptolemus was slain at Delphi, he left Andromache and the kingdom to Helenus, the brother of Hector (Virgil, *Aen.* iii. 294). After his death Andromache returned to Asia Minor with her youngest son Pergamus, who there founded a town named after himself.

ANDROMEDA, in Greek legend, the daughter of Cepheus and Cassiopeia (*q.v.*). To satisfy Poseidon, who had been offended, Andromeda, chained to a rock, was exposed to a sea monster. Perseus, returning from having slain the Gorgon, found her, slew the monster, set her free, and married her in spite of Phineus, to whom she had before been promised (Ovid, *Metam.,* v. 1). Andromeda followed her husband to Tiryns in Argos, and became the ancestress of the family of the Perseidae. After her death she was placed by Athena amongst the constellations in the northern sky, near Perseus and Cassiopeia. Sophocles and Euripides (and in modern times Corneille) made the story the subject of tragedies, and its incidents were represented in numerous ancient works of art.

The most famous feature of the astronomical constellation is the Great Andromeda Nebula—the brightest of the spiral nebulae. It can be seen without much difficulty with the naked eye and recognized by its diffuse appearance. It is an "island universe" probably containing millions of stars and of the same general nature as our own stellar system, though apparently of somewhat smaller dimensions. (*See* NEBULA.) From the brightness of the Cepheid variables in the nebula, Hubble has deduced that its distance is 900,000 light-years. A number of outbursts of Novae (temporary stars) have been observed in the nebula. Nearly all the spiral nebulae are receding from us with large velocities, but the Andromeda nebula is one of the exceptional approaching systems, its velocity in the line of sight being 300 kilometres per second. Photographs show in great detail its beautiful spiral structure; the plane of the spiral is tilted with respect to us, giving the nebula an apparently elongated form.

The double star γ Andromedae is a favourite object for observation with a small telescope on account of the striking contrast of colour of the two components.

The Andromedids are a swarm of meteors which made a notable display on Nov. 27 1872, and provide some of the November meteors year by year; the swarm is believed to be the debris of Biela's comet which was last seen in 1852.

ANDRONICUS I. (COMNENUS), Emperor of the East, son of Isaac, and grandson of Alexius I. Comnenus, was born about the beginning of the 12th century. In 1141 he was taken captive by the Turks (Seljuks) and remained in their hands for a year. On being ransomed he went to Constantinople to the court of his

cousin, the Emperor Manuel, with whom he was a great favourite. Andronicus repeatedly fell into disgrace with the emperor on account of his licentious conduct and his liaisons with different ladies connected with the imperial family. A great part of his life between 1152 and 1180, the date of the death of the Emperor Manuel was spent in hiding in courts in the outlying districts of the empire.

In 1180 the Emperor Manuel died and was succeeded by his son Alexius II., who was under the unpopular guardianship of the Empress Maria. He left his retirement, secured the support of the army and marched upon Constantinople, where his advent was stained by a cruel massacre of the Latin inhabitants. Alexius was compelled to acknowledge him as colleague in the empire, but was soon put to death. Andronicus, now (1183) sole emperor, married Agnes, widow of Alexius II., a child eleven years of age. His short reign was characterized by strong and wise measures. He resolved to suppress many abuses, but, above all things, to check feudalism and limit the power of the nobles. The people, who felt the severity of his laws, at the same time acknowledged their justice, and found themselves protected from the rapacity of their superiors. The aristocrats, however, were infuriated against him, and summoned to their aid William of Sicily. This prince landed in Epirus with a strong force, and marched as far as Thessalonica, which he took and destroyed; but he was shortly afterwards defeated, and compelled to return to Sicily. Andronicus seems then to have resolved to exterminate the aristocracy, and his plans were nearly crowned with success. But in 1185, during his absence from the capital, his lieutenant ordered the arrest and execution of Isaac Angelus, a descendant of the first Alexius. Isaac escaped and took refuge in the church of St. Sophia. He appealed to the populace, and a tumult arose which spread rapidly over the whole city. When Andronicus arrived he found that his power was overthrown, and that Isaac had been proclaimed emperor. Isaac delivered him over to his enemies, and for three days he was exposed to their fury and resentment. At last they hung him up by the feet between two pillars. His dying agonies were shortened by an Italian soldier, who mercifully plunged a sword into his body. He died Sept. 12 1185.

ANDRONICUS II. (PALAEOLOGUS) (1260–1332), eastern Roman emperor, was the elder son of Michael Palaeologus, whom he succeeded in 1282. He allowed the fleet, which his father had organized, to fall into decay; and the empire was thus less able than ever to resist the exacting demands of the rival powers of Venice and Genoa. During his reign the Turks under Osman conquered nearly the whole of Bithynia; and to resist them the emperor called in the aid of Roger di Flor, who commanded a body of Spanish adventurers. The Turks were defeated, but Roger was found to be nearly as formidable an enemy to the imperial power. He was assassinated by Andronicus's son and colleague, the emperor Michael IX., in 1305. His adventurers (known as the Catalan Grand Company) declared war upon Andronicus, and, after devastating Thrace and Macedonia, conquered the duchy of Athens and Thebes. From 1320 onwards the emperor was engaged in war with his grandson, Andronicus. He abdicated in 1328 and died in 1332.

ANDRONICUS III. (1296?–1341), eastern Roman emperor, grandson of Andronicus II. His conduct during youth was so violent that, after the death of his father, Michael, in 1320, his grandfather resolved to deprive him of his right to the crown. Andronicus rebelled; he had a powerful party, and the first period of civil war ended in his being crowned and accepted as colleague by his grandfather (1325). The quarrel broke out again and, notwithstanding the help of the Bulgarians, the older emperor was compelled to abdicate (1328). During his reign Andronicus III. was engaged in constant war, chiefly with the Turks, who greatly extended their conquests. He annexed large regions in Thessaly and Epirus, but they were lost before his death to the rising power of Serbia under Ştefan Dušan. He did something for the reorganization of the navy, and recovered Lesbos and Chios from the Genoese. He died on June 15, 1341.

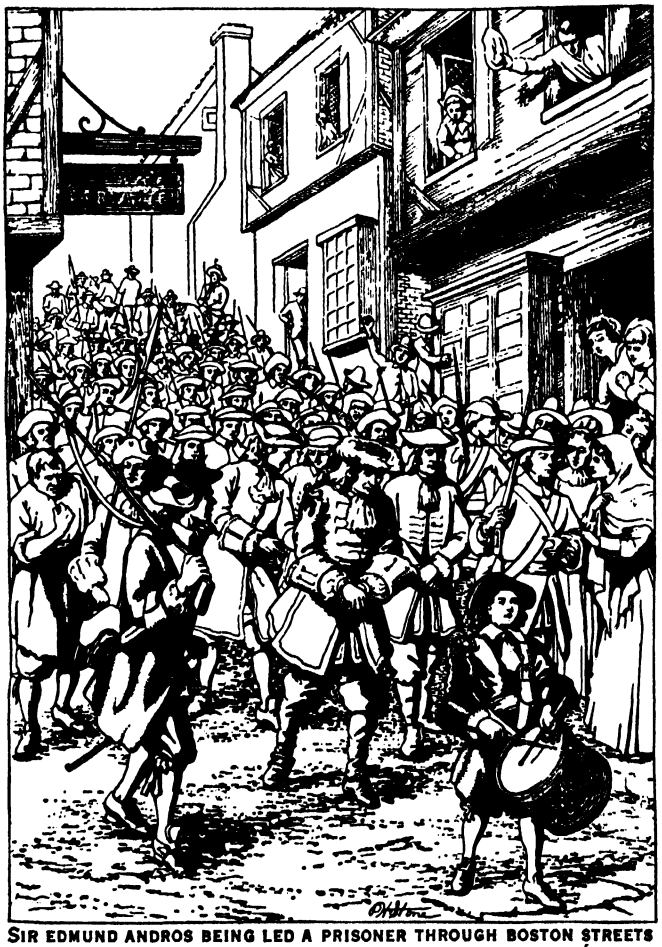
ANDRONICUS OF CYRRHUS, Greek astronomer, flourished about 100 B.C. He built a *horologium* at Athens, the so-called "tower of the winds," a considerable portion of which still exists. It is octagonal, with figures carved on each side, representing the eight principal winds. A brazen Triton on the summit, with a rod in his hand, turned round by the wind, pointed to the quarter from which it blew. From this model is derived the custom of placing weathercocks on steeples.

ANDRONICUS OF RHODES (*c.* 70 B.C.), the 11th scholarch of the Peripatetics. He edited the writings of Aristotle and Theophrastus, and wrote paraphrases of Aristotle and commentaries. Two treatises are sometimes erroneously attributed to him, one on the emotions, the other a commentary on Aristotle's *Ethics* (really by Constantine Palaeocappa in the 16th century, or by John Callistus of Thessalonica).

See Susemihl, *Geschichte der griechischen Literatur in der Alexandrinarzeit* ii. 301–305 (Leipzig 1891–92).

ANDROPHAGI, an ancient nation of cannibals placed by Herodotus (iv. 18, 106), who denies that they are Scythians, well to the north of Scythia, probably in the forests between the upper waters of the Dnieper and Don. They were most likely Finns (Samoyed has the same meaning) and perhaps the ancestors of the Mordvinians (q.v.).

ANDROS, SIR EDMUND (1637–1714), English colonial governor in America, was born in London on Dec. 6, 1637, son of Amice Andros, royal bailiff of the island of Guernsey. In 1674 he



SIR EDMUND ANDROS BEING LED A PRISONER THROUGH BOSTON STREETS
The deposition and arrest of Sir Edmund Andros, governor of the "Dominion of New England," by his colonists in 1689, was an early expression of the spirit of independence which less than 100 years later resulted in the American Revolution

was appointed by the duke of York (later James II.) governor of New York and the Jerseys, though his jurisdiction over the Jerseys was disputed, and until his recall in 1681 to meet an unfounded charge of dishonesty and favouritism, he proved himself to be a capable administrator. His imperious disposition, however, made him unpopular among the colonists. In 1686 he became governor, with Boston as his capital, of the "Dominion of New England," into which Massachusetts (including Maine), Plym-

outh, Rhode Island, Connecticut and New Hampshire were consolidated, and in 1688 his jurisdiction was extended over New York and the Jerseys. But his interference with colonial rights and customs aroused resentment, and on April 18, 1689, soon after news of the arrival of William, prince of Orange, in England reached Boston, the colonists deposed and arrested him, and the inter-colonial union was dissolved. Andros was sent to England for trial in 1690, but was immediately released, and from 1692 until 1698 he was governor of Virginia, but was recalled through the agency of Commissary James Blair (*q.v*) with whom he quarrelled. In 1693–94 he was also governor of Maryland. From 1704–06 he was governor of Guernsey. He died in London in Feb. 1714 and was buried at St. Anne's, Soho.

See *The Andros Tracts* (Boston, 1869–72).

ANDROS or **ANDRO,** the most northerly island of the Cyclades, 6m. S.E. of Euboea, and about 2m. N. of Tenos; nearly 25m long; greatest breadth 10 miles Pop. about 18,000. It is mountainous, with many fruitful and well-watered valleys. Andros, the capital, on the east coast, contains about 2,000 inhabitants. The ruins of Palaeopolis, the ancient capital, are on the west coast; the town possessed a famous temple, dedicated to Bacchus. The ancient population was mainly Ionian, perhaps with a Thracian admixture. Originally dependent on Eretria, by the 7th century B C, it sent colonies to Chalcidice (Acanthus, Stageirus, Argilus, Sane). In 480 it supplied ships to Xerxes and was subsequently harried by the Greek fleet. Though enrolled in the Delian League it remained disaffected towards Athens, and revolted in 411. In the Hellenistic period Andros was coveted as a frontier-post by the naval powers of Macedonia and Egypt. In 200 it was captured by a combined Roman, Pergamene and Rhodian fleet, and remained a possession of Pergamum until the bequest of that kingdom to Rome in 133 B C. Before falling under Turkish rule, Andros was from A D 1207 till 1566 governed by the families Zeno and Sommariva under Venetian protection. It is now an eparchy of Greece

ANDROTION (*c.* 350 B C.), Greek orator, was a pupil of Isocrates and a contemporary of Demosthenes. He is known to us chiefly from the speech of Demosthenes, in which he was accused of illegality against Androtion in proposing the usual honour of a crown to the Council of Five Hundred at the expiration of its term of office Androtion filled several important posts, and during the Social War was appointed extraordinary commissioner to recover certain arrears of taxes. He is said to have gone into exile at Megara, and to have composed an *Atthis,* or annalistic account of Attica from earliest times to his own days (Pausanias vi 7; x. 8). It is disputed whether the annalist and orator are identical, but an Androtion who wrote on agriculture is certainly a different person

Professor Gaetano de Sanctis (in *L'Attide di Androzione e un papiro di Oxyrhynchos,* Turin, 1908) attributes to Androtion, the atthidographer, a 4th-century historical fragment, discovered by B. P. Grenfell and A. S. Hunt (*Oxyrhynchus Papyri,* vol. v.). Strong arguments against this view were set forth by E. M. Walker in the *Classical Review,* May, 1908.

ANDUJAR, the ancient *Isturgi,* town of Spain, in the province of Jaén; on the right bank of the river Guadalquivir. Pop (1920) 17,950. Porous jars, called *alcarrazas,* which keep water cool in the hottest weather, are made from a whitish clay found at Andujar.

ANECDOTE, a word originally meaning something not published. It has now two distinct significations. The primary one is something not published, in which sense it has been used to denote either secret histories—Procopius, *e.g.,* gives this as one of the titles of his secret history of Justinian's court—or portions of ancient writers, which have remained long in ms. and are edited for the first time. Of such *anecdota* there are many collections; the earliest was probably L. A. Muratori's, in 1709. In the more general and popular acceptation of the word, however, anecdotes are short accounts of detached interesting particulars. Of such anecdotes the collections are almost infinite. Spence's *Anecdotes,* Horace Walpole's *Anecdotes of English Painting,* and Mrs. Thrale's *Anecdotes of the late Samuel Johnson, LL.D.* are 18th century collections that are still read. One of the best compilations is that made by T. Byerley (d. 1826) and J. Clinton Robertson (d. 1852) known as the *Percy Anecdotes* (1820–23). A more recent collection is *Literary Anecdotes of the Nineteenth Century,* edited by W. R Nicoll and T. J. Wise.

ANEL, DOMINIQUE (1679–1730), French surgeon, was celebrated for his successful treatment of *fistula lacrymalis.* While at Genoa he invented the fine-pointed syringe, still known by his name, for use in the operation.

ANEMOMETRY, the measurement of air speed. It is difficult to design instruments to measure accurately the speed of moving air; and although recent research has helped, difficulties still persist, particularly as regards the measurement of low air speeds The trouble is mainly because direct methods are impracticable, so it is necessary to measure some physical effect arising from the motion. Three such effects have been found suitable—namely, pressure changes associated with the motion; mechanical effects, such as the rotation of certain types of windmills appropriately mounted in the stream; and, lastly, the rate of cooling of a hot body, such as an electrically heated wire, exposed to the current. The first is most important, since a properly designed instrument, suitably inserted in the stream, experiences a pressure, commonly called the velocity head, entirely characteristic of the motion, and measurable on a pressure gauge. If such an instrument is constructed on what are now established principles it may be used without calibration as a standard for measurement of wind speed. This is not true of anemometers which depend on mechanical or electrical effects; these are subject to individual variations and require calibration against a standard instrument of the pressure-tube type.

Pressure-tube anemometers in general consist of two parts; one is common to all types—namely, an open-ended tube facing the air stream. If flow through this tube is prevented, by connecting the other end to a pressure gauge, the pressure at the mouth is found to be equal invariably to the sum of the static pressure and

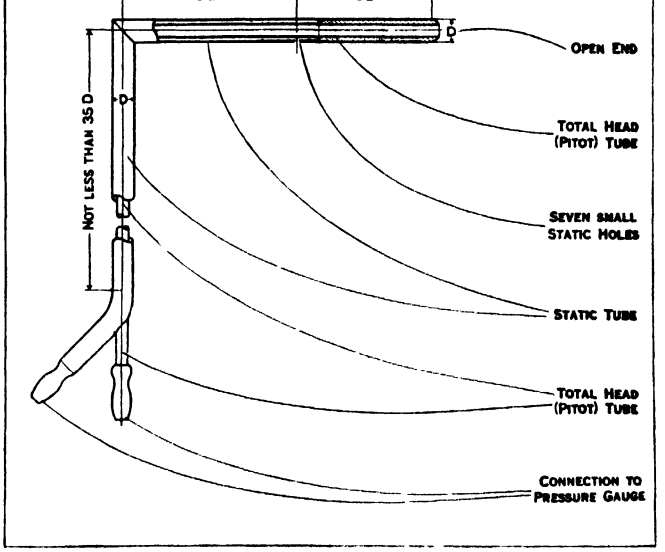


FIG 1.—DIAGRAM OF PITOT-STATIC PRESSURE TUBE, USED AS A STANDARD FOR THE MEASUREMENT OF WIND SPEED
The wind speed is calculated from the pressures set up in the two tubes when they are placed in an air current

the velocity head in the stream at that point. The other part of the anemometer varies in detail with different types, but always consists of a second tube with orifices so arranged as to measure either the static pressure in the stream or the static pressure multiplied by a certain coefficient characteristic of the instrument.

We may consider first the case in which the static tube measures accurately the static pressure itself. If then the two tubes of the complete anemometer are connected to opposite sides of the same differential pressure gauge, the static pressure portion of the pressure transmitted by the facing or "total head" tube will be

balanced by the pressure transmitted from the static tube, and the resultant reading on the gauge will be the velocity head p, which is related to the speed of the air-stream V by the equation

$$p = 0.5\rho V^2 \qquad (1)$$

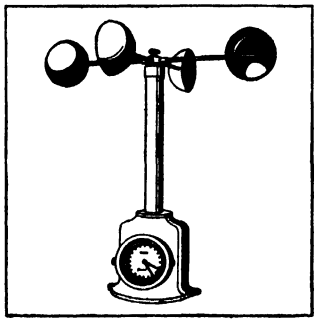
where p is measured as force per unit area and ρ is the air density (mass per unit volume), calculable in any given case from knowledge of the temperature and pressure of the air.

An instrument, whose differential readings measure the velocity-head to an accuracy of about 0·1% is shown in fig. 1. The two tubes are here arranged concentrically, the inner, or Pitot tube (so called after Pitot, who was the first to suggest the use of pressure-tube anemometers), measuring the sum of the velocity and static heads—that is the "total" head, whilst the outer one measures the static pressure at the series of small orifices around its periphery as shown on the diagram. Such an instrument forms a convenient standard to which the readings of other types of anemometers may be referred.

In pressure-tube instruments of the second type, in which the static side does not indicate the true static pressure, the differential pressure p_1 is usually given by an equation of the form

$$p_1 = k\rho v^2 \qquad (2)$$

where k is now a coefficient whose magnitude is in general greater than 0·5 and may vary with the wind speed. In the Dines pressure-tube, much used in meteorological work, the total head tube is mounted so that it is free to rotate about a vertical axis, and is equipped with a weathercock-vane which always points the tube into the wind. A vertical tube, pierced with a number of small holes past which the wind streams, forms the static side, the constant k in equation (2) for this instrument being about 0·75. The pressures are usually transmitted to a recording float-manometer, in which the float moves vertically by an amount corresponding to the applied pressure difference. The motion of the float is communicated to a pen which marks on a chart attached to the surface of a cylindrical drum driven by a clock, and making as a rule one complete revolution in 24 hours. Continuous records of wind speed extending over this period are thus obtained on one chart.



BY COURTESY OF NEGRETTI AND ZAMBRA

FIG 2.—A ROBINSON CUP ANEMOMETER

The velocity of the wind is transmitted to the dial by the revolution of the four metal cups. The dial is usually graduated in miles per hour

Many mechanical devices for measuring air speeds have been proposed, but only the Robinson cup anemometer and the vane anemometer now survive to any marked degree. The former (*see* fig. 2) consists essentially of four hemispherical cups carried with their bases vertical, at the outer ends of four light arms forming a 90° cross in a horizontal plane, and attached to a central sleeve free to rotate about a vertical axis. Opposite cups are arranged so that the concave side of one member of the pair is presented to the air current at the same time as the convex side of the other. Hence, since the aerodynamic force on a cup with its concave face presented to the wind is greater than when the wind is blowing on its convex face, rotation will ensue at a rate depending on the wind speed. The cups are connected by gearing to an indicating mechanism which may either show revolutions, or, as is almost universal practice, units of distance travelled by the wind. In the latter case the distance travelled by the wind for one revolution of the cups is deduced from experience with other instruments of similar type, and the gearing ratio is adjusted to suit this relationship. Under steady conditions, then, the wind speed is obtained by observing, with a stop watch, the motion of the indicating mechanism in a given time.

The ratio of wind speed to linear speed of the centres of the cups is termed the factor of the anemometer. Experimental evidence indicates that the value of this factor depends on the dimensions of the instrument and also on the wind speed, so that even for any particular instrument the factor is not constant at all speeds. These anemometers must be calibrated in winds of known speeds for accurate work. From tests on many such instruments of different sizes it appears that the factor may vary from about 2·2 at the high wind speeds to possibly a little over three at low speeds. A convenient form of cup anemometer has an electric generator attached to the cup shaft and driven by it. The E.M.F. generated thus depends on the rate of rotation of the cups, and can therefore be used as a measure of the wind speed, the relation between these two quantities being determined by test. An indicating voltmeter, connected to the generator, can then be calibrated to read wind speed directly on a scale. Alternatively, by the use of a recording voltmeter, continuous records of wind speed can be obtained. This form of instrument gives an instantaneous reading of wind speed, without the necessity for a stop watch, and also readings can be taken at a distance from the anemometer cups themselves. Obviously, the latter feature is often one of considerable importance, particularly in meteorological work, which is the main field of application of the cup anemometer, since its readings are not affected by changes of wind direction in the horizontal plane. Other forms of distant-recording mechanism have also been devised.

The vane anemometer consists of light flat vanes attached to radial arms mounted on a common spindle which rotates in two jewelled bearings. Eight vanes are usually employed, they are inclined at an angle to the axis of the spindle, which is set along the wind direction when the instrument is in use, and the wind forces acting on the vanes cause the spindle to rotate at a rate depending, in any given case, on the air speed. As in the cup anemometer, the motion of the spindle is communicated by a gear train to a pointer, or, more usually, to a number of pointers moving over dials graduated directly in feet. Experience has taught the makers how to proportion the various dimensions and gear ratios so that the number of feet indicated on the dials in unit time is approximately equal to the distance traversed by the wind in the same time, *i.e.*, to the wind speed. Instruments of this type are mainly of value for measuring air speeds in large ducts or ventilating shafts. They are particularly useful for measuring low speeds where the pressures to be measured with pressure-tube instruments are so small as to necessitate the use of extremely sensitive manometers.

Vane anemometers of normal design can be used over a range of wind speeds from about five to 50 feet per second. For higher speeds, up to 100 feet per second, special instruments are made which are either of heavier construction or, alternatively, incorporate a device by means of which the quantity of air actually passing through the vanes can be reduced. Vane anemometers of specially light construction can also be obtained to measure speeds of less than five feet per second, the lower limit of speed that will cause steady rotation of the vanes being the order of 0·5 feet per second. All instruments need calibration in a wind whose speed can be controlled and adjusted to known values, for it is not possible to predict accurately the readings of a mechanical anemometer from a knowledge of its dimensions only.

In the absence of mechanical friction due to weight of moving parts and to gearing, readings of both cup and vane anemometers would depend only on the wind speed, and so would be independent of changes of air density. In most cases these frictional couples will be small compared with the aerodynamic driving torque, and no attention need therefore normally be paid to changes in air density. If, however, the changes of density are large—more than about 5%—the readings should be corrected. The simplest method is, perhaps, to alter both the ordinate and the abscissa of any point on the original calibration curve of the instrument in the ratio $\sqrt{\frac{\rho_0}{\rho_1}}$, where ρ_0 is the air density at the time of calibration and ρ_1 is the new air density. In this way a point on the calibration curve for density ρ_1 is obtained, and by repeating this process for a number of points on the original curve the curve for density ρ_1 can be drawn.

As regards the effect of inclination to the wind direction, it has been shown that the axis of the vane circle may be out of align-

ment with the wind by an angle approaching 20° before the readings of the anemometer are in error by more than about two or three per cent. A fluctuating wind speed is another source of error, for the vane anemometer then tends to indicate more than the true mean speed, but errors will be negligible unless fluctuations are very violent. If maximum and minimum air speeds are respectively 50% above and below mean speed the error on the mean speed indicated by the instrument may be of the order of 10 or 15% high. It can be shown, however, that the error depends on the square of the amplitude of the fluctuations so it decreases rapidly as the wind becomes steadier. An amplitude of 50% on either side of the mean represents a very unsteady air stream.

Electrical or hot wire anemometers have not been much used because of the elaborate apparatus and manipulation involved, but certain types have been developed for industrial application. They may yield excellent laboratory results, and are, in particular, well suited to the measurement of low air speeds. (*See* also AERIAL NAVIGATION) (E. OW.)

ANEMONE or WIND-FLOWER, a genus of the buttercup family (Ranunculaceae), containing about 120 species in the temperate zones. *Anemone nemorosa,* wood anemone, and *A. Pulsatilla,* Pasque-flower, occur in Britain. The plants are perennial herbs with an underground rootstock and radical, deeply cut, leaves. The elongated flower stem bears white, red, blue or, rarely, yellow flowers; there is an involucre of three leaflets below each flower. The fruits often bear long hairy styles for distribution by the wind. Many are favourite garden plants; among the best known is *Anemone coronaria,* the poppy anemone, a tuberous-rooted plant, with divided leaves, and large showy poppy-like blossoms on stalks from 6 to 9in. high; the flowers are scarlet, crimson, blue, purple or white. There are also double-flowered varieties. It is enriched with manure. The genus contains many other spring-blooming plants, of which *A. hortensis* and *A. fulgens* have less divided leaves and rosy-purple or scarlet flowers. Another set is represented by the Pasque-flower whose violet blossoms have the outer surface hairy; these prefer a calcareous soil. The splendid *A. japonica,* and its white variety, Honorine Joubert, are fine autumn-blooming perennials; they grow well in light soil. A group of dwarf species, represented by the native British *A. nemorosa* and *A. apennina,* are beautiful spring flowers.

In the United States and Canada there are about 20 native species, with representatives in all regions from arctic America and Alaska south to Florida, Texas and California. Among these are some of the most attractive North American wild flowers. Noteworthy species are the American wood anemone (*A. quinquefolia*), of low woods from Nova Scotia to Minnesota south to Georgia, very similar to the wood anemone (*A. nemorosa*) of Great Britain; the Canada wind-flower (*A. canadensis*), with large white flowers, found in low grounds from Labrador to Saskatchewan and southward to Maryland and Colorado; the tall wind-flower or thimble-weed (*A. virginiana*), with greenish-white flowers, growing in woods from Nova Scotia to Alberta and south to South Carolina and Arkansas; the long-fruited wind-flower (*A. cylindrica*), a silky-hairy plant native to open grounds from New Brunswick to British Columbia and south in the Rocky Mountains to New Mexico; the Carolina wind-flower (*A. caroliniana*), with purple or white flowers, growing in open grounds from Florida to Texas and northward to Wisconsin and South Dakota; the mountain wind-flower (*A. trifolia*), with large white flowers, often growing with the lily-of-the-valley, native to the Appalachian region; the red wind-flower (*A. hudsoniana*), silky-hairy with red or greenish flowers, found from New Brunswick to Minnesota; the northern wind-flower (*A. parviflora*), a delicate plant with white flowers, ranging from Labrador to Alaska and southward in the Rocky Mountains to Colorado; and Richardson's wind-flower (*A. Richardsonii*), a slender boreal dwarf with yellow flowers, found from Labrador to Hudson bay and widely in arctic America.

To the division *Pulsatilla* belong the American pasque-flowers (*A. patens,* var. *Wolfgangiana*), with handsome blue, purple, or white flowers, a very early spring bloomer on dry prairies and high plains from Illinois to British Columbia and Alaska and southward to Utah and Texas; and the western pasque-flower (*A. occidentalis*), found on gravelly hills and mountain slopes from California to Alaska and eastward to Alberta and Montana. The former is the floral emblem or State flower of South Dakota.

ANENCLETUS or **ANACLETUS,** second bishop of Rome. About the 4th century he is treated in the catalogues as two persons—Anacletus and Cletus. According to the catalogues he occupied the papal chair for 12 years (*c.* 77–88).

ANERIO, FELICE (1560–1614), composer. He studied under Nanino, and succeeded Palestrina in 1594 as composer to the papal chapel. Masses and motets of his are printed in Proske's *Musica Divina* and other modern anthologies. The 12-part *Stabat Mater* in vol. vii. of Palestrina's works may have been by Felice Anerio.

His brother, GIOVANNI FRANCESCO, also a composer, was born about 1567, and died 1620.

ANEROID BAROMETER. This instrument consists essentially of a vacuum chamber, two opposite walls of which are thin metal membranes, which respond elastically to any variation of pressure on their outer faces, their movement being controlled by a spring and communicated to the indicating needle. An instrument depending on a similar principle is the Bourdon pressure gauge (*q.v.*). The aneroid barometer is not so accurate as the mercury barometer, but it is often employed when the use of the latter would be inconvenient. (*See* BAROMETER.)

ANET, town of north France, in the department of Eure-et-Loir, situated between the rivers Eure and Vègre, 10m. N.E. of Dreux by rail. Pop. (1926) 1,205. It possesses the remains of a magnificent castle, built in the middle of the 16th century by Henry II. for Diana of Poitiers. Near it is the plain of Ivry, where Henry IV. defeated the armies of the League in 1590.

ANEURIN, a British (Welsh) bard, author of the *Gododin,* flourished at the beginning of the 7th century. He is said to have been the son of Caw-ab-Geraint, a chief of the Gododin, who had their home on the sea-coast to the south of the Firth of Forth. In some of the mss. which give the names of Caw's sons, the name of Gildas appears, but where the name of Aneurin appears that of Gildas does not. It has therefore been assumed that the British historian Gildas and the bard Aneurin were one and the same person, though the internal evidence of their works appears to confute this. Thomas Stephens, the editor and translator of the *Gododin* epic, thinks that Aneurin may have been a son of Gildas.

Aneurin seems to have studied at St. Cadoc's College, Llancarvan, and to have acted both as priest and bard at the Battle of Cattraeth described in his epic. This fight is identified by Stephens with the battle of Degstan, assigned by the *Saxon Chronicle* to the year 603. Aneurin was taken prisoner after the battle. On his release he returned to Wales and became a friend of Taliesin. In his old age he returned to the north and lived with his brother in Galloway. The *Gododin* is vague in its language and in its description of events It relates the defeat of the Britons of Strathclyde at the hands of the Saxon invader at the battle of Cattraeth.

See the versions of the *Gododin* in Skene's *Four Ancient Books of Wales* (1866), and in the edition by Thomas Stephens published by the Cymmrodorion Society (1888).

ANEURYSM or ANEURISM, a cavity or sac which communicates with the interior of an artery and contains blood The walls of the cavity are formed partly by the dilated artery and partly by the tissues around that vessel. The dilatation of the artery is due to local degeneration or injury of the inner coats of the vessel. In a rare variety (dissecting aneurysm) the blood is contained at first in the region of the middle coat of the artery which may be opened up from arch of the aorta to the iliac vessels Aneurysms may be *spontaneous* or *traumatic* The man who has chronic inflammation of a large artery, the result, for instance, of syphilis, gout, arduous straining work, or kidney-disease, and whose artery yields under cardiac pressure, has a *spontaneous* aneurysm; the barman or window-cleaner, who has cut his radial artery, the soldier whose brachial or femoral artery has been bruised by a rifle bullet or grazed by a bayonet, and the boy whose

naked foot is pierced by a sharp nail, are apt to be the subjects of *traumatic* aneurysm. In saccular aneurysms bulging on one side of an artery the blood may be induced to coagulate, or may of itself deposit layer upon layer of pale clot, until the sac is obliterated, and the aneurysm is cured. But in those aneurysms which are *fusiform* dilatations of the vessel there is but slight chance of such cure, for the blood sweeps evenly through it without staying to deposit clot or laminated fibrine.

In the treatment of aneurysm the aim is generally to lower the blood pressure by absolute rest and moderated diet, but a cure is rarely effected except by operation. Speaking generally, if an aneurysm can be dealt with surgically the sooner that the artery is tied the better. Other measures are too apt to prove painful, dangerous, ineffectual and disappointing. For aneurysm of the great arteries in the chest or abdomen (which cannot be dealt with by operation) treatment is unsatisfactory and consists, mainly, in measures designed to avoid strain. Usually such an aneurysm ends life by rupture.

ANFRACTUOSITY, twisting and turning, circuitousness. Usually employed in the plural to denote winding channels such as occur in the depths of the sea, mountains, or the fissures (*sulci*) separating the convolutions of the brain.

ANGARIA, the term used to denote the postal system adopted by the Roman imperial government from the ancient Persians, among whom, according to Xenophon, it was established by Cyrus the Great. The word is derived from the Greek form of a word, originally Babylonian, meaning "mounted courier." Couriers on horseback were posted at certain stages along the chief roads of the empire, for the transmission of royal dispatches by night and day in all weathers. In the Roman system the supply of horses and their maintenance was a compulsory duty from which the emperor alone could grant exemption. The word came to mean generally "compulsory service." So *angaria*, in mediaeval Latin, and the rare English derivative "angariation," came to mean any service which was forcibly demanded, and oppression in general. *See* Xenophon, *Cyrop.*, viii. 6; Herodotus viii. 98.

ANGARY, RIGHT OF. The term "angary" is derived from a Persian word signifying "a messenger" upon the royal service who was entitled to requisition means of transport. This custom was adopted in Greece in the 3rd century B.C. and passed to Rome. In *Corpus Juris, angaria* denotes requisition of horses, wagons, etc., in connection with the *cursus publicus*. It was extended to the requisition of neutral shipping for the transport of troops. The right survived throughout mediaeval Europe as a royal prerogative, and was exercised for purposes of public and military transport, but the term was not generally applied to ships till the 17th century, when it became a rule of international law. In the 16th century the Venetians requisitioned a Genoese vessel and its cargo of corn to meet a food shortage, and its legality *ob publicam utilitatem* was approved. Requisition of neutral shipping became fairly general in the 18th century, but was exceptional in the 19th, although the right was expressly recognized in a number of treaties, whether in time of peace or war, in case of public necessity, subject of course to adequate compensation.

In the World War, the Italian Government, whilst still neutral, requisitioned, in 1915, 34 German merchantmen lying in Italian ports. Germany made no protest, but when Portugal requisitioned, in 1916, 72 German vessels lying in Portuguese ports, Germany made it a *casus belli* and declared war on that power. In 1917 Brazil, having revoked her proclamation of neutrality, and prior to her declaration of war, requisitioned 42 German merchantmen. At the same time Great Britain and the United States, after fruitless negotiations with Holland, requisitioned Dutch shipping to the amount of 1,000,000 tons lying in their ports "in exercise of the right of angary," one of the attributes of territorial sovereignty. In 1918 Spain requisitioned about 90 German vessels lying in Spanish ports as an act indispensable for her existence, and in view of the sinking of her own merchantmen by German submarines declared that no compensation was due. The United States also requisitioned a number of Norwegian ships under construction in American yards.

Consequently the right of angary, that is, the right of a State, whether belligerent or neutral, whether in time of peace or war, to requisition ships and goods situate in its territory, subject to adequate compensation, both by constitutional and international law, may be said to be firmly established. This right must be distinguished from that of requisition by a belligerent in territory occupied by him, which is based on military necessity under the laws of war. (H. H. L. B.)

ANGEL, a term used in the vocabulary of monotheistic religions to describe a personal being intermediate in nature, status, and powers, between God and man. It may be conjectured that in most instances a belief in such beings is an attempt to retain the subordinate gods and spirits of a polytheistic or an animistic faith which preceded the development of monotheism. Of the four great monotheistic religions, Islam and Christianity accepted current Jewish ideas of angels, while in Zoroastrianism they are clearly either degraded gods or personified qualities and abstractions.

The religion of the Old Testament recognized many such inferior superhuman beings. Whilst it was strictly monolatrous, and recognized Yahweh alone as an object of worship for Israel, it conceived of Him as dwelling in royal state, surrounded by attendants and servants (*cf.* I Kings xxii. 19; Job i. 6, ii. 1; Ps. xxix. 1). These are called "sons of God" (*bēnē ĕlōhīm* or *ēlīm*), and in Gen. vi. the origin of giants is ascribed to unions between such beings and mortal women. But Yahweh has other classes of beings at his orders and under his control; such are the "Cherubims" of Gen. iii. 24; Ez. ix.—apparently pictured in some such form as the divine or semi-divine winged bulls of Assyrian sculpture, the "seraphim" of Isaiah's vision—flaming six-winged serpents, or the numerous "men" who act as Yahweh's agents in the visions of Zechariah and Ezekiel and elsewhere. The "hosts" referred to in the phrase "Yahweh of Hosts" may also belong to this class.



AFTER A MOSAIC IN THE CHURCH OF SANT' APOLLINARE IN CLASSE FUORI, RAVENNA, ITALY

MICHAEL THE ARCHANGEL, IN CHRISTIAN THEOLOGY THE LEADER OF THE HEAVENLY HOST

The word "angel" (Heb. *mal'āk*), however, is seldom applied to such beings as these. The following is a list of passages in which it thus occurs, doubtful text or interpretation being indicated by an asterisk: Gen. xix. 1,* 15*; xxviii. 12*; xxxii. 1; Job iv. 18; Ps. lxxviii. 49*; xci. 11; ciii. 20; civ. 4; cxlviii. 2; Dan. iii. 28; vi. 22. The term is used in a peculiar sense in Zechariah of the prophetic spirit which gave to the prophet the sense of a dual personality—the "God within" him. Elsewhere the phrase Angel of Yahweh is employed to indicate the very presence of Yahweh—indeed the term is practically interchangeable with "presence." Its appearance is probably due to a growing feeling that to speak of Yahweh as coming in ordinary human form was unworthy of his majesty. As men began to outgrow the old anthropomorphic ideas they felt their way towards a conception which did not picture the whole of the personality of Yahweh to appear on earth, but yet insisted that it was really He and no other who came into human life. Thus the "angel" who appeared to Manoah and his wife (Jud. xiii.) accepts the sacrifice, and is in truth Yahweh Himself.

During the exile and the three centuries which followed the return, the thought of Israel was greatly influenced by the conceptions of the Gentile world, particularly, it seems, by those of Persia. We certainly find in the late Persian period and after the age of Alexander, that angels, in the modern popular sense of

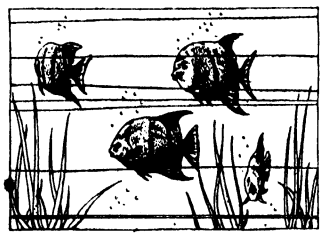
the term, play a much larger part in the realm of Jewish ideas. In the Book of Daniel each nation has its own guardian angel, commonly called "prince"; *e.g.* the guardian angels of Persia and Greece are mentioned in x. 20, and Michael, guardian of Israel, in vv. 13, 21. From this time onwards angels play a prominent part in all Jewish religious writings. Thus we find Raphael as one of the leading characters in the Book of Tobit, and the Enoch literature—to say nothing of other apocalyptic books of this period—is full of angels, good and bad.

With the growth of a belief in good angels there sprang up also a theory of wicked angels, demons, and the like. A number of different lines of thought converge here, of which two may be regarded as the most important. One of these is the belief in the effect of a "spirit" on man. Any abnormal psychological state was thought in early times to be due to the "breath" of God, a new life-force which entered into a man and changed him. To this source were ascribed the prophetic "ecstasy" and other phenomena which, to-day, might be classed as insanity or even epilepsy. Obviously the effect produced was sometimes evil, and though in primitive times men did not hesitate to ascribe even moral evil to Yahweh, yet as the doctrine of his moral goodness grew under the influence of prophetic teaching, it clearly became necessary to introduce another source. Hence arose a belief in wicked angels, "unclean spirits," and similar beings—a spiritual army hostile to God, as the good angels were His servants and messengers.

The other line of development is that of Satan. This person appears in the Old Testament—particularly in Zechariah and Job—as one of the servants of Yahweh, or rather, an important official of His court. It was the business of the Satan (the word in the O.T. is not a proper name) to detect evil in men and to charge them before Yahweh with their sin, actual or potential. In order to test them, he was compelled to "tempt" them, and when once the thought of an arch-enemy of God and man had been observed in the Persian Ahriman, it was easy for the "tempter" to pass from the side of God to that opposed to Him. Thus there grew up the conception of the Devil, supported by a hierarchy of sin, standing over against the divine court and kingdom. (*See* DEVIL.) (W. H. BE.; T. H. R.)

ANGEL, a gold coin, first used in France (*angelot, ange*) in 1340, and introduced into England by Edward IV. in 1465 as a new issue of the "noble," and so at first called the "angel-noble." It varied in value between that period and the time of Charles I. (when it was last coined) from 6s. 8d. to 10s. The name was derived from the representation it bore of St. Michael and the dragon. The angel was the coin given to those who came to be touched for the disease known as king's evil; after it was no longer coined, medals, called touch-pieces, with the same device, were given instead.

ANGEL-FISH, the popular name for several widely differing species of fishes, including (*a*) *Squatina squatina,* also called the monk fish, an Elasmobranch allied to the sharks and found in tropical and sub-tropical seas, including the Mediterranean. It takes its name from the large wing-like pectoral fins and reaches a length of 4 feet. (*b*) In Bermuda, Chaetodont fishes of the genus *Holocanthus,* especially *H. ciliaris;* these fishes are laterally compressed and brilliantly coloured. They haunt coral reefs. *H. ciliaris* may reach a weight of 4 lb. and is delicious eating.



BY COURTESY OF N.Y. ZOOLOGICAL SOCIETY

CHAETODIPTERUS FABER, AN ANGEL FISH OF PALE BLUE COLOUR WHICH INHABITS THE WARMER COAST WATERS OF AMERICA

Various species of *Holocanthus* occur on the west coast of tropical America from Cape San Lucas to the Galapagos islands, in the East Indies, Japan and Polynesia. In this same family (*Chaetondontidae*) the American genus *Pomacanthus* is also known as the angel fish. *Chaetodipterus faber,* sometimes called spade fish, is also known as the angel fish. It occurs from Cape Cod to Rio de Janeiro. A very similar species occurs on the west coast of Mexico. Certain varieties of porgy are also given this name and constitute a favourite dish along the south-east shores of the United States.

ANGELICA, a genus of plants of the family Umbelliferae, represented in Britain by one species, *A. sylvestris,* a tall perennial herb with large bipinnate leaves and large compound umbels of white or purple flowers. The name Angelica is popularly given to *Angelica* (*Archangelica*) *officinalis,* the tender shoots of which are used in making certain kinds of aromatic sweetmeats. In the Faroe islands and in Iceland, where the plant grows abundantly, *A. officinalis* has long been used as a vegetable, though in recent years angelica gardens have been more or less replaced by cabbage gardens.

Angelica balsam is obtained by extracting the roots with alcohol, evaporating and extracting the residue with ether.

ANGELICO, FRA (1387–1455), Italian painter. Il Beato Fra Giovanni Angelico da Fiesole is the name given to a painter-friar of the Florentine state in the 15th century. His baptismal name was Guido, Giovanni being only his name in religion. He was born at Vicchio, Tuscany, of unknown but seemingly well-to-do parentage, in 1387 (not 1390, as sometimes stated); in 1407 he became a novice in the convent of S. Domenico at Fiesole, and in 1408 he took the vows and entered the Dominican order. Whether he had previously been a painter by profession is not certain, but probable. The painter named Lorenzo Monaco may have contributed to his art training, and the influence of the Sienese school is plainly discernible in his work. According to Vasari, the first paintings of this artist were in the Certosa of Florence; none exists there now.

His earliest extant performances, in considerable number, are at Cortona, where he was sent during his novitiate, and here apparently he spent the early years of his monastic life. His first works executed in fresco were probably those, now destroyed, which he painted in the convent of S. Domenico in this city; as a fresco-painter, he may have worked under or as a follower of Gherardo Starnina. From 1418 to 1436, he was back at Fiesole; in 1436 he was transferred to the Dominican convent of S. Marco in Florence, and in 1438 undertook to paint the altar-piece for the choir, followed by many other works; he may have studied about this time the renowned frescoes in the Brancacci chapel in the Florentine church of the Carmine and also the paintings of Orcagna. In or about 1446 he was invited by the Pope, Eugenius IV., to Rome. If the story (first told by Vasari) is true—that the archbishopric of Florence had been offered to himself, and by him declined on the ground of his inaptitude—Eugenius, and not (as stated by Vasari) his successor Nicholas V., must have been the Pope who made the offer to Fra Giovanni, for Nicholas only succeeded in 1447. Certain it is that Angelico was staying in Rome in the first half of 1447; and he painted in the Vatican the Cappella del Sacramento, which was afterwards demolished by Paul III. In June 1447 he proceeded to Orvieto, to paint in the Cappella Nuova of the cathedral, with the co-operation of his pupil Benozzo Gozzoli. He afterwards returned to Rome to paint the chapel of Nicholas V. In this capital he died in 1455, and he lies buried in the church of the Minerva. He was beatified at a date unknown.

Fra Giovanni led a holy and self-denying life, shunning all advancement, and was a brother to the poor; no man ever saw him angered. He painted with unceasing diligence, treating none but sacred subjects; he never retouched or altered his work. He was wont to say that he who illustrates the acts of Christ should be with Christ. It is said that he never handled a brush without fervent prayer and he wept when he painted a Crucifixion. The Last Judgment and the Annunciation were two of the subjects he most frequently treated.

Bearing in mind the details already given as to the dates of Fra Giovanni's sojournings in various localities, the reader will be able to trace approximately the sequence of his works. In Florence, in the convent of S. Marco (now converted into a national museum) is a series of frescoes beginning towards 1443, all of which are later than the altar-piece which Angelico painted (as before mentioned) for the choir connected with this convent, and which is now in the academy of Florence. It represents the Virgin

with SS. Cosmas and Damian (the patrons of the Medici family), Dominic, Peter, Francis, Mark, John the Evangelist and Stephen; the pediment illustrated the lives of Cosmas and Damian, but it has long been severed from the main subject. In the Uffizi gallery is an altar-piece, the Virgin (life-sized), enthroned with the Infant and 12 angels. In S. Domenico, Fiesole, there are a few frescoes, less fine than those in S. Marco; also an altar-piece in tempera of the Virgin and Child, now much destroyed. The subject which originally formed the predella of this picture has, since 1860, been in the National Gallery, London. The subject is a Glory, Christ with the banner of the Resurrection, and a multitude of saints, including, at the extremities, the saints or beati of the Dominican order; here are no fewer than 266 figures or portions of figures, many of them having names inscribed. This predella was highly lauded by Vasari; still more highly another picture which used to form an altar-piece in Fiesole, and is now in the Louvre—the "Coronation of the Virgin," with eight predella subjects of the miracles of St. Dominic. For the church of Santa Trinita, Florence, Angelico executed a "Deposition from the Cross" and for the church of the Angeli, a "Last Judgment," both now in the Florentine academy; for S. Maria Novella, a "Coronation of the Virgin," with a predella in three sections, now in the Uffizi—this again is one of his masterpieces. In Orvieto cathedral he painted three triangular divisions of the ceiling, all now much repainted and damaged. In Rome, in the Chapel of Nicholas V., he painted the acts of SS. Stephen and Lawrence, also various figures of saints, and on the ceiling the four evangelists. These works of the painter's advanced age, which have suffered somewhat from restorations, show vigour superior to that of his youth, along with a more adequate treatment of the architectural perspectives. It has often been said that he frequently practised as an illuminator; illuminations executed by Giovanni's brother, Benedetto, also a Dominican, who died in 1448, have probably been ascribed to the more famous artist. Benedetto may perhaps have assisted Giovanni in the frescoes at S. Marco, but nothing of the kind is distinctly traceable. A folio series of engravings from these paintings, was published in Florence in 1852. Along with Gozzoli already mentioned, Zanobi Strozzi and Gentile da Fabriano are named as pupils of the Beato.

For an appreciation of Fra Angelico's art we may quote Sir Charles Holmes (*The National Gallery, Italian Schools*): "One very great colourist, Fra Angelico, arrives before Masaccio, and outlives him. The legend of his saintly life, the happy serenity and simplicity of his temper, tend to distract our attention from his greatness as an artist. Not only does he possess a mastery of design which enables him to treat a large variety of subjects with almost invariable success, but when his theme gives him the necessary scope he attains, as in his "Transfiguration" at Florence, to a power and sublimity which have never been surpassed. He has much of Giotto's power of making his figures seem living and substantial. But above all, he is one of the world's great colourists, and the single painting by his hand which we possess in London will enable us to understand this side of his art in some measure. His other claims to greatness can be estimated only in Florence."

BIBLIOGRAPHY.—S. Beissel, *Fra Giovanni Angelico: Sein Leben und Seine Werke* (Freiburg, 1895); D. Tumiati, *Fra Angelico* (Florence, 1897); R. L. Douglas, *Fra Angelico* (London, 1901); G. Williamson, *Fra Angelico* (London, 1901).

ANGELL, GEORGE THORNDIKE (1823–1909), American philanthropist, was born at Southbridge (Mass.), on June 5, 1823. He graduated at Dartmouth in 1846, studied law at the Harvard Law school, and in 1851 was admitted to the bar in Boston, where he practised for many years. In 1868 he founded and became president of the Massachusetts Society for the Prevention of Cruelty to Animals, in the same year establishing and becoming editor of *Our Dumb Animals*, a journal for the promotion of organized effort in securing the humane treatment of animals. In 1882 he initiated the movement for the establishment of Bands of Mercy (for the promotion of humane treatment of animals), of which in 1908 there were more than 72,000 in active existence. In 1889 he founded and became president of the American Humane Education Society. He became well known as a criminologist and also as an advocate of laws for the safeguarding of the public health. He died at Boston March 16, 1909.

ANGELL, JAMES BURRILL (1829–1916), American educationalist and diplomat, was born in Scituate, R.I., on Jan. 7, 1829. He graduated in 1849 at Brown university, at which, after travel in Europe, he was professor of modern languages and literature in 1853–60. In 1860–66 he was editor of the Providence *Daily Journal*. From 1866 to 1870 he was president of the University of Vermont. In 1871 he became president of the University of Michigan, serving until 1909, when he was made president emeritus. Under his administration the institution was brought to high rank among American universities. He was United States minister to China in 1880–81, and to Turkey in 1897–98. In 1887 he was a member of the Anglo-American international commission on Canadian fisheries. Besides numerous contributions to periodicals, he published *Progress in International Law* (1875), the article "Diplomacy in the United States" in the *Narrative and Critical History of America* (1888), *Reminiscences* (1912) and *Selected Addresses* (1912). He died at Ann Arbor, Mich., on April 1, 1916.

ANGELL, JAMES ROWLAND (1869–), American educationalist, was born at Burlington, Vt., May 8 1869. He was a son of James Burrill Angell (1829–1916), president of the University of Michigan (1871–1909), president emeritus, and afterwards minister to China and Turkey. He was educated at the Universities of Michigan and Harvard, and spent a year in Europe, chiefly at the Universities of Berlin and Halle. In 1893 he was appointed instructor in philosophy at the University of Minnesota. In 1894 he was called to the University of Chicago as assistant professor of psychology and, after 1905, was professor and head of the department. He was dean of the university faculties after 1911, and acting president during 1918–19. In 1906 he was elected president of the American Psychological Association, in 1914 exchange professor at the Sorbonne, and in 1915 special lecturer at Columbia university. In 1921, on the resignation of Arthur T. Hadley (*q.v.*), he was elected president of Yale university. His works include: *Psychology* (1904; rev. ed., 1908); *Chapters from Modern Psychology* (1911); and *An Introduction to Psychology* (1918).

ANGELUS, a Roman Catholic devotion in memory of the Annunciation. It consists of three texts (beginning "Angelus Domini nuntiavit Mariae," hence the name), with three Ave Marias and a concluding versicle, response and prayer. It is recited three times daily, about 6 A.M., noon and 6 P.M., when the Angelus bell is rung. In a simpler form the devotion can be traced back (as an evening observance) to 1307.

See H. Thurston in *The Catholic Encyclopaedia*.

ANGELUS SILESIUS (1624–1677), German religious poet, was born in 1624 at Breslau, and died there on July 9, 1677. His family name was JOHANN SCHEFFLER, but he is generally known by the pseudonym Angelus Silesius, under which he published his poems and which marks the country of his birth. Brought up a Lutheran, and at first physician to the duke of Württemberg-Oels, he joined in 1652 the Roman Catholic Church, and in 1661 took orders as a priest and became coadjutor to the prince bishop of Breslau. In 1657 Silesius published under the title *Heilige Seelenlust, oder geistliche Hirtenlieder der in ihren Jesum verliebten Psyche* a collection of 205 hymns, the best of which have been adopted in the German Protestant hymnal. His most important work is *Geistreiche Sinn und Schlussreime* (1657), afterwards called *Cherubinischer Wandersmann* (1674). This is a collection of "Reimsprüche" or rhymed distichs embodying a mystical pantheism drawn mainly from the writings of Jakob Böhme and his followers.

BIBLIOGRAPHY.—A complete edition of Scheffler's works (*Sämtliche poetische Werke*) was published by D. A. Rosenthal (Regensburg, 1862). Both the *Cherubinischer Wandersmann* and *Heilige Seelenlust* have been republished by G. Ellinger (1895 and 1901), and a selection from the former work by O. E. Hartleben (1896). For further notices of Silesius' life and work, *see* Hoffmann von Fallersleben in *Weimarisches Jahrbuch I.* (Hanover, 1854); A. Kahlert, *Angelus Silesius* (1853); C. Seltmann, *Angelus Silesius und seine Mystik* (1896), and a biog. by H. Mahn (Dresden, 1896).

ANGER is an emotion consisting of antagonistic, displeased, attacking feelings toward an offending person or thing. Some psychologists have attempted to distinguish anger from rage by supposing that true anger occurs only when the sex or love emotion is opposed, as in the sex combats of rival males among animals and human beings. It is said that anger, at such times, contains a self-abandonment never found in the rage accompanying struggles for food. In popular parlance, however, anger and rage are practically synonymous. This emotion has been found in the behaviour of very young infants (J. B. Watson). It occurs when the baby's spontaneous movements are hampered or interfered with by the experimenter, and is expressed by crying, holding the breath and threshing wildly about with arms and legs. Experiments on animals (W. B. Cannon) also have shown that anger or rage causes increased secretion of adrenalin, with heightened blood pressure, dilation of the pupils of the eyes and increase of blood sugar. Experiments on adult human beings (W. M. Marston) have shown that anger is accompanied by increased systolic blood pressure, more rapid heart beat and quicker and more explosive responses to questions or association words. The behaviour of both animals and human beings, during anger, always shows a certain element of wildness, or lack of voluntary control. For this reason anger is psychologically defined (W. M. Marston) as an abnormal, conflict emotion, consisting of interrupted or thwarted dominance, aggressiveness or self-assertion.

See J. B. and R. R. Watson, "Studies in Infant Psychology," *Scientific Monthly* (1921); W. B. Cannon, *Bodily Changes in Pain, Hunger, Fear and Rage* (1920); W. M. Marston, "Sex Characteristics of Systolic Blood Pressure Behavior," *Journal Experimental Psychology* (1923); *The Emotions of Normal People* (1928).

(W. M. M.)

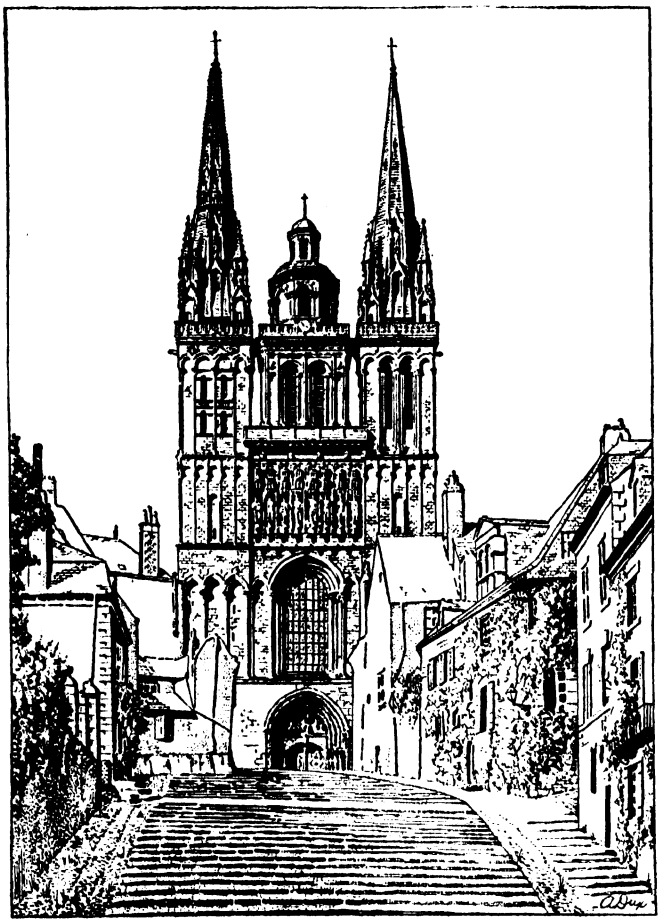
ANGERBURG, chief town of the south-western sub-division of the district of Gumbinnen, East Prussia. Pop. (1925) 6,911. It lies at the northern end of a long series of lakes, and serves as a road and rail centre. It makes small machinery and clay-products.

ANGERMÜNDE, a town of Germany in Brandenburg, on Lake Münde about 43m. from Berlin. Pop. (1925), 8,602. In 1420 the Elector Frederick I. of Brandenburg gained a victory here over the Pomeranians. The town is an important railway junction.

ANGERONA, a Roman goddess. According to ancient authorities, she relieved men from pain and sorrow, or delivered the Romans and their flocks from *angina* (quinsy); or she was the protecting goddess of Rome and the keeper of the sacred name of the city, which might not be pronounced lest it should be revealed to her enemies.

Modern scholars regard her as akin to Ops and Acca Larentia; or as the goddess of the new year and the returning sun. Her festival, called *Divalia* or *Angeronalia,* was celebrated Dec. 21. The priests offered sacrifice in the temple of Volupia, the goddess of pleasure, in which stood a statue of Angerona, with a finger on her mouth, which was bound and closed. She was worshipped as Ancharia at Faesulae (*q.v.*), where an altar belonging to her has been discovered.

ANGERS, capital of the department of Maine-et-Loire, west France, 191 m. S.W. of Paris by the Western railway to Nantes. Pop. (1926) 77,892. It occupies rising ground on both banks of the Maine, crossed by three bridges. The old town, on the left bank, is dominated by the cathedral and massive castle, and encircled by boulevards. On the right bank is the low-lying "Quartier de la Doutre." Angers is among the most handsome of French towns. Capital of the Gallic tribe of the Andegavi, it was known to the Romans as Juliomagus. During the 9th century it became the seat of the counts of Anjou (*q.v.*). It suffered severely from the invasions of the Northmen after 845 and of the English in the 12th and 15th centuries; the Huguenots took it in 1585, and the Vendean royalists were repulsed near it in 1793. Till the Revolution, Angers had a celebrated university (14th century). The cathedral of St. Maurice (12th and 13th centuries) has an unusually high west front, with three towers. The incongruous central tower (16th century) has a series of eight warriors carved on its base. The vaulting of the interior takes the form of a series of cupolas. There are rich stained-glass windows (12th and 16th centuries) and valuable tapestries (14th and 18th centuries). The adjoining bishop's palace contains a fine synodal hall (12th century). Other churches are St. Serge, an abbey-church (12th and 15th centuries), and La Trinité (12th century). The prefecture occupies the famous abbey of St. Aubin; the court-yard has elaborately sculptured arcades and there is a tower



WEST FAÇADE OF SAINT-MAURICE CATHEDRAL AT ANGERS, FRANCE, A FINE EXAMPLE OF 13TH CENTURY GOTHIC ARCHITECTURE

surviving from the abbey church (both of the 11th and 12th centuries). Ruins of the old churches of Toussaint (13th century) and Notre-Dame du Ronceray (11th century) are also to be seen. The castle of Angers (13th century), girt with towers and a moat, is now used as an armoury. The hospital of St. Jean (12th century) is occupied by an archaeological museum; and the Logis Barrault, a Renaissance house, contains the public library, the municipal museum with pictures and sculptures, and the Musée David, containing works by the famous native sculptor David d'Angers. The Hôtel de Pincé or d'Anjou (1523–30) is a fine stone mansion. Many wooden houses of the 15th and 16th centuries remain. Angers is the seat of a bishopric, dating from the 3rd century, a prefecture, a court of appeal and a court of assizes. It has a tribunal of first instance, a tribunal of commerce, a board of trade-arbitrators, a chamber of commerce, and several learned societies. The ancient university was resuscitated in 1875 as the "Université Catholique de l'Ouest." There are several free faculties (*facultés libres*). The prosperity of the town is largely due to the great slate-quarries in the vicinity (whence its old name Black Angers); other products are liqueurs (from fruit), cables, ropes, thread, boots and shoes. The weaving of sail-cloth and woollen and other fabrics, machine construction, nursery-gardening and the making of umbrellas are carried on. The chief articles of commerce, besides slate and French and Swedish iron goods, are hemp, early vegetables, fruit, flowers, wine, oil, leather and live stock. Angers is the ancient capital of Anjou, and its people are still known as Angevins.

ANGERSTEIN, JOHN JULIUS (1735–1823), London merchant and patron of the fine arts, was born at St Petersburg and settled in London about 1749. His collection of paintings, consisting of about 40 of the most exquisite specimens of the art, purchased by the British Government by a vote of £60,000, on his death, Jan. 22 1823, formed the nucleus of the National Gallery.

Angerstein was a great friend of Sir Thomas Lawrence, who helped him in the collection of his pictures and painted a portrait of him, which was given to the National Gallery by William IV.

See Young's *Catalogue of the celebrated Collection of Pictures of the late John Julius Angerstein* (1823); also *Nat. Gal. Catalogue,* Introduction to Foreign Schools.

ANGILBERT (d. 814), Frankish Latin poet, and minister of Charlemagne, was of noble Frankish parentage, and educated at the palace school under Alcuin. He is said to have been the father of two children by Charlemagne's daughter, Bertha, one of them named Nithard. From 790 he was abbot of St. Riquier, and in 800 he accompanied Charlemagne to Rome, and was one of the witnesses to his will in 814. Angilbert's poems show the culture and tastes of a man of the world, enjoying the closest intimacy with the imperial family; he was called the "Homer" of the emperor's literary circle, and a fragment of an epic, ascribed, probably correctly, to him, and called by its editors "Charlemagne et le pape Léon" describes the life at the palace and the meeting between Charlemagne and Leo III. Of the shorter poems, besides the greetings to Pippin on his return from the campaign against the Avars (796), an epistle to David (Charlemagne) incidentally reveals a delightful picture of the poet living with his children in a house surrounded by pleasant gardens near the emperor's palace. The reference to Bertha, however, is distant and respectful, her name occurring merely on the list of princesses to whom he sends his salutation.

Angilbert's poems have been published by E. Dümmler in the *Monumenta Germaniae Historica.* For criticism of this edition *see* Traube in Roederer's *Schriften fur germanische Philologie* (1888).

ANGINA PECTORIS, a term applied to a violent paroxysm of pain, arising almost invariably from disease of the coronary arteries with consequent degeneration of the heart muscle (*see* HEART, DISEASES OF). An attack of angina pectoris usually consists in a sudden agonizing pain, felt at first over the heart, but radiating through the chest in various directions, and frequently extending down the left arm. A feeling of constriction and of suffocation accompanies the pain, although there is seldom actual difficulty in breathing. When the attack comes on, as it often does, during bodily exertion, the sufferer is at once brought to rest. The countenance becomes pale, the surface of the body cold, the pulse feeble, and death appears to be imminent, when suddenly the attack subsides and complete relief is obtained. The duration of a paroxysm rarely exceeds two or three minutes, but it may last longer. The attacks are apt to recur on slight exertion, and in aggravated cases without any such exciting cause. Occasionally the first seizure proves fatal. Angina pectoris is extremely rare under middle life, and is much more common in males than in females. In the treatment of the paroxysm, nitrite of amyl has now replaced all other remedies. It can be carried by the patient in the form of nitrite of amyl pearls, each pearl containing the dose prescribed by the physician. As soon as the pain begins the patient crushes a pearl in his handkerchief and holds it to his mouth and nose. The relief given in this way is marvellous and usually takes place within a very few seconds. To prevent recurrence of the attacks something may be done by administration of nitroglycerine, scrupulous attention to the general health and the avoidance of mental and physical strain.

Pseudo-Angina.—In this condition there occur praecordial pains which very closely resemble those of true angina. The essential difference lies in the fact that pseudo-angina is independent of structural disease of the heart and coronary arteries. There are three main varieties: (1) the reflex, (2) the vasomotor, (3) the toxic. The reflex is by far the most common, and is generally due to irritation from one of the abdominal organs, often associated with mental anxiety or overwork. An attack of pseudo-angina may be agonizing, the pain radiating through the chest and into the left arm, but the patient does not usually assume the motionless attitude of true angina, and the duration of the seizure is usually much longer. The treatment is that of the underlying neurosis and the prognosis is a good one, sudden death not occurring.

ANGIOSPERMS. The botanical term angiosperm (ἀγγεῖον, receptacle, and σπέρμα, seed) was coined in the form Angiospermae by Paul Hermann in 1690, as the name of that one of his primary divisions of the plant kingdom which included flowering plants possessing seeds enclosed in capsules, in contradistinction to his Gymnospermae, or flowering plants with fruits containing only one seed or dividing into distinct one-seeded portions—the whole fruit or each of its pieces being here regarded as a naked seed. These terms were maintained by Linnaeus with the same sense, but with restricted application, in the names of the orders of his class Didynamia. Their use with any approach to their modern scope only became possible after Robert Brown had established in 1827 the existence of truly naked seeds in the cycads and conifers, entitling them to be correctly called gymnosperms. From that time onwards, so long as these gymnosperms were, as was usual, reckoned as dicotyledonous flowering plants, the term angiosperm was used antithetically by botanical writers, but with varying limitation, as a group-name for other dicotyledonous plants. Wilhelm Hofmeister's brilliant discovery in 1851 of the changes occurring in the embryo-sac of flowering plants, and his determination of the correct relationships of these with the cryptogams (non-flowering plants), fixed the true position of gymnosperms as a class distinct from Dicotyledons, and the term angiosperm then gradually came to be accepted as the suitable designation for the whole of the flowering plants other than gymnosperms, and as including, therefore, the classes of Dicotyledons and Monocotyledons. This is the sense in which the term is used in this article.

The trend of the evolution of the plant kingdom has been in the direction of the establishment of a vegetation of fixed habit and adapted to the vicissitudes of a life on land, and the angiosperms are the highest expression of this evolution and constitute the dominant vegetation of the earth's surface at the present epoch. There is no land-area, from the poles to the equator, where plant-life is possible, upon which angiosperms are not found. They occur also abundantly in the shallows of rivers and fresh-water lakes, and in less numbers in salt lakes and in the sea; such aquatic angiosperms are not, however, primitive forms, but are derived from immediate land-ancestors. Associated with this diversity of habitat is great variety in general form and manner of growth. The familiar duckweed which covers the surface of a pond consists of a tiny green thalloid shoot, one, that is, which shows no distinction of parts—stem and leaf, and a simple root growing vertically downwards into the water. The great forest-tree has a shoot, which in the course perhaps of hundreds of years, has developed a wide-spreading system of trunk and branches, bearing on the ultimate twigs or branchlets innumerable leaves, while beneath the soil a widely-branching root-system covers an area of corresponding extent. Between these two extremes is every conceivable gradation, embracing aquatic and terrestrial herbs, creeping, erect, or climbing in habit, shrubs and trees, and representing a much greater variety than is to be found in the other subdivision of seed-plants, the gymnosperms.

Internal Structure.—In internal structure also the variety of tissue-formation far exceeds that found in gymnosperms (*see* PLANTS: *Anatomy*). The vascular bundles of the stem belong to the collateral type, that is to say, the elements of the wood or xylem and the bast or phloem stand side by side on the same radius. In the larger of the two great groups into which the angiosperms are divided, the Dicotyledons, the bundles in the very young stems are arranged in an open ring, separating a central pith from an outer cortex. In each bundle, separating the xylem and phloem, is a layer of meristem or active formative tissue, known as cambium; by the formation of a layer of cambium between the bundles (interfascicular cambium) a complete ring is formed, and a regular periodical increase in thickness results

from it by the development of xylem on the inside and phloem on the outside. The soft phloem soon becomes crushed, but the hard wood persists and forms the great bulk of the stem and branches of the woody perennial. Owing to differences in the character of the elements produced at the beginning and end of the season, the wood is marked out in transverse section into concentric rings, one for each season of growth—the so-called annual rings. In the smaller group, the Monocotyledons, the bundles are more numerous in the young stem and scattered through the ground tissue. Moreover, they contain no cambium and the stem once formed increases in diameter only in exceptional cases.

Vegetative Organs.—As in the gymnosperms, branching is monopodial, that is, a branch is always developed below the apex of the growing point of the stem or root, dichotomy, or the forking of the growing point into two equivalent branches which replace the main stem, is absent both in the case of the stem and the root. The leaves show a remarkable variety in form (*see* LEAF), but are generally small in comparison with the size of the plant; exceptions occur in some Monocotyledons, *e.g*, in the Aroid family, where, in some genera the plant produces one huge, much-branched leaf each season, or in palms, where the unbranched stem bears a crown of large leaves.

In rare cases the main axis is unbranched and ends in a flower, as, for instance, in the tulip, where scale-leaves, forming the underground bulb, green foliage-leaves and coloured floral leaves are borne on one and the same axis. Generally, flowers are formed only on shoots of a higher order, often only on the ultimate branches of a much branched system. A potential branch or bud, either foliage or flower, is formed in the axil of each leaf; sometimes more than one bud arises, as for instance in the walnut, where two or three stand in vertical series above each leaf. Many of the buds remain dormant, or are called to development under exceptional circumstances, such as the destruction of existing branches. For instance, the clipping of a hedge or the lopping of a tree will cause to develop numerous buds which may have been dormant for years. Leaf-buds occasionally arise from the roots, when they are called adventitious; this occurs in many fruit trees, poplars, elms and others. For instance, the young shoots seen springing from the ground around an elm are not seedlings but root-shoots. Frequently, as in many Dicotyledons, the primary root, the original root of the seedling, persists throughout the life of the plant, forming, as often in biennials, a thickened tap-root, as in carrot, or in perennials, a much-branched root-system. In many Dicotyledons and most Monocotyledons, the primary root soon perishes and its place is taken by adventitious roots developed from the stem.

Flower.—The most characteristic feature of the angiosperm is the flower, which shows remarkable variety in form and elaboration and supplies the most trustworthy characters for the distinction of the orders and families into which the group is divided. The flower is a shoot (a stem bearing leaves) with a special form associated with the special function of ensuring the fertilization of the egg and the development of fruit containing seed. Except where it is terminal it arises, like the leaf-shoot, in the axil of a leaf, which is then known as a bract. Occasionally, as in the violet, a flower arises singly in the axil of an ordinary foliage-leaf; it is then termed axillary. Generally, however, the flower-bearing portion of the plant is sharply distinguished from the foliage-leaf-bearing or vegetative portion and forms a more or less elaborate branch-system in which the bracts are small and scale-like. Such a branch-system is called an inflorescence. The primary function of the flower is to bear the spores (minute one-celled reproductive organs). These, as in gymnosperms, are of two kinds, microspores or pollen-grains, borne in the stamens (or microsporophylls) and megaspores, in which the egg-cell is developed, contained in the ovule, which is borne enclosed in the carpel (or megasporophyll). The flower may consist only of spore-bearing leaves, as in the willow, where each flower comprises only a few stamens or two carpels. Usually, however, other leaves are present which are only indirectly concerned with the reproductive process, acting as protective organs for the sporophylls or forming an attractive envelope. These form the perianth and are in one series, when the flower is termed monochlamydeous, or in two series (dichlamydeous). In the second case the outer series (calyx of sepals) is generally green and leaf-like, its function being to protect the rest of the flower, especially in the bud; while the inner series (corolla of petals) is generally white or brightly coloured, and more delicate in structure, its function being to attract the particular insect or bird by agency of which transference of pollen (pollination) is effected. The insect, or bird, is attracted by the colour and scent of the flower, and frequently also by nectar which is secreted in some part of the flower. (For further details on the form and arrangement of the flower and its parts, *see* FLOWER.)

Stamen and Pollen.—Each stamen generally bears four pollen-sacs (microsporangia) which are associated to form the anther and carried up on a stalk or filament. The development of the microsporangia and the contained spores (pollen-grains) is closely comparable with that of the microsporangia in gymnosperms or heterosporous ferns. The pollen is set free by the opening (dehiscence) of the anther, generally by means of longitudinal slits, but sometimes by pores, as in the heath family (Ericaceae), or by valves, as in the barberry. It is then dropped or carried by some external agent, wind, water, or some member of the animal kingdom, on to the receptive surface of the carpel of the same or another flower. The carpel, or aggregate of carpels forming the pistil or gynaeceum, comprises an ovary containing one or more ovules and a receptive surface or stigma; the stigma is sometimes carried up on a style. The mature pollen-grain is, like other spores, a single cell; except in the case of some submerged aquatic plants, it has a double wall, a thin delicate wall of unaltered cellulose, the endospore or intine, and a tough outer cuticularized exospore or extine. The exospore often bears spines or warts, or is variously sculptured, and the character of the markings is often of value for the distinction of genera or higher groups. Germination of the microspore begins before it leaves the pollen-sac. In very few cases has anything representing the development of tissue, comparable with the prothallium of a fern, been observed; generally a small cell (the antheridial or generative cell) is cut off, leaving a larger tube-cell. When placed on the stigma, under favourable circumstances, the pollen-grain puts forth a pollen-tube which grows down the tissue of the style to the ovary, and makes its way along the placenta, guided by projections or hairs, to the mouth of an ovule. The nucleus of the tube-cell has meanwhile passed into the tube, as does also the generative nucleus which divides to form two male or sperm-cells. The male cells are carried to their destination in the tip of the pollen-tube.

Pistil and Embryo-Sac.—The ovary contains one or more ovules borne on a placenta, which is generally some part of the ovary-wall. The development of the ovule, which represents the macrosporangium, is very similar to the process in gymnosperms; when mature it consists of one or two coats surrounding the central nucellus; except at the apex where an opening, the micropyle, is left. The nucellus is a cellular tissue enveloping one large cell, the embryo-sac or macrospore. The germination of the macrospore consists in the repeated division of its nucleus to form two groups of four, one group at each end of the embryo-sac. One nucleus from each group, the polar nucleus, passes to the centre of the sac, where the two fuse to form the endosperm nucleus. Of the three cells at the micropylar end of the sac, all naked cells (the so-called egg-apparatus), one is the egg-cell or oosphere, the other two, which may be regarded as representing abortive egg-cells (in rare cases capable of fertilization), are known as synergidae. The three cells at the opposite end are known as antipodal cells and become invested with a cell-wall. The gametophyte or prothallial generation is thus extremely reduced, consisting of but little more than the male and female sexual cells—the two sperm-cells in the pollen-tube and the egg-cell (with the synergidae) in the embryo-sac.

Fertilization.—At the period of fertilization the embryo-sac lies in close proximity to the opening of the micropyle, into which the pollen-tube has penetrated, the separating cell-wall becomes absorbed, and the male or sperm-cells are ejected into the embryo-sac. Guided by the synergidae one male-cell passes into the oosphere with which it fuses, the two nuclei uniting, while the other

fuses with the endosperm-nucleus. After impregnation the fertilized oosphere immediately surrounds itself with a cell-wall and becomes the oospore, which by a process of growth forms the embryo of the new plant. The endosperm-nucleus divides rapidly to produce a cellular tissue which fills up the interior of the rapidly growing embryo-sac, and forms a tissue, endosperm, in which is stored a supply of nourishment for the use later on of the embryo.

We can recognize, therefore, two products of fertilization—one, the embryo, which becomes the future plant; the other, the endosperm, a short-lived undifferentiated nurse to assist in the nutrition of the former. The endosperm, like the embryo, being the product of a sexual act, hybridization will give a hybrid endosperm as it does a hybrid embryo, and herein we may have the explanation of the phenomenon of "xenia" observed in the mixed endosperms of hybrid races of maize and other plants. The antipodal cells aid more or less in the process of nutrition of the developing embryo, and may undergo multiplication, though they ultimately disintegrate, as do also the synergidae. As in gymnosperms and other groups an interesting qualitative change is associated with the process of fertilization. The number of chromosomes (*see* CYTOLOGY) in the nucleus of the two spores, pollen-grain and embryo-sac is only half the number found in an ordinary vegetative nucleus, and this reduced number persists in the cells derived from them. The full number is restored in the fusion of the male and female nuclei in the process of fertilization and remains until the formation of the cells from which the spores are derived in the new generation.

The above is a general account representing the normal sequence of events, but various departures have been noted. Thus in the family Rosaceae, the order Fagales and the anomalous genus *Casuarina* and others, instead of a single macrospore a sporogenous tissue is formed, but only one cell proceeds to the formation of a functional female cell. In *Casuarina, Juglans* and the family Corylaceae, the pollen-tube does not enter by means of the micropyle, but, passing down the ovary-wall and through the placenta, enters at the opposite, or chalazal, end of the ovule. Such a method of entrance is styled chalazogamic, in contrast to the porogamic or ordinary method of approach by means of the micropyle.

Embryology.—The result of fertilization is the development of the ovule into the seed. By the segmentation of the fertilized egg, invested by cell-membrane, the embryo plant arises. A varying number of transverse segment-walls transform it into a pro-embryo—a cellular row of which the cell nearest the micropyle becomes attached to the apex of the embryo-sac, and thus fixes the position of the developing embryo, while the terminal cell is projected into its cavity. In Dicotyledons the shoot of the embryo is wholly derived from the terminal cell of the pro-embryo, from the next cell the root arises, and the remaining ones form the suspensor. In many Monocotyledons the terminal cell forms the cotyledonary portion alone of the shoot of the embryo, its axial part and the root being derived from the adjacent cell; the cotyledon is thus a terminal structure and the apex of the primary stem a lateral one—a condition in marked contrast with that of the Dicotyledons. In some Monocotyledons, however, the cotyledon is not really terminal. The primary root of the embryo in all angiosperms points towards the micropyle. The developing embryo at the end of the suspensor grows out to a varying extent into the forming endosperm, from which by surface absorption it derives food-material for growth; at the same time the suspensor plays a direct part as a carrier of nutrition, and may even develop, where perhaps no endosperm is formed, special absorptive "suspensor roots" which invest the developing embryo, or pass out into the body and coats of the ovule, or even into the placenta. In some cases the embryo or the embryo-sac sends out suckers into the nucellus and ovular integument. As the embryo develops it may absorb all the food-material available, and store, either in its cotyledons or in its hypocotyl (the short portion of the stem below the cotyledons), what is not immediately required for growth, as reserve-food for use in germination, and by so doing it increases in size until it may fill entirely the embryo-sac; or its absorptive power at this stage may be limited to what is necessary for growth and it remains of relatively small size, occupying but a small area of the embryo-sac, which is otherwise filled with endosperm in which the reserve-food is stored. There are also intermediate states. The position of the embryo in relation to the endosperm varies; sometimes it is internal, sometimes external, but the significance of this has not yet been established.

The formation of endosperm starts, as has been stated, from the endosperm-nucleus. Its segmentation always begins before that of the egg, and thus there is timely preparation for the nursing of the young embryo. If in its extension to contain the new formations within it the embryo-sac remains narrow, endosperm formation proceeds upon the lines of a cell-division; but in wide embryo-sac the endosperm is first of all formed as a layer of naked cells around the wall of the sac and only gradually acquires a pluricellular character, forming a tissue filling the sac. The function of the endosperm is primarily that of nourishing the embryo, and its basal position in the embryo-sac places it favourably for the absorption of food material entering the ovule. Its duration varies with the precocity of the embryo. It may be wholly absorbed by the progressive growth of the embryo within the embryo-sac, or it may persist as a definite and more or less conspicuous constituent of the seed. When it persists as a massive element of the seed its nutritive function is usually apparent, for there is accumulated within its cells reserve-food, and according to the dominant substance it is starchy, oily, or rich in cellulose, mucilage, or proteid. In cases where the embryo has stored reserve-food within itself and thus provided for self-nutrition, such endosperm as remains in the seed may take on other functions, for instance, that of water-absorption.

Some deviations from the usual course of development may be noted. Parthenogenesis, or the development of an embryo from an egg-cell without the latter having been fertilized, has been described in species of *Thalictrum, Antennaria,* and *Alchemilla.* Polyembryony is generally associated with the development of cells other than the egg-cell. Thus in *Erythronium* and *Limnocharis* the fertilized egg may form a mass of tissue on which several embryos are produced. Isolated cases show that any of the cells within the embryo-sac may exceptionally form an embryo, *e.g.,* the synergidae in species of *Mimosa, Iris,* and *Allium,* and in the last-mentioned the antipodal cells also. In *Coelebogyne* (Euphorbiaceae) and in *Funkia* (Liliaceae) polyembryony results from an adventitious production of embryos from the cells of the nucellus around the top of the embryo-sac. In a species of *Allium* embryos have been found developing in the same individual from the egg-cell, synergids, antipodal cells, and cells of the nucellus. In two Malayan species of *Balanophora* the embryo is developed from a cell of the endosperm, which is formed from the upper polar nucleus only, the egg-apparatus becoming disorganized. The last-mentioned case has been regarded as representing an apogamous development of the sporophyte from the gametophyte comparable to the cases of apogamy described in ferns. But the great diversity of these abnormal cases as shown in the examples cited above suggests the use of much caution in formulating definite morphological theories upon them.

As the development of embryo and endosperm proceeds within the embryo-sac its wall enlarges and commonly absorbs the substance of the nucellus (which is likewise enlarging) to near its outer limit, and combines with it and the integument to form the seed-coat; or the whole nucellus and even the integument may be absorbed. In some plants the nucellus is not thus absorbed, but itself becomes a seat of deposit of reserve-food constituting the perisperm which may coexist with endosperm, as in the water-lily family (Nymphaeaceae), or may alone form a food-reserve for the embryo, as in *Canna.* Endospermic food-reserve has evident advantages over perispermic, and the latter is comparatively rarely found. Seeds in which endosperm or perisperm, or both, exist are commonly called albuminous or endospermic; those in which neither is found are termed exalbuminous or exendospermic. The presence or absence of endosperm, its relative amount when present, and the position of the embryo within it are valuable characters for the distinction of families and orders, or groups of families. Meanwhile the ovary-wall has developed to

form the fruit or pericarp, the structure of which is closely associated with the manner of distribution of the seed. Frequently the influence of fertilization is felt beyond the ovary, and other parts of the flower take part in the formation of the fruit, as the floral receptacle in the apple, strawberry, and others. The character of the seed-coat bears a definite relation to that of the fruit. Its function is the twofold one of protecting the embryo and of aiding in dissemination; it may also directly promote germination. If the fruit is a dehiscent one and the seed is, therefore, soon exposed, the seed-coat has to provide for the protection of the embryo and may also have to secure dissemination. On the other hand, indehiscent fruits discharge these functions for the embryo, and the seed-coat is only slightly developed.

Dissemination.—Dissemination is effected by an explosive mechanism resident in the fruit or seed, or by aid of some external agency—water, air, or animals. The need for this is obvious—buoyancy in water and resistance to wetting for the first, some sort of parachute for the second, and some attaching mechanism or attractive structure for the third. The methods in which these are provided are of infinite variety, and any and every part of the flower and of the inflorescence may be called into requisition to supply the adaptation (*see* FRUIT). Special outgrowths, arils, of the seed-coat are of frequent occurrence. In the feature of the fruit and seed, by which the distribution of angiosperms is effected, we have a distinctive character of class. In gymnosperms we have seeds, and the carpels may become modified and close around these, as in *Pinus* during the process of ripening to form an imitation of a box-like fruit which, subsequently opening, allows the seeds to escape; but there is never in them the closed ovary investing from the outset the ovules and ultimately forming the groundwork of the fruit.

Germination of Seed.—Their fortuitous dissemination does not always bring seeds upon a suitable nidus for germination, the first need for which is a sufficiency of moisture, and the duration of vitality of the embryo is a point of interest. Some seeds retain vitality for a period of many years, though there is no warrant for the popular notion that genuine "mummy wheat" will germinate; on the other hand some seeds lose vitality in a very short time. Further, the older the seed the more slow as a general rule will germination be in starting; but there are notable exceptions. This pause, often of so long duration, in the growth of the embryo between the time of its perfect development within the seed and the moment of germination, is one of the remarkable and distinctive features of the life of seed-plants (spermatophytes). The aim of germination is the fixing of the embryo in the soil, effected usually by means of the root, which is the first part of the embryo to appear, in preparation for the elongation of the portion of the shoot above the cotyledons (*epicotyl*), and there is infinite variety in the details of the process. In endospermic Dicotyledons the cotyledons act as the absorbents of the reserve-food of the seed and are commonly brought above ground (*epigeal*), either withdrawn from the seed-coat or carrying it upon them, and then they serve as the first green organs of the plant. The part of the stem below the cotyledons (hypocotyl) commonly plays the greater part in bringing this about. Exendospermic Dicotyledons usually store reserve-food in their cotyledons, which may in germination remain below ground (*hypogeal*). In endospermic Monocotyledons the cotyledon itself, probably in consequence of its terminal position, is commonly the agent by which the embryo is thrust out of the seed, and it may function solely as a feeder, its extremity developing as a sucker through which the endosperm is absorbed, or it may become the first green organ, the terminal sucker dropping off with the seed-coat when the endosperm is exhausted. Exendospermic Monocotyledons are either hydrophytes or strongly hygrophilous plants and have often peculiar features in germination.

Vegetative Reproduction.—Distribution by seed appears to satisfy so well the requirements of angiosperms that distribution by vegetative buds is only an occasional process. At the same time every bud on a shoot has the capacity to form a new plant if placed in suitable conditions, as the horticultural practice of propagation by cuttings shows; in nature we see plants spreading by the rooting of their shoots, and buds we know may be freely formed not only on stems but on leaves and on roots. Where detachable buds are produced, which can be transported through the air to a distance, each of them is an incipient shoot which may have a root, and there is always reserve-food stored in some part of it. In essentials such a bud resembles a seed. A relation between such vegetative distribution buds and production of flower is usually marked. Where there is free formation of buds there is little flower and commonly no seed, and the converse is also the case. Viviparous plants are an illustration of substitution of vegetative buds for flower. In these cases the ovule is replaced by a minute plantlet which develops *in situ* and separates from the plant when it is able to maintain an independent existence. This occurs in some grasses and other species living in Arctic or other situations where the normal course of seed-development as the result of fertilization is uncertain.

Phylogeny and Taxonomy.—Reference is made in the general article BOTANY to early systems of classification and to the evolution of the idea of a natural system in which families were grouped according to their affinities. This found expression in British botany in the system elaborated by George Bentham and Joseph Hooker in the *Genera Plantarum* (1862–1883), in which all known genera of flowering plants were described and arranged in families and higher groups. The system was based on that of the De Candolles and has been widely used in Great Britain and America. It will illustrate the principles of a system which, without claiming to be phylogenetic, represents in the sequence adopted a progression from simpler to more advanced families. The families of the two great divisions, Dicotyledons and Monocotyledons, are grouped in cohorts (or series); those of the Dicotyledons are arranged in three subdivisions: Polypetalae, where the petals are free from each other, Gamopetalae, with a corolla of united petals, and Monchlamydeae, without a corolla, and where the flower often consists merely of the reproductive organs. (*See* the article FLOWER for illustrations.) In the first two subdivisions the cohorts are arranged in a progressive series according to the relative position of the gynaecium and the other floral whorls; in the simplest forms sepals, petals, and stamens stand below the carpels on the floral axis (*i.e.*, are hypogynous), while in the most advanced they spring from the top of the ovary (*i.e.*, are epigynous). Diminution of the number of parts in the flower is also an indication of an advance, especially the number of carpels which in the most advanced members of each subdivision is reduced to two. A spiral arrangement of the floral leaves is also more primitive than a whorl; and a regular flower, that is one showing a radial structure, than one which is symmetrical only about one plane. To some extent also a woody habit indicates less advance than an herbaceous.

A great drawback to the value of this system is the inclusion among the Monochlamydeae of a number of families which are closely allied with families of Polypetalae though differing in absence of a corolla. The German systematist, A. W. Eichler, attempted to remove this disadvantage which since the time of Jussieu had characterized the French system, and in 1883 grouped the Dicotyledons in two subclasses. The earlier subclass, Choripetalae, embraces the Polypetalae and Monochlamydeae of the French and English systems, and is an attempt to arrange as far as possible in a linear series those families which are characterized by absence or freedom of petals. A modification of Eichler's system, embracing more recent views of the affinities of the families of angiosperms, has been put forward by Dr. Adolf Engler of Berlin, who adopts the suggestive names Archichlamydeae and Metachlamydeae for the two subdivisions of Dicotyledons. Engler regarded his system as phylogenetic; simplicity of floral structure was considered primitive and the earlier orders (as groups of families are now termed) in his system are thus characterized. But he recognized that a simple type of flower may also appear in an advanced group and is then obviously derived; and many botanists would regard all families characterized by simple flowers as derived from more advanced forms.

Divergent views as to the origin of the angiosperms have some bearing on this problem. The angiosperms appear in the Creta-

ceous period as a well-developed and widely distributed group of plants with the characters of the existing class. The fossil remains may be distributed among existing families and genera and give no clue to the early history of the group.

The great antiquity of the other class of seed-plants, the gymnosperms, has suggested that the origin of the angiosperms should be sought within it. Thus Richard Wettstein seeks to derive a simple form of flower from an ancestor, resembling *Ephedra* (Gnetaceae), and regards the simple flower as primitive in the angiosperms. A view which has found considerable support regards the extinct Mesozoic Cycadeoidea, a group allied to the cycads, as the nearest approach known to the ancestral angiosperm stock. The "flower" of Bennettites (*see* PALAEOBOTANY), which has an elongated axis bearing sterile leaves below and micro- and macro-sporophylls above, is regarded as the forerunner of the angiosperm flower as exhibited, for instance, in *Magnolia*, a perfect bisexual flower with free sepals, petals, stamens, and carpels following in spiral succession on an elongated floral receptacle. On this theory, which has been developed by E. A. N. Arber and J. W Parkin (see *Journ. Linn. Soc.* [*Bot.*] xxxviii. 29, 1907), this type of flower represents the starting point of a phylogenetic system of classification of Dicotyledons. Such are the systems elaborated by C. E. Bessey in America, Hans Hallier in Germany, and recently by John Hutchinson in England.

It is, however, probable that the original stock of the angiosperms has not yet been traced. A vast number of forms must have arisen and become extinct in the course of evolution of the group, and among these may be some of which certain of the existing simple-flowered groups are surviving representatives.

The relation of the two divisions, Dicotyledons and Monocotyledons, has also been much debated. Had each group a separate origin or has one been derived from the other? Botanists who uphold the Bennettites ancestry of Dicotyledons would derive the Monocotyledons from the base of the dicotyledonous stock. On the other hand strong arguments have been adduced in favour of its distinct origin, the two divisions representing a parallel development.

A phylogenetic tree including the whole plant-kingdom has recently been elaborated by Carl Mez and H. Ziegenspeck, based on the reaction to serum of members of the various families (*see* Von C. Mez and H. Ziegenspeck, "Der Königsberger Serodiagnostische Stammbaum," *Mez, Botanisches Archiv.* xiii. 482 [1926]).

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ANGKOR, an assemblage of ruins in Cambodia, the relic of the ancient Khmer civilization. They are situated in forests to the north of the Great Lake (Tonle-Sap), the most conspicuous of the remains being the town of Angkor-Thom and the temple of Angkor-Vat, both of which lie on the right bank of the river Siem-Reap, a tributary of the Tonle-Sap. Other remains of the same character lie scattered about the vicinity on both banks of the river. It has been decided to enclose them in a park.

Angkor-Thom, according to Aymonier, was begun about A.D. 860 and finished towards A.D. 900. Within a rectangular enclosure, nearly 2m. in each direction, which is entered by five monumental gates, are the remains of palaces and temples, overgrown by the forest. The chief of these are: (1) The vestiges of the royal palace and the pyramidal religious structure known as the Phimeanakas, both of which stood within an enclosure to the east of which extends a terrace decorated with magnificent reliefs. (2) The temple of Bayon, consisting of a double system of galleries enclosing a cruciform structure, at the centre of which rises a huge tower with a circular base. Fifty towers, decorated with quadruple faces of Brahma, are built at intervals upon the galleries, the whole temple ranking as perhaps the most remarkable of the Khmer remains.

Angkor-Vat, the best preserved example of Khmer architecture, lies less than a mile to the south of the royal city, within a park surrounded by a moat, the outer perimeter of which measures 6,060 yards. Although sometimes said to have been devoted to the worship of Brahma, the French school of the Far East now thinks that the temple was consecrated to the worship of Buddha. It consists of three stages, connected by exterior staircases and decreasing in dimensions as they rise, culminating in the sanctuary, a great central tower pyramidal in form. Three galleries with vaulting supported on columns lead from the three western portals to the second stage. They are connected by a transverse gallery thus forming four square basins Khmer decoration, profuse but harmonious, consists chiefly in the representation of gods, men and animals, which are displayed on every flat surface. Combats and legendary episodes are often depicted; floral decoration is reserved chiefly for borders, mouldings and capitals. Sandstone of various colours was the chief material employed by the Khmers, without the use of cement; limonite was also used. (*See* CAMBODIA.)

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ANGLE, in plane geometry, a figure formed by two lines which meet. The point of meeting is called the *vertex* of the angle. The original idea has been extended to include the figure formed by a plane and a line which meets it, by two intersecting planes (a *dihedral angle*), by three planes having a common point (a *trihedral angle*), by any number of planes having a common point (a *polyhedral angle*), or by two intersecting curves (a *curvilinear angle*). The angle in the last case is measured by the angle formed by tangents to the curves at their common point; it may also be formed by a curve and a straight line (*mixed angle*). The concept has also been extended to include the case of two lines in space that are not parallel and yet do not meet, like the upper edge of a box and a lower non-parallel one (*skew angle*). There are also *spherical angles*, formed by the intersection of two great circles of a sphere. An angle is measured by the amount of turning necessary to bring one of the lines (arms, sides, legs) into coincidence with the other, this being measured on a circle with its vertex (from Lat. *vertere*, to turn) at the centre.

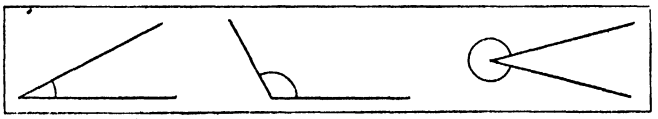


FIG. 1.—ACUTE, OBTUSE AND REFLEX ANGLES

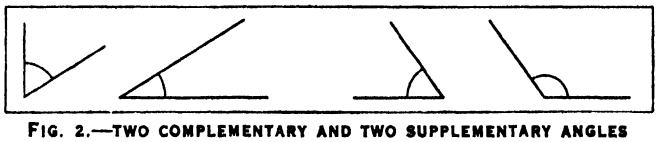
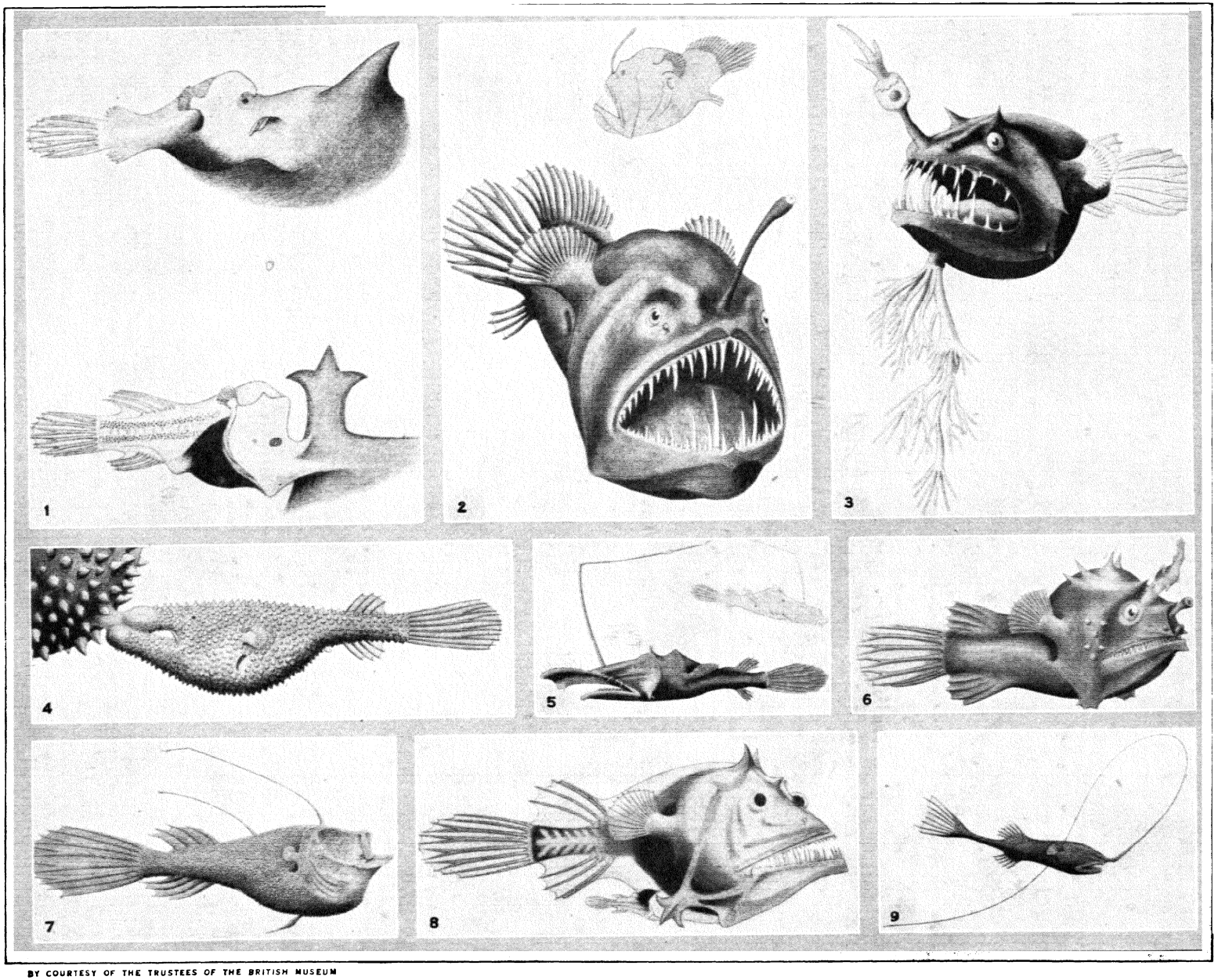


FIG. 2.—TWO COMPLEMENTARY AND TWO SUPPLEMENTARY ANGLES

The early idea of angle limited the concept to an angle less than 180°. The demands of science lead modern writers to speak of a *straight angle* (180°), a *reflex angle*, and of angles exceeding 360°, as in speaking of an angle arising from turning a radius



BY COURTESY OF THE TRUSTEES OF THE BRITISH MUSEUM

OCEANIC ANGLER FISHES

1. (a) Photocorynus spiniceps, male, (b) Edriolychnus schmidti, male
2. Melanocetus johnsoni
3. Linophryne arborifer
4. Ceratias holboelli, male
5. Lasiognathus saccostoma
6. Photocorynus spiniceps, female with male
7. Ceratias holboelli, female with male
8. Edriolychnus schmidti, female with male
9. Gigantactis macronema

beyond a complete revolution. This is seen in any rotary motion. An angle less than a right angle (90°) is said to be *acute;* between 90° and 180°, *obtuse;* and between 180° and 360°, *reflex.* The angle 90°—*a* is the *complement* of angle *a*; for example, the complement of 40° is 90°—40°, or 50°. The angle 180°—*b* is the *supplement* of angle *b.*

The term angle is itself such a basal term that it is not possible to give a satisfactory definition employing terms more simple than

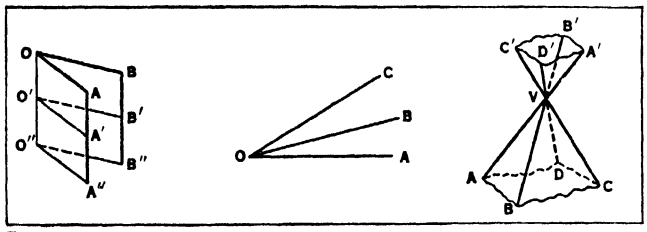


FIG. 3.—DIHEDRAL, ADJACENT AND SYMMETRIC POLYHEDRAL ANGLES

itself. Hilbert's definition represents one of the late efforts: "Let *a* be any arbitrary plane and *h, k* any two distinct half-rays lying in *a* and emanating from the point *o* so as to form a part of two different straight lines. We shall call the system formed by these two half-rays *h, k* an angle."

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ANGLER (*Lophius piscatorius*), also called the fishing frog, belongs to the order Pediculati. It is a bottom-living fish, abundant round the coasts of Europe and western North America; it does not extend beyond 60° N. lat. The enormous mouth, with long, backwardly-directed, depressible teeth, and the large flattened head are diagnostic points. The fish walks along the bottom by means of its paired fins, which are modified for this purpose. The first three rays of the anterior dorsal fin are long filaments placed on the head; the first, the longest, ends in a lappet, is freely movable, and acts as a lure to attract other fish. So large is the mouth and so extensible the stomach that the angler can engulf fish as big as or bigger than itself. It may reach a length of 5 ft. The spawn consists of a transparent, gelatinous sheet, 2 or 3 ft. broad and 25–30 ft. long. In this the eggs are embedded. A second species (*L. budegassa*) occurs in the Mediterranean and a third (*L. litulon*) on the coasts of Japan. Tropical species have 19 vertebrae instead of 26 to 32, and are placed in a distinct genus *Lophiomus.*

The order Pediculati includes also a number of little fishes (*Antennarius,* etc.) found in shallow water in warm seas and also a group, the Ceratioids, that live in the darkness of the middle depths of the ocean, from about 500 to 1,500 metres below the surface. These are blackish fishes, with a luminous lure; the males are dwarfed and parasitic on the females. (*See* FISHES.)

ANGLESEY, ARTHUR ANNESLEY, 1ST EARL OF (1614–1686), British statesman, son of the 1st Viscount Valentia (cr. 1621), born at Dublin on July 10, 1614, was educated at Magdalen College, Oxford, and admitted to Lincoln's Inn in 1634. He was commissioned by the English parliament in a mission to the duke of Ormonde, with whom he concluded a treaty on June 19, 1647. In that year he entered the House of Commons as member for Radnorshire, and supported the Parliamentary as against the Republican or Army Party. The anarchy of the last months of the Commonwealth converted him to the Royalist side and he helped to bring about the restoration. In 1661 he was created Baron Annesley and earl of Anglesey in the British peerage. From 1660 to 1667 he held various offices in the Irish administration, and in the British House of Commons supported Irish interests.

In the bitter religious controversies of his time Anglesey showed moderation and toleration. In the panic over the "Popish Plot" in 1678 he kept his head. He was one of the four peers who protested in that year against the bill for the disarming of convicted recusants; he was the only peer to dissent from the motion declaring the existence of an Irish plot; he interceded for Lord Stafford, although he believed in his guilt; and in 1683 he appeared as a witness in defence of Lord Russell. He died at Bletchingdon in Oxfordshire on April 26, 1686.

The unfavourable character drawn of him by Burnet is certainly unjust and not supported by any evidence. Pepys, a far more trustworthy judge, speaks of him invariably in terms of respect and approval as a "grave, serious man," and commends his appointment as treasurer of the navy as that of "a very notable man, and understanding, and will do things regular and understand them himself." He was a learned and cultivated man and collected a celebrated library, which was dispersed at his death. His works include *A True account of the Whole Proceedings betwixt . . . the Duke of Ormond and . . . the Earl of Anglesey* (1682).

Memoirs of Lord Anglesey were published by Sir P. Pett in 1693, but contain little biographical information and were repudiated as a mere imposture by Sir John Thompson (Lord Haversham), his son-in-law, in his preface to Lord Anglesey's *State of the Government* in 1694. However, the author of the preface to *The Rights of the Lords asserted* (1702), while blaming their publication as "scattered and unfinished papers," admits their genuineness.

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ANGLESEY, HENRY WILLIAM PAGET, 1ST MARQUIS OF (1768–1854), British field-marshal, was born May 17, 1768, the eldest son of Henry Paget, 1st Earl of Uxbridge, and was educated at Westminster School and Christ Church, Oxford. He served with distinction in the French revolutionary wars, and by 1808 had risen to be lieutenant-general. In command of the cavalry in Sir John Moore's Corunna campaign, he won the highest praise. His liaison with the wife of Henry Wellesley made it impossible at that time for him to serve with Wellington, and he did not serve actively, except during the disastrous Walcheren campaign, until in 1815 he commanded the British cavalry in Flanders. Wellington put him in command of the whole of the allied cavalry and horse artillery. He covered the retirement from Quatre Bras, and led the cavalry charge of the British centre which checked and in part routed d'Erlon's *corps d'armée* at Waterloo. He received a severe wound, which necessitated the amputation of his leg. He received a marquisate and other honours for his services, which were regarded as second only to those of the duke himself.

Anglesey became lord lieutenant of Ireland (1828) under Wellington's Government, and his recall, after a brief tenure of the office, on account of his advocacy of the relief of the Catholics from the penal laws imposed on them, was much regretted in Ireland. But in 1830, after the cause was won, he again became lieutenant under Earl Grey's Government. He had to face O'Connell's agitation for the repeal of the Union, and asked for coercive powers. In July 1833 the ministry resigned. His best legacy to Ireland was the Board of Education, established during his viceroyalty. Anglesey remained in retirement until 1846, when he became master-general of the ordnance. In that year he was promoted to the rank of field-marshal. He died April 29, 1854.

The marquis had two sons and six daughters by his first wife, and six sons and four daughters by the second. His eldest son, Henry, succeeded him in the marquisate; but the title passed rapidly in succession to the 3rd, 4th and 5th marquises. The last, whose extravagances were notorious, died in 1905, when the title passed to his cousin.

Other members of the Paget family distinguished themselves in the Army and the Navy. Of the first marquis's brothers, one, SIR CHARLES PAGET (1778–1839), rose to the rank of vice-admiral in the Royal Navy; another, General SIR EDWARD PAGET (1775–1849), won great distinction by his skilful handling of a division

at Corunna, and from 1822 to 1825 was commander-in-chief in India. One of the marquis's sons by his second marriage, LORD CLARENCE EDWARD PAGET (1811–95), became an admiral; another, LORD GEORGE AUGUSTUS FREDERICK PAGET (1818–80), led the 4th Light Dragoons in the charge of the Light Brigade at Balaklava; and subsequently commanded the brigade, and, for a short time, the cavalry division in the Crimea. In 1865 he was made inspector-general of cavalry, in 1871 lieutenant-general and K.C.B., and in 1877 full general. His Crimean journals were published in 1881.

ANGLESEY or **ANGLESEA,** an insular northern county of Wales, area about 276sq.m., is cut off from the adjoining mainland of Carnarvonshire by the shallow Menai strait. The island differs strikingly from most other parts of Wales in the lowness of the land—the highest points being 720ft., on Holy island in the north-west, and 494ft. on Parys mountain in the north-east. It is a much worn down ancient highland, the worn ribs of which run as lines of moorland between slightly lower lines of marsh in a north-easterly to south-westerly direction. Three distinct lines of very ancient rock (pre-Cambrian schists and slates), now worn down almost to sea level, follow the general north-easterly to south-westerly trend. The north-western section includes Holyhead and Llanfaethlu, the central Aberffraw and Trefdraeth, and the south-eastern Newborough and Pentraeth. In the region between the central and north-west lowland just described, we have slightly higher ground, composed of granite on its southern side, and much folded Ordovician slates and grits on the north. The latter fan out to the north-east of the island, where volcanic intrusions have given rich veins of copper at Parys mountain. Between the central and southern pre-Cambrian peneplains the slightly raised ground is mostly composed of carboniferous limestone. Similar patches of limestone outcrop on the extreme south of the island, forming the northern shore of the Menai strait. The latter is just another of these lower north-easterly to south-westerly lines that has been submerged, and is more picturesque, if less wild, than the island marshes lying parallel to it. There are abundant evidences of glaciation, and much boulder clay and drift sand cover the older rocks. Patches of blown sand occur on the south-west coast.

The importance of Anglesey in prehistoric times is clearly indicated by the large number of megalithic monuments (chiefly dolmens, called in Wales cromlechs, and menhirs), that cover the island, especially in the south and west (*see* E. N. Baynes, "The Megalithic Remains of Anglesey," *Cymmrod. Soc. Trans.* 1910–11, pp. 3–91). Thus Anglesey, together with many of the western promontories of Britain, France and Spain, seems to have been an important station on the coastwise and transpeninsular routes between Spain and Ireland (*see* PEMBROKESHIRE). A group of mediaeval chapels in the neighbourhood of Holyhead suggests the continual use of this route along lines similar to that at St. David's (*q.v.*) in mediaeval times. There are indications that a similar maritime trade reached Anglesey in the late bronze age. Finds of exotic bronzes, a gold bracelet and jet beads have occurred in the centre of the island and near the coast at Holyhead and Beaumaris. Occupational evidences of some shortly pre-Roman period are to be found in the Hut circles at Ty Mawr on Holyhead mountain. Agricola is known to have conquered and settled Anglesey about A.D. 78. The island was known to the Romans as Mona, and recorded by them as the home of the Druids. Domestic implements of native workmanship are found at Pen-y-Bone in connection with Roman coins of the 1st and 2nd centuries, as well as Samian ware and cinerary urns of Roman origin. In the turbulent post-Roman centuries Anglesey seems to have been the prey of raiders from Ireland, Man, Scotland, England, and Wales. The Scandinavian raids, and the conquest of the island by the Saxons, under Egbert, and their ultimate expulsion seem to be the outstanding features. The raids did not cease with the arrival of the Normans, as the fatal expedition of Hugh of Chester in 1098 shows. They realized that although they could retain the lowlands of South Wales and the Border, Anglesey and Powys could not be retained without serious risk of disaster. Consequently the island retained a measure of independence throughout the early middle ages, and at Aberffraw was located a capital of the Welsh princes of Gwynedd. The large expanses of low-lying ground (so rare in Wales) and the small rainfall, made the island one of the chief corn producing regions of the principality, and thereby earned it its name of "Môn Mam Cymru" ("Anglesey the mother [nourisher] of Wales"). The county was finally subdued by Edward I., who built an important castle at Beaumaris in 1295–96 and declared Aberffraw the capital of the island. Old traditions and customs, enriched by the age-long contacts with Ireland, lingered long in Anglesey, and gave a peculiar interest and charm to the mediaeval descriptions of the court at Aberffraw. Penmon priory, 4½m. from Beaumaris, was the most important monastic house, founded on an earlier site in the early part of the 13th century.

For centuries after the Edwardian conquest, the remoteness of Anglesey from the English plain made it the centre for those who plotted against the Crown. It became important for its seafaring and fisheries. Its people were deeply attached to the royalist cause in the 17th century. The development of Holyhead as a packet station for Ireland is the central feature in modern Anglesey, and provides an interesting example of how a route famous from prehistoric days has lived on under modern conditions. It was a regular station in the reign of William III., and was selected by the Government in 1801 as an Irish Packet station and as the terminus of Telford's great road (1815–19) from Shrewsbury, which crossed the island from south-east to north-west. A fine harbour was built by the London and North Western railway in 1880, and since then most of the Irish traffic to England has passed through Anglesey. Copper mining at Parys mountain in the north-east of the county was important between 1762–1850. Other minerals, including coal, have been worked in small quantities at different times in the island. Agriculture, sheep rearing and coastal fishing provide occupation for the bulk of the population at the present time. The county is connected with the mainland by two bridges over the Menai strait, viz., Telford's suspension bridge (1819–26) the largest in the kingdom, built at the zenith of the stage coach traffic, and Stephenson's tubular railway bridge, built in 1850.

The L.M.S. railway (Chester and Holyhead branch) crosses Anglesey from Llanfairpwllgwyngyll to Caerwen and Holyhead (Gaergybi), also from Gaerwen to Amlwch. The population of the county in 1921 was 51,744. There is no parliamentary borough, but one member is returned for the county. It is in the north-west circuit, and assizes are held at Beaumaris, the only municipal borough, pop. (1921) 1,841. Amlwch (2,699), Holyhead (11,761), Llangefni (1,690), and Menai Bridge (Pont y Borth) (1,798) are urban districts. The island is in the see of Bangor, and there are 678 parishes.

See E. Breese, *Kalendar of Gwynedd* (1873), and *The History of Powys Fadog;* E. Greenly, *The Geology of Anglesey,* vols. i. and ii., and *Memoir of Geological Survey* (1919).

ANGLESITE, a mineral consisting of lead sulphate, $PbSO_4$, crystallizing in the orthorhombic system, and isomorphous with barytes and celestite. It was first recognized as a mineral species, in 1783, by Dr. Withering, who discovered it in the Parys coppermine in Anglesey; the name anglesite, from this locality, was given by F. S. Beudant in 1832. The crystals from Anglesey are small in size and simple in form; they are brownish-yellow in colour, owing to a stain of limonite. Crystals from some other localities, notably from Monteponi in Sardinia, are transparent and colourless, possessed of a brilliant adamantine lustre, and numerous faces. The hardness is 3 and the specific gravity 6.3. There are distinct cleavages parallel to the faces of the prism (110) and the basal plane (001), but these are not so well developed as in the isomorphous minerals barytes and celestite. Anglesite is a mineral of secondary origin, having been formed by the oxidation of galena in the upper parts of mineral lodes, where these have been affected by weathering processes.

ANGLI, ANGLII or ANGLES, a Teutonic people mentioned by Tacitus in his *Germania* (cap. 40) at the end of the 1st century, without precisely indicating their geographical position. With six other tribes, including the Varini (the Warni of later times), they

worshipped a goddess named Nerthus, whose sanctuary was situated on "an island in the Ocean." Ptolemy in his *Geography* (ii. 11. § 15), half a century later, locates them between the Rhine, or rather perhaps the Ems, and the Elbe, as one of the chief tribes of the interior. This indication cannot be correct. They seem to have lived on the coasts of the Baltic, probably in the southern part of the Jutish peninsula. Striking affinities to the cult of Nerthus are found in Scandinavian, especially Swedish and Danish, religion. The island of Nerthus was probably Sjaelland (Zealand).

According to Bede the Angli before they came to Britain dwelt in a land called Angulus, and similar evidence is given by the *Historia Brittonum*. King Alfred and the chronicler Aethelweard identified this place with the district which is now called Angel in the province of Schleswig (Slesvig). During the 5th century the Angli invaded Britain (*see* BRITAIN, *Anglo-Saxon*).

The large cremation cemetery at Borgstedterfeld, in the province of Schleswig between Rendsburg and Eckernförde, has yielded many urns and brooches closely resembling those found in heathen graves in England. The great deposits at Thorsbjaerg (in Angel) and Nydam contained large quantities of arms, ornaments, articles of clothing, agricultural implements, etc., and in the latter case even ships. By the help of these discoveries we are able to reconstruct a fairly detailed picture of English civilization in the age preceding the invasion of Britain.

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ANGLICAN COMMUNION, the name used to denote that branch of the Christian Church consisting of the various ecclesiastical bodies, throughout the world, in communion with the Church of England. (*See* ENGLAND, CHURCH OF.)

ANGLICANISM, a general term for the ecclesiastical system, organization, and doctrine of the Church of England and the churches throughout the world in communion with it. (*See* ENGLAND, CHURCH OF..)

ANGLIN, MARGARET (1876–), American actress, was born on April 3, 1876, at Ottawa, Canada. She was educated in the convents of Loretto abbey, at Toronto, and Sault Recollet, at Montreal. She studied drama at the Wheatcroft school in New York, and made her stage début in 1894 as Madeline West in Charles Frohman's presentation of *Shenandoah*. In 1898 she appeared as Roxane in *Cyrano de Bergerac*. From 1900 till 1903 she was the leading woman at the Empire theatre, and in 1903–04 acted with Henry Miller in *Camille*, *The Devil's Disciple*, and other plays. Her appearance in William Vaughn Moody's *The Great Divide*, in 1907, added lustre to her growing fame. In 1909 she produced and took the leading part in *The Awakening of Helena Richie*, the dramatization of Margaret Deland's novel of that name. In 1910 she first turned to the Greek tragedies, appearing in the open air theatre in Berkeley, Calif., in *Antigone*, and in 1913 in *Electra*. In 1916 she led 1,200 players in a presentation of *As You Like It* for the Shakespeare tercentenary celebration in Forest Park, St. Louis, Mo. In 1918 she gave *Medea* and *Electra* in New York, and in 1927 her third revival of *Electra* in the same city. Apart from her rendering of character in modern plays such as *The Woman of Bronze*, she is famous for her beautiful presentations of the Greek dramas and her faithful portrayal of their heroines.

ANGLING, the art or practice of the sport of catching fish by means of a baited hook or "angle" (from the Indo-European root *ank–*, meaning "bend"). It is among the most ancient of human activities, and may be said to date from the time when man was in the infancy of the stone age, eking out a precarious existence by the slaughter of any living thing which he could reach with the rude weapons at his command. It is probable that attack on fishes was at first much the same as attack on animals: a matter of force rather than of guile, and conducted by means of a rude spear with a flint head. It is probable, too, that the primitive harpooners were not signally successful in their efforts, and so set their wits to work to devise other means of getting at the abundant food which waited for them in every piece of water near their caves. Observation would soon show them that fish fed greedily on each other and on other inhabitants of the water or living things that fell into it, and so, no doubt, arose the idea of entangling the prey by means of its appetite. Hence came the notion of the first hook, which, it seems certain, was not a hook at all but a "gorge," a piece of flint or stone which the fish could swallow with the bait but which it could not eject afterwards. From remains found in cave-dwellings and their neighbourhood in different parts of the world it is obvious that these gorges varied in shape, but in general the idea was the same: a narrow strip of stone or flake of flint, either straight or slightly curved at the ends, with a groove in the middle round which the line could be fastened. Buried in the bait it would be swallowed end first; then the tightening of the line would fix it cross-wise in the quarry's stomach or gullet and so the capture would be assured. The device still lingers in France and in a few remote parts of England in the method of catching eels which is known as "sniggling." In this a needle buried in a worm plays the part of the prehistoric gorge.

The evolution of the fish-hook is still a matter of doubt. The gorge pure and simple is most efficient when perfectly straight, so the stages of its development into a curved hook—if it did so develop—are not easy to follow. But barbed harpoons of the later stone age have been found, and it is logical to conclude that once the custom of barbing fish-spears had been established, the same modification may easily have been applied to gorges also. In this case it would be found that many fish were hooked by the barb, and this form of angular hook, having the advantage of enabling fish to be "struck" without waiting for the bait to be gorged, would follow as a natural corollary to the barbed gorge. Hooks of this kind made out of thorn, and in one case out of an insect's leg, are still in use among primitive races. The transformation of this angular hook into a curved implement probably took place as a convenient method of manufacture when metal began to be used. Material used obviously varied in different parts of the world. The nature of the line or the rod that may have been used with these early hooks is largely a matter of conjecture. The first line was perhaps the tendril of a plant, the first rod possibly a sapling. But it is fairly obvious that the rod must have been suggested by the necessity of getting the bait out over obstacles which lay between the fisherman and the water, and that it was a device for increasing both the reach of the arm and the length of the line. It seems not improbable that the rod very early formed a part of the fisherman's equipment.

Literary History.—From prehistoric times down to comparatively late in the days of chronicles, angling appears to have remained a practice; its development into an art or sport is a modern idea. In the earliest literature references to angling are not very numerous, but there are passages in the Old Testament which show that fish-taking with hook as well as net was one of the common industries in the East, and that fish, where it was obtainable, formed an important article of diet. In Numbers (xi. 5) the children of Israel mourn for the fish which they "did eat in Egypt freely." So much too is proved by the monuments of Egypt; indeed more, for the figures found in some of the Egyptian fishing pictures using short rods and stout lines are sometimes attired after the manner of those who were great in the land. This indicates that angling had already, in a highly civilized country, taken its place among the methods of diversion at the disposal of the wealthy, though from the uncompromising nature of the tackle depicted and the apparent simplicity of the fish it would scarcely be safe to assume that in Egypt angling arrived at the dignity of becoming an "art." In Europe it took very much longer for the taking of fish to be regarded even as an amusement, and the earliest references to it in the Greek and

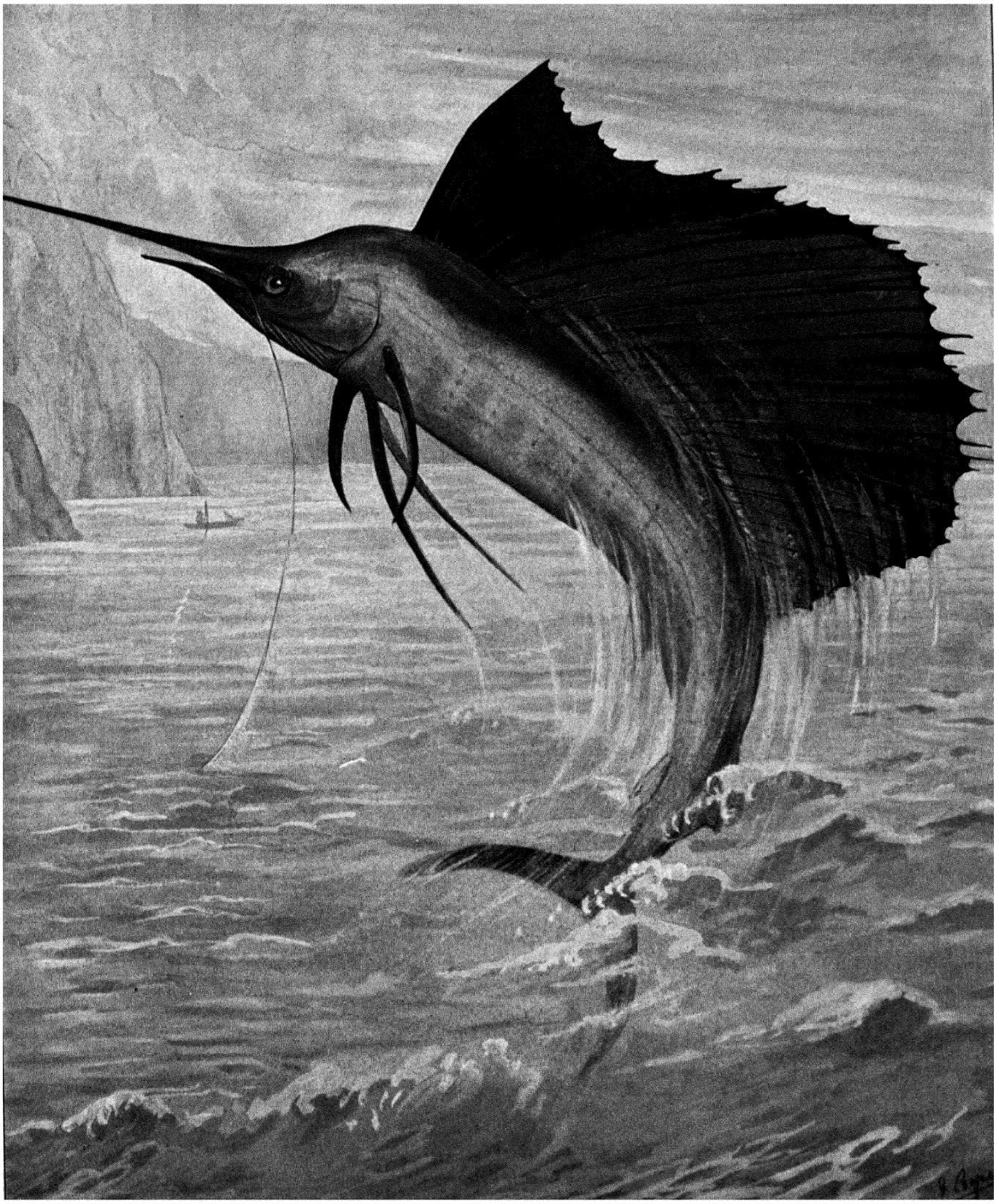
Latin classics are not very satisfying to the sportsman. There is, however, a passage in the *Odyssey* (xii. 247) which is of considerable importance, as it shows that fishing with rod and line was well enough understood in early Greece to be used as a popular illustration. It occurs in the well-known scene where Scylla seizes the companions of Odysseus out of the ship and bears them upwards, just as "some fisher on a headland with a long rod" brings small fishes gasping to the shore. Another important, though comparatively late, passage in Greek poetry is the 21st idyll of Theocritus. In this the fisherman Asphalion relates how in a dream he hooked a large golden fish and describes graphically, albeit with some obscurity of language, how he "played" it. Asphalion used a rod and fished from a rock, much after the manner of the Homeric angler. Among other Greek writers, Herodotus has a good many references to fish and fishing; the capture of fish is once or twice mentioned or implied by Plato, notably in the *Laws* (vii. 823); Aristotle deals with fishes in his *Natural History;* and there are one or two fishing passages in the anthology. But in Greek literature as a whole the subject of angling is not at all prominent. In writers of late Greek, however, there is more material. Plutarch, for instance, gives us the famous story of the fishing match between Antony and Cleopatra, which has been utilized by Shakespeare. Moreover, it is in Greek that the first complete treatise on fishing which has come down to us is written, the *Halieutica* of Oppian (*c.* A.D. 169). It is a hexameter poem in five books with perhaps more technical than sporting interest, and not so much even of that as the length of the work would suggest. Still it contains some information about tackle and methods, and some passages describing battles with big fish, in the right spirit of enthusiasm. Also in Greek is what is famous as the first reference in literature to fly-fishing, in the 15th book of Aelian's *Natural History* (3rd century A.D.). It is there described how the Macedonians captured a certain spotted fish in the river Astraeus by means of a lure composed of coloured wool and feathers, which was presumably used in the manner now known as "dapping" That there were other Greek writers who dealt with fish and fishing and composed "halieutics" we know from Athenaeus. In the first book of his *Deipnosophistae* he gives a list of them.

In Latin literature allusions to angling are more numerous than in Greek, but on the whole they are unimportant. Part of a poem by Ovid, the *Halieuticon,* composed during the poet's exile at Tomi after A.D. 9, still survives. In other Roman writers the subject is treated only by way of allusion or illustration. Martial, however, provides, among other passages, what may perhaps be entitled to rank as the earliest notice of private fishery rights—the epigram *Ad Piscatorem,* which warns would-be poachers from casting a line in the Baian lake. Pliny the elder devoted the ninth book of his *Natural History* to fishes and water-life, and Plautus, Cicero, Catullus, Horace, Juvenal, Pliny the younger and Suetonius all allude to angling here and there. Agricultural writers, too, such as Varro and Columella, deal with the subject of fish-ponds and stews rather fully. Later than any of these, but still just included in Latin literature, we have Ausonius (*c.* A.D. 320) and his well-known idyll the *Mosella,* which contains a good deal about the fish of the Moselle and the methods of catching them.

Post-classical Literature.—As to what happened in the world of angling in the first few centuries of the Christian era we know little. It may be inferred, however, that both fish and fishermen occupied a more honourable position in Christendom than they ever did before. The prominence of fishermen in the gospel narratives would in itself have been enough to bring this about, but it also happened that the Greek word for fish, ΙΧΘΥΣ, had an anagrammatic significance which the devout were not slow to perceive. The initials of the word resolve into what is practically a confession of faith, Ἰησοῦς Χριστὸς Θεοῦ Υἱὸς Σωτήρ (Jesus Christ, Son of God, Saviour). It is therefore not surprising that we find the fish very prominent as a sacred emblem in the painting and sculpture of the primitive church, or that Clement of Alexandria should have recommended it, among other things, as a device for signet rings or seals. The fisherman too is frequently represented in early Christian art, and it is worthy of remark that he more often uses a line and hook than a net. The references to fish and fishing scattered about in the writings of the early fathers for the most part reflect the two ideas of the sacredness of the fish and divine authorization of the fisherman; the second idea certainly prevailed until the time of Izaak Walton, for he uses it to justify his pastime. It is also not unlikely that the practice of fasting (in many cases fish was allowed when meat was forbidden) gave the art of catching fish additional importance. It seems at any rate to have been a consideration of weight when sites were chosen for monasteries in Europe, and in many cases when no fish-producing river was at hand the lack was supplied by the construction of fish-ponds. Despite all this, however, save for an occasional allusion in the early fathers, there is hardly a connecting link between the literature of pagan Rome and the literature that sprang up on the invention of printing.

The first printed book on angling (a translation of Oppian, 1478, excepted) was a little volume printed in Antwerp probably in 1492 at the press of Matthias van der Goes. In size it is little more than a pamphlet, and it treats of birds as well as fish: *Dit Boecxken leert hoe men mach Voghelen . . . ende . . . visschen vangen metten kanden. Ende oeck andersins. . . .* ("This book teaches how one may catch birds . . . and . . . fish with the hands, and also otherwise.") Only one copy apparently survives, in the Denison library, and a translation privately printed in 1872 was limited to 25 copies. At least two other editions of the book appeared in Flemish, and it also made its way, in 1502, to Germany, where, translated and with certain alterations and additions, it seems to have been re-issued frequently. Next in date comes the famous *Treatyse of Fysshynge wyth an Angle,* printed at Westminster by Wynkyn de Worde in 1496 as a part of the second edition of the *Boke of St. Albans.* The treatise is almost certainly a compilation from some earlier work on angling ("bokes of credence" are mentioned in its text), possibly from a ms. of the earlier part of the 15th century, of which a portion is preserved in the Denison collection. This was published in 1883 by Mr. Thomas Satchell under the title *An Older Form of the Treatyse of Fysshynge wyth an Angle.* But it is also possible that a still older work was the parent of both books, for it has been held that the ms. is an independent version. However this may be, it is certain that the treatise itself has been the parent of many other works. Many of the instructions contained in it are handed down from generation to generation with little change except in diction. Especially is this the case with the list of trout-flies, a meagre 12, which survives in many fishing books until well into the 18th century.

From the beginning of the 16th century the fisherman's library begins to grow apace, as, though books solely devoted to fishing are not yet frequent, works on husbandry and country pursuits almost all contain something on the subject. In Italy the fisherman and his occupation apparently were considered poetically; the word *pescatore* or its cognates are common on Italian 16th and 17th century title-pages, though in many instances the fulfilment of the implied promise is not adequate, from an angler's point of view. From the pages of *Bibliotheca Piscatoria* a fairly long list of Italian writers could be gleaned. Among them may be mentioned Sannazaro (*Piscatoria,* etc., Rome, 1526) and Andrea Calmo (*Rime pescatorie,* Venice, 1557). A century later was Parthenius, who published a volume of *Halieutica* at Naples. This writer has an amusing reference to the art of "tickling" trout as practised in Britain. In Germany, as has been shown, the original little Flemish treatise had a wide vogue in the 16th century, and fishing played a part in a good many books on husbandry such as that of Conrad Heresbach (1570). Fish and fish-ponds formed the main topic of a Latin work by Dubravius (1552), while Gesner in the middle of the 16th and Aldrovandi at the beginning of the 17th centuries wrote at length on the natural history of fishes. In France there were editions, now very rare, of the Flemish treatise published at Lyons about 1530, and *Les Pescheries* of Chris. de Gamon (Lyons, 1599) and *Le Plaisir des champs* of Cl. Gauchet (Paris, 1604) deserve to be noted. *Les Ruses innocentes* by François Fortin, first published



PAINTED FOR THE ENCYCLOPÆDIA BRITANNICA BY ISABEL COOPER, AFTER A SPECIMEN IN THE AMERICAN MUSEUM OF NATURAL HISTORY

THE SAILFISH A SPECIES OF SWORDFISH MUCH SOUGHT BY DEEP-SEA ANGLERS

The sailfish has a long, high back fin, which is often raised above the surface of the water. The Pacific ocean species, found in the waters around Lower California, grows 6 to 10 feet in length and weighs 50 to 150 pounds. The Atlantic ocean species is found in the waters around Florida

at Paris in 1600, and several times in later editions, is characterized by Messrs. Westwood and Satchell as "on the whole the most interesting contribution made by France to the literature of angling."

Modern Literature.—In 1600 appeared John Taverner's *Certaine Experiments concerning Fish and Fruite,* and after this the period of angling literature proper begins. The *Secrets of Angling* (1613), by J(ohn) D(ennys), Esq., is one of the most important volumes in the angler's library, both on account of the excellence of the verse in which it is written and also on account of its practical value. Gervase Markham, "the first journalist," as he has been called, published his first book of husbandry at the same date, and, as in most of his many books on the same subject, devoted a certain amount of space to fishing. But Markham gathered his materials in a rather shameless manner and his angling passages have little originality. Thomas Barker's *The Art of Angling* (1st ed., 1651) takes a more honourable position, and received warm commendation from Izaak Walton himself, who followed it in 1653 with *The Compleat Angler.* So much has been written about this treasured classic that it is only necessary to indicate its popularity here by saying that its editions occupy some 20 pages in *Bibliotheca Piscatoria* (1883), and that since that work was published at least 40 new editions have to be added to the list. During Walton's life-time the book ran through five editions, and with the fifth (1676) was incorporated Charles Cotton's second part, the "instructions how to angle for a trout or grayling, in a clear stream." In some cases too there was added a third book, the fourth edition of *The Experienced Angler,* by Robert Venables (1st ed., 1662). The three books together bore the title of *The Universal Angler.*

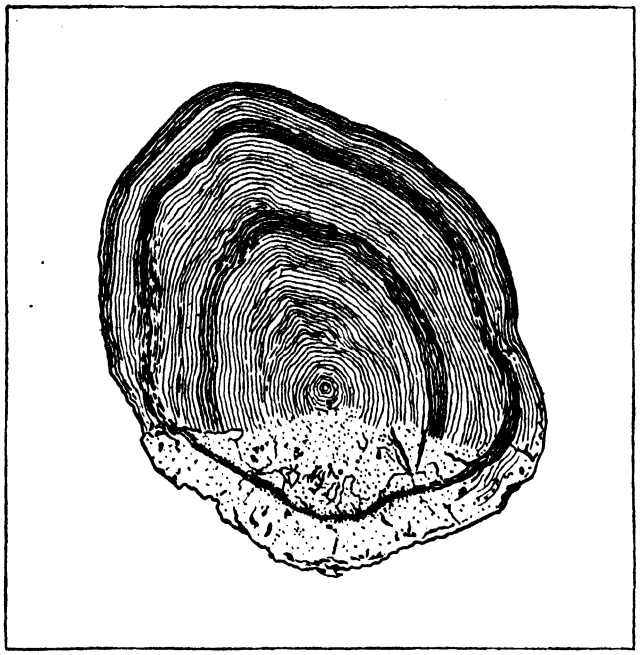
A few other notable books of the century call for enumeration, *The Gentleman's Recreation* by Nicholas Cox (1674), Gilbert's *The Angler's Delight* (1676), Chetham's *Vade-Mecum* (1681), *The Complete Troller* by Robert Nobbes (1682), R. Franck's *Northern Memoirs* (1694), and *The True Art of Angling* by J. S. (1696). Of these Chetham, Nobbes, Franck and J. S. have the merit of considerable originality. Franck has gained some notoriety by his round abuse of Walton. In the 18th century among others we find *The Secrets of Angling* by C. G. (1705), Robert Howlett's *The Angler's Sure Guide* (1706), *The Whole Art of Fishing* (1714), *The Compleat Fisherman* by James Saunders (1724), *The Art of Angling* by R. Brookes (1740), another book with the same title by R. and C. Bowlker (Worcester, *c.* 1750), *The Complete Sportsman* by Thomas Fairfax (*c.* 1760), *The Angler's Museum* by T. Shirley (1784), and *A Concise Treatise on the Art of Angling* by Thomas Best (1787). Of these only Saunders', Bowlkers' and Best's books are of much importance, the rest being for the most part "borrowed." One volume of verse in the 18th century calls for notice, Moses Browne's *Piscatory Eclogues* (1729).

With the 19th century angling literature becomes too big a subject to be treated in detail, and it is only possible to glance at a few of the more important books and writers. Daniel's *Rural Sports* appeared in 1801; it is a treasure-house of odd facts. In 1828 Sir Humphry Davy published his famous *Salmonia,* which was reviewed in the *Quarterly* by Sir Walter Scott. At about this time too were appearing the *"Noctes Ambrosianae"* in *Blackwood's Magazine.* Christopher North (Prof. Wilson) often touched upon angling in them, besides contributing a good many angling articles to the magazine. In 1835 that excellent angling writer Thomas Tod Stoddart began his valuable series of books with *The Art of Angling as Practised in Scotland.* In 1839 he published *Songs and Poems,* among which are pieces of great merit. During this period, too, first appeared, year by year, the *Newcastle Fishers' Garlands,* collected by Joseph Crawhall afterwards and republished in 1864. These border verses, like Stoddart's, have often a genuine ring about them which is missing from the more polished effusions of Gay and Thomson. Alfred Ronalds's *The Fly-Fisher's Entomology* (1st ed., 1836) was a publication of great importance, for it marked the beginning of the scientific spirit among trout-fishers. It ran through many editions and is still a valuable book of reference. A step in angling history is also marked by George Pulman's *Vade Mecum of Fly-fishing for Trout* (1841), for it contains the first definite instructions on fishing with a "dry fly." Another is marked by Hewett Wheatley's *The Rod and the Line* (1849), where is to be found the earliest reference to the "eyed" hook. Yet another is marked by W. C. Stewart's *The Practical Angler* (1857), in which is taught the new doctrine of "up-stream" fishing for trout. This is a book of permanent value. Among the many books of this period Charles Kingsley's *Miscellanies* (1859) stands out, for it contains the immortal "Chalk-Stream Studies." The work of Francis Francis begins at about the same time, though his *A Book on Angling,* which is still one of the most valuable text-books, was not first published till 1867. Among other English writers worthy of mention were William Senior, John Bickerdyke and F. M. Halford. (*See* further bibliography *ad fin.*). In America the latter half of the 19th century produced a good deal of fishing literature, much of it of a high standard. *I go a-Fishing* by Dr. W. C. Prime (1873), *Fishing with the Fly* by C. F. Orvis, A Nelson Cheney and others (1883), *The American Salmon Fisherman* and *Fly Rods and Fly Tackle* by H. P. Wells, *Little Rivers* and other books by the Rev. H. Van Dyke—these are only a few specially distinguished in style and matter. Germany and France have not contributed so largely to the modern library, but in the first country we find several useful works by Max von dem Borne, beginning with the *Handbuch der Angelfischerei* of 1875, and there are a good many other writers who have contributed to the subject, while in France there are a few volumes on fishing by different hands. The most noticeable is M. G. Albert Petit's *La Truite de rivière* (1897), an admirable book on fly-fishing.

During the present century the output of angling books has been too great for more than a selected list to be attempted, which will be found in the bibliography below, but mention may just be made here of one or two outstanding volumes that have appeared. There is, first of all, Mr. William Radcliffe's *Fishing from the Earliest Times* (2nd ed. 1926), in which the author has collected a mass of references to angling dating from cave frescoes, and implements of the stone age, through the dawn of history, down to about A.D. 500 and discusses the allusions to fishing in classical literature, on Egyptian monuments and Chinese records, and is the only attempt as yet made to compile a complete historical record of the sport. In 1907 Mr. W. L. Calderwood, the inspector of fisheries for Scotland, published his *The Life of the Salmon,* which is perhaps the most authoritative work on the knowledge of the salmon which modern scientific research has produced. Mr. Martin E. Mosely published *The Dry Fly Fisherman's Entomology* in 1921, a continuation of Mr. Halford's works on the same subject; Mr. G. E. M. Skues has produced *Minor Tactics of the Chalk Stream* (3rd ed. 1924) and *The Way of a Trout with a Fly,* which describe, in effect, a method of applying to the wet fly the scientific knowledge on which dry-fly fishing is founded. *A Bibliography of Fishes* by Bashford Dean and others published by the American Museum of Natural History was completed in three volumes in 1923, and is the biggest work of its kind ever undertaken. In France a notable contribution to fishing literature is Lt.-Col. Vavon's *La Truite: ses moeurs: L'Art de Pêcher,* which appeared in a limited edition in 1927. In it the author has collected the modern knowledge of the life history, structure and habits of the trout, and presents his recommendations for methods of capture as a logical deduction from its past history and propensities. Though it does not provide any really new information it is one of the most important books on fishing which France has yet produced.

Modern Conditions.—In the modern history of angling there are one or two features that should be touched upon A discovery in the natural history of the salmon by H. W. Johnson (*The Field,* Oct. 29, 1904) following on the work of the 17th-century Dutch naturalist, Leeuwenhoeck, that the age and past history of a fish can be read on its scales, has enormously increased our knowledge of the life history of migratory salmonidae. Briefly, the discovery was that a fish, without adding to the number of its scales, accommodates its increasing size by adding

layers to them, each layer on completion turning up slightly at its edge and thus forming a series of ridges which can easily be seen under a low-powered microscope. In summer when food is plentiful the rings thus formed are wide, while in winter owing to the comparative scarcity of food, and probably to the extra amount of nourishment absorbed in maintaining bodily warmth, the resulting rings are narrow. Thus a salmon's scale shows a



SKETCH OF SALMON SCALE FROM A SPRING FISH WITH SPAWNING MARK. ONLY A FEW OF THE RINGS ARE SHOWN

series of wide rings (summer zone) followed by a series of narrow rings (winter band) the two together forming one year in the fish's life. When a salmon enters a river for the purpose of spawning and loses condition, the edge of the scale (the greater part of which is embedded in the skin) is absorbed, and the outermost rings disappear. When scale formation starts again on recovery from spawning these rings are not replaced but new ones are laid down, the rough broken edges of the rings which have disappeared forming an uneven dark mark round the scale known as the "spawning mark." The information gained by reading the scales, supplemented by additional information from marking fish (with a metal label or similar device) and returning them to the water, has profoundly modified our ideas of the life of the salmon. Grilse (immature salmon) at one time regarded as a separate species, and later believed to be fish which had spent only a few months in the sea, is now the name given to salmon which have spent only one year (none spend less) and a few months in the sea before returning to fresh water. It has also been shown that the length of a salmon's "parr" life in fresh water has a considerable effect on the length of its sojourn in the sea, the rule being, roughly, that the longer a parr takes in growing to the smolt stage before migration the shorter will be its stay in salt water and the greater likelihood of its return to the river as a grilse instead of a larger and more profitable "spring" or "summer" fish (fish which have spent two or more years in the sea). It is now known, too, that very few fish return to spawn a second time, while a fish which has four or more spawning marks on its scales is worth recording as a phenomenal capture. Knowledge of sea trout, though increasing rapidly, has not kept pace with the knowledge of salmon, but the method of reading their scales is the same, though the interpretation of them is more difficult, owing to their habit of returning to fresh water for purposes other than spawning. Attempts have also been made to apply the same system to fresh-water fish other than the salmon family, but though some progress has been made it is not yet possible to interpret their rings with the same accuracy as with salmon and trout. All European trout, whether "sea," "brown" or any of the numerous variations that used to be listed as subspecies are now regarded as one and the same species (*S. trutta*) there being no discoverable structural difference, according to the latest scientific investigations. Trout varying in colour owing to quality of food, water, or other local conditions are regarded simply as "strains" of the same species.

The great increase in the number of fishermen has had several results. One is a corresponding increase in the difficulty of obtaining fishing, and a notable rise in the value of rivers, especially those which are famed for salmon and trout. Salmon-fishing now may be said to have become a pastime of the rich, and there are signs that trout-fishing will before long have to be placed in the same exclusive category, while even the right to angle for less-esteemed fish will eventually be a thing of price. The development is natural, and it has naturally led to efforts on the part of the angling majority to counteract, if possible, the growing difficulty. These efforts have been directed chiefly in two ways, one the establishment of fishing clubs, the other the adoption of angling in salt water. The fishing club of the big towns was originally a social institution, and its members met together to sup, converse on angling topics and perhaps to display notable fish that they had caught. Later, however, arose the idea that it would be a convenience if a club could give its members privileges of fishing as well as privileges of reunion. So it comes about that all over the United Kingdom, in British colonies and dependencies, in the United States, and various countries of Europe, fishing clubs rent waters, undertake preservation and restocking and generally lead an active and useful existence. It is a good sign for the future of angling and anglers that they are rapidly increasing in number. One of the oldest fishing clubs, if not the oldest, was the Schuylkill club, founded in Pennsylvania in 1732. An account of its history was published in Philadelphia in 1830. Among the earliest clubs in London are to be numbered such societies as The True Waltonians, The Piscatorial, The Friendly Anglers and The Gresham, which are still flourishing. A certain amount of literary activity has been observable in the world of angling clubs, and several volumes of "papers" are on the records. Most noticeable perhaps are the three volumes of *Anglers' Evenings* published in 1880–94, a collection of essays by members of the Manchester Anglers' association. The other method of securing a continuance of sport, the adoption of sea-angling as a substitute for fresh-water fishing, is quite a modern thing. Within the memory of men still young the old tactics of hand-line and force were considered good enough for sea fish. Now the fresh-water angler has lent his centuries of experience in deluding his quarry; the sea-angler has adopted many of the ideas presented to him, has modified or improved others, and has developed the capture of sea-fish into a science almost as subtle as the capture of their fresh-water cousins.

During the last few years a greater development still has taken place in the capture of exceptionally large fish—sharks, swordfish, tuna, etc.—running up to weights of several hundred pounds and now known under the name of big-game fishing. This fishing was first inaugurated as a separate branch of the sport by the Tuna club of Santa Catalina. The discovery of tuna grounds on the coast of Nova Scotia, where subsequently Mr. Zane Grey took the record tuna, weighing 758 lb., with rod and line, widened the geographical scope of the fishing, since when the north shore of the northern island of New Zealand has provided some wonderful takes of "marlin" and "broadbill" swordfish, and Mako shark, and is now by way of being the most notable big-game fishing ground in the world. It is probable that the neighbourhood of Hongkong and off the east coast of Japan will also develop into fishing centres for the sport, since some of the species in the New Zealand coastal currents are known to be present in these waters also. The spawning grounds of tuna are in the Mediterranean, but since, like many other fish, they seem to cease feeding on the approach of the spawning season, rod and line fishing there is little developed, but they have been caught at times in the North sea and a capture (August 1927) of large tuna (over 500 lb.) by Danish anglers in the Kattegat, off the coast of Denmark, is an indication that this fishing may be within reach of British coasts. Up to the present, however, British anglers

regard the conger, skate, halibut and tope (*Galeus vulgaris*), a small species of shark, allied to the dogfishes, as the "big-game" of home waters. Several important fresh-water species have also become a later part of angling enterprise, notably the dorado of South American rivers, the "Euphrates salmon" of the Euphrates watershed, a fish resembling the mahseer in character but reaching much greater weights, and the Nile perch and tiger fish of the big African rivers. One more modern feature, which is also a result of the increase of anglers, is the great advance made in fish-culture, fish-stocking and fish-acclimatization during the last half-century. Fish-culture is now a recognized industry; every trout-stream of note and value is restocked from time to time as a matter of course; salmon-hatcheries are numerous, though their practical utility is still a debated matter, in Great Britain at any rate; coarse fish are also bred for purposes of re-stocking; and, lastly, it is now considered a fairly simple matter to introduce fish from one country to another, and even from continent to continent. In England the movement owes a great deal to Francis Francis, who, though he was not the earliest worker in the field, was among the first to formulate the science of fish-breeding; his book *Fish-Culture,* first published in 1863, still remains one of the best treatises on the subject. In the United States, where fishery science has had the benefit of generous governmental and official support and countenance and so has reached a high level of achievement, Dr. T. Garlick (*The Artificial Reproduction of Fishes,* Cleveland, 1857) is honoured as a pioneer. On the continent of Europe the latter half of the 19th century saw a very considerable and rapid development in fish-culture, but until comparatively recently the propagation and care of fish in most European waters have been considered almost entirely from the point of view of the fish-stew and the market. As to what has been done in the way of acclimatization it is not necessary to say much. Trout (*Salmo fario*) were introduced to New Zealand in the late '60s from England; in the '80s rainbow trout (*S. irideus*) were also introduced from California; now New Zealand provides the finest trout-fishing of its kind in the world. The quinnat salmon from the Pacific coast of North America and the Atlantic salmon (*S. salar*) from European waters have also been acclimatized in New Zealand, but whereas the quinnat has adopted the life habit of its original home, the Atlantic salmon has shown peculiarities of behaviour and development that have for some time puzzled both anglers and scientists. The earlier attempts to introduce it were failures, possibly on account of the comparatively high temperature of the coastal waters as compared with the original habitat in the northern hemisphere; but the more recent attempts in the early years of the present century in Lake Te Anau and the river Waiau in the south island have produced a considerable stock of fish, which are evidently spawning in those waters and may be considered, from that point of view, to have acclimatized themselves. They, however, show several peculiarities which differentiate them from the *S. salar* of Europe. The first and most noticeable is the fact that mature fish feed regularly in fresh water, even when approaching the spawning period, a habit unknown among sea-going *salar,* either in Europe or America. Although they descend to tidal water no specimen has, as yet, been caught in the sea out of reach of tidal influence. Their size, considering their age, is small, the largest fish recorded being little more than 20 lb. and the majority even of the larger fish running from 12 lb. to 14 lb. An examination of their scales shows that they give no sign of the customary wide zones denoting rich sea-feeding, but that, on the contrary, the arrangement of the rings bears a strong resemblance to the landlocked *salar* of North America. It is considered by Tate Regan, W. L. Calderwood, Arthur Hutton and other authorities (*Salmon and Trout Magazine,* July 1927), that these fish have adopted a fresh-water habit, and have become, in effect, voluntarily landlocked. The quinnat, on the other hand, seem to have the same sea-going habit as the fish of American waters. American trout of different kinds have been introduced into England, and brown trout have been introduced into America; but neither innovation can be said to have been an unqualified success, though the rainbow has established itself firmly in some waters of the United Kingdom. It is still regarded with some suspicion, as it has a tendency to wander from waters which do not altogether suit it. For the rest, trout have been established in Ceylon, in Kashmir, in South Africa (where carp have also been introduced with very surprising results, being now regarded almost as a nuisance), and in British Central Africa. In fact the possibilities of acclimatization are so great that it seems probable that in time no river of the civilized world capable of holding trout will be without them.

METHODS AND PRACTICE

Angling falls into two main divisions, fishing in fresh water and fishing in the sea. The two branches of the sport have much in common, and sea-angling is really little more than an adaptation of fresh-water methods to salt-water conditions. Therefore it will not be necessary to deal with it at great length and it naturally comes in the second place. Angling in fresh water is, again, divisible into three principal parts: fishing on the surface, *i.e.,* with the fly; in mid-water, *i.e* , with a bait simulating the movements of a small fish or with the small fish itself; and on the bottom with worms, paste or one of the many other baits which experience has shown that fish will take. With the premise that it is not intended here to go into the minutiae of instruction which may more profitably be discovered in the many works of reference cited at the end of this article, some account of the subdivisions into which these three styles of fishing fall may be given.

FRESH-WATER FISHING

Fly-fishing.—Fly-fishing is the most modern of them, but it is the most highly esteemed, principally because it is the method *par excellence* of taking members of the most valuable sporting family of fish, the *Salmonidae.* It may roughly be considered under three heads: the use of the "wet" or sunk fly, of the "dry" or floating fly, and of the natural insect. Of these the first is the most important, for it covers the widest field and is the most universally practised. There are few varieties of fish which may not either consistently or occasionally be taken with the sunk fly in one of its two forms. The large and gaudy bunch of feathers, silk and tinsel with which salmon, very large trout, black bass and occasionally other predacious fish are taken is not, strictly speaking, a fly at all. It rather represents, if anything, some small fish or subaqueous creature on which the big fish is accustomed to feed, and it may conveniently receive the generic name of salmon-fly. The smaller lures, however, which are used to catch smaller trout and other fish that habitually feed on insect food are in most cases intended to represent that food in one of its forms and are entitled to the name of "artificial flies." The dry- or floating-fly is simply a development of the imitation theory, and has been evolved from the wet-fly in course of closer observation of the habits of flies and fish in certain waters. Both wet- and dry-fly methods are really a substitute for the third and oldest kind of surface-fishing, the use of a natural insect as a bait. Each method is referred to incidentally below

Spinning, etc.—Mid-water fishing, as has been said, broadly consists in the use of a small fish, or something that simulates it, and its devices are aimed almost entirely at those fish which prey on their fellows. Spinning, live-baiting and trolling[1] are these devices. In the first a small dead fish or an imitation of it made in metal, india-rubber, or other substance, is caused to revolve rapidly as it is pulled through the water, so that it gives the idea of something in difficulties and trying to escape. In the second a small fish is put on the angler's hook alive and conveys the same idea by its own efforts. In the third a small dead fish is caused to dart up and down in the water without revolving; it conveys the same idea as the spinning fish, though the manipulation is different.

Bottom-fishing.—Bottom-fishing is the branch of angling which is the most general. There is practically no fresh-water fish that will not take some one or more of the baits on the angler's list if they are properly presented to it when it is hungry.

[1]Trolling is very commonly confused in angling writing and talk with *trailing,* which simply means drawing a spinning-bait along behind a boat in motion.

Usually the baited hook is on or near the bottom of the water, but the rule suggested by the name "bottom-fishing" is not invariable and often the bait is best used in mid-water; similarly, in "mid-water fishing" the bait must sometimes be used as close to the bottom as possible. Bottom-fishing is roughly divisible into two kinds, float-fishing, in which a bite is detected by the aid of a float fastened to the line above the hook and so balanced that its tip is visible above the water, and hand-fishing, in which no float is used and the angler trusts to his hand to feel the bite of a fish. In most cases either method can be adopted and it is a matter of taste, but broadly speaking the float-tackle is more suited to water which is not very deep and is either still or not rapid. In great depths or strong streams a float is difficult to manage.

THE FISH

It is practically impossible to classify the fish an angler catches according to the methods which he employs, as most fish can be taken by at least two of these methods, while many of those most highly esteemed can be caught by all three. Sporting fresh-water fish are therefore treated according to their families and merits from the angler's point of view, and it is briefly indicated which method or methods best succeed in pursuit of them.

Salmon.—First in importance come migratory *Salmonidae*, and at the head of them the salmon (*Salmo salar*), which has a twofold reputation as a sporting and as a commercial asset. The salmon fisheries of a country are a very valuable possession, but it is only comparatively recently that this has been realized and that salmon rivers have received the legal protection which is necessary to their well-being. Even now it cannot be asserted that in England the salmon question, as it is called, is settled. Partly owing to former ignorance of the life-history of the fish, partly owing to the difficulty of reconciling the opposed interests of commerce and sport, the problem as to how a river should be treated remains only partially solved, though it cannot be denied that there has been a great advance in the right direction. The life-history of the salmon, so far as it concerns the matter in hand, may be very briefly summed up. It is bred in the rivers and fed in the sea. The parent fish ascend in late autumn as high as they can get, the ova are deposited on gravel shallows, hatching out in the course of a few weeks into parr. The infant salmon remains in fresh water at least one year, generally two years, without growing more than a few inches, and then about May assumes what is called the smolt-dress; that is to say, it loses the dark parr-bands and red spots of infancy and becomes silvery all over. After this it descends without delay to the sea, where it feeds to such good purpose that in a year it has reached a weight of several pounds, and it may then reascend as a grilse. If the fish survives the perils of its first ascent and spawning season and as a kelt or spawned fish gets down to the sea again, it may come up a second time as a salmon some pounds heavier.

But in fact only a small percentage of salmon survive for a second spawning in the rivers of Great Britain though on the east coast of Canada a much larger percentage do so. The various "runs" of fish which occur in all salmon rivers do not consist of fish about to spawn for the first, second or third time, but of fish which have spent one, two or three years in the sea after their first descent to salt water. These runs are now for statistical purposes reckoned by the number of *winters* spent in the sea, the fish whose scales end in a winter band being known as "spring" fish, and those whose scales end in a summer zone as "summer" fish. The classes are: grilse (one winter), small spring and summer (two winters), large ditto (three winters), very large ditto (four winters). Why some fish are much heavier than others of the same age, what their mode of life is in the sea, why some run up in spring and summer when the breeding season is not till about November or December, whether they were originally sea-fish or river-fish—these and other similar questions await a conclusive answer. One principal fact, however, stands out amid the uncertainty, and that is that without a free passage up and down unpolluted rivers and without protection on the spawning beds salmon have a very poor chance of perpetuating their species. Economic prudence dictates therefore that every year a considerable proportion of running salmon should be allowed to escape the dangers that confront them in the shape of nets, obstructions, pollutions, rods and poachers. And it is in the adjustment of the interests which are bound up in these dangers (the last excepted; officially poachers have no interests, though in practice their plea of "custom and right" has too often to be taken into consideration) that the salmon question consists. To secure a fair proportion of fish for the market, a fair proportion for the rods and a fair proportion for the *redds*, without unduly damaging manufacturing interests, this is the object of those who have the question at heart, and with many organizations and scientific observers at work it should not be long before the object is attained. It is very largely due to the efforts of anglers that the matter has gone so far.

Whether salmon feed in fresh water is another question of peculiar interest to anglers, for it would seem that if they do not then the whole practice of taking them must be an anomaly. Champions have arisen on both sides of the argument, some, scientists, asserting that salmon (parr and kelts excluded, for both feed greedily as opportunity occurs) do not feed; others, mostly anglers, maintaining strongly that they do, and bringing as evidence their undoubted and customary capture by rod and line, not only with the fly, but also with such obvious food-stuffs as dead baits, worms and prawns. On the other side it is argued that food is never found inside a salmon after it has been long enough in a river to have digested its last meal taken in salt water. The very few instances of food found in salmon which have been brought forward to support the contrary opinion are, in the scientific view, to be regarded with great caution.

It has been lately found, however, that there is often a kind of slime in the stomach of captured salmon, consisting of food juices, and there is a certain amount of evidence that salmon in fresh water have a habit of chewing food and then rejecting it. From this it has been suggested that while salmon may take food in fresh water they swallow merely the essence of it and reject the valueless remains. Such a theory might help to reconcile both sets of observations. At the same time, since many good salmon rivers contain only sufficient food to maintain a meagre stock of undersized trout, it is evident that the food a salmon can get in such water would only be a trifle in comparison with the sustenance necessary for so large a fish. Dr. J. Kingston Barton, in the first of the two volumes on "Fishing" (*Country Life* series), has suggested that after exertion, such as that entailed by running from pool to pool during a spate, the fish may feel a very transient hunger and be impelled thereby to snap at anything in its vicinity which looks edible. The fact that the angler's best opportunity is undoubtedly when salmon have newly arrived in a pool, supports this contention. The longer they are compelled to remain in the same spot by lack of water the worse becomes the prospect of catching them, and "unfishable" is one of the expressive words which fishermen use to indicate the condition of a river during the long periods of drought which too often distinguish the sport.

Salmon Tackle and Methods.—It is when the drought breaks up and the long-awaited rain has come that the angler has his chance and makes ready his tackle, against the period of a few days (on some short streams only a few hours) during which the water will be right; *right* is a very exact term on some rivers, meaning not only that the colour of the water is suitable to the fly, but that its height shall be within an inch or two of a given mark, prescribed by experience. As to the tackle which is made ready, there is, as in most angling matters, divergence of opinion. Salmon fly-rods are now made principally of two materials, greenheart and split-cane; the former is less expensive, the latter is more durable; it is entirely a matter of taste which a man uses, but the split-cane rod is now more in favour. It has been a matter of debate whether it is better built with a core of steel running from butt to tip and known as a "steel centre." How long the rod shall be is also a matter on which anglers differ, but from 16ft. to 17ft. 6in. represents the limits within which most rods are preferred. The tendency is to reduce rather than to increase the length of the rod, which

may be accounted for by the adoption of a heavy line. Early in the 19th century anglers used light-topped rods of 20ft. and even more, and with them a light line composed partly of horse-hair; they thought 60ft. with such material a good cast. Modern experience, however, has shown that a shorter rod with a heavier top will throw a heavy dressed silk line much farther with less exertion. Ninety feet is now considered a good fishing cast, while many men can throw a great deal more. In the United States, where rods have long been used much lighter than in England, the limits suggested would be considered too high. Single-handed rods are in common use there and are becoming popular elsewhere. The variety of reels, lines, gut collars and other forms of tackle which is now presented to the angler's consideration and for his bewilderment is too wide a subject to be touched upon here. Something, however, ought to be said about flies. One of the perennially fruitful topics of enquiry is what the fish takes a salmon-fly to be. Beyond a fairly general admission that it is regarded as something endowed with life, perhaps resembling a remembered article of marine diet, perhaps inviting gastronomic experiment, perhaps merely irritating and rousing an impulse to destroy, the discussion has not reached any definite conclusion. But more or less connected with it is the controversy as to variety of colour and pattern. Some authorities hold that a great variety of patterns with very minute differences in colour and shades of colour is essential to complete success; others contend that salmon do not differentiate between nice shades of colour, that they only draw distinctions between flies, broadly, as being light, medium or dark in general appearance, and that the size of a fly rather than its colour is the important point for the angler's consideration. Others, again, go some way with the supporters of the colour-scheme and admit the efficacy of flies whose general character is red, or yellow, or black, and so on. The opinion of the majority, however, is probably based on past experience, and a man's favourite flies for different rivers and conditions of water are those with which he or someone else has previously succeeded. It remains a fact that in most fly-books great variety of patterns will be discoverable, while certain old standard favourites, such as the Jock Scott, Durham Ranger, Silver Doctor, and Thunder and Lightning, will be prominent. Coming out of the region of controversy it is a safe generalization to say that the common rule is: big flies for spring fishing when rivers are probably high, small flies for summer and low water, and flies medium or small in autumn according to the conditions. Spring fishing is considered the cream of the sport. Though salmon are not as a rule so numerous or so heavy as during the autumn run, and though kelts are often a nuisance in the early months, yet the clean-run fish of February, March or April amply repays patience and disappointment by its fighting powers and its beauty. Summer fishing on most rivers in the British Islands is uncertain, but in Norway summer is the season, which possibly explains to some extent the popularity of that country with British anglers, for the pleasure of a sport is largely increased by good weather.

Two methods of using the fly are in vogue, casting and harling. The first is by far the more artistic, and it may be practised either from a boat, from the bank or from the bed of the river itself; in the last case the angler wades, wearing waterproof trousers or wading-stockings and stout nail-studded brogues. In either case the fishing is similar. The fly is cast across and down stream, and has to be brought over the "lie" of the fish, swimming naturally with its head to the stream, its feathers working with tempting movement and its whole appearance suggesting some live thing dropping gradually down and across stream Most anglers add to the motion of the fly by "working" it with short pulls from the rod-top. When a fish takes, the rise is sometimes seen, sometimes not; in any case the angler should not respond with the rod until he *feels* the pull. Then he should *tighten*, not strike. The fatal word "strike," with its too literal interpretation, has caused many a breakage Having hooked his fish, the angler must be guided by circumstances as to what he does; the salmon will usually decide that for him. But it is a sound rule to give a well-hooked fish no unnecessary advantage and to hold on as hard as the tackle will allow. Good tackle will stand an immense strain, and with this "a minute a pound" is a fair estimate of the time in which a fish should be landed. A foul-hooked salmon (no uncommon thing, for a fish not infrequently misses the fly and gets hooked somewhere in the body) takes much longer to land. The other method of using the fly, harling, which is practised on a few big rivers, consists in trailing the fly behind a boat rowed backwards and forwards across the stream and dropping gradually downwards. Of recent years many anglers have adopted light rods for salmon-fishing. This is, in effect, trout-fishing applied to salmon, the rod used being a single-handed one of 10ft. 6in. to 11ft. and the flies of about the same size as loch trout flies. Great success has attended this method of fishing at times of low water, when, by the older methods, it would have been considered hardly worth while trying. Dry-fly fishing for salmon on calm days, more particularly perhaps in American waters, which are more liable than British to periods of high temperature, is another innovation with salmon anglers. Fly-fishing for salmon is also practised on some lakes, into which the fish run. On lakes the boat drifts slowly along a "beat," while the angler casts diagonally over the spots where salmon are wont to lie. Salmon may also be caught by "mid-water fishing," with a natural bait either spun or trolled and with artificial spinning-baits of different kinds, and by "bottom-fishing" with prawns, shrimps and worms. Spinning is usually practised when the water is too high or too coloured for the fly; trolling is seldom employed, but is useful for exploring pools which cannot be fished by spinning or with the fly; the prawn is a valuable lure in low water and when fish are unwilling to rise; while the worm is killing at all states of the river, but except as a last resource is not much in favour. There are a few waters where salmon have the reputation of not taking a fly at all; in them spinning or prawning is the usual mode of fishing. But most anglers, wherever possible, prefer to use the fly. The rod for the alternative methods is generally shorter and stiffer than the fly-rod, though made of like material. Twelve to 14ft. represents about the range of choice. Outside the British Islands the salmon-fisher finds his headquarters in Scandinavia and Iceland, and, in the New World, in some of the waters of Canada and Newfoundland

Landlocked Salmon.—The landlocked salmon (*Salmo salar ouananiche* and *sebago*) of Canada and the lakes of Maine is, as its name implies, now regarded by scientists as merely a landlocked form of the salmon It does not often attain a greater size than 20 lb, but it is a fine fighter and is highly esteemed by American anglers. In most waters it does not take a fly so well as a spinning-bait, live-bait or worm. The methods of angling for it do not differ materially from those employed for other *Salmonidae*.

Pacific Salmon.—Closely allied to *Salmo salar* both in appearance and habits is the genus *Oncorhynchus*, commonly known as Pacific salmon. It contains six species, is peculiar to the North Pacific ocean, and is of some importance to the angler, though of not nearly so much as the Atlantic salmon. The quinnat is the largest member of the genus, closely resembles *salar* in appearance and surpasses it in size. The others, sockeye, humpback, cohoe, dog-salmon and masu, are smaller and of less interest to the angler, though some of them have great commercial value. The last-named is found only in the waters of Japan, but the rest occur in greater or less quantities in the rivers of Kamchatka, Alaska, British Columbia and Oregon. The problems presented to science by *salar* are offered by *Oncorhynchus* also, but there are variations in its life-history, such as the fact that few if any fish of the genus are supposed to survive their first spawning season. When once in the rivers none of these salmon is of very much use to the angler, as, though it is stated that they will occasionally take a fly or spoon in fresh water, they are not nearly so responsive as their Atlantic cousin and in many streams are undoubtedly not worth trying for. At the mouths of some rivers, however, where the water is distinctly tidal, and in certain bays of the sea itself they give very fine sport, the method of fishing for them being usually to trail a heavy spoon-bait behind a boat. By this means remarkable bags of fish have been made by anglers The sport is of quite recent development.

Sea-Trout.—Next to the salmon comes the sea-trout, the other migratory salmonid of Europe. This is a fish with many local names and a good deal of local variation. Modern science, however, recognizes one "race" only, *Salmo trutta,* the sea-trout proper. The life-history of sea-trout is much the same as that of salmon, and the fish on their first return from the sea in the grilse-stage are called by many names, finnock, herling and whitling being perhaps the best known. The bull-trout, formerly considered a separate species, is now regarded as an old sea-trout which has survived many spawnings, but its exact place in salmonology is still in dispute. It is a strong fish and grows to a great size and it is a pity that it is not of greater sporting value, if only to make up for its bad reputation as an article of food. Some amends, however, are made by its cousin the sea-trout, which is one of the gamest and daintiest fish on the angler's list. It is found in most salmon rivers and also in not a few streams which are too small to harbour the bigger fish, while there are many lakes in Scotland and Ireland (where the fish is usually known as white trout) where the fishing is superb when the trout have run up into them. Fly-fishing for sea-trout is not a thing apart. A three-pounder that will impale itself on a big salmon-fly might equally well have taken a tiny trout-fly. Many anglers, when fishing a sea-trout river where they run large, 5 lb. or more, and where there is also a chance of a salmon, effect a compromise by using a light 13ft. or 14ft. double-handed rod, and tackle not so slender as to make hooking a salmon a certain disaster. But undoubtedly to get the full pleasure out of sea-trout-fishing a single-handed rod of 10ft. to 12ft. with reasonably fine gut and small flies should be used, and the way of using it is much the same as in wet-fly fishing for brown trout, which will be treated later. When the double-handed rod and small salmon-flies are used, the fishing is practically the same as salmon-fishing except that it is on a somewhat smaller scale. Flies for sea-trout are numberless and local patterns abound, as may be expected with a fish which has so catholic a taste. But, as with salmon-fishers so with sea-trout-fishers, experience forms belief and success governs selection. Among the small salmon-flies and loch-flies which will fill his book, the angler will do well to have a store of very small trout-flies at hand, while experience has shown that even the dry fly will kill sea-trout on occasion, a thing that is worth remembering where rivers are low and fish shy. July, August and September are in general the best months for sea-trout, and as they are dry months the angler often has to put up with indifferent sport. The fish will, however, rise in tidal water and in a few localities even in the sea itself, or in salt-water lochs into which streams run. Sea-trout have an irritating knack of "coming short," that is to say, they will pluck at the fly without really taking it. There are occasions, on the other hand, in loch-fishing where plenty of time must be given to the fish without tightening on it, especially if it happens to be a big one. Like salmon, sea-trout are to be caught with spinning-baits and also with the worm. The main controversy that is concerned with sea-trout is whether or not the fish captured in early spring are clean fish or well-mended kelts. On the whole, as sea-trout seldom run before May, the majority of opinion inclines to their being kelts.

Non-migratory Salmonidae.—Of the non-migratory members of the *Salmonidae* the most important in Great Britain is the brown trout (*Salmo fario*). Its American cousin the rainbow trout (*S. irideus*) is now fairly well established in Britain, too, while other trans-Atlantic species both of trout and char (which are some of them partially migratory, that is to say, migratory when occasion offers), such as the steelhead (*S. gairdneri*), fontinalis (*S. fontinalis*) and the cut-throat trout (*S. clarkii*), are at least not unknown. All these fish, together with their allied forms in America, can be captured with the fly, and speaking broadly, the wet-fly method will do well for them all. Therefore it is only necessary to deal with the methods applicable to one species, the brown trout.

Trout.—Of the game-fishes the brown trout is the most popular, for it is spread over the whole of Great Britain and most of Europe, wherever there are waters suited to it. It is a fine sporting fish and is excellent for the table, while in some streams and lakes it grows to a very considerable size, examples of 16 lb. from southern rivers and 20 lb. from Irish and Scottish lakes being not unknown. One of the signs of its popularity is that its habits and history have produced some very animated controversies. Some of the earliest discussions were provoked by the liability of the fish to change its appearance in different surroundings and conditions, and so at one time many a district claimed its local trout as a separate species. Now, however, science admits but one species, though, to such well-defined varieties as the Loch Leven trout, the estuarine trout and the gillaroo, it concedes the right to separate names and "races." In effect all, from the great *ferox* of the big lakes of Scotland and Ireland to the little fingerling of the Devonshire brook, are one and the same—*Salmo fario.*

Wet-Fly Fishing for Trout.—Fly-fishing for trout is divided into three kinds: fishing with the artificial fly sunk or "wet," fishing with it floating or "dry" and fishing with the natural insect. Of the first two methods the wet-fly is the older and may be taken first. Time was when all good anglers cast their flies down-stream and thought no harm. But in 1857 W. C. Stewart published his *Practical Angler,* in which he taught that it paid better to fish up-stream, for by so doing the angler was not only less likely to be seen by the trout but was more likely to hook his fish. The doctrine was much discussed and criticized, but it gradually won adherents, until now up-stream fishing is the orthodox method where it is possible. Stewart was also one of the first to advocate a lighter rod in place of the heavy 12ft. and 13ft. weapons that were used in the north in his time. There are still many men who use the long rod for wet-fly fishing in streams, but there are more who find 10ft. or less enough for their purpose. For lake-fishing from a boat, however, the longer rod is still in many cases preferred In fishing rivers the main art is to place the right flies in the right places and to let them come naturally down with the stream. The right flies may be ascertained to some extent from books and from local wisdom, but the right places can only be learnt by experience. It does not, however, take long to acquire "an eye for water" and that is half the battle, for the haunts of trout in rapid rivers are very much alike. In lake-fishing chance has a greater share in bringing about success, but here too the right fly and the right place are important; the actual management of rod, line and flies, of course, is easier, for there is no stream to be reckoned with. Though there is little left to be said about wet-fly fishing where the fly is an imitation more or less exact of a natural insect, there is another branch of the art which has been stimulated by modern developments. This is the use of salmon-flies for big trout much in the same way as for salmon. In such rivers as the Thames, where the trout are cannibals and run very large, ordinary trout-flies are of little use, and the fly-fisher's only chance is to use a big fly and "work" it, casting across and down-stream. The big fly has also been found serviceable with the great fish of New Zealand and with the inhabitants of such a piece of water as Blagdon lake, near Bristol, where the trout run very large. For this kind of fishing much stronger tackle and a heavier rod are required than for catching fish that seldom exceed the pound.

Dry-Fly.—The theory of dry-fly fishing is indeed very simple and consists in placing before the fish an exact imitation of the insect on which it is feeding, in such a way that it shall float down exactly as if it were an insect of the same kind. To this end special tackle and special methods have been found necessary. Not only the fly but also the line has to float on the water; the line is very heavy and therefore the rod (split-cane or greenheart) must be stiff and powerful; special precautions have to be taken that the fly shall float unhindered and shall not "drag"; special casts have to be made to counteract awkward winds; and, lastly, the matching of the fly with the insect on the water is a matter of much nicety, for the water-flies are of many shades and colours. Many brains have busied themselves with the solution of these problems with such success that dry-fly fishing is now a finished art. The entomology of the dry-fly stream has been studied very deeply by F. M. Halford, his friend G. S. Marryat and others, and improvements both in flies and tackle have been very great. Quite lately, however, there has been a

movement in favour of light rods for dry-fly fishing as well as wet-fly fishing. The English split-cane rod for dry-fly work weighs about an ounce to the foot, rather more or rather less. The American rod of similar action and material weighs much less—approximately 6 oz. to 10ft. The light rod, it is urged, is much less tiring and is quite powerful enough for ordinary purposes. Against it is claimed that dry-fly fishing is not "ordinary purposes," that chalk-stream weeds are too strong and chalk-stream winds too wild for the light rod to be efficient against them. However, the light rod is growing in popular favour; British manufacturers are building rods after the American style; and anglers are taking to them more and more. The dry-fly method is now practised by many fishermen both in Germany and France, but it has only recently found a footing in the United States or Canada.

Fishing with the Natural Fly.—The natural fly is a very killing bait for trout, but its use is not wide-spread except in Ireland. In Ireland "dapping" with the green drake or the daddy-longlegs is practised from boats on most of the big loughs. A light whole-cane rod of stiff build, about 16ft. in length, is required with a floss-silk line light enough to be carried out on the breeze; the "dap" (generally two mayflies or daddy-longlegs on a small stout-wired hook) is carried out by the breeze and just allowed to touch the water. When a trout rises it is well to count "ten" before striking. Very heavy trout are caught in this manner during the mayfly season. In the north "creeper-fishing" is akin to this method, but the creeper is the larva of the stone-fly, not a fly itself, and it is cast more like an ordinary fly and allowed to sink. Sometimes, however, the mature insect is used with equally good results. A few anglers still practise the old style of dapping or "dibbling" after the manner advised by Izaak Walton. It is a deadly way of fishing small overgrown brooks. A stiff rod and strong gut are necessary, and a grasshopper or almost any large fly will serve for bait.

Other Methods.—The other methods of taking trout principally employed are spinning, live-baiting and worming. For big-river trout such as those of the Thames a gudgeon or bleak makes the best spinning or live bait, for great-lake trout (*ferox*) a small fish of their own species and for smaller trout a minnow. There are numberless artificial spinning-baits which kill well at times, the Devon being perhaps the favourite. The use of the drop-minnow, which is trolling on a lesser scale, is a killing method employed more in the north of England than elsewhere. The worm is most deadly in thick water, so deadly that it is looked on askance. But there is a highly artistic mode of fishing known as "clear-water worming." This is most successful when rivers are low and weather hot, and it needs an expert angler to succeed in it. The worm has to be cast up-stream rather like a fly, and the method is little inferior to fly-fishing in delicacy and difficulty. The other baits for trout, or rather the other baits which they will take sometimes, are legion. Wasp-grubs, maggots, caterpillars, small frogs, bread—there is very little the fish will not take. But except in rural districts little effort is made to catch trout by means less orthodox than the fly, minnow and worm, and the tendency nowadays is to restrict anglers where possible to the use of the artificial fly only.

Grayling.—The only other member of the salmon family in England which gives much sport to the fly-fisher is the grayling, a fish which possesses the recommendation of rising well in winter. It can be caught with either wet or dry fly, and with the same tackle as trout, which generally inhabit the same stream. Grayling will take most small trout-flies, but there are many patterns of fly tied specially for them, most of them founded on the red tag or the green insect. Worms and maggots are also largely used in some waters for grayling, and there is a curious contrivance known as the "grasshopper," which is a sort of compromise between the fly and bait. It consists of a leaded hook round the shank of which is twisted bright-coloured wool. The point is tipped with maggots, and the lure, half artificial, half natural, is dropped into deep holes and worked up and down in the water. In some places the method is very killing. The grayling has been very prominent of late years owing to the controversy "grayling *versus* trout." Many people hold that grayling injure a trout stream by devouring trout-ova and trout-food, by increasing too rapidly and in other ways. Beyond, however, proving the self-evident fact that a stream can only support a given amount of fish-life, the grayling's opponents do not seem to have made out a very good case, for no real evidence of its injuring trout has been adduced.

Char.—The chars (*Salvelinus*) are a numerous family widely distributed over the world, but in Great Britain are not very important to the angler. One well-defined species (*Salvelinus alpinus*) is found in some lakes of Wales and Scotland, but principally in Westmorland and Cumberland. It sometimes takes a small fly but is more often caught with small artificial spinning-baits. The fish seldom exceeds 1½ lb. in Great Britain, though in Scandinavia it is caught up to 5 lb. or more. There are some important chars in America, *fontinalis* being one of the most esteemed. Some members of the genus occasionally attain a size scarcely excelled by the salmon. Among them are the Great Lake trout of America, *Cristivomer namaycush*, and the Danubian "salmon" or huchen, *Salmo hucho*. Both of these fish are caught principally with spinning-baits, but both will on occasion take a salmon-fly, though not with any freedom after they have reached a certain size. An attempt was once made to introduce huchen into the Thames, but it had no conclusive results.

Pike.—The pike (*Esox lucius*), which after the *Salmonidae* is the most valued sporting fish in Great Britain, is a fish of prey pure and simple. Though it will occasionally take a large fly, a worm or other ground-bait, its systematic capture is only essayed with small fish or artificial spinning-baits. A live-bait is supposed to be the most deadly lure for big pike, probably because it is the method employed by most anglers. But spinning is more artistic and has been found quite successful by those who give it a fair and full trial. Trolling, the method of "sink and draw" with a dead bait, referred to previously in this article, is not much practised nowadays, though at one time it was very popular. It was given up because the traditional form of trolling-tackle was such that the bait had to be swallowed by the pike before the hook would take hold, and that necessitated killing all fish caught, whether large or small. The same objection formerly applied to live-baiting with what was known as a gorge-hook. Now, however, what is called snap-tackle is almost invariably used in live-baiting, and the system is by some few anglers extended to the other method too. Pike are autumn and winter fish and are at their best in December. They grow to a very considerable size, fish of 20 lb. being regarded as "specimens" and an occasional 30-pounder rewarding the zealous and fortunate. The heaviest pike caught with a rod in recent years, which is sufficiently authenticated, is the 53 lb. specimen caught in Lake Conn, Ireland, in 1920, by John Garvin. River pike up to about 10 lb. in weight are excellent eating.

America has several species of pike, of which the muskelunge of the Great Lakes region (*Esox masquinongy*) is the most important. It is a very fine fish, excelling *Esox lucius* both in size and looks. From the angler's point of view it may be considered simply as a large pike and may be caught by similar methods. It occasionally reaches the weight of 50 lb. or perhaps more. The pickerel (*Esox reticulatus*) is the only other of the American pikes which gives any sport. It reaches a respectable size, but is as inferior to the pike as the pike is to the muskelunge.

Perch.—Next to the pikes come the perches, also predatory fishes. The European perch (*Perca fluviatilis*) has a place by itself in the affections of anglers. When young it is easy to catch by almost any method of fishing, and a large number of Walton's disciples have been initiated into the art with its help. Worms and small live-baits are the principal lures, but at times the fish will take small bright artificial spinning-baits well, and odd attractions such as boiled shrimps, caddis-grubs, small frogs, maggots, wasp-grubs, etc., are sometimes successful. The drop-minnow is one of the best methods of taking perch. Very occasionally, and principally in shallow pools, the fish will take an artificial fly greedily, a small salmon-fly being the best thing to use in such a case. A perch of 2 lb. is a good fish, and a specimen of 4½ lb.

about the limit of angling expectation. There have been rare instances of perch over 5 lb. and there are legends of eight-pounders, which, however, need authentication.

Black Bass.—The yellow perch of America (*Perca flavescens*) is very much like its European cousin in appearance and habits, but it is not so highly esteemed by American anglers, because they are fortunate in being possessed of a better fish in the black bass, another member of the perch family. There are two kinds of black bass (*Micropterus salmoides* and *Micropterus dolomieu*), the large-mouthed and the small-mouthed. The first is more a lake and pond fish than the second, and they are seldom found in the same waters. As the black bass is a fly-taking fish and a strong fighter, it is as valuable to the angler as a trout and is highly esteemed. Bass-flies are *sui generis*, but incline more to the nature of salmon-flies than trout-flies. An artificial frog cast with a fly-rod or very light spinning-rod is also a favourite lure. For the rest the fish will take almost anything in the nature of worms or small fish, like its cousin the perch. A 4 lb. bass is a good fish, but five-pounders are not uncommon. Black bass have to some extent been acclimatized in Italy and France, and experiments in England are in progress.

The *ruffe* or *pope* (*Acerina vulgaris*) is a little fish common in the Thames and many other slow-flowing English rivers. It is very like the perch in shape but lacks the dusky bars which distinguish the other, and is spotted with dark brown spots on a golden olive background. It is not of much use to the angler as it seldom exceeds 3 oz. in weight. It takes small worms, maggots and similar baits greedily, and is often a nuisance when the angler is expecting better fish. Allied to the perches is the pike-perch, of which two species are of some importance to the angler, one the wall-eye of eastern America (*Stizostedion vitreum*) and the other the zander of Central Europe (*Sandrus lucioperca*). The last especially is a fine fighter, occasionally reaching a weight of 20 lb. It is usually caught by spinning, but will take live-baits, worms and other things of that nature. The Danube may be described as its headquarters. It is a fish whose sporting importance will be more realized as anglers on the Continent become more numerous.

Cyprinidae.—The carp family (*Cyprinidae*) is a large one and its members constitute the majority of English sporting fishes. In America the various kinds of chub, sucker, dace, shiner, etc., are little esteemed and are regarded as spoils for the youthful angler only, or as baits for the better fish in which the Continent is so rich. In England, however, the *Cyprinidae* have an honoured place in the affections of all who angle "at the bottom," while in Europe some of them have a commercial value as food-fishes. In India at least one member of the family, the mahseer, takes rank with the salmon as a "big game" fish.

Carp, Tench, Barbel, Bream.—The family as represented in England may be roughly divided into two groups, those which feed on the bottom purely and those which occasionally take flies. The first consists of carp, tench, barbel and bream. Of these carp, tench and bream are either river or pool fish, while the barbel is found only in rivers, principally in the Thames and Trent. The carp grows to a great size, 20 lb. being not unknown; tench are big at 5 lb.; barbel have been caught up to 14 lb. or rather more; and bream occasionally reach 8 lb., while a fish of over 11 lb. is on record. All these fish are capricious feeders, particularly carp and barbel. In some waters it seems to be impossible to catch the large specimens, and the angler who seeks to gain trophies in either branch of the sport needs both patience and perseverance. Tench and bream are not quite so difficult. The one fish can sometimes be caught in great quantities, and the other is generally to be enticed by the man who knows how to set about it. Two main principles have to be observed in attacking all these fish, ground-baiting and early rising. Ground-baiting consists in casting food into the water so as to attract the fish to a certain spot and to induce them to feed. Without it very little can be done with shy and large fish of these species. Early rising is necessary because they only feed freely, as a rule, from daybreak till about three hours after sunrise. The heat of a summer or early autumn day makes them sluggish, but an hour or two in the evening are sometimes remunerative. The bait for them all should usually lie on the bottom, and it consists mainly of worms, wasp and other grubs, pastes of various kinds; and for carp, and sometimes bream, of vegetable baits such as small boiled potatoes, beans, peas, stewed wheat, pieces of banana, etc. None of these fish feed well in winter.

Roach, Rudd, Dace, Chub.—The next group of *Cyprinidae* consists of fish which will take a bait similar to those already mentioned and also a fly. The sizes which limit the ordinary angler's aspirations are roach about 2 lb., rudd about 2½ lb., dace about 1 lb. and chub about 5 lb. There are instances of individuals heavier than this, one or two roach and many rudd of over 3 lb. being on record, while dace have been caught up to 1 lb. 6 oz., and chub of over 7 lb. are not unknown. Roach only take a fly as a rule in very hot weather when they are near the surface, or early in the season when they are on the shallows; the others will take it freely throughout the summer. Ordinary trout flies do well enough for all four species, but chub often prefer something larger, and big bushy lures called "palmers," which represent caterpillars, are generally used for them. The fly may be used either wet or dry for all these fish, and there is little to choose between the methods as regards effectiveness. Fly-fishing for these fish is a branch of angling which might be more practised than it is, as the sport is a very fair substitute for trout-fishing. Roach, chub and dace feed on bottom food and give good sport all the winter.

Gudgeon, Bleak, Minnow, etc.—The small fry of European waters, gudgeon, bleak, minnow, loach, stickleback and bullhead, are principally of value as bait for other fish, though the first-named species gives pretty sport on fine tackle and makes a succulent dish. Small red worms are the best bait for gudgeon and minnows, a maggot or small fly for bleak, and the rest are most easily caught in a small-meshed net. The loach is used principally in Ireland as a trout bait, and the other two are of small account as hook-baits, though sticklebacks are a valuable form of food for trout in lakes and pools.

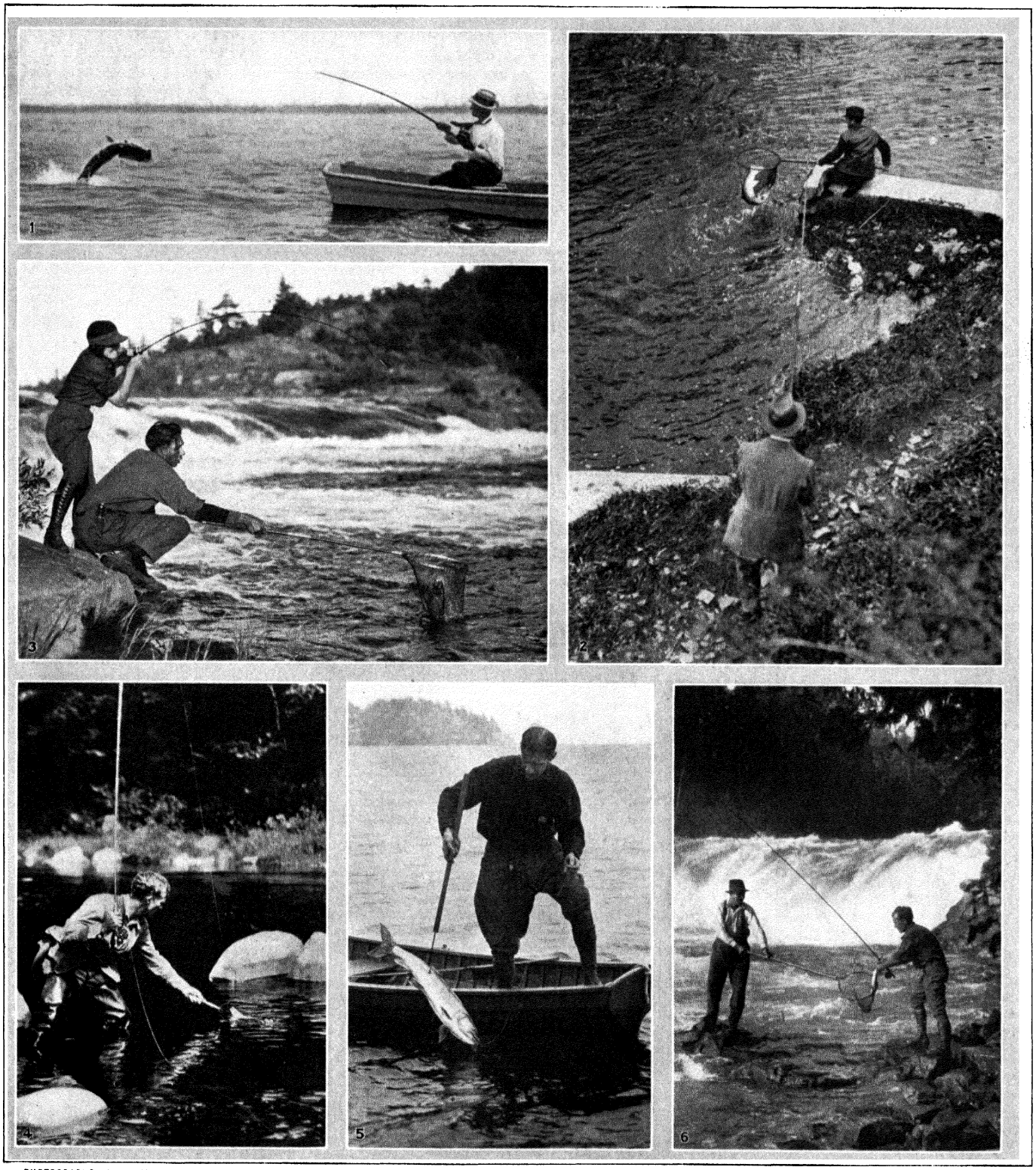
Mahseer.—Among the carps of India, several of which give good sport, special mention must be made of the mahseer (*Barbus mosal*), a fish which rivals the salmon both in size and strength. It reaches a weight of 60 lb. and sometimes more and is fished for in much the same manner as salmon, with the difference that after about 10 lb. it takes a spinning-bait, usually a heavy spoon-bait, better than a fly

Cat-fish.—None of the fresh-water cat-fishes (of which no example is found in England) can be described as sporting fish, but several may be caught with rod and line. There are several kinds in North America, and some of them are as heavy as 100 lb., but the most important is the wels (*Silurus glanis*) of the Danube and neighbouring waters This is the largest European fresh-water fish, and it is credited with a weight of 300 lb. or more. It is a bottom feeder and will take a fish-bait either alive or dead; it is said occasionally to run at a spinning-bait when used very deep.

Burbot.—The burbot (*Lota vulgaris*) is the only fresh-water member of the cod family in Great Britain, and it is found only in a few slow-flowing rivers such as the Trent, and there not often, probably because it is a fish of sluggish habits which feeds only at night. It reaches a weight of 3 lb. or more, and will take most flesh or fish baits on the bottom. The burbot of America has similar characteristics.

Sturgeon.—The sturgeons, of which there are a good many species in Europe and America, cannot be taken by angling. They are anadromous fishes of which little more can be said than that a specimen might take a bottom bait once in a while. In Russia they are sometimes caught on long lines armed with baited hooks, and occasionally an angler hooks one. Such a case was reported from California in *The Field* of Aug. 19, 1905.

Shad.—Two other anadromous fish deserve notice. The first is the shad, a herring-like fish of which two species, allice and twaite (*Clupea alosa* and *C. finta*), ascend one or two British and several Continental rivers in the spring. The twaite is the more common, and in the Severn, Wye and Teme it sometimes gives very fair



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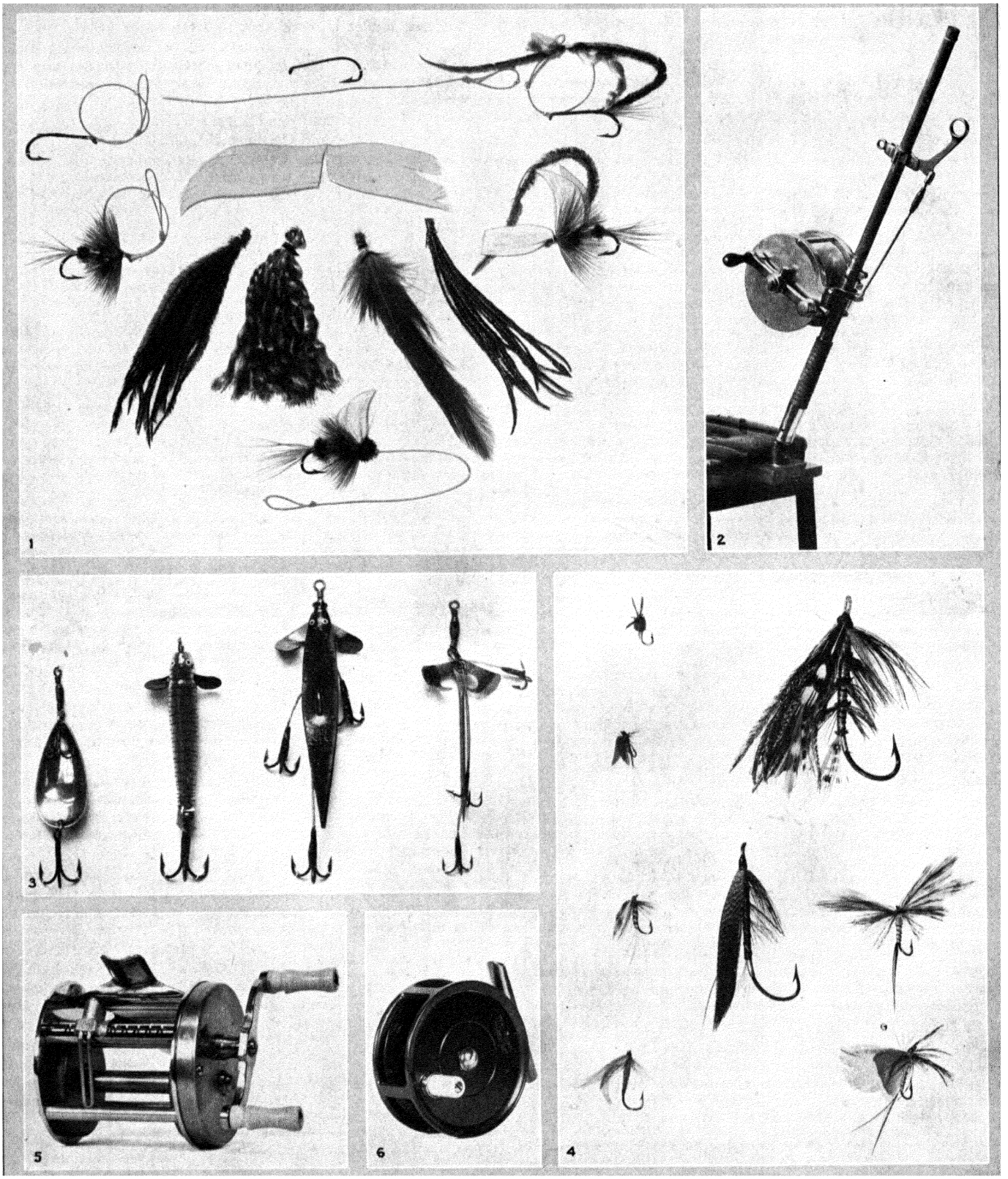
ANGLING IN ENGLAND AND AMERICA

1. An American entrant in the national tarpon tournament at Venice, Florida, landing an 87-pound tarpon
2. Gilly landing a salmon from the Torridge river, Devon, England, after it has been hooked and played by the angler, seen in the foreground
3. Fishing with a net on the French river, at the outlet of Lake Nipissing, in Ontario
4. Landing fish with a dip net, commonly used for catching game fish in lakes and mountain streams
5. Bringing in an 11-pound trout from Lake George, in the foothills of the Adirondack mountains
6. Trout fishing in the Nipigon river, the largest Canadian tributary to Lake Superior

ANGLING



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TYPES OF FISHING REELS AND FLIES

1. Steps taken in making a dry fly. A peacock's quill, a cock's hackle and a starling's wing feathers are all used in making a dry fly
2. The reel shown in position on the rod. The butt end of the rod is attached to the angler's seat when extra leverage is needed
3. Left to right: A spoon; silk phantom minnow as used on River Wye, England; Wagtail; an archer flight for mounting a natural dead minnow
4. Left, reading up: trout fly, old style wet fly; trout fly, modern wet fly; trout fly with upright wings; trout fly, modern nymph. Upper right, salmon fly, old type, heavily dressed; centre, salmon fly, modern, lightly dressed; right centre, May fly, spent gnat; lower right, May fly, green drake
5. Casting reel. The gearing between handle and drum compensates for the small diameter of the spool
6. Fly fishing reel. This type, with narrow drum, is used for trout. A similar reel with larger drum is used for salmon

sport to anglers, taking worm and occasionally fly or small spinning bait. It is a good fighter, and reaches a weight of about 3 lb. Its sheen when first caught is particularly beautiful. America also has its shads.

Flounder.—The other is the flounder (*Pleuronectes flesus*), the only flat-fish which ascends British rivers. It is common a long way up such rivers as the Severn, far above tidal influence, and it will take almost any flesh-bait used on the bottom. A flounder of 1 lb. is, in a river, a large one, but heavier examples are sometimes caught.

Eel.—The eel (*Anguilla vulgaris*) is regarded by the angler more as a nuisance than a sporting fish, but when of considerable size (and it often reaches a weight of 8 lb. or more) it is a splendid fighter and stronger than almost any fish that swims. Its life history has long been disputed, but it is now accepted that it breeds in the sea in the neighbourhood of the Azores and ascends rivers in its youth. It is found practically everywhere, and its occurrence in isolated ponds to which it has never been introduced by human agency has given rise to a theory that it travels overland as well as by water. The best baits for eels are worms and small fish, and the best time to use them is at night or in thundery or very wet weather.

SEA ANGLING

Sea angling is attended by almost as many refinements of ' ckle and method as fresh-water angling. The chief differences - e differences of locality and the habits of the fish. To a certain extent sea angling may also be divided into three classes—fishing on the surface with the fly, at mid-water with spinning or other bait, and on the bottom; but the first method is only practicable at certain times and in certain places, and the others, from the great depths that often have to be sounded and the heavy weights that have to be used in searching them, necessitate shorter and stouter rods, larger reels and stronger tackle than fresh-water anglers employ. Also, of course, the sea-fisherman is liable to come into conflict with very large fish occasionally. In British waters the monster usually takes the form of a skate or halibut A specimen of the former weighing 194 lb. has been landed off the Irish coast with rod and line in recent years. In American waters there is a much greater opportunity of catching fish of this calibre.

Great Game Fishes.—There are several giants of the sea which are regularly pursued by anglers, among them being the tarpon (*Tarpon atlanticus*) and the tuna or tunny (*Thynnus thynnus*), to which must now be added sharks, swordfish and others, particularly in Australian waters, that have already been mentioned in the section devoted to *modern conditions*. Jew-fish and black sea-bass of over 400 lb. have been taken on rod and line. Practically all of them are taken with a fish-bait either live or dead, and used stationary on the bottom or in mid-water trailed behind a boat.

British Game Fishes.—On a much smaller scale are the fishes most esteemed in British waters. The bass (*Labrax lupus*) heads the list as a plucky and rather difficult opponent. A fish of 10 lb. is a large one, but 15-pounders have been taken. Small or "school" bass up to 3 lb. or 4 lb. may sometimes be caught with the fly (generally a roughly constructed thing with big wings), and when they are really taking, the sport is magnificent. In some few localities it is possible to cast for them from rocks with a salmon rod, but usually a boat is required. In other places bass may be caught from the shore with fish-bait used on the bottom in quite shallow water. They may again sometimes be caught in mid-water, and in fact there are few methods and few lures employed in sea angling which will not account for them at times. The pollack (*Gadus pollachius*) and coal-fish (*Gadus virens*) come next in esteem. Both in some places reach a weight of 20 lb. or more, and both when young will take a fly. Usually, however, the best sport is obtained by trailing some spinning-bait, such as an artificial or natural sand-eel, behind a boat. Sometimes, and especially for pollack, the bait must be kept near the bottom and heavy weights on the line are necessary; the coal-fish are more prone to come to the surface for feeding. The larger grey mullet (*Mugil capito*) is a great favourite with many anglers, as it is extremely difficult to hook, and when hooked fights strongly. Fishing for mullet is more akin to fresh-water fishing than any branch of sea-angling, and indeed can be carried on in almost fresh water, for the fish frequent harbours, estuaries and tidal pools. They can be caught close to the surface, at mid-water and at the bottom, and as a rule vegetable baits, such as boiled macaroni, or rag-worms are found to answer best. Usually ground-baiting is necessary, and the finer the tackle used the greater is the chance of sport. Not a few anglers fish with a float as if for river fish. The fish runs up to about 8 lb. in weight. The cod (*Gadus morhua*) grows larger and fights less gamely than any of the fish already mentioned. It is generally caught with bait used on the bottom from a boat, but in places codling, or young cod, give some sport to anglers fishing from the shore. The mackerel (*Scomber scomber*) gives the best sport to a bait, usually a strip of fish skin, trailed behind a boat fairly close to the surface, but it will sometimes feed on the bottom. Mackerel on light tackle are game fighters, though they do not usually much exceed 2 lb. Whiting and whiting-pout (*Gadus merlangus* and *G. luscus*) both feed on or near the bottom, do not grow to any great size, and are best sought with fine tackle, usually an arrangement of three or four hooks at intervals above a lead which is called a "paternoster." If one or more of the hooks are on the bottom the tackle will do for different kinds of flat fish as well, flounders and dabs being the two species most often caught by anglers. The bream (*Pagellus centrodontus*) is another bottom-feeder which resembles the fresh-water bream both in appearance and habits. It is an early morning or rather a nocturnal fish, and grows to a weight of 3 lb. or 4 lb. Occasionally it will feed in mid-water or even close to the surface. The conger eel (*Conger vulgaris*) is another night-feeder, which gives fine sport, as it grows to a great size and is very powerful. Strong tackle is essential for conger fishing, as so powerful an opponent in the darkness cannot be given any law. The bait must be on or near the bottom. There are, of course, many other fish which come to the angler's rod at times, but the list given is fairly complete as representing the species which are especially sought. Beside them are occasional (in some waters too frequent) captures such as dog-fish and sharks, skates and rays. Many of them run to a great size and give plenty of sport on a rod, though they are not as a rule welcomed. Lastly, it must be mentioned that certain of the *Salmonidae*, smelts (*Osmerus eperlanus*), sea-trout, occasionally brown trout, and still more occasionally salmon can be caught in salt water either in sea-lochs or at the mouths of rivers. Smelts are best fished for with tiny hooks tied on fine gut and baited with fragments of shrimp, rag-worm and other delicacies.

Legislation.—A Fishery Act for England and Wales, passed in 1923, improves and consolidates previous legislation. The pollution of rivers has inspired a new movement of co-operation between industrial and fishing interests. The British government set up a pollution committee, which has been at work for several years, and from its labours some good results are apparent. A deputation to the prime minister organized by the joint efforts of the Salmon and Trout Association and the British Waterworks Association in Feb. 1927, urging the appointment of a central water authority, has resulted in the setting up of two new committees, one for technical research into ways and means of abating pollution, the other to act in an advisory capacity to the government on legislative and administrative questions in regard to rivers. A new source of danger is the dressing of roads made necessary by increased motor traffic. It has been established that tar, very largely used at first, may have disastrous effects when road washings get into streams. The trouble is in some cases being removed by the use of bitumen instead, and experiment is being carried on by the pollution committee in regard to other safeguards. (H. T. S.; H. D. T.)

UNITED STATES

Sea angling in the United States has enrolled more new members since 1918 than any other sport. This is largely due to cheap and rapid transportation. Where in the days of the old sail boats it would take five or six hours to reach a spot off shore, the same run is now made in an hour or so with a cer-

tainty of getting back within a specified time. In 1918 there were perhaps five or six open deep-sea fishing boats leaving from New York or nearby ports. Ten years later there was a fleet of over 200 Inland anglers, tired of catching smaller species of fresh-water fish, go from Cincinnati, Pittsburgh or other inland cities to try their luck for the big fish along the shores of Virginia, North Carolina and Florida, or to the west coast for tuna or broadbill swordfish.

Big-fish angling has advanced more than any other branch of angling. Big-fish hunters on both the Atlantic and Pacific coasts have caught with rod and reel tuna weighing up to 758 lb. and broadbill swordfish of more than 500 lb. In 1926, in the waters of New Zealand, an American with rod and reel landed a black marlin swordfish that tipped the scale at 976 lb. It seems almost impossible to believe that human ingenuity has made rods, reels and lines capable of landing fish of such great size. There are many sea anglers who catch their fish on the lightest possible tackle, and valuable prizes are offered for landing huge game fish with this tackle. In fact, one club in America permits its members to use only cotton thread, and striped bass, weakfish or bluefish over 10 lb., handled on this thread, take considerable time and skill to land.

The tackle used for sea angling consists of a rod made of six strips of bamboo glued together, or hickory, bathabara, greenheart, black palm, lancewood or palma brava woods. To these rods are attached guides, preferably of agate. At the end of the rod is a butt upon which is affixed a reel seat, made of German silver, to which the reel is fastened. Butts are made of hickory or other wood, and wound with either cane or cork. Only lines of linen should be used and great care should be exercised when drying them as rust spots will prove disastrous. The hooks, sinkers and various lures differ according to the species of fish sought. There are hundreds of species of salt-water fish which abound on the east and west coasts of the United States. In fact in the salt waters bordering on Florida there are more than 600 species, but there will be discussed here only those that are most sought after for their gameness and flesh by the followers of Izaak Walton.

Flounders, Fluke and Halibut.—Flounders are caught on the east coast from Maine to Virginia and usually come out of their mud beds about February. They are found in bays or inlets where there is a sandy bottom. A light rod is employed in their capture, the tip of which should weigh 3 or 4 oz. A nine or ten Chestertown hook, six thread linen line and a sinker just heavy enough to hold bottom in the tide should be used. The hooks should be tied closely to the sinker as the flounder is a bottom feeder, and sand, blood or earth worms should be used as a lure. As the flounder has an exceedingly small mouth and has a habit of sucking in the bait, do not try to strike him at the first nibble, but allow plenty of time for the bait and hook to pass into the mouth before sinking the hook. Flounders weigh from ½ lb. to 4 lb. each, with an occasional specimen of 6 lb. Net fishermen have brought them in weighing over 10 lb. each.

The fluke is of the flat species, belonging to the flounder family, but is larger in size and has a fairly big mouth with teeth. He is found in the oceans, inlets and bays, usually along sandy, clean bottoms. A rod with a tip weighing 5 oz. to 6 oz. is used and a linen line of six to nine thread, affixed to which is a gut leader about 3 ft. long. A number 4 to 10 Kirby hook is the right size. Killies spearing or cut-fish bait is used principally as lures. The fluke may be taken at any time during the day regardless of tides. The best method of capture is to allow the boat to drift over the grounds where fluke have their habitat, allowing bait to drag on the bottom Fluke weigh from 1 lb. to 16 lb.; occasionally one is brought in by the beam trawlers weighing from 20 to 25 lb.

Halibut are rarely sought by anglers owing to the fact that their habitat is so far off shore that it is difficult to reach them. They are usually taken at the banks off Newfoundland and off the coast of California, Oregon and Washington. The largest halibut ever known to be caught was landed off the Grand Banks about 1918 and weighed 680 lb.

Striped Bass, Seabass, Porgies and Blackfish.—The striped bass is a much sought after salt-water fish, and ranges from Maine to the Carolinas. In 1886, 300 of them were taken from the Shrewsbury river of New Jersey and planted in the waters of California. They have flourished on the west coast because of the strictly enforced laws in California protecting them. They can be taken from April to November and are found in the ocean close to shore, in bays and rivers of brackish water. The rod should weigh from 3 oz. to 10 oz. and the line should be of linen from 6 to 15 thread. A 4 to 10-O Sproat hook affixed to gut is used when bait fishing, and crabs, clams, worms, eels, mullet and cut-up fish are used as lures. They will also strike a lead squid or spoon. They are caught at any time of day or night and on almost any tide. Striped bass weigh from 1 lb. to 73 lb—the world's record by angling. But specimens have been taken in the nets weighing over 100 lb.

Seabass range from Long Island to the Carolinas. They resemble, somewhat, fresh-water bass, and come in huge schools, having their habitat around rocks or wrecks. A 5 oz. or 6 oz. rod is used in their capture, and the line should be of from 9 to 12 thread. They feed on sea clams, squid (inkfish) and mossbunker. A 3 to 5-O Sproat or O'Shaughnessy hook should be used and a sinker heavy enough to hold bottom. As a rule when a seabass hits the lure he hooks himself and gives a fair account of himself, considering his size. Seabass weigh from ½ lb to 7 lb., and are eagerly sought after by the deep-sea anglers of New Jersey and Long Island.

Porgies usually make their appearance with the seabass and are caught on the same tackle. The blackfish or tautog is caught over rocks and wrecks in the oceans and bays from Maine to the Carolinas. A number 1 to 6 Virginia hook is employed and the same tackle used as prescribed for seabass. Blackfish feed on clams, crabs and worms. The larger fish, being suspicious, are hard to hook, but they usually give warning before they take hold, and it is advisable to allow a blackfish plenty of time to let the bait pass well into his jaws before setting the hook.

Cod, Pollock, Hake and Ling.—These species are caught along the Atlantic coast from Newfoundland to Virginia and also along the west coast. A rod weighing from 6 oz. to 10 oz. is used and the line should be from 12 to 15 thread. The hooks can be either 6–O to 9–O Sproat or O'Shaughnessy, and clams, conchs, scallop guts or cut-fish bait are used as lure. These species are caught during the spring and winter. At times they come fairly close to shore, but are usually taken from 1m to 12m. from the shore line, in water anywhere from 60ft. to 90ft. deep. They can hardly be termed game fish. The cod usually captured by angling weighs from 3 to 60 lb. These four species travel together and often on one ground all four may be taken on the same day.

Bluefish and Weakfish.—These two species are eagerly sought by anglers from Massachusetts south to Florida. They are both game, hard fighting fish with the bluefish the harder fighter of the two. In fact, the bluefish is classed by many as being the gamest fish for his weight and size that swims the Seven Seas He is a veritable bulldog at the end of a swaying rod and knows every trick of getting away. Tackle employed for the capture of weakfish and bluefish consists of a rod weighing from 3 to 6 oz. The line should be of linen from 6 to 12 thread A 3-O to 7-O Sproat or O'Shaughnessy hook is best. Bluefish are usually caught by trolling with a lead spoon or squid or by grinding up moss bunker and throwing it overboard thus causing what is known as a slick which runs from the boat out across the water with the tide bringing the bluefish close to the boat. A piece of bunker bait is affixed to the hook, which is attached to 4ft. or 5ft. of German silver wire. This is thrown overboard and allowed to drift out in the chum line.

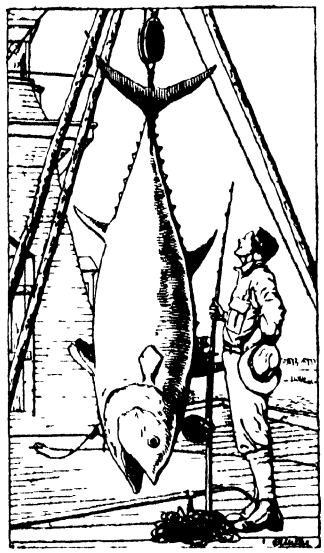
Weakfish are chummed to the boat using small shrimp or mossbunker and as a bait for weakfish, crabs, cut-fish, large sand or blood worms, squid (inkfish) or shrimp are used. These fish can be taken during the day or night and bite on the first of the flood and the last of the ebb tides. Weakfish range in weight from 1 lb. to 16 lb. and some which weighed over 20 lb. have been taken in the nets by professional fishermen. The bluefish range in weight about the same as weakfish, and a 10 or 12 pounder of either of these species is a prize worth angling for.

Channel Bass and Drum.—Channel bass or red drum is dis-

tinguishable from the ordinary drum by a black spot near its tail. It is shaped somewhat like striped bass and is a fine fighter. It may be caught from New Jersey south to Florida, and is found feeding close to shore along the surf, in inlets and bays. A rod weighing from 10 oz. to 12 oz., a linen line, 6 to 15 thread, and 3-O Ring Virginia hooks, affixed to German silver wire 2ft. long should be used. The best lures for these fish are menhaden, crabs and mullet. They are caught from May to October during the day or night; nightfall is the best, on the flood tide. Channel bass weigh from 5 lb. to 65 lb. Drum fish are often caught weighing 70 lb. and 80 lb., but do not give one the battle that the channel bass does.

Tuna, Albacore and Bonita.—These three species are similar in shape, but differ in their markings and size. The bonita is the smallest with the albacore next in size. They are usually found feeding on the same grounds and all three are swift swimmers and hard fighters. Heavy tackle is employed because one usually is seeking tuna. The tackle is so strong that little difficulty is experienced in reeling in a bonita of 6 lb. or an albacore of 20 lb., when one is after tuna weighing 200 lb. or 300 lb. These three species are usually caught while trolling and various artificial lures are affixed to a 9ft. German silver wire leader. The rod is extremely heavy, weighing in the neighbourhood of 16 oz. The reel is a huge affair, weighing 7 or 8 lb., and is capable of holding 900ft. to 1200ft. of number 36 thread line. These fish range along the Atlantic coast from Canada to Florida and also in the Pacific ocean, off California. They are taken from daylight to sunset.

When one is fishing from an anchored boat, cut-fish bait is used as a lure Tuna range in weight from 30 lb. to 1500 lb. The largest ever taken by angling weighed 758 lb. They are rarely caught off the Long Island or New Jersey coasts weighing more than 100 lb; but in the Pacific ocean, many weighing well over this weight have been captured. The tuna is one of the most powerful fish that swims and a big specimen will give an angler a tussle long to be remembered. They never jump clear of the water and have a tendency after being hooked to go down to the bottom and must be "pumped" up.



BY COURTESY OF CANADIAN PACIFIC RAILWAYS
A GIANT TUNA FISH, WEIGHING 758 LB., CAUGHT IN CANADIAN WATERS

Broadbill and Marlin Swordfish.—Within recent years these two species have claimed many devotees, who concentrate their efforts around Catalina island, Calif., where hundreds of both of these species have been taken. The same tackle that is employed for tuna is used for swordfish, only a whole fish of two or three pounds is used as the lure, or a large portion of cut-fish. They are difficult to entice to take the bait and are hard to hook once they have struck it with their bill. When one is hooked, since the jaws are soft, when the fish leaps clear of the water the hook is often thrown from the fish's mouth. The most experienced broadbill swordfisherman tries to snag the fish anywhere in the body but the mouth.

The first broadbill swordfish taken by angling off the Atlantic seaboard was landed off Montauk, L.I., in 1927. This fish weighed 193 lb. Expert broadbill swordfishermen claim this species to be more prolific off Block island, R.I., and Montauk, L. I., than at the famous waters around Catalina island, and the capture of this fish should open up a new swordfishing resort in the east. Swordfish rarely weigh under 100 lb., and go to 500 lb. or 600 lb., with the world's record for any fish caught by rod and reel being held by a black marlin 976 lb. swordfish taken in 1926 off New Zealand.

Tarpon.—Tarpon or silver king, is the most advertised fish in the world. It is caught on the east and west coasts of Florida, in the Gulf of Mexico and off Panama. It is a huge herring and when hooked leaps many feet into the air. The rods used for its capture weigh 6 oz., 8 oz. and 12 oz. The line should be of linen 9 to 24 thread, and hooks 8-O to 10-O O'Shaughnessy. The tarpon are found in bays and inlets and the best time to seek them is on moonlight nights during the flood tide. They may be caught from February to June, May and June being the best months. One uses a spoon while trolling, and when still fishing, mullet or cut-fish. Tarpon weigh anywhere from 10 lb. to 200 lb. with the average fish weighing about 100 lb. They are practically useless as food, and many anglers after catching them allow them their freedom.

Sailfish.—The sailfish resembles the swordfish. It derives its name from the huge dorsal fin that extends a foot or two above the body, resembling a sail. They also clear the water by many feet when hooked, and are eagerly sought in the waters off Florida and off southern California. About the same tackle is employed as in the capture of the tarpon. Five to 8-O tandem hooks, baited with cut-fish, usually are most effective. The sailfish is a surface feeder and is caught by trolling in the daytime. Sailfish weigh from 30 lb. to 100 lb., a new world's record being established in 1927 with a sailfish caught off Panama measuring 10½ft. in length, and weighing 177 lb. They are an exceedingly difficult fish to hook owing to their unreadiness to take the lure into their mouths. Hooking a sailfish is an art that some anglers cannot master even after repeated trials.

Bonefish.—Veteran anglers claim the bonefish to be one of the gamest fish that swims. They are the colour of mother of pearl, are long and have a streamlike body, with tail and fins of large proportions which send them through the water with lightning speed. They are found in shallow water in Florida and the Bimini islands. The rod universally used weighs 6 oz.; the line is of linen, 9 thread; the hook is 1 to 1-O Sproat Hermit crab is the best lure. They are taken from February to June at almost any time of day. They are exceedingly shy and are usually sighted in the 18in. to 24in. of water in which they swim by their tails sticking out of the water when they are rooting for food at the bottom. Bonefish weigh from 3 lb. to 10 lb. When fishing in southern waters on either the east or west coast along with the tarpon and sailfish, one catches barracuda, amberjack, yellow tail, king mackerel and a host of other species, all of which are caught on the same tackle as is used for tarpon or sailfishing. The same lures are likewise effective with these species (F FL.)

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ANGLO-ISRAELITE THEORY, the contention, historically and etymologically unsound, that the English-speaking peoples are the descendants of the "ten tribes" of Israel, deported by Sargon of Assyria on the fall of Samaria in 721 B.C. The theory, still held by over 2,000,000 people, materially assisted the resettlement of Jews in England in the 17th century. Richard Brothers (1757–1824), the "Nephew of the Almighty," may be regarded as its first modern apostle

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ANGLO-JAPANESE ALLIANCE. On Jan. 30 1902, owing to the threat of Russian aggression in the Far East, Great Britain and Japan concluded an alliance of a defensive character which provided for mutual assistance in the safeguarding of British interests in China and Japanese interests in China and Korea. The agreement was a valuable asset to Japan in the war with Russia which broke out in 1904; but it did not involve Great Britain in active hostilities.

In 1905 the agreement was revised; its scope was extended to India and Eastern Asia generally, and Japan's paramount position in Korea was more definitely emphasized. Later developments, notably the annexation of Korea to the Japanese Empire in 1910, led to the renewal of the alliance on July 13, 1911. An important feature of the new agreement was the inclusion of an article exempting either high contracting party from the obligation to come to the armed assistance of the other in case of war against a Power with whom either party had concluded a general arbitration treaty (Article 4). The alliance of 1911 was to last for ten years, but in the absence of a year's notice from either contracting party to terminate the agreement it would automatically continue in existence, even after July 1921.

Abrogation of the Alliance.—In consequence of the Anglo-Japanese alliance Japan entered readily into the World War on Aug. 23 1914; but the Treaty of Versailles brought forth the League of Nations, and apart from doubts whether the alliance was not inconsistent with the obligations of the Covenant of the League, both Great Britain and Japan were becoming aware that it was increasingly unpopular in the United States and in China. At the Washington Conference (*q.v.*), therefore, in Dec. 1921, the agreement made for a Four-Power Pacific treaty (United States, France, British Empire, Japan) provided for the conclusion of the Anglo-Japanese alliance. The alliance, therefore, ceased to exist on the deposition of the ratifications of the above treaty on Aug. 17 1923. For 21 years it had been the most stable influence in the Far Eastern position, and a cardinal factor in British and Japanese policy. (*See* JAPAN: *History.*)

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ANGLO-NORMAN LITERATURE. The French language (*q.v.*) came over to England with William the Conqueror. During the whole of the 12th century it shared with Latin the distinction of being the literary language of England, and it was in use at the court until the 14th century. It was not until the reign of Henry IV. that English became the native tongue of the kings of England. After the loss of the French provinces, schools for the teaching of French were established in England, among the most celebrated of which we may quote that of Marlborough. The language then underwent certain changes which gradually distinguished it from the French spoken in France; but, except for some graphical characteristics, from which certain rules of pronunciation are to be inferred, the changes to which the language was subjected were the individual modifications of the various authors, so that, while we may still speak of Anglo-Norman writers, an Anglo-Norman language, properly so called, gradually ceased to exist. The prestige enjoyed by the French language, which, in the 14th century, the author of the *Manière de language* calls "le plus bel et le plus gracious language et plus noble parler, après latin d'escole, qui soit au monde et de touz genz mieulx prisée et amée que nul autre (quar Dieux le fist si douce et amiable principalement à l'oneur et loenge de luy mesmes. Et pour ce il peut comparer au parler des angels du ciel, pour la grand doulceur et biaultée d'icel)," was such that it was not till 1363 that the chancellor opened the parliamentary session with an English speech. And, although the Hundred Years' War led to a decline in the study of French and the disappearance of Anglo-Norman literature, the French language continued, through some vicissitudes, to be the classical language of the courts of justice until the 17th century. It is still the language of the Channel islands, though there too it tends more and more to give way before the advance of English.

It will be seen from the above that the most flourishing period of Anglo-Norman literature was from the beginning of the 12th century to the end of the first quarter of the 13th. The end of this period is generally said to coincide with the loss of the French provinces to Philip Augustus, but literary and political history do not correspond quite so precisely, and the end of the first period would be more accurately denoted by the appearance of the history of William the Marshal in 1225 (published for the *Société de l'histoire de France,* by Paul Meyer, 3 vols., 1891–1901). It owes its brilliancy largely to the protection accorded by Henry II. of England to the men of letters of his day. "He could speak French and Latin well, and is said to have known something of every tongue between 'the Bay of Biscay and the Jordan.' He was probably the most highly educated sovereign of his day, and amid all his busy active life he never lost his interest in literature and intellectual discussion; his hands were never empty, they always had either a bow or a book" (*Dict. of Nat. Biog.*). Wace and Benoît de Sainte-More compiled their histories at his bidding, and it was in his reign that Marie de France composed her poems. An event with which he was closely connected, viz., the murder of Thomas Becket, gave rise to a whole series of writings, some of which are purely Anglo-Norman. In his time appeared the works of Beroul and Thomas respectively, as well as some of the most celebrated of the Anglo-Norman *romans d'aventure.* It is important to keep this fact in mind when studying the different works which Anglo-Norman literature has left us.

Epic and Romance.—The French epic came over to England at an early date. We know that a *Chanson de Roland* was sung

at the battle of Hastings, and we possess Anglo-Norman mss. of a few *chansons de geste*. The *Pèlerinage de Charlemagne* (Koschwitz, *Altfranzösische Bibliothek*, 1883) was, for instance, only preserved in an Anglo-Norman manuscript of the British Museum (now lost), although the author was certainly a Parisian. The oldest manuscript of the *Chanson de Roland* that we possess is also a manuscript written in England, and amongst the others of less importance we may mention *La Chançun de Willame*, the ms. of which has (June 1903) been published in facsimile at Chiswick (*cf.* Suchier's edition in *Bibliotheca Normanica*. T. viii. [1911] and Elizabeth Hearns Tyler [Oxford Univ. Press, 1916]). Although the diffusion of epic poetry in England did not actually inspire any new *chansons de geste*, it developed the taste for this class of literature, and the epic style in which the tales of *Horn*, of *Bovon de Hampton*, of *Guy of Warwick* (still unpublished), of *Waldef* (still unpublished) and of *Fulk Fitz Warine* are treated, is certainly partly due to this circumstance. Although the last of these works has come down to us only in a prose version, it contains unmistakable signs of a previous poetic form, and what we possess is really only a rendering into prose similar to the transformations undergone by many of the *chansons de geste* (*cf.* L. Brandin, *Fouke Fitz Warin* [1928]).

The interinfluence of French and English literature can be studied in the Breton romances and the *romans d'aventure* even better than in the epic poetry of the period. The *Lay of Orpheus* is known to us only through an English imitation; the *Lai du cor* was composed by Robert Biket, an Anglo-Norman poet of the 12th century (Wulff, Lund, 1888). The *lais* of Marie de France were written in England, and the greater number of the romances composing the *matière de Bretagne* seems to have passed from England to France through the medium of Anglo-Norman. The legends of Merlin and Arthur, collected in the *Historia Regum Britanniae* by Geoffrey of Monmouth (d. 1154), passed into French literature bearing the character which the bishop of St. Asaph had stamped upon them. Chrétien de Troyes' *Perceval* (*c.* 1175) is doubtless based on an Anglo-Norman poem. Robert de Boron (*c.* 1215) took the subject of his *Merlin* (published by G. Paris and J. Ulrich, 1886, 2 vols., *Société des Anciens Textes*) from Geoffrey of Monmouth Finally, the most celebrated love-legend of the middle ages, and one of the most beautiful inventions of world-literature, the story of Tristan and Iseult, tempted two authors, Beroul and Thomas, the first of whom is probably, and the second certainly, Anglo-Norman (*see* ARTHURIAN LEGEND; GRAIL, THE HOLY; TRISTAN). One *Folie Tristan* was composed in England in the last years of the 12th century. (For all these questions see *Soc. des Anc. Textes*, Muret's ed. 1903; Bédier's ed. 1902–05.) Less fascinating than the story of Tristan and Iseult, but nevertheless of considerable interest, are the two *romans d'aventure* of Hugh of Rutland, *Ipomedon* (published by Kölbing and Koschwitz, Breslau, 1889) and *Protesilaus* (still unpublished), written about 1185. The first relates the adventures of a knight who married the young duchess of Calabria, niece of King Meleager of Sicily, but was loved by Medea, the king's wife. The second poem is the sequel to *Ipomedon*, and deals with the wars and subsequent reconciliation between Ipomedon's sons, Daunus, the elder, lord of Apulia, and Protesilaus, the younger, lord of Calabria. Protesilaus defeats Daunus, who had expelled him from Calabria. He saves his brother's life, is reinvested with the dukedom of Calabria and, after the death of Daunus, succeeds to Apulia. He subsequently marries Medea, King Meleager's widow, who had helped him to seize Apulia, having transferred her affection for Ipomedon to his younger son (*cf.* Ward, *Cat. of Rom.*, i. 728). To these two romances by an Anglo-Norman author, *Amadas et Idoine*, of which we possess only a Continental version, is to be added. Gaston Paris has proved indeed that the original was composed in England in the 12th century (*An English Miscellany presented to Dr. Furnivall in Honour of his Seventy-fifth Birthday*, 1901, 386–394). The Anglo-Norman poem on the *Life of Richard Coeur de Lion* is lost, and an English version only has been preserved. About 1250 Eustace of Kent introduced into England the *roman d'Alexandre* in his *Roman de toute chevalerie*, many passages of which have been imitated in one of the oldest English poems on Alexander, namely, *King Alisaunder* (P. Meyer, *Alexandre le grand*, 1886, ii. 273, and Weber, *Metrical Romances*, Edinburgh).

Fabliaux, Fables and Religious Tales.—In spite of the incontestable popularity enjoyed by this class of literature, we have only seven *fabliaux* written in England. As to fables, one of the most popular collections in the middle ages was that written by Marie de France, which she claimed to have translated from *King Alfred*. In the *Contes moralisés*, written by Nicole Bozon shortly before 1320 (*Soc. Anc. Textes*, 1889), a few fables bear a strong resemblance to those of Marie de France.

The religious tales deal mostly with the Mary Legends, and have been handed down to us in three collections:

(i.) The Adgar's collection. Most of these were translated from William of Malmesbury (d. 1143?) by Adgar in the 12th century ("Adgar's Marien-Legenden," *Altfr. Biblioth.* ix.; J. A. Herbert, *Rom.* xxxii. 394).

(ii) The collection of Everard of Gateley, a monk of St. Edmund at Bury, who wrote *c.* 1250 three Mary Legends (*Rom.* xxix. 27).

(iii.) An anonymous collection of 60 Mary Legends composed *c.* 1250 (Brit. Museum Old Roy. 20 B, xiv.), some of which have been published in Suchier's *Bibliotheca Normannica;* in the *Altfr. Bibl. See* also Mussafia, "Studien zu den mittelalterlichen Marienlegenden" in *Sitzungsb. der Wien. Akademie* (t. cxiii., cxv., cxix., cxxiii., cxxix.).

Another set of religious and moralizing tales is to be found in Chardri's *Set dormans* and *Josaphat, c.* 1216 (Koch, *Altfr. Bibl.*, 1880; G. Paris, *Poèmes et légendes du moyen âge*).

History.—Of far greater importance, however, are the works which constitute Anglo-Norman historiography. The first Anglo-Norman historiographer is Geoffrey Gaimar, who wrote his Estorie des Angles (between 1147 and 1151) for Dame Constance, wife of Robert Fitz-Gislebert (*The Anglo-Norman Metrical Chronicle*, Hardy and Martin, i. ii., 1888). This history comprised a first part (now lost), which was merely a translation of Geoffrey of Monmouth's *Historia Regum Britanniae*, preceded by a history of the Trojan War, and a second part which carries us as far as the death of William Rufus. For this second part he has consulted historical documents, but he stops at the year 1087, just when he has reached the period about which he might have been able to give us some first-hand information. Similarly, Wace in his *Roman de Rou et des ducs de Normandie* (edit. Andresen, Heilbronn, 1877–79, 2 vols.), written 1160–74, stops at the battle of Tinchebray in 1107 just before the period for which he would have been so useful. His *Brut* or *Geste des Bretons* (Le Roux de Lincy, 1836–38, 2 vols), written in 1155, is merely a translation of Geoffrey of Monmouth. "Wace," says Gaston Paris, speaking of the *Roman de Rou*, "traduit en les abrégeant des historiens latins que nous possédons; mais çà et là il ajoute soit des contes populaires, par exemple sur Richard Ier, sur Robert Ier, soit des particularités qu'il savait par tradition (sur ce même Robert le magnifique, sur l'expédition de Guillaume, etc.) et qui donnent à son oeuvre un réel intérêt historique. Sa langue est excellente; son style clair, serré, simple, d'ordinaire assez monotone, vous plaît par sa saveur archaïque et quelquefois par une certaine grâce et une certaine malice."

The History of the Dukes of Normandy by Benoît de Sainte-More is based on the work of Wace. It was composed at the request of Henry II. about 1170, and takes us as far as the year 1135 (edit. by Francisque Michel, 1836–44, *Collection de documents inédits*, 3 vols.). The 43,000 lines which it contains are of but little interest to the historian; they are too evidently the work of a *romancier courtois*, who takes pleasure in recounting love-adventures such as those he has described in his romance of Troy. Other works, however, give us more trustworthy information, for example, the anonymous poem on Henry II.'s *Conquest of Ireland* in 1172 (edit. Francisque Michel, 1837), which, together with the *Expugnatio hibernica* of Giraud de Barri, constitutes our chief authority on this subject. The *Conquest of Ireland* was republished in 1892 by Goddard Henry Orpen, under the title of *The Song of Dermot and the Earl*. Similarly, Jourdain Fan-

tosme, who was in the north of England in 1174, wrote an account of the wars between Henry II , his sons, William the Lion of Scotland and Louis VII., in 1173 and 1174 (*Chronicle of the reigns of Stephen . . .* III., edit. by Joseph Stevenson and Fr. Michel, 1886, pp 202–307). Not one of these histories, however, is to be compared in value with *The History of William the Marshal, Count of Striguil and Pembroke,* regent of England from 1216–19, found and subsequently edited by Paul Meyer for the Société de l'histoire de France (3 vols., 1891–1901). This masterpiece of historiography was composed in 1225 or 1226 by a professional poet of talent at the request of William, son of the marshal. It was compiled from the notes of the marshal's squire, John d'Early (d. 1230 or 1231), who shared all the vicissitudes of his master's life and was one of the executors of his will. This work is of great value for the history of the period 1186–1219, as the information furnished by John d'Early is either personal or obtained at first hand. In the part which deals with the period before 1186, it is true, there are various mistakes, due to the author's ignorance of contemporary history, but these slight blemishes are amply atoned for by the literary value of the work. The style is concise, the anecdotes are well told, the descriptions short and picturesque; the whole constitutes one of the most living pictures of mediaeval society. Very pale by the side of this work appear the *Chronique* of Peter of Langtoft, written between 1311 and 1320, and mainly of interest for the period 1294–1307 (edit by T. Wright, 1866–68); the *Chronique* of Nicholas Trevet (1258?–1328?), dedicated to Princess Mary, daughter of Edward I (Duffus Hardy, *Descr. Catal.* III., 349–350); the *Scala Chronica* compiled by Thomas Gray of Heaton (died *c.* 1369), which carries us to the year 1362–63 (edit. by J. Stevenson, Maitland Club, Edinburgh, 1836); the *Black Prince,* a poem by the poet Chandos, composed about 1386, and relating the life of the Black Prince from 1346–76 (re-edited by Francisque Michel, 1883); and, lastly, the different versions of the *Brutes.,* the form and historical importance of which have been indicated by Paul Meyer (*Bulletin de la Société des Anciens Textes,* 1878, pp. 104–145), and by F W. D. Brie (*Geschichte und Quellen der mittelenglischen Prosachronik, The Brute of England or The Chronicles of England,* Marburg, 1905).

Finally we may mention, as ancient history, the translation of Eutropius and Dares, by Geoffrey of Waterford (13th century), who gave also the *Secret des Secrets,* a translation from a work wrongly attributed to Aristotle (*Rom.* xxiii. 314).

Satire and Drama.—The popularity enjoyed by the *Roman de Renart* and the Anglo-Norman version of the *Riote du Monde* (*Z. f rom. Phil.* viii. 275–289) in England is proof enough that the French spirit of satire was keenly appreciated. The clergy and the fair sex presented the most attractive target for the shots of the satirists. However, an Englishman raised his voice in favour of the ladies in a poem entitled *La Bonté des dames* (Meyer, *Rom.* xv. 315–339), and Nicole Bozon, after having represented "Pride" as a feminine being whom he supposes to be the daughter of Lucifer, and after having fiercely attacked the women of his day in the *Char d'Orgueil* (*Rom.* xiii. 516), also composed a *Bounté des femmes* (P. Meyer, *op. cit.* 33) in which he covers them with praise, commending their courtesy, their humility, their openness and the care with which they bring up their children A few pieces of political satire show us French and English exchanging amenities on their mutual shortcomings. The *Roman des Français,* by André de Coutances, was written on the Continent, and cannot be quoted as Anglo-Norman although it was composed before 1204 (*cf.* Gaston Paris: *Trois versions rimées de l'évangile de Nicodème, Soc. Anc. Textes,* 1885). It is a very spirited reply to French authors who had attacked the English.

Dramatic literature must have had a considerable influence on the development of the sacred drama in England, but none of the French plays acted in England in the 12th and 13th centuries has been preserved. *Adam,* which is generally considered to be an Anglo-Norman mystery of the 12th century, was probably written in France at the beginning of the 13th century (*Romania* xxxii. 637), and the so-called Anglo-Norman *Resurrection* belongs also to continental French. It is necessary to state that the earliest English moralities seem to have been imitations of the French.

Didactic and hagiographic literature are represented by numerous works, a complete list of which will be found in Johan Vising's *Anglo-Norman Language and Literature.*

BIBLIOGRAPHY.—J. Vising, *Anglo-Norman Language and Literature* (1923); O. H. Prior, "Remarques sur l'anglo-normand" (*Romania,* 1923); J. P. Strachey, *Poem on the Assumption,* H. J. Chaytor, *Poem on the day of Judgment,* D. H. Prior, *Divisiones Mundi;* these three pieces are published in *Cambridge Anglo-Norman Texts* (1924).

(L. B.)

ANGLO-PERSIAN OIL COMPANY, LTD. This company was registered in London in 1909 to work a concession (originally obtained from the Persian Government by William Knox D'Arcy), which runs for 60 years from May 28, 1901, and gives the exclusive right to drill for, produce, pipe and carry away natural gas, petroleum, asphalt, etc , throughout the Persian empire, except in the provinces of Azarbaijan, Gilan, Mazandaran, Astrabad and Khurāsān, *i.e* , an area of about 500,000 square miles

After much unsuccessful drilling in the neighbourhood of Qasr-i-Shirin and elsewhere, oil was struck in large quantities in the year 1908 at Masjid-i-Sulaiman, about 30m east of Shuster in the province of Khuzistan (south-west Persia). By 1913 the company was in need of further capital and, as the British Admiralty was then anxious to secure fresh sources of supply for its fuel oil, the Government entered into an agreement; important supply contracts still subsist between the Admiralty and the company.

Through the British Tanker Co., Ltd the Anglo-Persian Oil Co , Ltd. controls some 80 tank steamers, all built in Great Britain, and having a total carrying capacity of over 700,000 tons; and through subsidiary companies it operates refineries in South Wales, Scotland, and (through associated companies) in France, Australia and Argentina. The greater part of the present crude production is refined at Abadan in Persia The company's main production is still obtained from Masjid-i-Sulaiman and is conveyed by pipe lines to its refinery at Abadan on the Shatt-el-Arab, a distance of 145 miles. A limited production of oil is also obtained by the company at Naft Khana in Iraq This particular oil-field may be found to extend into Persian territory.

The main Persian oil belt, in which oil has been proved in a total area of 30 sq. m , comprises a tract which extends into Iraq and there appears to be a fundamental geological concordance throughout the whole belt The production of oil from the Persian field for the years ending March 1921–27 was as follows: (tons) 1,743,557, 2,327,221, 2,959,028, 3,714,216, 4,333,933, 4,556,157, 4,806,667—all obtained from large flowing wells, others being held in reserve to meet the constant expansion of the company's trade

Of the yearly net profits 16% is payable to the Persian Government, who have received on this account the following sums:

Year ended March	£	Year ended March	£
1921	585,290	1925	824,086
1922	593,429	1926	1,048,135
1923	533,251	1927	1,341,963
1924	377,575		

The company employs in Persia 26,000 persons, most of whom are Persians.

See Comm. Paper 7419 of 1914; also Winston Churchill, *The World Crisis,* vol. i., 1923.

(J. C.)

ANGLO-SAXON CHRONICLE. It is usual to speak of "the Anglo-Saxon Chronicle"; it would be more correct to say that there are four Anglo-Saxon Chronicles It is true that these all grow out of a common stock, that in some even of their later entries two or more of them use common materials; but the same may be said of several groups of mediaeval chronicles, which no one dreams of treating as single chronicles. Of this fourfold Chronicle there are seven mss. in existence: *C.C.C. Cant.* 173 (A); *Cott. Tib.* A vi. (B); *Cott Tib.* B i. (C); *Cott. Tib.* B iv. (D); *Bodl. Laud. Misc.* 636 (E); *Cott. Domitian* A viii. (F); *Cott. Otho* B xi. (G). Of these G is now a fragment, and it is known to have been a transcript of A, while A. C, D, E have every right to be treated as independent chronicles. The rela-

tions between the four vary very greatly in different parts, and the neglect of this consideration has led to much error and confusion. The common stock, out of which all grow, extends to 892. There seems to be no reason to doubt that the idea of a national, as opposed to earlier local chronicles, was inspired by Alfred, who may even have dictated, or at least revised, the entries relating to his own campaigns; while for the earlier parts pre-existing materials, both oral and written, were utilized. The impulse given by Alfred was continued under Edward, and we have what may be called an official continuation of the history of the Danish wars, which, in B, C, D extends to 915, and in A to 924. After 915 B, C insert as a separate document a short register of Mercian affairs during the same period (902–924), which might be called the acts of Aethelflaed, the famous "Lady of the Mercians," while D has incorporated it, not very skilfully, with the official continuation. From 925 to 975 all the chronicles are very fragmentary; a few obits, three or four poems, among them the famous ballad on the battle of Brunanburh, make up the meagre tale of their common materials. From 983 to 1018 C, D and E are practically identical, and give a connected history of the Danish struggles under Aethelred II. This section was probably composed at Canterbury. From 1018 the relations of C, D, E become too complicated to be expressed by any formula; sometimes all three agree together, sometimes all three are independent; in other places each pair in turn agree against the third. It may be noted that C is strongly anti-Godwinist, while E is equally pro-Godwinist, D occupying an intermediate position C extends to 1066, where it ends abruptly, and is probably mutilated D ends at 1079 and is certainly mutilated. In its later history D is associated with some place in the diocese of Worcester, probably Evesham. In its present form D is a comparatively late ms, none of it probably much earlier, and some of it later, than 1100. In the case of entries in the earlier part of the chronicles, which are peculiar to D, we cannot exclude the possibility that they may be late interpolations. E is continued to 1154. In its present form it is unquestionably a Peterborough book The earlier part is full of Peterborough interpolations, to which place many of the later entries also refer. But (apart from the interpolations) it is only the entries after 1121, where the first hand in the ms. ends, which were actually composed at Peterborough. The section 1023–67 certainly, and possibly also the section 1068–1121, was composed at St. Augustine's, Canterbury; and the former is of extreme interest and value, the writer being in close contact with the events which he describes. The later parts of E show a great degeneration in language, and a querulous tone due to the sufferings of the native population under the harsh Norman rule.

BIBLIOGRAPHY.—The above account is based on the introduction in vol. ii. of the Rev. C. Plummer's edition of *Two of the Saxon Chronicles Parallel* (1892, 1899); to which the student may be referred for detailed arguments. The *editio princeps* of the Anglo-Saxon Chronicle was by Abraham Wheloc (1643–44). In 1861 appeared Benjamin Thorpe's six-text edition in the Rolls Series. Though not free from defects, this edition is absolutely indispensable. A second volume contains the translation. The best translation is that by the Rev. Joseph Stevenson, in his series of *Church Historians of England* (1853). *An Anglo-Saxon Chronicle*, edited by E. Classen and F. E. Harmer (1926) is a useful reprint of D with emendations and notes.

ANGLO-SAXON LAW. The body of legal rules and customs which obtained in England before the Norman Conquest constitutes, with the Scandinavian laws, the most genuine expression of Teutonic legal thought. While the so-called "barbaric laws" (*leges barbarorum*) of the Continent, not excepting those compiled in the territory now called Germany, were largely the product of Roman influence, the continuity of Roman life was almost completely broken in the island, and even the Church, the direct heir of Roman tradition, did not carry on a continuous existence: Canterbury was not a see formed in a Roman province in the same sense as Tours or Reims. One of the striking expressions of this Teutonism is presented by the language in which the Anglo-Saxon laws were written. They are uniformly worded in English, while Continental laws, apart from the Scandinavian, are all in Latin. The English dialect in which the Anglo-Saxon laws have been handed down to us is in most cases a common speech derived from West Saxon—naturally enough as Wessex became the predominant English State. Traces of Kentish speech may be detected, however, in the *Textus Roffensis*, the ms. of the Kentish laws, and Northumbrian dialectical peculiarities are also noticeable, while Danish words occur as technical terms At the conquest Latin takes the place of English in the compilations made to meet the demand for Anglo-Saxon law texts as still applied in practice.

Classification.—It is easy to group the Anglo-Saxon laws according to the manner of their publication. They would fall into three divisions: (1) laws and collections of laws promulgated by public authority; (2) statements of custom; (3) private compilations of legal rules and enactments. To the first division belong the laws of the Kentish kings, Aethelbert, Hlothhere and Eadric, Wihtraed; those of Ine of Wessex, of Alfred, Edward the Elder, Aethelstan, Edmund, Edgar, Aethelred and Canute; the treaty between Alfred and Guthrum and the so-called treaty between Edward and Guthrum. The second division would include the law of the Northumbrian priests and fragments of local custumals entered in Domesday Book. The third division would consist of the post-Conquest collections of the so-called *Pseudo-leges Canuti*, the laws of Edward the Confessor, of Henry I, and the great compilation of the *Quadripartitus*, then of a number of short notices on various matters, such as the formalities of betrothal (*Bewifmannes beweddunge*), agricultural conditions (*Rectitudines singularum personarum*), the duties of a reeve (*gerefa*) and of a judge (*dema*), wergelds, oaths, ordeals, etc. A fourth group might be made of the charters, as they are based on Old English private and public law and supply us with most important materials in regard to it. Looking somewhat deeper at the sources from which Old English law was derived, we shall have to modify our classification to some extent, as the external forms of publication, although important from the point of view of historical criticism, are not sufficient standards as to the juridical character of the various kinds of material. Direct statements of law would fall under the following heads, from the point of view of their legal origins: i. customary rules followed by divers communities capable of formulating law; ii. enactments of authorities, especially of kings; iii. private arrangements made under recognized legal rules The first would comprise a great many of the rules entered in collections promulgated by kings; most of the paragraphs of Aethelbert's, Hlothhere's, and Eadric's and Ine's laws are popular legal customs that have received the stamp of royal authority by their insertion in official codes. On the other hand, from Wihtraed's and Alfred's laws downwards, the element of enactment by central authority becomes increasingly prominent, though there are no outward signs enabling us clearly to distinguish between both categories of laws in the codes, nor can we draw a line between permanent laws and personal ordinances of single sovereigns, as has been attempted in the case of Frankish legislation.

Analysis of Content.—Even in the course of a general survey of the legal lore at our disposal, one cannot help noticing that matters which seem to us of primary importance are almost entirely absent in Anglo-Saxon laws. A brief analysis of the contents of royal codes and laws may be found instructive.

In these codes the paragraphs devoted to criminal law and procedure far outnumber those concerned with matters of private law and civil procedure. A very large number of the criminal law clauses are concerned with tariffs of fines, while a considerably smaller number deal with punishments, such as outlawry, confiscation of property, mutilation and death. Private law is concerned mainly with contracts (including marriage) and matters connected with property. Questions of public law and administration (concerned chiefly with the power and privileges of the king, with police regulations and, to a much less extent, with local administration and purely economic and fiscal matters) are frequently discussed. Clauses which concern the Church (in collections not purely ecclesiastical) appear time and again, most commonly in the form of general precepts based on religious and moral considerations. A certain number, however, relate to secular privileges conferred on the Church and to matters of organization.

A consideration of chronological sequence in the elaboration of

the laws reveals interesting results. The code of Aethelbert is almost entirely a list of fines or "compositions" for various crimes, and similar lists figure largely in the laws of Hlothhere and Eadric, Ine and Alfred. In the codes of Edward the Elder and his successors, however, lists of fines for criminal offences are much less prominent, and gradually a new penal system is evolved, based on outlawry, confiscation, capital and corporal punishment.

Fines and compensations throughout the laws are carefully graded, in accordance with the social standing of the persons concerned. In early times it would appear that the different classes of society were more sharply distinguished than they were later. From the time of Aethelstan onwards the distinction between the thegn or *twelfhynde* man (*i.e.*, the man with a wergeld of 1,200 shillings) and the ceorl or *twihynde* man (*i e.*, the man with a wergeld of 200 shillings) is the chief dividing line between the classes of society. In the arrangements of the commonwealth the clauses treating of royal privileges are more or less evenly distributed over all reigns, but the systematic development of police functions, especially in regard to responsibility for crimes, the catching of thieves, the suppression of lawlessness, is mainly the object of 10th and 11th century legislation. The reign of Aethelred, which witnessed the greatest national humiliation in English history, is also marked by the most lavish expressions of religious feeling and the most frequent appeals to morality. Such an analysis of the Old English laws is by no means complete, but will convey some idea of the trend of State legislation during the period.

Derivation.—The next question to be approached concerns the pedigree of Anglo-Saxon law and the latter's natural affinities. How far has it been influenced by non-Germanic elements, especially by Roman and Canon law? The oldest Anglo-Saxon codes, especially the Kentish and the West Saxon ones, disclose a close relationship to the barbaric laws of Lower Germany—those of Saxons, Frisians, Thuringians. We find a division of social ranks which reminds us of the threefold gradation of Lower Germany (edelings, frilings, lazzen—Kentish eorls, ceorls, laets), and not of the twofold Frankish one (*ingenui Franci, Romani*), nor of the minute differentiation of the Upper Germans and Lombards. In subsequent history there is a good deal of resemblance between the capitularies' legislation of Charlemagne and his successors on one hand, the acts of Alfred, Edward the Elder, Aethelstan and Edgar on the other, a resemblance called forth less by direct borrowing of Frankish institutions than by the similarity of political problems and conditions. Frankish law becomes a powerful modifying element in English legal history after the Conquest, when it was introduced wholesale in royal and in feudal courts. The Scandinavian invasions brought in many northern legal customs, especially in the districts thickly populated with Danes. The Domesday survey of Lincolnshire, Nottinghamshire, Yorkshire, Norfolk, etc., shows remarkable deviations in local organization and justice (lagmen, sokes), and great peculiarities as to status (socmen, freemen), while from laws and a few charters we can perceive some influence on criminal law (*nidingsvaerk*), special usages as to fines (*lahslit*), the keeping of peace, attestation and sureties of acts (*festermen*), etc. But, on the whole, the importance of the introduction of Danish and Norse elements, apart from local cases, is owing chiefly to the conflicts and compromises it called forth and its social results; the Scandinavians coalesced easily with the natives.

The direct influence of Roman law was not great during the Saxon period: we notice neither the transmission of important doctrines, nor the continuous stream of tradition in local usage. But indirectly Roman law did exert a by no means insignificant influence through the medium of the Church, which for all its insular character, was still permeated with Roman ideas and forms of culture. The Old English "books" are derived in a roundabout way from Roman models, and the tribal law of real property was deeply modified by the introduction of individualistic notions as to ownership, donations, wills, rights of women, etc. Yet here also the Norman Conquest increased the store of Roman conceptions by breaking the isolation of the English Church and opening the way for closer intercourse with France and Italy.

Folk-right and Privilege.—It would be useless to attempt to trace in a brief sketch the history of the legal principles embodied in the documents of Anglo-Saxon law. But it may be of some value to give an outline of a few particularly characteristic subjects. The Anglo-Saxon legal system cannot be understood unless one realizes the fundamental opposition between folk-right and privilege. Folk-right is the aggregate of rules, formulated or latent but susceptible of formulation, which can be appealed to as the expression of the juridical consciousness of the people at large or of the communities of which it is composed. It is tribal in its origin, and differentiated, not according to boundaries between States, but on national and provincial lines. There may be the folk-right of West and East Saxons, of East Angles, of Kentish men, Mercians, Northumbrians, Danes, Welshmen, and these main folk-right divisions remain even when tribal kingdoms disappear. The centres for the formulation and application of folk-right were in the 10th and 11th centuries the shire-moots, while the councillors (*witan*) of the realm generally placed themselves on the higher ground of State expediency, although occasionally using folk-right ideas. The older law of real property, of succession, of contracts, the customary tariffs of fines, were mainly regulated by folk-right; the reeves employed by the king and great men were supposed to take care of local and rural affairs according to folk-right. The law had to be declared and applied by the people itself in its communities, while the spokesmen of the people were the leading men—the 12 eldest thanes or a similar quorum. Folk-right could, however, be broken or modified by special law or special grant, and the fountain of such privileges was the royal power. Alterations and exceptions were, as a matter of fact, suggested by the interested parties themselves, and chiefly by the Church. Thus a privileged land-tenure was created—bookland; the rules as to the succession of kinsmen were set at nought by concession of testamentary power and confirmations of grants and wills; special exemptions from the jurisdiction of the hundreds and special privileges as to levying fines were conferred. In time the rights originating in royal grants of privilege overbalanced folk-right in many respects, and became the starting-point of a new legal system—the feudal one.

The King's Peace.—Another feature of vital importance in the history of Anglo-Saxon law is its tendency towards the preservation of peace. Society is constantly struggling to ensure the main condition of its existence—peace. Already in Aethelbert's legislation we find characteristic fines inflicted for breach of the peace of householders of different ranks—the ceorl, the eorl and the king himself appearing as the most exalted among them. Peace is considered not so much a state of equilibrium and friendly relations between parties, but rather as the rule of a third within a certain region—a house, an estate, a kingdom. This leads on one side to the recognition of private authorities —the father's, the master's, the lord's—while, on the other, the tendency to maintain peace naturally takes its course towards the strongest ruler, the king, and we witness the gradual evolution of stringent rules in respect of the king's peace.

The more ancient documents of Anglo-Saxon law show us the individual not merely as the subject and citizen of a certain commonwealth, but also as a member of some group, all the fellows of which are closely allied in claims and responsibilities. The most elementary of these groups is the *maegth*, the association of agnatic and cognatic relations. Personal protection and revenge, oaths, marriage, wardship, succession, supervision over settlement and good behaviour, are regulated by the law of kinship. A man's actions are considered not as exertions of his individual will, but as acts of the kindred, and all the fellows of the *maegth* are held responsible for them. What began as a natural alliance was used later as a means of enforcing responsibility and keeping lawless individuals in order. When the association of kinsmen failed (and it seems to have done so at an early period in England), the voluntary associations—gilds—appeared as substitutes. The gild brothers associated in mutual defence and support, and they had to share in the payment of fines. The township and the hundred came in also for certain forms of collective responsibility.

In course of time the natural associations get loosened and in-

termixed, and this calls forth the elaborate police legislation of the later Anglo-Saxon kings. Regulations are issued about the sale of cattle in the presence of witnesses. Enactments about the pursuit of thieves, and the calling in of warrantors to justify sales of chattels, are other expressions of the difficulties attending peaceful intercourse. Personal surety appears as a complement of and substitute for collective responsibility. The *hlaford* and his *hiredmen* are an institution not only of private patronage, but also of police supervision for the sake of laying hands on malefactors and suspected persons. The *landrica* assumes the same part in a territorial district. Ultimately the laws of the 10th and 11th centuries show the beginnings of the frankpledge associations, which came to act so important a part in the feudal age.

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(P. VI.; A. J. R.)

ANGLO-SAXONS. The term "Anglo-Saxon" is commonly applied to that period of English history, language and literature which preceded the Norman Conquest It goes back to the time of King Alfred, who seems to have frequently used the title *rex Anglorum Saxonum* or *rex Angul-Saxonum* The origin of this title is not quite clear It is generally believed to have arisen from the final union of the various kingdoms under Alfred in 886 Bede (*Hist Eccl* i. 15) states that the people of the more northern kingdoms (East Anglia, Mercia, Northumbria) belonged to the Angli, while those of Essex, Sussex and Wessex were sprung from the Saxons (*q v*), and those of Kent and southern Hampshire from the Jutes (*q v.*) Other early writers, however, do not observe these distinctions, and neither in language nor in custom do we find evidence of any appreciable differences between the two former groups, though in custom Kent presents most remarkable contrasts with the other kingdoms. Still more curious is the fact that West Saxon writers regularly speak of their own nation as a part of the *Angelcyn* and of their language as *Englisc*, while the West Saxon royal family claimed to be of the same stock as that of Bernicia. On the other hand, it is by no means impossible that the distinction drawn by Bede was based solely on the names Essex (East Seaxan), East Anglia, etc We need not doubt that the Angli and the Saxons were different nations originally; but from the evidence at our disposal it seems likely that they had practically coalesced in very early times, perhaps even before the invasion.

See W. H. Stevenson, *Asser's Life of King Alfred* (1904, pp. 148 *seq.*); H. Munro Chadwick, *The Origin of the English Nation* (1907); also BRITAIN: *Anglo-Saxon.*

(H. M. C.)

ANGOLA, the general name of Portuguese possessions in West Africa south of the equator. The name (a Portuguese corruption of the Bantu *Ngola*) is sometimes confined to the 105m. of coast, with its hinterland, between the rivers Dande and Kwanza; but is officially applied to a whole province situated south of the Congo save for the enclave of Kabinda (Portuguese Cabinda). It extends about 1,000m. along the coast from the Congo (6° S, 12° E.) its northern frontier for 80m, to the mouth of the Kunene (Cunene) river (17° 18′ S, 11° 50′ E.). From the Congo the frontier goes due east to the Kwango river. The eastern boundary, dividing Angola from the Belgian Congo and Barotseland (North-west Rhodesia), is highly irregular. Angola's border towards South-west Africa, somewhat south of 17° S lat., is being demarcated (1928) jointly by the Portuguese and Union of South Africa Governments, while a study is being made of the deviation of the Kunene waters towards Damaraland. By a recent convention Portugal ceded a small area south of the Congo, near Matadi, for laying the Boma–Leopoldville railway; Belgium gave in exchange about 3,000sq.km. of the Bota de Dilolo, the Congo frontier passing behind and almost parallel to the river Luao. This helps construction of the Angola–Katanga railway. The area is given as 1,256,000sq.km. The population (1927) is something over 4,000,000, among whom are 35,000–40,000 Europeans, mostly officials.

Physical Features.—The coast is for the most part flat, with occasional low cliffs of red sandstone Great Fish bay (or Bahia dos Tigres), a little north of the Portuguese South-west African frontier, is the one deep inlet. Farther north are Port Alexander, Little Fish bay and Lobito bay, while shallower bays are numerous Lobito bay allows large ships to unload close inshore. The sparsely watered, sterile coast plain extends 30–100m inland. The great central plateau of Africa is approached by a series of irregular terraces, covered with luxuriant vegetation. Water is fairly abundant, though in the dry season obtainable only by digging in the sandy beds of the rivers. The plateau, of altitude 4,000 to 6,000ft., consists of well-watered, wide, rolling plains and low hills with scanty vegetation In the east the tableland falls away to the basins of Congo and Zambezi; to the south it merges into barren sandy desert The numerous westward rivers, save the Kwanza and Kunene (*q v*), are unimportant. The mountain chains, edging or dominating the plateau run generally parallel to the coast, as Tala Mugongo (4,400ft), Chella and Vissecua (5,250ft. to 6,500ft). In the district of Benguella are the highest points of the province, viz., Loviti (7,780ft), in 12° 5′ S, and Mt. Elonga (7,550ft). South of the Kwanza is the volcanic mountain Caculo-Cabaza (3,300ft.). From the tableland the Kwango and many other streams flow north to join the Kasai (one of the largest affluents of the Congo), which, in its upper course, forms for fully 300m. the boundary between Angola and the Congo State. In the south-east the rivers flow to the Zambezi or, like the Okavango, drain to Lake Ngami.

Geology.—The central plateau consists of ancient crystalline rocks with granites overlain by unfossiliferous sandstones and conglomerates considered to be of Palaeozoic age. The outcrops are largely hidden under laterite. The median zone of hills parallel with the coast is composed largely of crystalline rocks with granites and some Palaeozoic unfossiliferous rocks. The littoral zone contains the only fossiliferous strata; they are of Tertiary and Cretaceous ages, the latter rocks resting on a reddish sandstone of older date. The Cretaceous rocks of the Dombe Grande region (near Benguella) are of Albian age and belong to the *Acanthoceras mamillari* zone. The beds containing *Schloenbachia inflata* are referable to the Gault. Tertiaries are met with at Dombe Grande, Mossámedes and near Loanda. The sandstones with gypsum, copper and sulphur of Dombe may be Triassic. Recent eruptive rocks, mainly basalts, form a line of hills almost bare of vegetation between Benguella and Mossámedes. Nepheline basalts and liparites occur at Dombe Grande. Gum copal occurs in quantity in some superficial rocks.

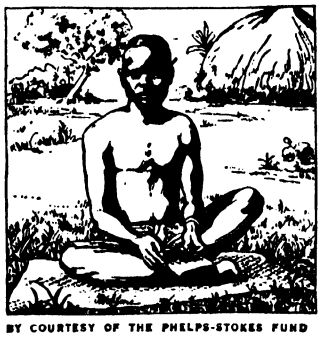
Minerals.—Thick beds of copper are found at Bembe, and deposits on the M'Brija and the Cuvo and in various places in the south. Iron is known in many parts, chiefly at Oeiras (on the Lucalla affluent of the Kwanza) and in Bailundo. It is worked by native blacksmiths, who are held in high repute A foundry at Oeiras has undergone important development. Concessions for petroleum and asphalt have been granted to British syndicates

and active prospecting is proceeding near the rivers Dande and Kwanza and Baixo Amboim. Mineral salt is worked by natives in several places, *e.g.*, Quissama. Gold occurs in Lombije and Kassinga, lead at Caxibo and lignite in the valley of the Kwanza. Coal is found at Calucala, Quilungo, Dondo and Chapeu Armado. The output is absorbed by the railways. Diamonds are worked in Lunda under concession from the Government which shares in the profits. Fifty-five Europeans and 5,000 natives are employed (1927), the production being 101,509 carats in 1927. Other minerals known to occur in Angola are silver, manganese and sulphur.

Climate.—With the exception of the district of Mossámedes, the coast plains are unsuited to Europeans. In the interior, above 3,300ft., temperature and rainfall, together with malaria, decrease. The plateau climate is healthy and invigorating. The mean annual temperature at São Salvador do Congo is 72·5°; at Loanda, 74·3°, and at Caconda, 67·2°. The prevailing winds are west, south-west and south-south-west. The cool season lasts from June to September; and the rainy, from October to May; the heaviest rainfall occurs with storms in April.

Flora and Fauna.—As far south as Benguella the coast is rich in oil-palms and mangroves. In the north are dense forests, in the south, towards the Kunene, regions of dense thorn scrub. Rubber vines and trees are abundant, but have been reduced by the ruthlessness of native collectors; the commonest are various root rubbers, notably *Carpodinus chylorrhiza; Landolphias* are also found. Coffee, cotton and Guinea pepper are indigenous, and tobacco flourishes in several districts. Among timber trees are the tacula (*Pterocarpus tinctorius*), which grows to an immense size, its wood being blood-red in colour, and the Angola mahogany. The bark of the musuemba (*Albizzia coriaria*) is used in tanning leather. The mulundo bears a hard green-shelled fruit like a cricket ball, with scarlet pips like a pomegranate. The fauna includes lion, leopard, cheetah, elephant, giraffe, rhinoceros, hippopotamus, buffalo, zebra, kudu and many other kinds of antelope, wild pig, ostrich and crocodile. Among fish are the barbel, bream and African yellow fish.

Inhabitants.—Portuguese predominate very greatly in the European population, but the Dutch in the interior at Humpata number over 2,000. Portuguese immigration at present averages a little over 200 per month. The great majority of the inhabitants are of Bantu-Negro stock mixed in the Congo district with the pure Negro. In the south-east are various tribes of Bushmen. Bantu-Negroes include the Ba-Kongo (Ba-Fiot) in the north, and the Abunda (with Portuguese admixture) (Mbunda, Ba-Bundo), in the centre. The Bangala, west of the upper Kwango, must not be confounded with the Bangala of the middle Congo. The Ba-Lunda inhabit the Lunda district. The Mushi-Kongo and other divisions of the Ba-Kongo were Christian in the 16th and 17th centuries and possibly later, and they use crucifixes as fetish charms or as symbols of power, whilst every native has a "Santu" or Christian name and is dubbed dom or dona. Fetishism is the prevailing religion throughout the province. The natives have usually small simple huts, used for sleeping; the day is spent in an open space in front of the hut protected from the sun by a roof of palm or other leaves. Native languages reduced to writing are Kisi Kongo (in the north), Kimbundu (north central), Umbundu (highlands east of Lobito) and Luchazi (south). A considerable mulatto population, growing in number and importance, is settled mainly in the coast areas.



BY COURTESY OF THE PHELPS-STOKES FUND

A NATIVE MUSICIAN OF ANGOLA
The African races are fond of music, and some of their musical instruments, though primitive in construction, produce tones of haunting sweetness

Administration and Government.—A high commissioner, resident at present in Loanda, and appointed by the Lisbon Government, has powers wider than those of the former governor-general, and similar to those of the colonial minister, granted expressly for the solution of stated questions of administration. Under the high commissioner are the district governors. The province is divided into the following districts: Loanda, Benguella, Bié, Congo, Cuanza-Norte, Cuanza-Sul, Huila, Cubango, Lunda, Malange, Mossámedes, Moxico, Luchazes, Zaire. (Lunda is part of the old Bantu kingdom of Muata Yanvo, divided by international agreement between Portugal and the Congo Free State.) Each district is divided into civil circumscriptions, each under an administrator, who is resident magistrate. In each circumscription, responsible to the administrator, are "chefes do posto," responsible for outlying posts. A local legislative council founded in 1922 has colonist representatives; it acts except in such matters as are reserved to the congress of the republic, or in general measures affecting more than one colony. Gen. Norton de Mattos, high commissioner 1921–24, initiated a scheme with development of communications, immigration of Portuguese settlers, supervision of foreign immigrants, introduction of Portuguese municipal institutions, inclusion of the Congo customs service in that of Angola, thus unifying the province, progressive native policy, health services, improved military organization, education—especially technical education—scientific services, strict supervision of concessions, regulation of religious missions and the raising of loans. This policy was adversely criticized, and, since de Matos' resignation, only part has been carried out. The administrative personnel has been reduced; but recruiting and promotion have been improved.

There are plans for industrializing State railways, for a tariff system to benefit exporting producers, and for separating charges of first establishment from running costs. A commission has been appointed to assist the natives, mainly medically, and technical staffs are being improved. The public services are divided into 13 directorships and five departments, concentrated at Loanda, with delegations in the districts. Angola constitutes a judicial district, with nine subdivisions, each in charge of a judge of first instance. There is an appeal court at Loanda.

Ecclesiastical.—The province forms a diocese of the Roman Catholic Church, in the province of Lisbon. This church began work at São Salvador in 1491, and controlled all educational activities till 1908. Since 1852 the Society of the Holy Ghost has carried on work in the Benguella district. The Society of the Sacred Heart has a station at Huila, in the Mossámedes district, and some mission schools. The Baptist Missionary Society has headquarters at São Salvador. The American Methodist Episcopal Foreign Missionary Society works in the Loanda district, and the Canadian and American Congregational Churches and the Plymouth, Brethren Mission in the highlands east of Lobito bay. In the Mossámedes district are stations of the South Africa General Mission and the Swiss Mission. The missions have schools, especially for agriculture.

Military Organization.—The military force consists of one battery of artillery, two mixed companies of infantry and artillery, one squadron of cavalry (on the plateau of Mossámedes), one company of European infantry, 16 companies of native infantry, one police force (Loanda) and one disciplinary battalion.

Public Instruction.—There are 52 Government schools, seven municipal and private schools, one seminary under an important mission at Huila, one principal secondary school and primary schools in all districts, a technical school for male natives in the circumscription of Cachingues, one for female natives at Malange and one for natives of both sexes in the circumscription of Alto Cuanza. Mixed primary schools for whites exist at Malange, Cangoma, Monongue (in the Cubango district), Silva Porto and at Humpata, the last having been doubled in size. 3,500 children (1,300 whites, the rest mainly mulatto) attend official primary schools. Native education is almost entirely in the hands of missions. A decree of 1921 prohibits teaching of native languages and printing of books of religion or instruction in native languages. This has been so far relaxed as to allow of the printing of a few books bilingually—in Portuguese and a native language.

Health.—Sleeping-sickness appears especially in the north-east and on the coast between Lobito and Benguella. Common diseases are malaria, hookworm, smallpox, leprosy, elephantiasis

and goitre among the women of the uplands. There are hospitals at Loanda and other coast towns, and several mission hospitals. A "travelling health mission" in the Congo district began work in Sept. 1927 for Melange and Marimba; another is being prepared for Zaire, Congo and the Cabinda enclave. There is a special fund for medical assistance to natives.

Chief Towns.—Until 1927, Loanda (São Paulo de Loanda), an excellent port, was the capital of the province of Angola. It is 8° 48′ S., 13° 7′ E., on a bay between the rivers Bango and Kwanza. The bay, protected from the surf by a long narrow island of sand, is backed by a low sandy cliff which sweeps sharply southward to a bold point crowned by Ft. São Miguel. The bay has silted up considerably, but there is a good anchorage about 1½m. from the shore in 7 to 14 fathoms, and the depth at the entrance is 20 fathoms. Vessels discharge into lighters, and are rarely delayed by weather. Part of the town lies on the foreshore, but the offices, governor's residence, bishop's palace and hospital are on higher ground. Most European houses are large stone buildings of one storey with red tile roofs. Loanda possesses a meteorological observatory.

Loanda was founded in 1576, and except between 1640 and 1648, when it was occupied by the Dutch, has always been in Portuguese possession. It was the chief centre of the slave trade between Portuguese West Africa and Brazil but suppression of that trade caused depression for a time. There is a regular service to Lisbon (16 days), Liverpool and Hamburg. The town's 16,000 inhabitants include a larger European element than any other place on the west coast of Africa. It is connected by submarine cables with Europe and South Africa. Fully half the import and export trade of Angola passes through Loanda. In Nov. 1927 it was announced that the capital was to be transferred to Huambo, a modern town created by the Benguella railway, 266m. from the coast. This is now an important administrative, trading and railway centre, with wireless station and aerodrome. Lobito, 20m. north of Benguella, was founded 1905, because its bay was chosen as the terminus of the Benguella railway. It has 429 hectares of anchorage, and a quay at which three steamers can lie and discharge cargo direct. Lobito is connected with Benguella by a railway through Katumbella, a town at the mouth of the river of the same name, and the sea terminus of an ancient route from the heart of Central Africa through Bié. Old Benguella is a town about 120m. north of Lobito bay. Other chief towns are, in the district of Congo: Cabinda, a good port and capital of the district; Landana, a port north of the Zaire; São Salvador do Congo (4,000), an ancient town, capital of the old kingdom of Congo, and formerly called Bonza Congo, 1,840ft. above sea-level, and about 160m. inland, and 100m. S.E. of Noki (*q.v.*) in 6° 15′ S. Only scanty ruins remain of the cathedral of the 16th century. The stone of the city walls was used recently to build Government offices; a fort was built about 1850. Ambrizete is a small port south of the Zaire river; Noki is at the head of navigation on the south bank of the Congo and takes large ships. In the district of Loanda: Ambriz, at the mouth of the Loje river, in 7° 50′ S., 13° E., some 70m. N. of Loanda, lies within the free-trade area of the conventional Congo basin and exports rubber, gum, coffee and copper; its population is 2,500. Ambaca in the district of Cuanza Norte, east of Loanda, and connected with it by railway, in a fertile agricultural district; Cazungo, capital of the best coffee district; Dondo (4,000), a commercial town on the right bank of the Kwanza, communicating with Loanda by steamer; Novo Redondo, a small port south of Loanda. In the district of Benguella: Benguella (São Felipe de Benguella) capital of the district, on a bay of the same name, in 12° 33′ S., 13° 25′ E., was founded in 1617 by the Portuguese under Manoel Cerveira Pereira. It was long the centre of the slave trade to Brazil and Cuba, but has now greatly declined. The anchorage, about a mile from the town, in four to six fathoms, is nothing but an open roadstead. The white population numbers about 4,000. A short way beyond Benguella is Bahia Tarta, where salt is manufactured and sulphur excavated. Caconda, south-west of Benguella, on a plateau, is a commercial centre; Bié, east of Benguella, is capital of the fertile and healthy district of the same name, and a large caravan centre; Kangomba, the residence of the former kings of Bié, is a large town; Catumbela is a port north of, and near, Benguella. In the district of Mossámedes: Mossámedes, capital of the district, on the south side of Little Fish bay (Bay of Mossámedes or Angra do Negro) is a healthy port, with a harbour affording excellent anchorage (pop. 5,000). A railway (248km. in use) starts from the harbour and crosses the semi-desert coast-region to the fertile Chela plateau. Mossámedes is the headquarters of an important fishing industry. Porto Alexandre is south of Mossámedes. In the district of Huila,



BY COURTESY OF THE PHELPS-STOKES FUND

A PALISADED VILLAGE OF THE TYPE CONSTRUCTED BY ANGOLA NATIVES
The huts, fairly uniform in size, are built of mud and roofed with and surrounded by a palisade whose gates are barred at nightfall

capital of an elevated, very healthy and fertile district, recently created out of the territories of Mossámedes, capable of growing European plants, Humpata, about 95m. N.E. of Mossámedes, with Dutch settlers, produces cereals and tobacco. In the district of Malange is Malange, provisional capital of the district, 120km. from Ambaca. Capenda-Camalembe is to be the future capital of the Loanda district.

Economic and Financial.—Credit was badly damaged in 1924–26 but the situation is improving. Revenue, chiefly from customs, excise duties and direct taxation, is generally less than expenditure, which is, however, partly on railways and other productive works. The natives pay, throughout the territory, a single tax of 80 escudos. State debts, partly capital for development, amount to 140,260 contos (Angolese), costing in service 14,815 contos per annum. The cost of civil administration is 17,767 contos. The Bank of Angola is being strengthened, a Land Bank has been founded and a new stable currency is to be decreed.

The Lisbon Government has assumed responsibility for deficits for four years after 1928, hoping that intensified production and restriction of imports will make budgets balance. An issue of short-period Treasury notes payable on demand has been well received.

Returns of general commerce in 1926 showed (in Lisbon currency) a decrease of 27,577 contos in imports and of 45,170 in exports, the totals being imports 225,569 contos, and exports 188,459 contos. The chief goods imported were, in order of value, common wines, railway material, cement, iron and steel, flour and cotton cloths. The chief exports were maize, sugar, coffee, dried fish, coconuts, palm oil and wax. Diamonds valued at £346,251 were exported. Exports to S. Thomé and Principe were valued at 9,931 contos.

The balance of trade in 1926 showed an excess of imports over exports of 37,110 contos (Lisbon currency). Excluding material for the Benguella railway and the port of Lobito the excess of imports over exports in 1926 was 622 contos. Three-quarters of the exports go to Portugal. In 1925, 23% was exported under foreign flags. In the last seven years, the value of imports of national origin has almost always exceeded that of those of foreign origin. The tonnage of goods imported in foreign ships has tended to decrease since 1923, but the total value of goods imported and exported in German ships has risen from 645 contos in 1920, to 42,002 contos in 1926, beer being an important item. Maize exported in 1926 was valued at 22,589 contos. The returns of the Bank of Angola showed, in March 1927, a balance of about 50,000 contos (Portuguese) against the colony. Gold is beginning to enter

the province in important amounts.

Ports and Shipping.—There is regular steamship communication between Portugal, England, Germany and Loanda. There is also a regular service between Cape Town, Lobito and Lisbon and Southampton. The Portuguese line is subsidized by the Government. Coastwise traffic and river navigation need development. Only in the port of Lobito is there a quay to which ships can moor. Plans are being made for new quays at Novo Redondo, Benguella and Loanda, the last being for big ships.

In 1926, 548 ships, of 1,663,706 tonnage, entered the Angolan ports of Benguella, Cabinda, Lobito, Loanda, Noki, Novo Redondo and Amboim. (No figures are available for the ports of Mossámedes, S. Antonio do Zaire, Ambriz and Ambrizete.) The highest figures were: Loanda 94, Lobito 72, Novo Redondo 72, Amboim 67. Of these ships, 386 were Portuguese, 119 German, 8 American, 15 English and 20 of various other nations.

Communications.—In 1927 24,413km. of road were good enough for cars and lorries travelling at 40–50km. per hour, but both they and the rivers are little used. The following railways are open (1927) to traffic: Loanda-Ambaca-Malange (Trans-African railway), of 1m gauge, begun in 1887, has now 592km. working. It was intended to carry the line across Africa to Mozambique, but when the line reached Ambaca (225m) in 1894 that scheme was abandoned. The railway, the most expensive in tropical Africa, costing £8,942 per mile, was bought by the Government in 1918. Golungo-Alto railway (gauge ·6om), has 31km. of line in use, the Amboim railway (60m. gauge), 80 kilometres. The Benguella railway, from Lobito bay, 25m. north of Benguella, begun in 1904, has reached the Belgian frontier, and is to be prolonged 104km. in consequence of the cession of 3,000 sq km. (Bota de Dilolo) in exchange for 3 sq km. at the mouth of the Congo river. It is of standard South African gauge (3ft. 6in.), is worked by an English company and has 1,156km. open to traffic; it serves the Katanga copper mines In consequence of the recent alteration of frontier, a further 104km. of line is to be constructed, bringing the final length up to 1,364km. The Mossámedes railway, running up to the Chela mountains, of ·6om. gauge, has 248km. open. Thus the total extent of lines open to traffic is 2,107 kilometres. Lines now under construction are: Loanda-Malange, 50km.; Amboim, 28km; Benguella, 475km. (which is shortly to be extended); Mossámedes, 67km.

Telegraphic and Telephonic Communication.—Angola is connected by cable with east, west and south African telegraph systems. Land telegraph lines in use extend to 8,528km. including 869 in reconstruction, with 92 stations. Wireless stations are in operation at the chief centres. There are 414 km. of telephone wires, with eight stations, of which only that at Loanda is in good condition.

Industries.—The most important industries at present are palm oil, whale oil, fish oil, resin and derivatives, milling of cereals, preserving fruits, preserving and salting fish, preserving meat. The sugar industry employs 200 Europeans and 9,000 natives, in seven factories near the Dande river, at Catumbela, Bom Jesus, Novo Redondo, Dombe Grande and Quissol; the output is 12,000–15,000 tons per annum. Fishing occupies 2,000 whites and 6,000 natives. There are 120 establishments for catching and preserving fish, employing 500 boats. There is a whaling station at Mossámedes (Porto Amelia). Soap is made in Loanda and Benguella for local use and for export to Belgian Congo and S. Thomé. More than 10,000 tons of salt, mainly to preserve fish, are produced annually. Several factories produce vegetable fibre. Other industries are ceramics, brick and tile-making; carpentry and joinery, practised on a large scale, especially wagon-building; saw-mills; tobacco, with two modern factories in Loanda, local growths being mixed with imported; foundries, the best being that of the State railways.

There is probably a good future before such industries as tanning, production of milk products, lime, paper pulp, rubber products, iron-working, etc. There are several deposits of guano. Ochres, chalks, marbles and lime-stones are known, and would repay working. Ivory and gums are exported.

Agriculture, etc.—There is a Government agricultural museum and experimental station at Loanda, and others in the interior. Hitherto their activities have been limited. The organization of a forestry department has been officially approved, and the woods of Moxico are being exploited. The chief agricultural products are coffee, the principal export, of which four types are grown, the best being that of Novo Redondo (Amboim); maize, the second most important export, grown almost entirely by natives, and chiefly in Benguella and the hinterland of Loanda; palm oil and coconut, grown without much method in the north, a crop with great possibilities on scientific lines; fibre-plants, agaves and furcroias, some plantations having modern machinery; the castor-oil plant grows almost everywhere and there are plantations in Benguella, Libôlo, Amboim, etc.; ground-nuts are grown by natives in many parts of the province; cotton is grown in Mossámedes on a large scale; wheat has done well on the Benguella plateau and in Malange; potatoes, rice, peas, beans and other vegetables are commonly grown on the high lands; the agricultural station at Bié has proved that rye, oats and barley can do well on the high lands, cocoa does well in Cabinda and parts of Amboim; manico is cultivated almost everywhere by natives; bananas thrive everywhere, except in the highest parts of the south; tropical fruits, such as pineapples, guavas and pawpaws, do well almost everywhere; almost all the fruits of Portugal are successfully grown on the high lands; tobacco, of rather inferior quality, is grown a good deal, and could be improved Sugar-cane is one of the most important products of the province Some factories have modern machinery. Rubber is found in the interior of Benguella, and is the basis of the present trade with the natives. There are possibilities of the cultivation of flax, especially on the southern plateaux.

Stock-raising.—There is much pasture, and it could be improved; forage can be grown well The veterinary station at Humpata has achieved good results in the acclimatization of stock, and the improvement of pasture There is a veterinary mission at Huila. Good cattle, horses and donkeys have been introduced. Sheep and goats do very well, and parts of the highlands have great possibilities. Pigs are second only to cattle in Angola. Crossing of the native pig with foreign strains has given good results. Domestic birds can be acclimatized but native breeds are poor. Ostrich farming has begun. The trade in wax and honey is almost entirely in native hands; but some Europeans are engaging in it successfully. Silk worms have been bred in Huila The growing of wool is certainly possible on some of the plateaux.

Native Labour.—Recent legislation has improved conditions of recruiting and service. A census of males between 18 and 45 years of age, in 1926, gave, in round numbers, a total of 588,300. The hut-tax list gave the number of men between 16 and 60 as 744,400. The total estimated male population is 1,633,400. Estimates of labour required, probably exaggerated, gave a total of 378,800 as follows: Public Works, 77,200; European agriculture, 101,300; native industries, 24,800; native agriculture, 129,100; various, 46,400. There were available, of men between 18 and 45, 209,500; and between 16 and 60, 365,600, there being a deficit, in native labour available, in the districts of Loanda, Cuanza-Norte and Mossámedes. It is thought that, allowing for evidently exaggerated demands, there is a surplus of 300,000 men fit for work, counting 130,000 for native agriculture. The problem is one of distribution and rational use, made the more difficult by the undesirability of employing men far from their homes For general necessities there is only one man (of between 16 and 60) to every 1½sq.km. It is necessary, not only to intensify European colonization, but to foster the native population.

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HISTORY

The Portuguese established themselves on the west coast of Africa towards the close of the 15th century, the river Congo

and the whole coastline of Angola being discovered by Diogo Cam or Cão in 1482, and the three following years. He erected a stone pillar at the mouth of the river, which accordingly took the title of Rio de Padrão, and established friendly relations with the natives, who reported that the country was subject to a great monarch, Mwani Congo or lord of Congo, resident at Bonza Congo. The Portuguese were not long in making themselves influential in the country. Gonçalo de Sousa was despatched on a formal embassy in 1490; and the first missionaries entered the country in his train. The king was soon after baptized and Christianity was nominally established as the national religion. In 1534 a cathedral was founded at Bonza Congo (renamed São Salvador), and in 1560 the Jesuits arrived with Paulo Diaz de Novaes. Of the prosperity of the country the Portuguese have left the most glowing and indeed incredible accounts. It was, however, about this time ravaged by cannibal invaders (Bangala) from the interior, and Portuguese influence gradually declined. The attention of the Portuguese, moreover, was now turned more particularly to the southern districts of Angola. In 1627 the bishop's seat was removed to São Paulo de Loanda and São Salvador declined in importance: but in the 18th century, in spite of hindrances from Holland and France, steps were taken towards re-establishing Portuguese authority in the northern regions. Until the "scramble for Africa" began in 1884, however, they possessed no settlement on the coast to the north of Ambriz, which was first occupied in 1855; but in 1884–85 they succeeded in securing the southern shores of the estuary of the Congo (*see* CONGO FREE STATE). The last of the native princes of Congo who had real authority was a potentate known as Dom Pedro V. He was placed on the throne in 1855 with the help of a Portuguese force, and reigned over 30 years. In 1888 a Portuguese resident was stationed at Salvador, and the kings of Congo became pensioners of the government.



BY COURTESY OF THE PHELPS-STOKES FUND

A CHIEF OF ANGOLA
Although chiefs still rule the native tribes, their administration is supervised by the Portuguese Government

The first governor sent to Angola was Paulo Diaz, a grandson of Bartholomew Diaz, who reduced to submission the region south of the Kwanza nearly as far as Benguella. The city of Loanda was founded in 1576, Benguella in 1617. From that date the sovereignty of Portugal over the coastline, from its present southern limit as far north as Ambriz (7° 50′ S.) has been undisputed save between 1640 and 1648, during which time the Dutch attempted to expel the Portuguese and held possession of the ports. Whilst the economic development of the country was not entirely neglected and many useful food products were introduced, the prosperity of the province was very largely dependent on the slave trade with Brazil, which was not legally abolished until 1830 and in fact continued for many years subsequently.

Agreements concluded with the Congo Free State, Germany and France in 1885–86 (modified in details by subsequent arrangements) fixed the limits of the province, except in the south-east, where the frontier between Barotseland (north-west Rhodesia) and Angola was determined by an Anglo-Portuguese agreement of 1891 and the arbitration award of the king of Italy in 1905 (*see* AFRICA: *History*). Up to the end of the 19th century the hold of Portugal over the interior of the province was slight, though its influence extended to the Congo and Zambezi basins. The abolition of the external slave trade proved very injurious to the trade of the seaports, but from 1860 onward the agricultural resources of the country were developed with increasing energy, a work in which Brazilian merchants took the lead. After the definite partition of Africa among the European powers, Portugal applied herself with some seriousness to exploit Angola and her other African possessions. Nevertheless, in comparison with its natural wealth the development of the country has been slow. Slavery and the slave trade continued to flourish in the interior in the early years of the 20th century, despite the prohibitions of the Portuguese Government. The extension of authority over the inland tribes proceeded very slowly and was not accomplished without occasional reverses.

A measure granting Angola a degree of autonomy was passed by the Portuguese parliament in 1914, followed in 1920 by a more liberal measure. In 1920, also, Gen. Norton de Mattos, a former governor, returned to Angola as High Commissioner with an ambitious programme of development and colonization. Chief attention was to be paid to harbour improvements and railways, the deficiency of means of communication being a leading cause of the backward state of the country. For two years there was much activity, but then a crisis arose, due in part to the lack of sufficient produce for export to pay for the imports of the Government and the trading community, and in part to the inability of Angola to raise more than about a sixth of the authorised loan of 60,000 gold contos (about £13,300,000). The crisis was acute throughout 1924. In 1925 the Portuguese Government voted 9,000 gold contos (£2,000,000) to enable the colony to carry out the most needed public works. These included the reconstruction of the Loanda railway, which had been bought by the state in 1918 and serves valuable coffee areas. Apart from the cost of development works, public expenditure frequently exceeded revenue. Between 1910 and 1925 the revenue increased from about £500,000 a year to over £1,000,000.

A Native Affairs Department was created in 1913 and it effected various reforms, but the principle of compulsory labour was maintained. From 1918 to 1921 the authorities took an active part in the recruitment of labour for private enterprise. The system led to abuses and was abolished in 1921. Continued complaints that labour was not procurable resulted, however, in 1925, in a partial return to the old system, chiefs being required to produce the men and both chiefs and officials receiving payment per head for the labour obtained.

The Benguella railway, a British enterprise, which starts at Lobito Bay, was intended primarily to serve the copper fields of Katanga, Belgian Congo, but in crossing the plateau of southern Angola it opened up the territory best suited to European settlement. (*See* above "Communications.") By an agreement made with Belgium in 1927, a small part of the Belgian Congo on the Upper Kasai basin was transferred to Angola, the effect being to lengthen the Benguella railway by 40 miles. The junction with the Congo line was fixed at the Luao river. In 1928 the Portuguese determined to make Huambo, a town on the Benguella railway and finely situated on the plateau, the capital of the province.

Germany had for many years looked upon Angola as a field of economic and ultimately political penetration, and a treaty with Great Britain negotiated in 1913–14 recognized German economic interests as supreme in the greater part of Angola. The outbreak of the World War prevented the signature of this treaty, while the loss of South-west Africa, conquered by General Botha in 1915, deprived Germany of a base for penetration. Nevertheless after the war German influence and trade within the colony steadily grew, so that by 1925 Germans exceeded in number all other European residents combined, with the exception of the Portuguese.

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ANGOLA, a conventional trade term used to describe a particular type of "union" or "mixture" yarn produced from short staple or "shoddy" wool and raw staple cotton, blended together by a "scribbling" process to ensure their thorough admixture, before spinning. The wool and cotton are blended in varying proportions chiefly according to the particular class of fabric for which it is intended, and the peculiar characteristics of texture, such as the "handle" or "feel" and other features that may be desired in the finished fabric. A typical and recognized standard quality of angola yarn is produced from wool and cotton blended in the proportion of 80% wool and 20% cotton.

The admixture of cotton with the short staple "shoddy" wool not only improves the spinning properties of the latter and thus enables yarn of finer counts to be spun than would be possible from the short fibres of wool themselves, but the cotton staple also serves to impart to the yarn a soft and mellow "feel," which is one of the distinctive characteristics of Angola fabrics.

Angola yarn is manufactured into quite a large variety of textile fabrics, both knitted and woven, in each of which classes of goods it may be employed either alone or in combination with yarns produced from any other class of textile fibre, as cotton, silk, artificial silk, and worsted yarns. In the production of certain types of warp-faced worsted fabrics, as exemplified in amazon, covert coating, venetian, and similar varieties, angola yarn is sometimes employed for the weft series of threads which, in fabrics of this class, lies entirely obscured at the back of the cloth and is not, therefore, exposed to wear and tear.

Angola yarn, however, is chiefly employed alone both as warp and weft in the production of so-called "union" fabrics, usually of some simple weave structure as the plain calico or "tabby" weave; a regular twill weave such as the 3-end or 4-end (2 × 2) twill; the 2 × 2 matt or dice, or similar elementary structure. Fabrics of this class are made up into garments for underwear, as undervests and shirts, also for night attire, as pyjamas, night-dresses and dressing gowns.

It should be noted that the term angola is not synonymous with angora, the name of a famous breed of goats that yield a valuable fleece of wool known as "mohair." (H. N.)

ANGONI. The name, an appellation bestowed by the Bantu immediately north of them, is recognized by the Angoni as their own, and they are also known as Tuta, Gwangwara, Zitu and Fiti according to their geographical position. The Angoni, now a ruling caste rather than a distinct race, were originally a Zulu clan which was expelled by Chaka in the 19th century. Under Zwangendaba they marched northwards, incorporating with themselves Swazi and Thonga and elements of other tribes whom they victoriously traversed. During their progress they dropped colonies which have become incorporated into the neighbouring tribes. Thus the Anyanja absorbed a section known as Chekusi's men, which broke off and settled near Chindundo, south-west of Lake Nyasa. The main body, however, passed northward and reached Ufipa at the south-east corner of Lake Tanganyika, where they remained till the death of Zwangendaba in the late '40s.

The Angoni live partly in scattered homesteads, partly in villages. These are neither fenced nor fortified except in the case of a few chiefs Quite often the village consists only of a man, his wives and children and his slaves, but a chief would naturally be surrounded by a larger following, whose huts are usually grouped in a circle round the enclosure containing the chief's hut. The huts are conical with a pointed roof, often 30ft. in height, fully covering the substructure, a 5-ft. wall of poles and clay. It is thatched with thick bundles of grass supported by converging poles. The diameter varies but may reach 38ft., though it is usually considerably smaller. Almost certainly the huts are indigenous and not Zulu, as they are similar to those of their neighbours and their size and structure are doubtless conditioned by the local materials. Their weapons are of the Zulu pattern: a heavy thrusting spear, a few throwing spears, a large oval shield of unframed ox-hide and a club or a battle axe.

Polygyny prevails, each wife owning a separate hut, and the number of wives is only limited by a man's means and ability to pay the dowry. The clans are exogamous and patrilineal, but the family of the mother must be of distinguished blood when it is a question of the succession to the chieftainship.

The political organization varies with the different groups according to the degree to which the Angoni have imposed themselves on the indigenous population. The chief rules as a military autocrat, but his power is limited by his indunas or military chiefs. Those near him will be kept under control, whereas the outliers may become almost independent. The military organization is based on the Zulu model, for all freemen are liable to service, enrolled in regiments, constantly disciplined and kept in garrisons. They are under the command of indunas, who form a military and civil council to the chief. As among the Zulu, the regiments are not allowed to marry until given permission to do so by the chief.

Their religious system includes a deity *Mulungu*, the director or governor of the earth, and the worship of dead ancestors (*mahoka*), who are more intimately concerned with the affairs of men. The soul is indestructible and sacrifices are made at the graves of the dead to propitiate even more than to supplicate the ancestral spirits. The nature of *mulungu* is not quite clear, but as it is applied also to the spirits of the dead and as local deities seem to be in many instances identical with deceased chiefs it is probable that *mulungu* is the great impersonal spirit of all men who are dead.

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ANGORA or **ENGURI.** (1) The capital of Turkey (anc. ANCYRA), situated upon a steep, rocky hill, which rises 500 ft. above the plain, on the left bank of the Enguri Su, a tributary of the Sakaria (Sangarius), about 220m. E S E. of Constantinople. The hill is crowned by the ruins of the old citadel, which add to the picturesqueness of the view; but the town is not well built, its streets being narrow and many of its houses constructed of sun-dried mud bricks; there are, however, many fine remains of Graeco-Roman and Byzantine architecture, the most remarkable being the temple of Rome and Augustus, on the walls of which is the famous *Monumentum Ancyranum* (*see* ANCYRA). Ancyra was the centre of the Tectosages, one of the three Gaulish tribes which settled in Galatia in the 3rd century B.C., and became the capital of the Roman province of Galatia when it was formally constituted in 25 B.C. During the Byzantine period, throughout which it occupied a position of great importance, it was captured by Persians and Arabs; then it fell into the hands of the Seljuk Turks, was held for 18 years by the Latin Crusaders, and finally passed to the Ottoman Turks in 1360. In 1402 a great battle was fought in the vicinity of Angora, in which the Turkish sultan Bayezid was defeated and made prisoner by the Tatar conqueror Timur. In 1415 it was recovered by the Turks under Mohammed I, and since that period has belonged to the Ottoman empire. In 1832 it was taken by the Egyptians under Ibrahim Pasha. Angora exports wool, mohair and grain. Mohair cloth is manufactured, and the town is noted for its honey and fruit. Pop. (1927), 107,641.

The Turkish Nationalist Movement, which was organized by Mustafa Kemal in 1919, led to the setting up of a Nationalist Government at Angora in April 1920, the city being chosen owing to the fact that, while it was far enough from the coast to be reasonably safe from attack by the Greeks, or the principal Allied Powers, it was in touch with other parts of the interior of Anatolia, and was the railhead of the north-eastern branch of the Anatolian railway. The ability of the surrounding area to supply the food requirements of the population and the raw materials needed by local industry was also of importance. On Oct. 13, 1923, by a decision of the Great National Assembly, Angora was declared the capital of Turkey.

The city is connected by the Anatolian railway with Constantinople, and a line to Sivas had reached Kaisarieh in 1927. In view of its increased importance and growing population, Angora is badly equipped as regards accommodation for its population and for the Government, and as regards sanitary arrangements, etc. Considerable progress has, however, been made by the munici-

pality in house building, road construction and sanitation. A beginning was made with the drainage of the swampy fields between the station and the town, a breeding ground for the malarial mosquito, and with the construction of a public park; modern systems of drainage and of water supply were commenced. A new parliament house and buildings for the Ministry of Finance, Courts of Justice, General Post Office, etc., and a modern hotel have been built. The industrial development of the city is being actively encouraged, and German engineers have been called in to erect factories and workshops for the production of tiles, cotton and flax goods, etc. The installation of a power station capable of furnishing electric light throughout the city has been completed, sawmills constructed, and a flourmill equipped with modern machinery. The Government decided in 1925 to install a telephone exchange and erect a powerful wireless station. By the end of 1925 certain foreign legations had moved their headquarters from Constantinople to Angora, and the others were represented by secretaries.

(2) A Turkish vilayet in north-central Asia Minor, which includes most of the ancient Galatia (pop. [1927], 404,726). It is an agricultural country, depending for its prosperity on its grain, wool and mohair obtained from the beautiful Angora goats. It includes the city of Angora.

See C Ritter, *Erdkunde von Asien,* vol. xviii. (1837–39); V. Cuinet, *La Turquie d'Asie* (1891); Murray's *Handbook to Asia Minor* (1895); and other works mentioned under ANCYRA.

ANGOSTURA BARK, the bark of *Cusparia febrifuga,* is used in the form of an extract as an astringent to increase the appetite, to stimulate gastric secretion and as a tonic. Its effect, best obtained by administration a few minutes before meals, is due to the bitter taste. Its action is probably a reflex one between the taste buds and the gastric glands. Angostura bark is now very seldom prescribed.

ANGOULÊME, CHARLES DE VALOIS, DUKE OF (1573–1650), natural son of Charles IX. of France by Marie Touchet, was born at Fayet, Dauphiné, April 28 1573 His mother married François de Balzac, Marquis d'Entragues, and one of her daughters, Henriette, marquise de Verneuil, afterwards became the mistress of Henry IV. Charles, known in his early manhood as Comte d'Auvergne, was made colonel of horse by Henry IV., and served in the campaigns of Arques and Ivry. But in 1601 he was implicated in the Biron conspiracy, one of the objects of which was to persuade Henry to repudiate his wife. Biron was executed, but Auvergne, after making a full confession, was released. He then engaged in fresh intrigues with the Spanish court, acting in concert with his half sister, the king's mistress, and her father. Henriette was pardoned, but Auvergne spent 11 years in the Bastille. On his release in 1616 he was reinstated in the army, and employed in several campaigns. He became Duke of Angoulême in 1619. He commanded at the siege of La Rochelle in 1627, and in Lorraine in 1635. He retired soon after Richelieu's death in 1643, and lived in retirement until Sept. 24 1650.

The duke was the author of the following works: (1) *Mémoires,* from the assassination of Henri III. to the battle of Arques (1589–93), published at Paris by Boneau, and reprinted by Buchon in his *Choix de chroniques* (1836) and by Petitot in his *Mémoires* (1st series, vol. xliv.); (2) *Les Harangues, prononcés en assemblée de MM. les princes protestants d'Allemagne,* par Monseigneur le duc d'Angoulême (1620); (3) a translation of a Spanish work by Diego de Torres. To him has also been ascribed the work *La générale et fidèle Rélation de tout ce qui s'est passé en l'isle de Ré, envoyée par le roi à la royne sa mére* (Paris, 1627).

ANGOULÊME, LOUIS-ANTOINE DE BOURBON, DUKE OF (1775–1844), the last dauphin of France, elder son of the count of Artois (afterwards Charles X.) and of Marie-Thérèse of Savoy, was born in Versailles on Aug. 6, 1775, and died in Goritz, in Austria, on June 3, 1844. In 1789 he left France with his father and, after completing his military training at Turin, commanded a corps of émigrés in the campaign of 1792. After residing in Poland and in England he returned to France in 1814, took possession of Bordeaux, and, as lieutenant-general, organized a futile attempt to resist Napoleon on the latter's return from Elba, after which Angoulême was captured and transported to Barcelona. In Louis XVIII.'s reign he commanded the French expedition to Spain in support of Ferdinand VII. (1823); on the accession of Charles X. the duke of Angoulême became dauphin, but in 1830, with his father, he renounced his claim to the throne, and finally settled in Austria, at Goritz, under the title of count of Marne, until his death.

In 1799 he had married his cousin MARIE-THÉRÈSE CHARLOTTE, the daughter of Louis XVI. and Marie Antoinette, who was born at Versailles on Dec. 19, 1778, and died at Frohsdorf on Oct 19, 1851. During the Revolution she was imprisoned for three years, from Aug. 1792 until 1795, when she was released in exchange for prisoners handed over to the Convention by Dumouriez. In 1814 she returned to France in the train of Louis XVIII., and for ten days after Napoleon had entered the Tuileries during the Hundred Days, she was able to maintain Bordeaux's loyalty to the royal family.

ANGOULÊME, south-west France, capital of the department of Charente, 83m. N.N.E. of Bordeaux on the railway from Poitiers. Pop. (1926) 32,002. The old town is on a small steep-sided peninsula washed on the north by the Charente, and on the south and west by a small tributary, the Anguienne. The more important suburbs lie towards the east where the promontory joins the surrounding plateau The main railway line passes through a tunnel beneath the town.

Angoulême (*Iculisma*) was taken by Clovis from the Visigoths in 507, and plundered by the Normans in the 9th century.

In 1360 it was surrendered by the peace of Bretigny to the English; they were, however, expelled in 1373 by Charles V., who granted the town numerous privileges. It suffered during the Wars of Religion, especially in 1568 after its capture by Protestants under Coligny

The countship of Angoulême dated from the 9th century, the most important of the early counts being William Taillefer, whose descendants held the title till the end of the 12th century. After a short period of possession by King John of England it passed by marriage, in 1220, to the Lusignan family, counts of Marche. In 1394 the countship came to the house of Orléans, a member of which, Francis I., became king of France in 1515 and raised it to the rank of duchy. The duchy afterwards changed hands several times, one of its holders being Charles of Valois, natural son of Charles IX. The last duke was Louis-Antoine, eldest son of Charles X., who died in 1844.

Angoulême is encircled by boulevards, which, as in so many French towns, are altered ramparts. The cathedral of St Pierre, a church in the Byzantine Romanesque style (*cf.* Périgueux), dates from the 11th and 12th centuries, but has been often restored. The façade, flanked by two towers with cupolas, is highly decorated The crossing is surmounted by a dome, and the extremity of the north transept by a fine square tower over 160ft. high. The domed style in this district is a characteristic feature. The *hôtel de ville,* by Abadie, is modern but preserves two towers of the *château* of the counts. Angoulême is the seat of a bishop, a prefect, and court of assizes. Its public institutions include tribunals of first instance and of commerce, a council of trade-arbitrators and chamber of commerce. It also has a library and several learned societies. It is the centre of an old-established paper-making industry. Most of the mills are situated on watercourses near the town. Subsidiary industries, such as those of small machinery and wire fabrics, are numerous. Commerce is carried on in wine and brandy.

ANGOUMOIS, an old province of France, nearly corresponding to-day to the department of Charente. Its capital was Angoulême.

ANGRA or **ANGRA DO HEROISMO** ("Bay of Heroism," a name given it in 1829, to commemorate its successful defence against the Miguelist party), the former capital of the Azores (Portuguese), and chief town of an administrative district, comprising the islands of Terceira (on which it lies), St. George and Graciosa. Pop. (1920) 10,057. It is the headquarters of a military command and the see of a Roman Catholic bishop; its principal buildings are the cathedral, military college, arsenal and observatory. The harbour, formerly a naval station, is shel-

tered by the promontory of Mt. Brazil. Pineapples and other fruit are exported.

ANGRA PEQUENA: *see* LÜDERITZ.

ÅNGSTRÖM, ANDERS JONAS (1814–1874), Swedish physicist, was born on Aug. 13, 1814, at Lögdö, Medelpad, Sweden. He was educated at Uppsala university, where in 1839 he became *Privatdozent* in physics. In 1843 he became observer at Uppsala Observatory. In 1858 he succeeded Adolph Ferdinand Svanberg (1806–1857) in the chair of physics at Uppsala, and there he died on June 21, 1874. His most important work was concerned with the conduction of heat and with spectroscopy. In his optical research *Optiska Undersökningar,* presented to the Stockholm Academy in 1853, he not only pointed out that the electric spark yields two superposed spectra, one from the metal of the electrode and the other from the gas in which it passes, but deduced from Euler's theory of resonance that an incandescent gas emits luminous rays of the same refrangibility as those which it can absorb This statement entitles him to rank as one of the founders of spectroscopy. The Ångström unit was named in his honour.

From 1861 onwards he paid special attention to the solar spectrum. He announced in 1862 the existence of hydrogen, among other elements, in the sun's atmosphere, and in 1868 published his great map of the normal solar spectrum, which long remained authoritative in questions of wave-length although his measurements were inexact to the extent of one part in 7,000 or 8,000, the metre which he used as his standard having been slightly too short. He was the first, in 1867, to examine the spectrum of the aurora borealis and to detect and measure the characteristic bright line in its yellow green region; but he was mistaken in supposing that this same line, which is often called by his name, is also to be seen in the zodiacal light.

His son KNUT JOHAN ÅNGSTRÖM (1857–1910) became professor of physics at Uppsala in 1896. He investigated the radiation of heat from the sun and its absorption by the earth's atmosphere and devised various delicate methods and instruments, including his electric compensation pyrheliometer, invented in 1893, and apparatus for obtaining a photographic representation of the infra-red spectrum (1895).

ÅNGSTRÖM UNIT, the unit employed for measuring wave-lengths of light, being equal to one ten-millionth of a millimetre, *i.e.,* 1×10^{-10} metre. The usual abbreviation for this unit is Å.U. (*See* SPECTROSCOPY.)

ANGUIER, FRANÇOIS (*c.* 1604–1669) and **MICHEL** (1612–1686), French sculptors, were two brothers, natives of Eu in Normandy. The mausoleum of Henri II., last duc de Montmorency, at Moulins, is the work of François. To Michel are due the sculptures of the triumphal arch at the Porte St. Denis, begun in 1674, to serve as a memorial for the conquests of Louis XIV. A marble group of the Nativity in the church of Val De Grâce was reckoned his masterpiece. It was he who superintended the decoration of the apartments of Anne of Austria in the old Louvre. F. Fouquet also employed him for his château in Vaux.

See Henri Stein, *Les frères Anguier* (1889), with catalogue of works and many references to original sources; Armand Sanson, *Deux Sculpteurs Normands; les frères Anguier* (1889).

ANGUILLA or Snake Island, British West Indies, part of the presidency of St. Kitts-Nevis, in the colony of the Leeward Islands, 18° 12′ N. and 63° 5′ W., about 60m. N.W. of St. Kitts, 16m. long, area 35sq.m., population estimated 4,398, mostly negroes. Charcoal-burners have almost completely denuded the island, which having but little rain is very subject to drought. Nearly all the land is in the hands of peasant proprietors, who cultivate cotton, sweet potatoes, peas, beans, corn, etc., and rear sheep and goats. Cotton, cattle, phosphate of lime and salt are the principal exports.

ANGULATE, shaped with corners or angles; used in botany and zoology for the shape of stems, leaves and wings.

ANGUS, EARLS OF. Angus is the official name of the former county of Forfarshire (*q.v.*), and was that of one of the original earldoms of Pictish, Scotland, said to have been occupied by seven brothers of whom Angus was the eldest. The Celtic line ended with Matilda (*c.* 1240), countess of Angus in her own right, who married in 1243 Gilbert de Umfravill and founded the Norman line of three earls, which ended in 1381, the then holder of the title being summoned to the English parliament. Meanwhile John Stewart of Bonkyl, Co. Berwick, had been created earl of Angus in a new line. This third creation ended with Margaret Stewart, countess of Angus in her own right, and widow of Thomas, 13th earl of Mar. By an irregular connection with William, 1st earl of Douglas, who had married Mar's sister, she became the mother of George Douglas, 1st earl of Angus (*c.* 1380–1403), and secured a charter of her estates for her son, to whom in 1389 the title was granted by King Robert II. He was taken prisoner at Homildon Hill and died in England.

His great-grandson was ARCHIBALD DOUGLAS (*c.* 1450–*c.* 1514), 5th earl, known as the *Great Earl* and nicknamed *Bell-the-Cat* for his capture of Robert Cochrane, earl of Mar, the favourite of James III. He joined Alexander Stewart, earl of Albany, in intriguing with Edward IV., acknowledged the overlordship of the English Crown and was one of the leaders of the rebellion against James III. in 1487–88. He renewed his English intrigues under the reign of James IV., but was in favour with the court between 1493 and 1498 and became chancellor of the kingdom. At Flodden Field he lost two of his sons. His third son, Gavin, bishop of Dunkeld, is separately noticed.

ARCHIBALD DOUGLAS (1489?–1557), 6th earl, son of George, master of Douglas, who was killed at Flodden, succeeded on his grandfather's death. By his marriage in 1514 to his second wife, the queen dowager, Margaret of Scotland, sister of Henry VIII., he aroused the jealousy of the nobles. In the civil war which followed, Albany (the regent) besieged the queen in Stirling and obtained possession of the young king, Margaret's son. Margaret left for London, and Angus made his peace with Albany. During his wife's absence he formed a liaison with a daughter of the laird of Traquair. When Margaret returned she therefore sided with Albany against her husband. Angus was charged with high treason and sent to France in 1522. He returned two years later with the support of Henry VIII., entered Edinburgh in 1525, and called a parliament. After a short struggle he and the Douglases became all powerful. James V. did not like his stepfather's tutelage, but all attempts at that time to secure his liberation failed. In 1528 Margaret obtained a divorce from her husband, James escaped from his custody and took refuge with Margaret and Arran at Stirling. The next year Angus took refuge in England, and James avenged himself on his kinsmen, including Angus's sister Janet, Lady Glamis, who was burned at the stake on Castle hill, Edinburgh (July 17 1537). It was only in 1542, after the death of James V., that Angus returned to Scotland, entrusted with a mission to arrange a marriage between Mary queen of Scots and Prince Edward (afterwards Edward VI.). The marauding expedition of Lord Hertford in 1544 seems to have cured him of his English sympathies, and he was made lieutenant of the south of Scotland. On Feb. 27 1545 he defeated the English at Ancrum moor, and he led the Scottish van when the Scots were defeated at Pinkie.

The career of Angus was a long struggle for power and for the interests of his family, to which national considerations were completely subordinate. He died in Jan. 1557. By Margaret Tudor he had Margaret, his only surviving legitimate child, who married Matthew, 4th earl of Lennox, and was mother of Lord Darnley. He was succeeded by his nephew David, son of Sir George Douglas of Pittendriech.

ARCHIBALD DOUGLAS (1555–1588), 8th earl, and earl of Morton, was the son of David, 7th earl. He succeeded to the title and estates in 1558. In 1573 he was made a privy councillor and sheriff of Berwick, in 1574 lieutenant-general of Scotland, in 1577 warden of the west marches and steward of Fife, and in 1578 lieutenant-general of the realm. For his support of his uncle, the 4th earl of Morton, he was declared guilty of high treason on June 2 1581. He appealed to the English Government for an invasion of Scotland to rescue Morton, and on the latter's execution in June went to London, where he was welcomed by Elizabeth. After the raid of Ruthven in 1582 Angus was reconciled to James, but soon afterwards was again banished from

the court. In 1584 he joined the rebellion of Mar and Glamis, but the movement failed. The rebels fled to Newcastle, which became a centre of Presbyterianism and of projects against the Scottish Government, encouraged by Elizabeth. In October they invaded Scotland and secured from James the restoration of their estates and the control of the Government. In 1586 Angus was appointed warden of the marches and lieutenant-general on the border, but he was unable to overcome the king's hostility to the establishment of Presbyterian government. He died on Aug. 4 1588.

He was succeeded in the earldom by his cousin WILLIAM, a descendant of the 5th earl. During a visit to France he became a convert to Roman Catholicism, and on his return to Scotland became involved in various conspiracies against the Government, being twice imprisoned. In 1593 he joined the rebellion of the earls of Huntly and Erroll. The revolt failed, and in 1597 all three renounced their religion, declared themselves Presbyterians, and were restored to the lands and honours they had forfeited. Angus recanted in 1608 and withdrew to France; he died in Paris on March 3 1611. He was succeeded by his son William (1589-1660), 11th earl, afterwards 1st marquess of Douglas. The title is now held by the dukes of Hamilton.

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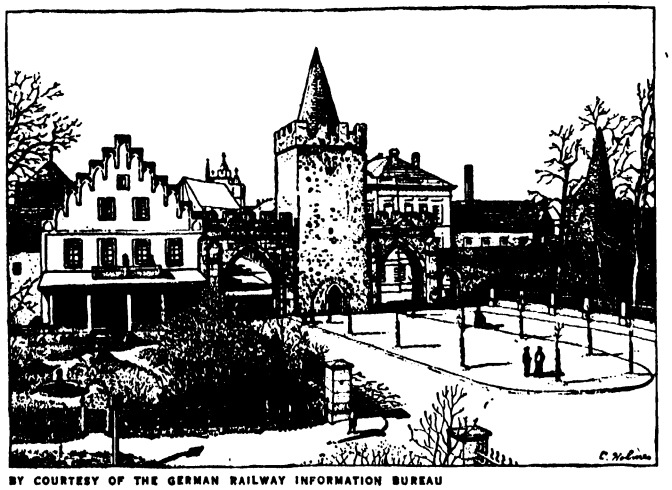
ANGUSSOLA or **ANGUSSCIOLA, SOPHONISBA,** Italian portrait painter of the latter half of the 16th century, was born at Cremona about 1535, and died at Palermo in 1626. In 1560, at the invitation of Philip II., she visited the court of Madrid, where her portraits elicited high praise. Vandyck is said to have declared that he had derived much knowledge of the true principles of his art from her conversation. She painted several fine portraits of herself, one of which is at the Uffizi. A few specimens of her painting are to be seen at Berlin, Milan, Rome, Bergamo, Madrid and in private collections in England. She had three sisters who were also celebrated artists.

ANHALT, a free State of Germany, with constitution dated July 18, 1919. The former duchy was created in 1863 by amalgamation of two duchies, Anhalt-Dessau-Cöthen and Anhalt-Bernburg, and comprised all the Anhalt territories sundered in



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OLD TOWN WALL GATE OR "HEIDETOR," AT ZERKT IN THE DUCHY OF ANHALT, A PART OF THE MEDIAEVAL FORTIFICATIONS ROUND THE CITY

1603. It now consists of two larger portions—eastern and western Anhalt, separated by part of Prussian Saxony—and of five enclaves surrounded by Prussian territory, viz., Alsleben, Mühlingen, Dornburg, Gödnitz and Tilkerode-Abberode. The eastern and larger portion of the State is low-lying, and occupies a section of the sandy plains of the valley of the Elbe which crosses it from east to west, and portions of the tributary valleys of Mulde and Saale, flowing northwards. There is fertile loess land east of the Saale, but the State contains much pine forest and bog land, interspersed with rich pasture.

Western Anhalt is much smaller and its southern half forms part of the Harz range, reaching to nearly 2,000ft. in the south-east. Of the whole surface, land under tillage amounts to about 60%, meadowland to 7% and forest to 25%. The chief crops are grain (especially wheat), fruit, vegetables, potatoes, beet, tobacco, flax, linseed and hops. The country is very rich in lignite, and salt works are abundant. The chief industrial products are sugar spirits, beer and chemicals, and there is commerce in corn, cattle, timber and wool. Coal (lignite), guano, oil and bricks are also exported. The trade of the country is furthered by its excellent roads, navigable rivers and railways. There is a chamber of commerce in Dessau. The area of Anhalt is 888sq.m. with a population of 351,471 in 1925. The country is divided into the districts of Dessau, Cöthen, Zerbst, Bernburg and Ballenstedt. The chief towns are Dessau, the capital (70,241), Bernburg (34,178), Cöthen (26,588), Zerbst (19,229) and Rosslau (12,306). The inhabitants of the State are mainly Protestant, organized under the consistory in Dessau. The Roman Catholics are under the bishop of Paderborn. Since 1922 there has been an Assembly, with executive power in the hands of a Ministry of State, under the presidency of the prime minister, with whom are associated one or two other ministers.

History.—During the 11th century most of Anhalt was included in the duchy of Saxony, and in the 12th century it came under the rule of Albert the Bear, margrave of Brandenburg. When Albert died in 1170, his son Bernard, who received the title of duke of Saxony in 1180, became count of Anhalt. Bernard died in 1212, and Anhalt, separated from Saxony, passed to his son Henry, who in 1218 took the title of prince and was the real founder of the house of Anhalt. On Henry's death in 1252 his three sons partitioned the principality and founded respectively the lines of Aschersleben, Bernburg and Zerbst. Early in the 16th century, however, owing to the death or abdication of several princes, the family had become narrowed down to the two branches of Anhalt-Cöthen and Anhalt-Dessau. These were united temporarily in 1570, but Anhalt was divided again in 1603.

The family of Anhalt-Cöthen became extinct in 1847, and Cöthen was added to Anhalt-Dessau. In 1863, for the same reason, Anhalt-Bernburg was united with Anhalt-Dessau.

Anhalt-Dessau had been divided in 1632, but was quickly reunited; and in 1693 it came under the rule of Leopold I. (*see* ANHALT-DESSAU, LEOPOLD I., PRINCE OF). Leopold IV. (reigned 1817–71) in 1863 reunited the whole of Anhalt. He took the title of duke of Anhalt and summoned one *Landtag* for the whole of the duchy. In 1871 Anhalt became a state of the German empire. In 1918, in common with the rest of Germany, it threw off its allegiance to the emperor, and on July 18, 1919, received its constitution as the Free State of Anhalt.

ANHALT-DESSAU, LEOPOLD I., PRINCE OF (1676–1747), called the "Old Dessauer" (Der alte Dessauer), general field marshal in the Prussian army, was the only surviving son of John George II., prince of Anhalt-Dessau, and was born on July 3, 1676, at Dessau. His first campaign was that of 1695 in the Netherlands, in which he was present at the siege of Namur. He remained in the field to the end of the war of 1697, the affairs of the principality being managed chiefly by his mother, Princess Henriette Catherine of Orange. In 1698 he married Anna Luise Föse, an apothecary's daughter, of Dessau, in spite of his mother's opposition, and subsequently he procured for her the rank of a princess from the emperor (1701). The princess acquired an influence over the stern nature of her husband which she never ceased to exert on behalf of his subjects, and after the death of Leopold's mother she performed the duties of regent when he was absent on campaign. Often, too, she accompanied him into the field. Leopold's career as a soldier in important commands begins with the outbreak of the War of the Spanish Succession. He had made many improvements in the Prussian army, notably the introduction of the iron ramrod about 1700, and he then took the field at the head of a Prussian corps on the Rhine, serving at the sieges of Kaiserswerth and Venlo. Leopold was present at Höchstädt, Blenheim, Cassano, Turin, Tournay, and Malplaquet, and in 1710 he succeeded to the command of the

whole Prussian contingent at the front. In 1712, at the particular desire of the crown prince, Frederick William, who had served with him as a volunteer, he was made a general field marshal. Shortly before this he had executed a *coup de main* on the castle of Mörs, which was held by the Dutch in defiance of the claims of the king of Prussia. The operation was effected with absolute precision and the castle was seized without a shot being fired. In the earlier part of the reign of Frederick William I., the prince of Dessau was one of the most influential members of the Prussian governing circle. In the war with Sweden (1715) he commanded an army of 40,000 men, and met and defeated Charles XII. in a severe battle on the island of Rügen (Nov. 16). His conduct of the siege of Stralsund which followed was equally skilful, and the great results of the war to Prussia were largely to be attributed to his leadership in the campaign.

In the years of peace he devoted himself to the training of the Prussian army. The reputation it had gained in the wars of 1675 to 1715, though good, gave no hint of its coming glory, and it was even in 1740 accounted one of the minor armies of Europe. That it proved, when put to the test, to be by far the best military force existing may be taken as the summary result of Leopold's work. The "Old Dessauer" was one of the sternest disciplinarians in an age of stern discipline, and the technical training of the infantry, under his hand, made them superior to all others in the proportion of five to three. He was essentially an infantry soldier—in his time artillery did not decide battles—but he suffered the cavalry service, in which he felt little interest, to be comparatively neglected, with results which appeared at Mollwitz. Frederick the Great formed the cavalry of Hohenfriedberg and Leuthen himself, but had it not been for the incomparable infantry trained by the "Old Dessauer" he would never have had the opportunity of doing so. Thus Leopold, heartily supported by Frederick William, who was himself called the great drill-master of Europe, turned to good account the 20 years following the peace with Sweden. Two incidents of that period in his career call for special mention: first, his intervention in the case of the crown prince Frederick, who was condemned to death for desertion, and his continued and finally successful efforts to secure Frederick's reinstatement in the Prussian army; and secondly, his part in the War of the Polish Succession on the Rhine, where he served under his old chief Eugene and held the office of field marshal of the Empire.

With the death of Frederick William in 1740, Frederick succeeded to the Prussian throne, and a few months later took place the invasion and conquest of Silesia, the first act in the long Silesian wars and the test of the work of the "Old Dessauer's" lifetime. The prince himself was not often employed in the king's own army, though his sons held high commands under Frederick. The king, indeed, found Leopold, who was reputed, since the death of Eugene, the greatest of living soldiers, somewhat difficult to manage, and the prince spent most of the campaigning years up to 1745 in command of an army of observation on the Saxon frontier. Early in that year his wife died. He was then over 70, but his last campaign was destined to be the most brilliant of his long career. A combined effort of the Austrians and Saxons to retrieve the disasters of the summer by a winter campaign towards Berlin itself led to a hurried concentration of the Prussians. Frederick from Silesia checked the Austrian main army and hastened towards Dresden. But before he had arrived, Leopold, no longer in observation, had decided the war by his overwhelming victory of Kesselsdorf (Dec. 14 1745). It was his habit to pray before battle, for he was a devout Lutheran. On this last field his words were, "O Lord God, let me not be disgraced in my old days. Or if Thou wilt not help me, do not help these scoundrels, but leave us to try it ourselves." With this great victory Leopold's career ended. He retired from active service, and the short remainder of his life was spent at Dessau, where he died on April 7, 1747.

He was succeeded by his son, LEOPOLD II., MAXIMILIAN, PRINCE OF ANHALT-DESSAU (1700–51), who was one of the best of Frederick's subordinate generals, and especially distinguished himself by the capture of Glogau in 1741, and his generalship at Mollwitz, Chotusitz (where he was made general field marshal on the field of battle), Hohenfriedberg and Soor.

Another son, PRINCE DIETRICH OF ANHALT-DESSAU (d. 1769), was also a distinguished Prussian general.

But the most famous of the sons was PRINCE MORITZ OF ANHALT-DESSAU (1712–60), who entered the Prussian army in 1725, saw his first service as a volunteer in the War of the Polish Succession (1734–35), and in the latter years of the reign of Frederick William held important commands. In the Silesian wars of Frederick II., Moritz greatly distinguished himself, especially at the battle of Hohenfriedberg (Striegau), 1745. At Kesselsdorf it was the wing led by the young Prince Moritz that carried the Austrian lines and won the "Old Dessauer's" last fight. In the years of peace preceding the Seven Years' War, Moritz was employed by Frederick the Great in the colonizing of the waste lands of Pomerania and the Oder Valley. When the king took the field again in 1756, Moritz was in command of one of the columns which hemmed in the Saxon army in the lines of Pirna, and he received the surrender of Rutowski's force after the failure of the Austrian attempts at relief. Next year Moritz underwent changes of fortune. At the battle of Kolin he led the left wing, which, through a misunderstanding with the king, was prematurely drawn into action and failed hopelessly. In the disastrous days which followed, Moritz was under the cloud of Frederick's displeasure. But the glorious victory of Leuthen (Dec. 5, 1757) put an end to this. At the close of that day, Frederick rode down the lines and called out to General Prince Moritz, "I congratulate you, Herr Feldmarschall!" At Zorndorf he again distinguished himself, but at the surprise of Hochkirch fell wounded into the hands of the Austrians. Two years later, soon after his release, his wound proved mortal.

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ANHWEI (Nganhui), a province of China lying astride the Yangtze-kiang in its final S.W.–N.E. course before it enters on its delta. It has an area of 54,826 sq m. and a population of about 20,000,000 (1920). Anhwei falls into two divisions distinct from almost every point of view. Northern Anhwei, beyond the Hwai-yang shan, belongs physically to the North China Plain; its level surface is liable to flooding by the Hwai-ho and it is covered by river detritus and wind-borne loess. It has too the climate and cultivates the crops (wheat, millet and beans) typical of north China. Southern Anhwei, on the other hand, enjoys a more genial climate and is part of the mountain and valley country of south China. Its hillsides are terraced and planted largely with the tea shrub and its river plains constitute rice-growing paddy-fields. Southern Anhwei is itself divided into two: the northern part is the wide valley of the Yangtze between the Hwai-yang shan on the north and Hwang shan on the south; the southern, at a rather higher elevation, lies south of the Hwang shan. The centre of the northern division, the Yangtze valley, is the capital, Anking, and of the southern division Hwei-chow, a great tea centre. The name An-hwei is compounded out of the first syllables of each. It was not constituted a separate province until the 17th century in the early days of the Ch'ing (Manchu) dynasty and during the preceding Ming dynasty (14th–17th centuries) it formed, together with Kiangsu, the greater province of Kiang-nan. Anhwei is therefore one of the more modern artificial provinces and is neither a physical unit nor an historical entity.

ANHYDRIDE, an oxide (*q.v.*) which will combine with water to form an acid (*q.v.*).

ANHYDRITE, a mineral, differing chemically from the more commonly occurring gypsum in containing no water of crystallization, being anhydrous calcium sulphate, $CaSO_4$. It crystallizes

in the orthorhombic system, and has three directions of perfect cleavage parallel to the three planes of symmetry. Distinctly developed crystals are somewhat rare, the mineral usually presenting the form of cuboidal cleavage masses. The hardness is 3½ and the specific gravity 2·9. The colour is white, sometimes greyish, bluish, or reddish. On the best developed of the three cleavages the lustre is pearly, on other surfaces it is of the ordinary vitreous type.

Anhydrite is most frequently found in salt deposits, but it is only met with at some depth; nearer the surface it has been altered to gypsum owing to absorption of water.

A peculiar variety occurring as contorted concretionary masses is known as tripe-stone, and a scaly granular variety, from Vulpino, near Bergamo, in Lombardy, as vulpinite; the latter is cut and polished for ornamental purposes.

ANI, a ruined ancient city in the Armenian S S R. (anc. *Abnicum*). Altitude 4,390ft. In A.D. 961 it was the capital of the Bagratid kings of Armenia; later it was known as the city of 1,001 churches; frequently besieged by Turks, Georgians and Mongols, it was finally ruined by an earthquake in 1319. The double wall, partly in ruins, remains, and also 11th, 12th and 13th century churches are extant.

See M. F. Brosset, *Les Ruines d'Ani* (St. Petersburg, 1860–61).

ANICETUS, Pope (*c.* 157–168). It was during his pontificate that St. Polycarp visited the Roman Church to confer with him about the Paschal controversy.

ANICHINI, LUIGI, Italian engraver of seals and medals, a native of Ferrara, lived in Venice about 1550. Michelangelo pronounced his "Interview of Alexander the Great with the high-priest at Jerusalem" "the perfection of the art." His medals of Henry II. of France and Pope Paul III. are highly valued.

ANILINE, PHENYLAMINE or **AMINOBENZENE,** an organic base first obtained from the destructive distillation of indigo in 1826 by O. Unverdorben, who named it Crystallin ($C_6H_5NH_2$). In 1834, F. Runge isolated from coal-tar a substance which produced a beautiful blue colour on treatment with chloride of lime; this he named kyanol or cyanol. In 1841, C. J. Fritzsche showed that by treating indigo with caustic potash it yielded an oil, which he named aniline, from the specific name of one of the indigo-yielding plants, *Indigofera anil, anil* being derived from the Sanskrit *nila,* dark-blue, and *nīlā,* the indigo plant. About the same time N. N. Zinin found that on reducing nitrobenzene a base was formed, which he named benzidam A W. von Hofmann investigated these variously prepared substances, and proved them to be identical, and thenceforth they took their place as one body, under the name aniline or phenylamine having the composition $C_6H_5{\cdot}NH_2$. Pure aniline is a basic substance of an oily consistence, colourless, melting at −8° and boiling at 184° C; it dissolves in 31 parts of water. On exposure to air it absorbs oxygen and slowly resinifies, becoming deep brown in colour. It possesses a somewhat pleasant vinous odour and a burning aromatic taste; it is highly poisonous, having a destructive action on the red corpuscles of the blood.

Aniline is a weak base and forms salts with the mineral acids. Aniline hydrochloride forms large colourless tables, which become greenish on exposure; it is the "aniline salt" of commerce. Although aniline is but feebly basic, it precipitates zinc, aluminium and ferric hydroxides from their salts, and expels ammonia from ammonium compounds when warmed with them. When aniline hydrogen sulphate is baked at 200° C sulphanilic acid,

$$NH_2{\cdot}C_6H_4{\cdot}SO_3H,$$

is produced. Anilides, compounds in which the amino-group is substituted by an acid radical, are prepared by heating aniline with certain acids; antifebrin or acetanilide (*q.v.*) is thus obtained from acetic acid and aniline. When aniline vapour and hydrogen are passed over finely divided nickel heated at 190° C., the reduction products, *cyclohexylamine, dicyclohexylamine,* and *cyclohexylaniline* are produced. The oxidation of aniline has been carefully investigated. In alkaline solution azobenzene results, while arsenic acid produces the violet colouring matter, violaniline. Chromic acid converts it into quinone, while chlorates, in the presence of certain metallic salts (especially of vanadium), give aniline black. Hydrochloric acid and potassium chlorate give chloranil. Potassium permanganate oxidizes it, in alkaline solution to azobenzene; Caro's acid, H_2SO_5, converts it into nitrosobenzene. Hypochlorous acid gives para-amino-phenol and para-amino-diphenylamine (E. Bamberger). Bleaching powder gives a purple coloration.

The great commercial value of aniline is due to the readiness with which it yields, directly or indirectly, valuable dyestuffs. The discovery of mauve in 1858 by Sir W. H. Perkin was the first of a series of dyestuffs which are now to be numbered by hundreds. Reference should be made to the articles DYES, SYNTHETIC; FUCHSINE; SAFRONINE; INDULINES, for more details on this subject. It is a starting-product for the manufacture not only of dyestuffs but of many drugs.

Aniline is manufactured by reducing nitrobenzene with iron borings and water slightly acidified with hydrochloric acid, the product being purified by steam distillation followed by distillation under reduced pressure. Monomethyl- and dimethyl-aniline are colourless liquids prepared by heating in an autoclave at 220° aniline, aniline hydrochloride and methyl alcohol, or aniline, methyl alcohol and about 0·5% of iodine. They are of great importance in the colour industry. Monomethylaniline boils at 193–195°; dimethylaniline at 192°. (*See* also AMINES.)

ANIMAL, a term first used to denote a living thing, but now used to designate one branch of living things as opposed to the other branch known as plants. Until the discovery of protoplasm, and the series of investigations by which it was established that the cell was a fundamental structure essentially alike in both animals and plants (*see* CYTOLOGY), there was a vague belief that plants, if they could really be regarded as animated creatures, exhibited at the most a lower grade of life. We know now that in so far as life and living matter can be investigated by science, animals and plants cannot be described as being alive in different degrees. Animals and plants are extremely closely related, alike in their fundamental characters, and each grading into organisms which possess some of the characters of both classes or kingdoms (*see* PROTISTA). The actual boundaries between animals and plants are artificial; and are solely due to the ingenious analysis of the systematist. The most obvious distinction is that the animal cell-wall is either absent or composed of a nitrogenous material, whereas the plant cell-wall is composed of a carbohydrate material—cellulose. The animal and the plant alike require food to repair waste, to build up new tissue and to provide material which, by chemical change, may liberate the energy which appears in the processes of life The food is alike in both cases; it consists of water, certain inorganic salts, carbohydrate material and proteid material. Both animals and plants take their water and inorganic salts directly as such. The animal cell can absorb its carbohydrate and proteid food only in the form of carbohydrate and proteid; it is dependent, in fact, on the pre-existence of these organic substances, themselves the products of living matter, and in this respect the animal is essentially a parasite on existing animal and plant life. The plant, on the other hand, if it be green, containing chlorophyll, is capable, in the presence of light, of building up both carbohydrate material and proteid material from inorganic salts; if it be a fungus, devoid of chlorophyll, whilst it is dependent on pre-existing carbohydrate material and is capable of absorbing, like an animal, proteid material as such, it is able to build up its proteid food from material chemically simpler than proteid. On these basal differences are founded most of the characters which make the higher forms of animal and plant life so different. The animal body, if composed of many cells, follows a different architectural plan; the compact nature of its food, and the yielding nature of its cell-walls, result in a form of structure consisting essentially of tubular or spherical masses of cells arranged concentrically round the food-cavity. The relatively rigid nature of the plant cell-wall, and the attenuated inorganic food-supply of plants, make possible and necessary a form of growth in which the greatest surface is exposed to the exterior, and thus the plant body is composed of flattened laminae and elongated branching growths The distinctions between animals and plants are in fact obviously secondary

and adaptive, and point clearly towards the conception of a common origin for the two forms of life, a conception which is made still more probable by the existence of many low forms in which the primary differences between animals and plants fade out.

An animal may be defined as a living organism, the protoplasm of which does not secrete a cellulose cell-wall, and which requires for its existence proteid material obtained from the living or dead bodies of existing plants or animals. The common use of the word animal as the equivalent of mammal, as opposed to bird or reptile or fish, is erroneous.

For the classification of the animal kingdom, *see* ZOOLOGY.

ANIMAL BEHAVIOUR. To give a plain tale of this or that instance of animal behaviour is not easy. The language in which it is described nearly always introduces words which imply more than can be seen. And what most people want is not only a plain tale of that which one can see, but an interpretation in terms of which one may, in some wise, account for the observable behaviour.

Three Instances of Behaviour.—Let us keep as near as we can to simple description of three selected episodes in the life-history of three widely different animals.

(1) Carmine particles are suspended in the water in which the unicellular organism, *stentor,* is under observation. At first the behaviour is not visibly affected. After a while the animalcule turns this way and that. Then there is reversal of the ciliary action in the wreath that surrounds the mouth. Later on, the *stentor* withdraws into its sheath. Then it breaks away and swims off. Such is a plain tale of facts which Professor Jennings has placed on record.

(2) Under experimental conditions some chicks, a few days old, are quietly feeding. Maggots seem specially attractive. Each time a selected chick is about to seize a maggot a toy pistol is fired at some little distance, out of sight. Each time the chick starts and turns aside. After about a dozen repetitions of this procedure the pistol is no longer fired. None the less there is aversive behaviour at sight of a maggot. During the next day no maggots are eaten by this chick.

(3) Suitably placed before an orang-utan, Julius, are nine compartments. Food can be obtained by passing through one of them. The entrance doors are visibly open or shut. Matters are so arranged that, on different occasions, or "settings," three consecutive doors are open—2, 3, 4; 7, 8, 9; and so on. But only by entering the left-hand door of the three, and passing through this compartment, can food be obtained. In some ten observations on each of 24 days there is no difference of behaviour in relation to "this" rather than "that" of the three open doors. On the 25th day the left-hand door is entered on each of the ten settings. On the following day a series of ten settings, different from those of the preceding days, is responded to promptly, readily, and without a mistake. Further details are given by Prof. Yerkes.

Scientific Interpretation.—If one start with the behaviour of *stentor,* one has, under interpretation, to take account of (1) the external conditions of stimulation, and (2) the internal state of the organism. The external conditions are pretty constant. The internal state appears to pass through several step-like changes; and at each change of state the observed behaviour is different (Jennings). It seems, then, that under the continuous influence of similar external conditions there is an order in which the internal changes of state occur. But what is seen is a routine in modes of behaviour, from which the changes of state may be inferred. Assuming that this inference is valid we may say: given the continuance of these external conditions; and given this or that internal state of the organism then such and such is the behaviour. When we can say this we have so far a scientific interpretation of what happens.

There are many who urge that, so long as we keep within the domain of inductive science as they define it, this is all that we are justified in saying. But there are others who urge that in saying this and no more one does not really "account for" what happens in this or any other instance of animal behaviour. To *account for* what happens, it is said to be imperative that an answer be given to the question: through the operation of what *agency,* as efficient cause, is this or that manner of behaving to be explained?

When this question is raised one enters a region of acute controversy. But need we enter this region? May it not be better to shun controversy by discussing animal behaviour in a delimited domain of inquiry—a domain which is common to disputants on this side and on that? If so we should formulate concisely what lies within this delimited domain. It is for us that domain in which the canon of interpretation runs: given such and such relations of the animal to surrounding events, and given such and such relations of events within the organism, then such and such is the observable behaviour.

In what was said above with regard to an interpretation of the behaviour of *stentor* we kept within this domain. It may, however, be objected that such an interpretation is wholly in terms of physical conditions external to the organism, and of physiological states within it. Is that so? Does our statement imply that physical and physiological relations only are present, and that mental relations, in some comprehensive sense of the word "mental," are absent? It does not. That would imply that we are quite arbitrarily to exclude from our survey of animal behaviour a kind of relatedness that is assuredly inferable from much of the behaviour of more highly developed organisms.

It is here that difficulty attends our starting with the behaviour of *stentor* rather than with that of the orang-utan. There are few who deny that mental relations have being and play some part in the behaviour of the anthropoid apes. There are some who say that there is no evidence of any relations of the mental kind in the unicellular organisms. We must, however, accept some hypothesis on which to conduct our enquiry. As an hypothesis, frankly entertained as such, let us proceed on the supposal that relations *of the mental kind* are present in all instances of animal behaviour. For lack of better words, let us say that in *stentor* there is some "percipience" having reference to external events, and some "sentience" concomitant with the internal changes of state. Let us assume that in any living animal there are not only relations of the physical and physiological kind, but also relations of the mental kind. Nay more, let us chiefly consider the part that mental relations play in animal behaviour. The emphasis here is on relations. Efficient causality is not within our province. Let us keep to our canon of interpretation, and say: Given such and such relations, physical and mental (a) of the organism to its surroundings, and (b) within the organism, such and such is the observable behaviour. On this hypothesis, since relations of both kinds are always present, the question does not arise: Would the behaviour be just the same were either kind of relatedness absent? *Ex hypothesi* neither kind is absent in any instance of animal behaviour.

It may, however, be said: Even if it be granted that in all instances of animal behaviour both kinds are in being, it does not follow that the presence of mental relations makes any difference in the course of events. The implication here is that the presence of physical relations does make a difference. But what is meant by the ambiguous expression "make a difference"? In one sense whether they do or do not make a difference, in the case of *stentor,* or the chick, or Julius the orang, is a question of evidence—or more strictly the question how best to interpret the available evidence. But in another sense it is the operation of some Force that is invoked to explain what *makes* the difference. Such explanation lies beyond our purview, since the concept of Force in this sense—any Force, whether mechanical or vital or other—is borrowed from the vocabulary of a philosophy which deals with efficient causality. One may hazard the assertion that this concept has no place in modern physics as a branch of science. In any case it has no place in our canon of interpretation. In formulating such a canon one's aim is (1) to include all kinds of relations which may be inferred from what we observe in the whole range of animal behaviour; and (2) to exclude from our inquiry an issue that is the storm-centre of much philosophical controversy.

Primary and Secondary Behaviour.—Proceeding on the method thus indicated, we accept the hypothesis that relations

of the mental kind are in being in every instance of animal behaviour. We accept also the hypothesis that in what we may speak of as "primary behaviour," that of *stentor* for example, percipience has reference at some given "now" to that from which physical influence is then and there received. Thus far, therefore, we entertain two supposals: (1) that even in one of the unicellular organisms there is percipience, as a primitive form of reference to the external world, and sentience, as a primitive mode of that which Professor Alexander speaks of as enjoyment; (2) that, at the level of primary behaviour, percipience is in being only at the moment of receipt of physical influence from surrounding events.

We now pass to the behaviour of the chick as an instance of what may be called "secondary behaviour." We have here a much more highly developed animal in which there is a "synaptic" nervous system. When we try to get down to essentials we must ask: What is the salient difference which distinguishes secondary from primary behaviour? So far as mental relations are concerned, may we not find a clue in the further supposal that secondary behaviour implies reference that is no longer confined to the moment of receipt of physical influence? The hypothesis then is that there is not only percipient reference on receipt of influence now, on this occasion, but also what we may call "supplementary reference" to the like of that which was the source of such influence on some previous occasion or occasions. To percipience is added that "meaning"—in some sense of this word—which raises bare percipience to the level of naïve perception. Then we may say: Given this mode of mental relatedness, such and such modification of the course of behaviour is observed.

Apply this to the selected instance of secondary behaviour. On the first occasion, when the pistol was fired, there was, we assume, percipience and sentience with which a specific mode of primary behaviour was linked up in accordance with the hereditary nature of the bird and the build of its nervous system. On this first occasion, however, there is no call to go beyond percipience and sentience as relations of the mental kind. The behaviour described as "starting and turning aside" is, on the first occasion, primary. And in so far as on subsequent occasions like behaviour is repeated *da capo,* it is still of the primary order.

But on some subsequent occasion the maggot is avoided at sight. The aversive behaviour—an observable change of attitude—is in evidence in the absence of the external conditions which on the first occasion elicited this specific response. Furthermore, the behaviour we describe as "seizing and swallowing," primary in origin, which on previous occasions was elicited at sight of the maggot, is no longer elicited. There is thus an observable difference of behaviour on earlier and on later occasions. On earlier occasions under receipt of physical influence we have *this* mode of stimulation and percipience, linked with *this* mode of behaviour and concomitant "enjoyment" in thus behaving. But on later occasions we have *this* mode of stimulation (visual) linked with *that* mode of behaviour (aversive).

What here calls for interpretation is the switching off of responsive action in such wise as to give this observable outcome. It is clear that the interpretation should be sought in some *internal* conditions within the organism that is in receipt of stimulation. For under closely similar external conditions the behaviour is different on the first and on some later critical occasion. This sets a problem for physiology. The switching off seems in large measure to be interpretable in terms of the opening up of functionally new routes—secondary connecting-routes—in the central nervous system. This is discussed under the heading of the "conditioned reflex." One cannot enlarge upon it here. Two things may be noted: (1) that the connection is such as to link the afferent or receptor limb of "this" primary route with the efferent or effector limb of "that" primary route; (2) that the reorganisation effected in this way is acquired in the course of individual life.

However it be interpreted physiologically there is some specific change within the organism—almost certainly within the synaptic nervous system, probably only when there is a nervous system of this type—such as to provide for a new distribution of behaviour-output on receipt of physical influence on the sensory receptors. And this redistribution of output, distinctive of the wide range of secondary behaviour, is relatively abiding. But the more primitive distribution, initially inherited, may at times be reinstated. The old primary "this-to-this" routes seem to be reopened in certain states of the organism.

To the internal states and the part they play in animal behaviour we shall have presently to direct consideration. Here it is in place to emphasize two things: (1) that the redistribution of behaviour-output entails a redistribution of naïve perceptual reference; (2) that the latter redistribution is of the cognitive type, with supplementary reference and the acquisition of fuller "meaning."

In the naïve perception of animals this "meaning" is probably referred to the external situation as a whole. The analysis of this whole into "objects" in relation to each other and to the percipient, and its resynthesis "as a whole," comes only with reflective thought. None the less behaviour is commonly centred on something salient in the external situation which *we* reflectively recognize as an object in relation to its surroundings and to us. In the genesis of objective reference in the animal, as in the human infant, primary behaviour thereto leads and carries with it such "meaning" for further behaviour as the secondary step in advance entails.

In the selected instance of secondary behaviour, we have, in effect, distinguished (*a*) the external situation to which there is perceptual reference on receipt of physical influence therefrom, and (*b*) the internal situation—the existing condition and state of the organism. What seems to be essential is that the chick behaves as if a sound-shock formed part of the external situation, although there is no receipt of any such physical influence. We resort, therefore, in accordance with the method of science, to hypothesis. We ask: Is there not in the internal situation supplementary reference to something more than is physically present in the existing external situation? If so that "something more" is what we speak of as "meaning"—practical meaning for the guidance of behaviour.

Of course it may be said that on later critical occasions the chick "remembers" the sound-shock received on prior occasions; or that a sound-shock is present in "expectation." Under suitable definitions such language is permissible. In us, however, memory implies reflective reference to incidents dated in the conceptualised past; and expectation implies reference to incidents in the future as we conceive that it will be. Hence it is better in discussing animal behaviour to use words of less reflective import. It is well to avoid the word "purpose," since this word is specially earmarked by some controversialists to emphasize the concept of mental *agency.* Even the word "meaning" is likely to suggest some tinge of that reflective *significance* which it commonly carries in current speech. Since, however, the animal lives forward, what has been spoken of as supplementary reference (to avoid reflective implications) has presumably "prospective meaning" in the sense that, to be of practical avail the reference is to that which, through behaving forward, will be secured or avoided.

But the question still remains: How is it that certain events which form part of the *internal* situation, and are interpretable as due to excitation from within *via* connecting neurone-routes—how is it that these events, in their mental relations, carry supplementary reference to the *external* situation? All that one can say is that there seems call for the supposal that they do so in animals as in us. If these events, whatever they may be, carry percipient reference when they are initially instated from without, it is not unreasonable to suppose that they retain like reference when their likes are subsequently reinstated through excitation from within.

The Behaviour of the Orang. Foreplans of Action.—In the earlier days of the life of any animal in which a synaptic nervous system has been evolved, there accompanies progressive "conditioning," progressive expansion of "prospective meaning." In later days this reaches such level of attainment as the status of organism permits. The chief turning-point in the evolution of animal behaviour is the critical passage in mental reference from primary to secondary. But when the secondary comes, the primary does not go. In all perception there is a central core of percipience.

In some animals, however, behaviour is raised to a higher level. This is illustrated by the procedure of Julius the orang. Here the presumptive evidence suggests that on some critical occasion there is what one may speak of as a "mental foreplan of action." It arises in the internal situation. But it has *reference to* the external situation as objectively "in mind" at the time-being.

The physiological counterpart of this higher form of reference seems, from the work of Professor Bianchi and others, to be, in mammals, a "conditioned" nexus of interconnecting neurone-routes in the frontal region of the cerebral cortex. This statement is necessarily somewhat technical. The point for emphasis is that we may infer a gradually acquired structural plan in a specialized part of the brain, which takes referential form pretty suddenly, as a foreplan of the objective situation; and that this mental foreplan thereafter serves to guide behaviour in like situations.

There is little question that a cognitive attitude of this sort reaches a higher level in such apes as the orang and the chimpanzee than it does in the monkeys. But whether this step in advance involves something new in principle or only added complexity is open to question. A good deal lower in the mammalian scale, it is difficult to interpret such behaviour of the rat, as has recently been described with admirable care by Professor McDougall, save on the hypothesis of foreplans of action. More questionable is the presumptive evidence of such mental plans of action in birds—partly because in their later life the major episodes seem so largely to be modes of behaviour in which hereditary rather than acquired factors are dominant.

It should be remembered that all behaviour, in detail if not in its secondary integration, is so to speak built to the plan of the organism that behaves. This is so even in *stentor*. It is so in all primary behaviour. But when the rubicon of the secondary is overpassed there seem to be two—no doubt quite probably more than two—critical "moments" of mental advance correlated with physiological advance; first, that at which reference becomes supplementary and prospective, and thereafter the "crystallizing out" of such reference in a mental foreplan of action. It is the task of comparative neurology and of comparative psychology (*q.v.*) to work out the details. The careful observations of Professor Yerkes, Dr. Köhler, and others, have shown how highly developed in the anthropoid apes is supplementary reference to a complex external situation in presence of which they behave, as we infer, with a foreplan in mind; and how nicely adapted to special circumstances are many of their feats of skill. It may be that some apes have overpassed the next critical stage in onward advance—that in which action is not only *carried out* to a successful outcome, but is *interpreted* in a reflective "framework of reference" under conceptual thought. This must be kept in view as an open possibility. But, as at present advised, the writer is of opinion that, on the available evidence, in man only is reflective thought developed. If so its interpretation does not fall within the scope of a discussion of animal behaviour.

The Part Played by Internal States.—The emphasis thus far falls on those mental relations which are, broadly speaking, of the cognitive order. It is noteworthy that, no matter how highly elaborate in effective detail may be the primary response to adequate stimulation on some first occasion or on subsequent *da capo* occasions—and it is often highly elaborate—still, as primary, it lacks that supplementary reference which is distinctive of the secondary step in advance.

On the physiological side we have seen that interpretation of the internal situation lays stress on the provision in a synaptic nervous system for conditioned response to stimulation. So too in the frontal lobes of the mammalian brain there is provision for an acquired nexus of neurone-routes. From such more or less abiding "conditioning" of the central nervous system let us distinguish the more labile internal state of the animal. The internal state then denotes the changing physiological poise of the organism as a whole at some given time. This is not only in a general way dependent on the reciprocal interaction (however brought about) of all the organs and tissues on each other; it is dependent in a special way on the influence of the internal secretions of certain endocrine glands transmitted by the blood stream to the fluid in which the tissues are bathed. Their influence on all that intervenes, including the passage of nerve impulses along neurone-routes, between receipt of stimulation and overt behaviour consequent thereon, is subtle and penetrating. It is not improbable that changes of state or physiological poise are subject to hereditary transmission and thus modify the number of occasions requisite for the acquisition of a conditioned response.

One cannot follow up these intricate clues to physiological interpretation. The mental concomitant of the internal state of the body is sentience and the affective enjoyment founded thereon. It becomes integrated as that which may be spoken of as the "self of enjoyment." We must take for granted that in animals, as in us, it is pleasurably toned or the reverse. We want to get at that which is essential in principle with respect to the rôle that is played by internal states. Here and now, while they are in being, they raise or depress the vigour of animal behaviour, and, by differentially raising or depressing, they modify the course of that behaviour. The stress is on *here and now*. It matters not whether cognitive reference be prospective, or whether a foreplan of future action be, or be not, in being. What matters is the state of the organism; and that state is here and now. Here and now is the behaviour the current course of which is felt as enjoyment in behaving. Here and now, too, is enjoyment in perceiving. It is only that *to which perceiving has reference* that is other than here and now. The affective state, in animals as in us, is always that of the current time-being.

We have sought to distinguish (1) the plain tale of the behaviour we observe; (2) the cognitive reference with which we credit the animal; (3) the affective state which may be inferred. But we often use one word to do duty for all three. One says, for example, that some male bird shows "hostility" when another male crosses the bounds of his territory. Under this one word is comprised (1) how he behaves; (2) his cognitive attitude, probably on later occasions with prospective reference to the further behaviour of the "intruder"; (3) what he "feels like" then and there. This last is the affective state as such The point for emphasis is that this affective state—which we can only describe in terms of what *we* "feel like" on what we deem to be analogous occasions—is here and now, and if not here and now leaves behaviour "unaffected."

Instinct and Intelligence in Animals.—For popular thought the leading question with respect to any instance of animal behaviour takes the form: Is it instinctive or intelligent? The word "instinctive" is here commonly applied to an approximately invariable manner of behaving that is not "learnt" in the course of individual life, as contrasted with the more variable manner of behaving which is so learnt and which therefore betokens intelligence on the part of the animal.

To account for intelligent behaviour it used to be deemed sufficient to say that what is learnt by the animal is the outcome of that profiting by experience with which we are familiar in our own life. To account for instinctive behaviour there was recourse either to inherited experience or to inherited structural organization of the nervous system. Some said: Just as intelligent habits are acquired and become automatic in the course of individual life, so have the more typical instincts been similarly acquired and have become automatic in the course of racial life. Others said: Just as the hereditary mode of development of the plumage of a bird is interpretable biologically, so is the hereditary manner in which that plumage is displayed on some first occasion of courtship biologically interpretable.

Discussion on lines such as these is now somewhat out of date. More up to date, as things are, is the discussion of instinct and intelligence in terms of diverse expressions of that *élan vital* which —as some assert, and others roundly deny—must be invoked to explain all that happens in any living creature. Thus is raised the controversial issue which it has been our aim to avoid by delimiting the domain of our inquiry.

Apart, however, from this further issue, the words "instinctive" and "intelligent" will for long continue in popular use with signification best inferred from the context. The context for most people is seldom that of *stentor*, or even that of the sea-anemone

or starfish. It is generally that of behaviour of animals in which both sensory and motor organs are well developed, and in which there is a highly organized (technically "synaptic") nervous system. It is generally also a context in which arises the question: Is the behaviour in evidence instinctive or intelligent? This implies some doubt as to which it is. If certain salient features of the behaviour are clearly the outcome of prior experience acquired in the course of individual life, the procedure is spoken of as that of an intelligent animal—and the more nicely adaptive it is in this way, the more intelligence is attributed to the animal. If, on the other hand, the predominant feature is *not* the outcome of prior experience, it is called instinctive—and the more adaptive it is in an inherited and unlearnt way, the more typically instinctive, rather than merely reflex, is such behaviour.

If this gives adequate expression to the popular attitude, how does it stand in relation to the foregoing treatment? The behaviour commonly called instinctive, in so far as it is unconditioned and carries no supplementary reference, is that which has been spoken of as "primary" in the context of such animals as birds for example. The behaviour commonly regarded as betokening intelligence is at a fairly high level of that which has been spoken of as "secondary," and more especially that which seems to imply a foreplan of action.

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ANIMAL BREEDING. The aim of the breeder is to obtain and maintain generation by generation improvement in the sum of the desirable qualities exhibited by his stock and to eliminate qualities regarded as undesirable. His task is that of producing true-breeding types which, under the circumstances in which they are to be maintained, shall flourish and fulfil the purposes for which they were bred. Before there can be improvement there must be a standard of the ideal. Often it is a simple matter to assess the value of an individual or type in relation to the purposes for which it has been bred: in the case of dairy cattle and sheep, for example, it is possible to determine the quantity and quality of milk and wool and to use such determinations as guides in breeding practices. In the case of meat-producing animals the value of the individual cannot be assessed at all accurately until after slaughter, and breeders have been obliged to rely largely on outward signs that are not always trustworthy indications of quality. In the case of work-animals it is exceedingly difficult to assess potential usefulness, since no final test can be reached until the end of the working life, and here too breeders have been forced to adopt somewhat unsatisfactory empirical standards. It is a general rule that the simpler and more direct the test of utility is, the easier and the more rapid will improvement be.

In the task of securing breed improvement the breeder seeks to control (1) the environment of his stock, and (2) the forces of heredity and reproduction. With regard to the first, conspicuous improvement has followed directly upon advances in knowledge of animal nutrition and disease and of the general biology of the animals concerned. Such improvement is but temporary, however, and can only be maintained by ceaseless care. There is too a limit to such advance, and when this is reached further progress can only be made by deliberate control of the inborn qualities of the stock.

When the great pioneers first undertook the improvement of British livestock about the middle of the 18th century (*see* AGRICULTURE), the farm animals were of very mixed type and generally of poor quality. Certain local types were distinguished by peculiarities of size, prevailing colour and productiveness, but there were no breeds in the modern sense, and in all these local types there was great variability in respect of all characters. The modern breeds had thus their beginnings in the picture of an ideal type at which the breeder aimed, and in the fortunate and fortuitous appearance of one or more superior individual animals. Having this ideal in mind, the breeder chose from among the local stock individuals which exhibited one or more of the components of his ideal. The initial stages in the improvement of each breed was the collection, in as small a group of the local type as possible, of as many of the characters of the ideal as possible. The breeder has not the power of producing hereditary characters, desirable or undesirable, but only of creating any combination of such heritable characters as already exist separately, and of manipulating the environment so that these become more fully expressed.

Having started on a basis sufficiently wide to ensure the inclusion of all the characters that were esteemed, the second stage in improvement has been the fixing of the desired characterization of the stock and the elimination of undesirable qualities. By the selection of individuals in each generation as parents of the next, the breeder has sought to weed out the undesirable characters and to combine the desirable, first in one or two individuals, and finally throughout a true-breeding strain. He has selected the animals for breeding and controlled their matings. Though this process of selection has never yet been carried to the point of complete and final success, it has played an all important rôle in all instances of breed improvement.

Selection.—The simplest form of selection for breeding purposes is that which is termed "mass" selection, the choice of individuals on the simple basis of individual merit as judged by appearance or performance without reference to ancestry, progeny, or to the degree of the relationship of the individuals concerned. The application of this kind of selection has given widely different results according to the kind of characters in relation to which it has been employed. For the purpose of changing the average characterization of a stock, mass selection has usually been applied to such characters as show a quantitative variation. The breeder has selected continuously, generation after generation, such individuals as showed a slight variation in the desired direction, as increased size, improved shape or pattern. The breeder quickly found that certain characters yielded very rapidly to such selection up to a given point, after which the method proved ineffectual. In other instances such selection yielded no advance, and so it is that till quite recently there has been no general explanation of the manner in which mass selection sometimes accomplishes its aims and in certain instances fails to do so. An entirely satisfactory explanation has been disclosed within the last 20 years. It has been shown that mass selection is only followed by a movement in the desired direction when applied to a population or stock that is heterozygous for many of its characters, and when the characters for which selection is being practised are inherited in a straightforward fashion, not being conditioned in their expression to any marked extent by the conditions of nurture (*see* MENDELISM and HEREDITY). In the dairy cow, for example, the characters of the milk yield and composition are conditioned in their expression not only by the effects of age, time of calving, and feeding, but also by a multitude of environmental agencies, the total influence of which cannot yet be assessed. Selection will not lead to so great advance in a case such as this as it will when applied to the case of a simple recessive character the expression of which is in no way influenced by environmental agencies. It is a simple and rapid matter to establish a true-breeding strain of red cattle by selecting for breeding the occasional red that crops up in black breeds, but the same methods will not yield a true-breeding roan or blue if, as seems the case, these coat colours are peculiar to unfixable heterozygotes.

The result of such selection, when effectual, is the isolation of individuals homozygous and therefore true-breeding for the characters for which selection is being practised, and so it is that when complete homozygosity has been attained, further selection is unavailing. It is for this reason that mass selection is relatively ineffectual in changing the characters of well established breeds. That this method has been and still is so successful is explained by the fact that most domesticated animals are so heterozygous that selection practised on ordinary stock is bound to be followed by some advance in quality.

Selection can create nothing; it merely sorts out individuals and types homozygous for the characters for which the breeder is aiming, and alters the average characterization of the stock by altering the proportions of the different hereditary constitutions

within it. Commonly it is impossible to disentangle the effects of selection in the production of improved types from those consequent upon advances in husbandry inevitably developed in the case of a stock which is becoming more and more valuable to its owner.

Pedigree and Progeny Test.—Appearance alone is not a reliable guide to breeding ability. This was a lesson quickly learned. The acid test of the worth of the sire and dam is that it shall beget offspring certainly not less valuable and preferably more valuable than itself. Selection on an estimate of the hereditary constitution of the individual is revealed in its pedigree and in its progeny. Pedigree, when rationally used, forms a valuable aid to the breeder in his work of selection, but its importance can be, and commonly is, over-emphasized. Individual merit is a safer guide than pedigree, but the two in conjunction are better than either alone. From the pedigree the breeder seeks information concerning the average merit of the immediate ancestors, not merely of sire and dam, grandsire and granddam, but also of their brothers and sisters, and also indications of the orderliness and mode of inheritance of these good qualities from generation to generation. Commonly too much importance is paid to more remote ancestors and to descent in the direct female line from some particular "foundation female." There is no biological justification for this.

Though it is sound policy to use for breeding only those individuals of manifest merit out of admirable and true-breeding parents, the real test of breeding worth is the progeny test. The breeding value of an individual is estimated by examination of a sample of its early progeny. The progeny test is applied most readily to males because of the greater number of offspring which may be obtained from a single individual and because the flock or herd can be improved more rapidly in this way than through the selection of superior females, in the case of which half the breeding life must be over before a sufficient number of offspring has been secured. Those males which beget the best progeny are retained, the others, even though in general appearance better specimens, are discarded. The test of a dairy bull, for example, is the average milk-production of a number of his daughters compared with that of their dams, assuming, of course, that the conditions of husbandry are similar in the two cases To compare the merits of different sires in the bacon pig, it is necessary to rear, under carefully controlled conditions, groups of at least four offspring of each sire and finally to convert them into bacon.

Systems of Mating.—Having secured individuals of merit for breeding, the next step is to mate them. The object in mating is to produce another generation, of equal or finer merit, to multiply the number of individuals exhibiting the desired qualities and to eliminate inborn variability.

In the early days of breed improvement, the problem of deciding which individuals should be mated did not exist. The improver found it increasingly difficult to find in other stocks animals which approached his ideal as nearly as did animals in his own, and so he was forced by circumstances to inbreed. So it was that Robert Bakewell (*q.v.*), when he found that he could mate closely related animals without disadvantageous results, resorted, as his blood lines became more and more intermingled, to more and more intensive inbreeding. Since his time all efforts towards the production of uniform and valuable breeds, have involved, sooner or later, the deliberate mating of closely related individuals.

Inbreeding.—Inbreeding (*q.v.*), in practice, is the term restricted to describe the matings of close relatives, *e.g.*, brother and sister, parent and offspring, and matings between comparatively unrelated or only distantly related individuals are described as outbreeding. Matings involving individuals of different breeds or varieties are examples of crossbreeding. Line-breeding involves matings between relatives in an attempt to increase or concentrate in one line of descent the hereditary constitution of one or a few individuals. All these systems can be grouped under the two headings of inbreeding and outbreeding, these differing one from the other only in the degree of relationship of the individuals concerned. Inbreeding is not necessarily harmful but can be definitely advantageous, leading to the development of a uniform and true-breeding stock. It is equally true, however, that benefit does not always follow this practice, for in certain cases there has been, and under experimental conditions still is, disappointing regression, diminution of vigour, lowered powers of resistance, decreased fertility, even reduction in size. In human societies this disagreement has resulted in laws and customs as diverse as those which forbid marriages outside a restricted group of relatives and those which forbid matings between relatives altogether. Though the facts vary, however, there has grown up amongst students of heredity a considerable degree of unanimity concerning the principles involved and a general interpretation has been promulgated which explains the conflicting results scientifically. The effects of inbreeding depend, not on any pernicious attribute of this system of mating, but upon the hereditary constitutions of the individuals involved. Inbreeding has but one demonstrable effect upon the stock subjected to its action—the isolation of homozygous types. It can be stated confidently that no individual is homozygous for all the characters which it exhibits (*see* MENDELISM).

In the case of an undesirable character that is dominant, it will be eliminated either by its effects upon the individual or by artificial selection as practised by the breeder. If the undesirable character is a recessive, however, it will remain hidden in the stock until two individuals, each heterozygous in respect of it, are mated. If only one animal in ten carries the factor for such a recessive character and mating is at random, one individual in every four hundred of the next generation may be expected to exhibit this undesirable character, and even though there are 20 factors for different undesirable recessive characters among the stock and these are distributed in the same proportion, still 95% of the progeny will not exhibit these characters. But when mating ceases to be at random and related individuals are used, the probability that the two parents each carry the factor for some undesirable character is greatly increased and the proportion of the progeny exhibiting the undesirable character is also raised.

Inbreeding leads to a rapid increase in homozygosity, and when this state has been achieved, stability and uniformity will be reached. But as this process proceeds, there is an inevitable reshuffling of all factors, and so it is that individuals will appear which are homozygous for recessive characters which are definitely deleterious to their possessor. The weak, sterile, and abnormal individuals which appear amongst the offspring of an inbred line are such as have received during this process of the reshuffling of the hereditary factors those which correspond to undesirable recessive characters, these factors ultimately coming to be present in the duplex state. Such individuals will be eliminated, whilst, on the other hand, others which, thanks to this same process, have come to possess the factors for desirable factors in the duplex state, will show improvement over their ancestors. Rigorous selection from amongst these improved types will isolate strains that will compare very favourably with the original stock.

If inbreeding results in disappointment, all that has happened is that disadvantageous characters, the ingredients of which were previously hidden and unexpressed, have been brought to light. Inbreeding thus purifies a stock. This system of mating may be disastrously expensive if the ingredients of hereditary combinations which result in undesirable or non-viable types pre-exist. But, on the other hand, such individuals as have been made homozygous for the desirable characters will be far more valuable material in the hands of the breeder than the stock with which he started, for in virtue of their hereditary constitution they must now breed true. The principal effects of inbreeding are (1) a reduction of variability in the expression of inherited characters within inbred lines or families, and (2) a usual, but not inevitable, decline in general vigour. Line-breeding and family-breeding are merely inbreeding in a less intensive form and may therefore be expected to yield the same results in a longer period of time.

Outcrossing.—Having secured, through inbreeding, strains fairly homozygous for the characters they display, the breeder is then in a position to use these for the production of types destined for special purposes other than breeding. The highly improved breeds of cattle do not thrive in certain regions, being subject to the attacks of insect pests or unable to withstand the rigours of the climate. Successful efforts to populate such regions with

economically valuable animals have been made. The disease-resistant but economically inferior zebu (*Bos indicus*) has been crossed with cattle (*Bos domesticus*). The crossbred is economically less valuable than the purebred cattle but is superior to the zebu and inherits the latter's powers of disease-resistance. To provide an economically valuable animal that can thrive farther north than purebred cattle, the cross of bison with cattle has been made. The crossbred is inferior to purebred cattle as meat, but is superior to the bison and possesses the latter's powers of withstanding climatic severity.

Since the earliest times, animal husbandmen have been familiar with the observed fact that the first crosses of different breeds or races of the same kind of farm animals commonly exhibit a remarkable sturdiness. This "hybrid vigour" is manifested in different ways. Frequently the crossbred offspring are stronger, attain a larger size, mature in a shorter time than either parental stock, and not uncommonly possess notable powers of resistance to unfavourable conditions. Livestock breeders are well acquainted with this superiority of the first cross for many commercial purposes. As an example, the breeder of cattle will doubtless quote the case of the blue-grey, frosty-coated cattle of Scotland, a combination of Black Galloway or Aberdeen-Angus with white Shorthorn, which have long been deservedly esteemed for their large size, goodly proportions and early marketability. The shepherd will extol the qualities of the Blackface with Border Leicester crosses so popular on account of their quick growth and general usefulness. As an example of a wide outcross deliberately made, the case of the mule may be cited. It is better fitted for certain purposes, in virtue of the hybrid vigour that it exhibits, than either parent.

From critical experimental work undertaken to examine the conclusions of practical men, the following facts have emerged.

(1) Crossbreds do not invariably exhibit this hybrid vigour. Any and all crosses will not produce offspring of greater excellence than their parental stocks.

(2) In those cases in which hybrid vigour is exhibited by the first cross, further crossing of the hybrids results in a manifest decrease of this vigour in subsequent generations. Hybrid vigour is the peculiar possession of the first cross

(3) In order to obtain hybrid vigour in any degree, it is essential that the two parental stocks shall be unrelated, purebred, and that each shall itself be possessed of qualities that, in relation to the object of the crossing, are excellent.

The explanation of these demonstrable facts concerning hybrid vigour is simple. It will be agreed that in general there is a tendency for the qualities of the parents to be expressed in the offspring. This is the basis for an understanding of the vigour derived from crossing. Every individual is a mixture of desirable and undesirable qualities. In crossing, the qualities of the two parents are pooled; the deficiencies of one parent can be made good by the excellencies of the other, the good of one can be reinforced by the good of the other. If an individual is deficient in any way in its hereditary constitution, there is a good chance that its needs may be supplied when it is crossed with other individuals, since it may well be that their deficiencies are not of the same kind: a pooling of the hereditary resources may easily yield a combination that is better than either of the ingredients alone. Hybrid vigour is based on heterozygosity.

If this interpretation is correct, then it follows that undesirable qualities are inherited as well as desirable, and that in order to secure this hybrid vigour, it is necessary that the individuals used for the production of the first cross shall be as excellent as may be and that the good qualities of the two shall be, as far as is possible, complementary. The qualities that are concerned are not necessarily those of form and structure but are physiological, concerned with the kind and rate of functional activity, and so it is that hybrid vigour, as great as that which results from the crossing of different species or breeds, can follow the crossing of different families or strains of one and the same variety or breed. The breeder who keeps his family lines distinct can, by appropriate matings, secure all the hybrid vigour he seeks, without calling on the aid of other stocks.

Since for the production of hybrid vigour the qualities of the two parties must be compensatory and complementary, it follows that all matings cannot be expected to yield it. Experimentation alone can decide whether a particular mating will be attended by hybrid vigour in the offspring. Since it is the pooling of qualities that leads to hybrid vigour, and since breeding implies the assortment and redistribution of these qualities among the offspring, it follows that the further breeding of the first cross can lead to reduction in general sturdiness. The mule has kept its reputation because in the great majority of cases it is infecund, incapable of producing functional ova or sperm. Without the purebred there cannot be the crossbred of any worth. The first cross, deliberately bred for a definite commercial purpose, must not be used for further breeding.

Conclusion.—In the future all intelligent essays in animal breeding will be directed by a few and simple principles. New characters will not be created by the professional scientist, at least not yet, and new breeds, when made, will be nothing more than fresh combinations of already existing characters, called into being by the economic or other requirements of society. A new breed of this kind will be fashioned out of an already existing breed by continued and careful selection in the desired direction far more often than by hybridization, involving two or more recognized breeds. The problem for the breeder and for the biologist is not that of making new breeds but of raising the average production of the breeds already existing. In every breed of farm animals the average production is far below that of outstanding individuals, and the task before the agriculturalist is that of defining the economic upper limit of productivity (since all production of this kind is physiologically expensive) and of reducing the margin between the average and the best.

Thus it appears that the principles of animal breeding are as follow:

(1) The definition of the ideal type in relation to habitat and destiny.

(2) The definition of the shortcomings of already existing types in relation to the ideal.

(3) The improvement of the already existing types by continued selection in the direction of the ideal.

(4) The selection of animals for breeding as far as possible on the basis of the progeny test; individual merit and pedigree also to be considered.

(5) The system of inbreeding to be followed to as great an extent as is practicable.

(6) The system of outcrossing to be practised for the production of special types for purposes other than for further breeding.

(*See* HEREDITY; VARIATION IN NATURE; SELECTION, ARTIFICIAL; INBREEDING; REPRODUCTION; CATTLE; HORSE, etc.)

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ANIMAL EXTRACTS. Many substances used in therapeutics are derived from the animal kingdom; the majority are obtained from the animals themselves, only a few, such as honey and wax, being obtained through the activity of a member of the animal kingdom. The most common animal extracts are adrenalin, beeswax, cod liver oil, gelatin (or gelatine), honey, insulin, lanolin (or lanoline), lard, pepsin, spermaceti, suet, thyroid gland extract (*qq.v.*) and cantharidin (*see* CANTHARIDES). Others widely used are the following:

Pituitary extract, prepared from the posterior lobe of the pituitary body of the sheep. It is a circulatory stimulant which acts within a minute or so of injection and has a somewhat prolonged action; it is therefore of great use in cardiac failure. It is also used in obstetric medicine instead of ergot to promote uterine contraction. It is never given by the mouth. *Testicular extract* or architic substance is given for sterility and premature sterility, arrested growth, and various neuroses. *Ovarian extract* is used in amenorrhoea and dysmenorrhoea, in vicarious menstruation and certain other diseases; it is useful in nervous symptoms at the change of life and after removal of the ovaries. *Pancreatic solu-*

tion, prepared from the fresh pancreas of the pig, contains at least four ferments, the most important of which is trypsin, which acts in an alkaline medium, converting proteids into peptones. Many pancreatised foods are on the market and are often of use to invalids and those whose digestions are weak. *Ox-gall,* obtained from the gall bladder of bullocks, is sometimes used as a purgative in cases in which there are indications of a deficient secretion of bile.

ANIMAL FAT: *see* GLYCERIDES.

ANIMAL HEAT. Under this heading is discussed the physiology of the temperature of the animal body.

The higher animals have within their bodies certain sources of heat, and also some mechanism by means of which both the production and loss of heat can be regulated. This is conclusively shown by the fact that both in summer and winter their mean temperature remains the same. But it was not until the introduction of thermometers that any exact data on the temperature of animals could be obtained. It was then found that local differences were present, since heat production and heat loss vary considerably in different parts of the body, although the circulation of the blood tends to bring about a mean temperature of the internal parts. Hence it is important to determine the temperature of those parts which most nearly approaches to that of the internal organs. Also for such results to be comparable they must be made in the same situation. The rectum gives most accurately the temperature of internal parts, or in women and some animals the vagina, uterus or bladder. Occasionally that of the urine as it leaves the urethra may be of use. More usually the temperature is taken in the mouth, axilla or groin.

Warm and Cold Blooded Animals.—By numerous observations upon men and animals, John Hunter showed the essential difference between the so-called warm-blooded and cold-blooded animals to lie in the constancy of the temperature of the former, and the variability of the temperature of the latter. Those animals high in the scale of evolution, birds and mammals, have a high temperature almost constant and independent of that of the surrounding air, whereas among the lower animals there is much variation of body temperature, dependent entirely on their surroundings. There are, however, certain mammals which are exceptions, being warm-blooded during the summer, but cold-blooded during the winter when they hibernate. But it must be remembered there is no hard and fast line between the two groups. Also, from work recently done by J. O. Wakelin Barratt, it has been shown that under certain pathological conditions a warm-blooded (homoiothermic) animal may become for a time cold-blooded (poikilothermic). He has shown conclusively that this condition exists in rabbits suffering from rabies during the last period of their life, the rectal temperature being then within a few degrees of the room temperature and varying with it. He explains this condition by the assumption that the nervous mechanism of heat regulation has become paralysed. The respiration and heart-rate being also retarded during this period, the resemblance to the condition of hibernation is considerable. Again, Sutherland Simpson has shown that during deep anaesthesia a warm-blooded animal tends to take the same temperature as that of its environment. He demonstrated that when a monkey is kept deeply anaesthetized with ether and is placed in a cold chamber, its temperature gradually falls, and that when it has reached a sufficiently low point (about 25°C. in the monkey), the employment of an anaesthetic is no longer necessary, the animal then being insensible to pain and incapable of being roused by any form of stimulus; it is, in fact, narcotized by cold, and is in a state of what may be called "artificial hibernation." Once again this is explained by the fact that the heat-regulating mechanism has been interfered with. Similar results have been obtained from experiments on cats. In man, injury of the spinal cord, as in gun-shot wounds, may abolish the heat regulating portion of the lower part of the body, in which case the body temperature can only be maintained constant by artificial means. These facts—with many others—tend to show that the power of maintaining a constant temperature has been a gradual development, as Darwin's theory of evolution suggests, and that anything that interferes with the due working of the higher nerve-centres puts the animal back again, for the time being, on to a lower plane of evolution.

Variations in the Temperature of Man and Some Other Animals.—As stated above, the temperature of warm-blooded animals is maintained with but slight variation. In health under normal conditions, the temperature of man varies between 36°C. and 38°C., or if the thermometer be placed in the axilla, between 36·25°C. and 37·5°C. In the mouth the reading would be from ·25°C. to 1·5°C. higher than this; and in the rectum some ·9°C. higher still. The temperature of infants and young children has a much greater range than this, and is susceptible of wide divergencies from comparatively slight causes.

Of the lower warm-blooded animals, there are some that appear to be cold-blooded at birth. Kittens, rabbits and puppies, if removed from their surroundings shortly after birth, lose their body heat until their temperature has fallen to within a few degrees of that of the surrounding air. But such animals are at birth blind, helpless and in some cases naked. Animals who are born when in a condition of greater development can maintain their temperature fairly constant. In strong, healthy infants a day or two old the temperature rises slightly, but in that of weakly, ill-developed children it either remains stationary or falls. The cause of the variable temperature in infants and young immature animals is the imperfect development of the nervous regulating mechanism.

The average temperature falls slightly from infancy to puberty and again from puberty to middle age, but after that stage is passed the temperature begins to rise again, and by about the 80th year is as high as in infancy. A diurnal variation has been observed dependent on the periods of rest and activity, the maximum ranging from 10 A.M. to 6 P.M., the minimum from 11 P.M. to 3 A.M. Sutherland Simpson and J. J. Galbraith have recently done much work on this subject. In their first experiments they showed that in a monkey there is a well marked and regular diurnal variation of the body temperature, and that by reversing the daily routine this diurnal variation is also reversed. The diurnal temperature curve follows the periods of rest and activity, and is not dependent on the incidence of day and night; in monkeys which are active during the night and resting during the day, the body temperature is highest at night and lowest through the day. They then made observations on the temperature of animals and birds of nocturnal habit, where the periods of rest and activity are naturally the reverse of the ordinary through habit and not from outside interference. They found that in nocturnal birds the temperature is highest during the natural period of activity (night) and lowest during the period of rest (day) but that the mean temperature is lower and the range less than in diurnal birds of the same size; that the temperature curve of diurnal birds is essentially similar to that of man and other homoiothermal animals, except that the maximum occurs earlier in the afternoon and the minimum earlier in the morning. Also that the curves obtained from rabbit, guinea-pig and dog were quite similar to those from man. The mean temperature of the female was higher than that of the male in all the species examined whose sex had been determined.

Meals sometimes cause a slight elevation, sometimes a slight depression—alcohol seems always to produce a fall. Exercise and variations of external temperature within ordinary limits cause very slight change, as there are many compensating influences at work, which are discussed later. Even from very active exercise the temperature does not rise more than one degree, and if carried to exhaustion a fall is observed. In travelling from very cold to very hot regions a variation of less than one degree occurs, and the temperature of those living in the tropics is practically identical with those dwelling in the Arctic regions.

Limits Compatible with Life.—There are limits both of heat and cold that a warm-blooded animal can bear, and other far wider limits that a cold-blooded animal may endure and yet live. The effect of too extreme a cold is to lessen metabolism, and hence to lessen the production of heat. Both katabolic and anabolic changes share in the depression, and though less energy

is used up, still less energy is generated. This diminished metabolism tells first on the central nervous system, especially the brain and those parts concerned in consciousness. Both heart-beat and respiration-number become diminished, drowsiness supervenes, becoming steadily deeper until it passes into the sleep of death. Occasionally, however, convulsions may set in towards the end, and a death somewhat similar to that of asphyxia takes place. Cats are unable to survive when the rectal temperature is reduced below 16°C. At this low temperature respiration becomes increasingly feeble, the heart-impulse usually continues after respiration ceases, the beats becoming very irregular, apparently ceasing, then beginning again. Death appears to be mainly due to asphyxia.

The heart has great powers of surviving reductions of temperature. It is said that in Siberia the hearts of animals which have been buried hours or days have, when excised and perfused, been made to beat.

Too high a temperature hurries on the metabolism of the various tissues at such a rate that their capital is soon exhausted. Blood that is too warm produces dyspnoea and soon exhausts the metabolic capital of the respiratory centre. The rate of the heart is quickened, the beats then become irregular and finally cease. The central nervous system is also profoundly affected, consciousness may be lost, and the patient falls into a comatose condition, or delirium and convulsions may set in. All these changes can be watched in any patient suffering from an acute fever. The lowest limit of temperature that man can endure depends on many things, but no one can survive a temperature of 45°C. (113°F.) or above for very long. Mammalian muscle becomes rigid with heat rigor at about 50°C., and obviously should this temperature be reached the sudden rigidity of the whole body would render life impossible. H. M. Vernon has recently done work on the death temperature and paralysis temperature (temperature of heat rigor) of various animals. He found that animals of the same class of the animal kingdom showed very similar temperature values, those from the Amphibia examined being 38·5°C., Fishes 39°, Reptilia 45° and various Molluscs 46°. Also in the case of pelagic animals he showed a relation between death temperature and the quantity of solid constituents of the body, *Cestus* having lowest death temperature and least amount of solids in its body. But in the higher animals his experiments tend to show that there is greater variation in both the chemical and physical characters of the protoplasm, and hence greater variation in the extreme temperature compatible with life.

Regulation of Temperature.—The heat of the body is generated by the chemical changes—those of oxidation—undergone not by any particular substance or in any one place, but by the tissues at large. The ultimate source of heat is the food which is oxidized in the body and the oxidation of which liberates the same quantity of energy as it would do if burned. This energy is dissipated either in mechanical work or as heat—the latter forming by far the greater proportion. Not all foods have the same heat producing or caloric value. The ordinary heat production of a person is made up somewhat as follows, per day:

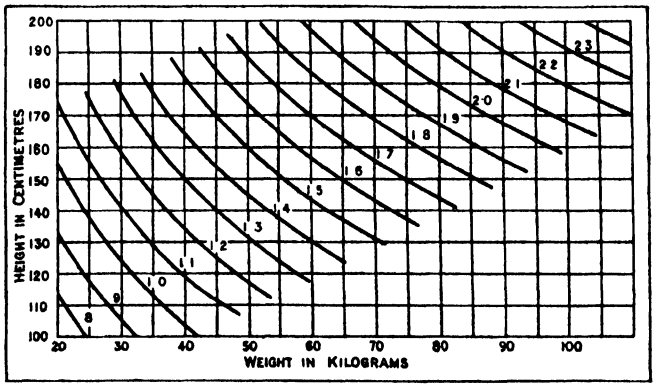
Protein . . .	120 grams	=	480,000 calories.
Fat . . .	100 „	=	940,000 „
Carbohydrate . . .	330 „	=	1,385,000 „
			2,805,000 calories.

Wherever destructive metabolism (katabolism) is going on, heat is being set free. When a muscle does work it also gives rise to heat, and if this is estimated it can be shown that the muscles alone during their contractions provide far more heat than the whole amount given out by the body. Also it must be remembered that the heart—itself a muscle—never resting, must give rise to no inconsiderable amount of heat. From this it is clear that the larger proportion of total heat of the body is supplied by the muscles. These are essentially the "thermogenic tissues." Next to the muscles as heat generators come the various secretory glands, especially the liver, which appears never to rest in this respect. Also a certain amount of heat is produced by the changes which the food undergoes in the alimentary canal before it really enters the body.

But heat is also continually being lost. And it is by the constant modification of these two factors (1) heat production and (2) heat loss, that the constant temperature of a warm-blooded animal is maintained. Heat is lost to the body through the faeces and urine, respiration, conduction and radiation from the skin, and by evaporation of perspiration. The following are approximately the relative amounts of heat lost through these various channels (different authorities give somewhat different figures): faeces and urine about 3, respiration about 20, skin (conduction, radiation and evaporation) about 77. Hence it is clear that the chief means of loss are the skin and the lungs. The more air that passes in and out of the lungs in a given time, the greater the loss of heat. And in such animals as the dog, which do not perspire easily by the skin, respiration becomes far more important. The dog when lying in the sun adopts a special type of very rapid shallow respiration, whereby the proportion of air passing into and out of the respiratory passages is great as compared with that which invades the deeper portions of the lung—hence he can evaporate large quantities of aqueous vapour without working out a corresponding quantity of aqueous vapour. It is claimed that by this means his blood may be reduced to a temperature lower than normal in which case the stimulus must be sought in the temperature of the skin, rather than that of the brain.

But for man, the great heat regulator is undoubtedly the skin, which regulates heat loss by its vasomotor mechanism, and also by the nervous mechanism of perspiration. Dilation of the cutaneous vascular areas leads to a larger flow of blood through the skin and so tends to cool the body and vice versa. Also the special nerves of perspiration can increase or lessen heat loss by promoting or diminishing the secretions of the skin. There are great difficulties in the exact determination of the amount of heat produced, but there are certain well-known facts in connection with it. A larger living body naturally produces more heat than a smaller one of the same nature, but the surface of the smaller, being greater in proportion to its bulk than that of the larger loses heat at a more rapid rate. Hence to maintain the same constant bodily temperature, the smaller animals must produce a relatively larger amount of heat.

Food temporarily increases the production of heat, the rate of production steadily rising after a meal until a maximum is reached from about the 6th to the 9th hour. If sugar be included in the meal the maximum is reached earlier; if mainly fat, later. Muscular work very largely increases the production of heat, and hence the more active the body the greater the production of heat.



BY COURTESY OF PROF E O DU BOIS

FIG. 1.—THE DU BOIS HEIGHT-WEIGHT CHART FOR DETERMINING THE SURFACE AREA OF MAN IN SQUARE METRES FROM WEIGHT IN KILOGRAMS (WT) AND HEIGHT (HT.). THE FORMULA IS: AREA (SQ IN) = WT.$^{.425}$ X HT.$^{.725}$ X 71·84

Under basal conditions, *i.e.*, at rest in bed before breakfast, the quantity of heat given out is proportional to the surface of the body. The latter may be calculated approximately from a knowledge of the height and weight of the person according to Du Bois' "Height and Weight Chart" fig 1. A heat loss of 40 calories per square metre of surface per hour is regarded as the normal basal metabolic rate. In miners the heat loss may

become on the average of 24 hours over 100 calories per square metre of body surface per day. Such persons have developed the power of losing water from the skin to a very high pitch. An average loss of water of over 3 lb. per hour on a five-hour shift has been registered in the case of coal miners.

But all the arrangements in the animal economy for the production and loss of heat are themselves probably regulated by the central nervous system, there being a thermogenic centre—situated above the spinal cord, and according to some observers in the optic thalamus. (*See* also NUTRITION.)

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ANIMAL MAGNETISM: *see* HYPNOTISM.

ANIMAL PSYCHOLOGY, the study of the behaviour of the lower animals with a view to ascertaining their mentality. Animal Psychology is a part of Comparative Psychology (*q.v.*), and its special interest consists in the light which it throws on the development of the human mind, and especially on human instincts and impulses.

ANIMALS, DOMESTICATION OF. Animals are captured and tamed by man either as pets or for use, and some of the more familiar domestic animals, such as the dog and the cat, come under both headings.

Pets.—The keeping of pets with no ulterior object is practically universal wherever attractable animals are found. The Australians have never domesticated any animal, but they like pets. They catch rats, opossums, wallabies, bandicoots, frogs or young birds for playthings. They tie them up at night to prevent their escape, and as they are not fed or cared for, they soon die. Cassowaries, with wings clipped, are allowed to wander about the camp and pick up scraps, and young opossums or wallabies often learn to be self supporting. The dingo is usually caught young and tied by its leg until it is reconciled to its surroundings. In America many tribes tame animals and birds in this way.

From such unpromising experiments the taming and domestication of animals made a start, and the subsequent steps are easy to follow, the last being conscious breeding by man, by which he creates new species or varieties for his use and pleasure. In the first stage, that of toleration, there is no definite ownership or "purposive control" by man. The animals are free, but are encouraged and protected in consideration of services rendered Next comes domestication, the private or collective ownership of animals trained to be of use to their masters, such as cattle, horses and domestic animals in general. In the further stage of artificialization, "previsional breeding or stirpiculture," animals are bred and reared for special purposes. The influence of religion or magic, either in animal cults or totemism, has probably been an important factor in the domestication of certain animals. The reverence paid to sacred animals tends to establish friendly relations with it; animal cults are connected with many domestic animals, and especially with cattle, and the origin of domestic cattle is traced to this source. Thus totemism has been claimed as the starting point of domestication. The totem animal, being venerated, protected and encouraged, acquired confidence and became domesticated.

History.—But neither the "pet" theory nor the "totem" theory of the origin of domestication is of universal application, and no definite evidence of the domestication of the more familiar animals is to be expected. Owing to the existence of wild species, all used for food, the determination of the date of domestication is difficult.

Dog.—The dog, a sociable animal, is of use to man at his lowest culture stage, assisting the hunter in tracking, chasing, attacking, and capturing the game. The origin of the domestic dog is uncertain. At least four different types were in existence in Europe (Portugal, Switzerland and Denmark) and Asia (Anau) in the Stone Age. America also has several varieties of dogs.

Cat.—The cat, like the dog, probably domesticated itself, and is usually derived from Egypt, where it was known about 2000 B.C. The importance of grain-growing in that region has suggested that the reverence paid to it was based on its services to the agriculturist. It is found wild in Europe, Asia, and Africa. It is recorded in Greece about 1500 B.C. and in Rome, much later, possibly not much before the Christian era. According to popular belief, it was introduced into Britain by the Romans.

Cattle, Goats, Sheep, Pigs.—Domestication of cattle, goats, sheep and pigs was an established feature of the Neolithic age in Western Europe and of the earlier—but still Neolithic—settlements of Anau in Russian Turkestan and of Susa in Mesopotamia in the 3rd and 4th millennia, suggesting that Asia may have been the area where the domestic species and their culture originated, and whence they were derived. In arid regions such as desert oases like Anau, animals are forced into proximity to man, and there, in drier seasons, they could survive in desperate cases only by the sacrifice of their independence.

Ass, Horse.—The ass was probably domesticated at about the same time both by the pre-dynastic Egyptians and by the Sumerians of Mesopotamia, but the origin of the domesticated horse, for which there is no such early evidence, is a more difficult problem. At least four varieties were known to, and probably hunted for food, by palaeolithic man. Its domestication appears to have been fairly late, and though its remains occur in the Swiss lake dwellings there is little evidence for its use in western Europe until the Bronze Age. It is characteristic of the steppe culture of Asia, and spread thence both east and west, and is referred to in early Japanese traditions, which contain no mention of the dog. The story of the horse in America is more clear, as the native animal was extinct in prehistoric times and was unknown to the Americas before the coming of the Spaniards who followed Columbus. Stray horses soon multiplied on the plains of both North and South America, and were so quickly caught and tamed by the Indians that horse culture was established among many of the tribes long before they came in direct contact with Europeans.

Reindeer.—The reindeer shows interesting grades of domestication. The American caribou was always hunted and never domesticated, though recent experiments indicate that this was not impracticable. The eastern Siberian tribes such as the Chukchi own huge herds of wild deer, used mainly for slaughter and barter; the Tungus, farther west, train the deer for sledge work, and do most of the carrying trade of the tundra; the Lapps in north-west Europe and to a certain extent the Samoyeds to the east alone have domesticated the reindeer, using it both for transport and for milking.

Influence of Domestication.—The existence of domesticable species has undoubtedly influenced the uneven civilization of the world. Europe and Asia were well supplied. North America, at the time of the discovery, had none except the dog. The Peruvian had domesticated the llama and its relative the paco or alpaca for flesh, wool, and transport, and the *ccoy* or guinea-pig for food and cheap sacrifice. Australia, owing to its early separation from the rest of the world, had no domestic species at all if we except the questionable dingo, and this lack contributed largely to the backward condition of its inhabitants. The domestication of cattle in the early history of man made a settled life possible for him, with an assured food supply and the acquisition of property—the identity of cattle and property in early time being illustrated in the word "pecunious" (Lat. *pecus*, cattle).

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ANIMALS, EXPERIMENTS ON. The making of experiments on the lower animals for the purpose of advancing med

cal knowledge is in some countries unrestricted; in others it is restricted by law.

METHODS EMPLOYED AND EXPERIMENTS

The Existing Law in Britain.—The present law relating to experiments on animals was passed in 1876. At that time bacteriology was in its infancy, bio-chemistry was unborn and the majority of these experiments were physiological. The Act, therefore, was drafted with a view to physiology. At the present time the vast majority of animal experiments are inoculations in researches upon bacterial diseases or cancer. Every experiment must be made in a registered place open to government inspection. But inoculation experiments are sometimes permitted in non-registered places, for the immediate study of outbreaks of disease, or if circumstances render it impracticable to use a registered place. Every experiment must be made under a licence.

Most experiments are made not under a licence alone, but under a licence *plus* one or more certificates, and the wording and working of these certificates must be clearly understood, because it is over them that the question arises as to the amount of pain inflicted by these experiments. Under the licence alone, the animal must be kept under an anaesthetic during the whole of the experiment; and "if the pain is likely to continue after the effect of the anaesthetic has ceased, or if any serious injury has been inflicted on the animal," it must be killed forthwith under the anaesthetic. Thus, under the licence alone, it is impossible to make an inoculation; for the experiment consists, not in the introduction of the needle under the skin, but in the observation of the results of the inoculation. A guinea-pig inoculated with tubercle cannot be kept under an anaesthetic till the disease appears. The disease is the experiment, an experiment made without an anaesthetic, and not authorized by the licence alone.

To remove these disabilities, the Act empowers the Secretary of State for Home Affairs to allow certificates to be held with the licence. They must be recommended by two signatures, and the home secretary attaches to licences and certificates such endorsements and restrictions as he thinks fit. The Act is administered with great strictness, under a careful system of enquiry and reference.

The certificates are distinguished as A, B, C, E, EE and F. Certificate D, which permitted the testing, by experiments, of "former discoveries alleged to have been made," has fallen into disuse. Certificate C permits experiments to be made in illustration of lectures. They must be made under the provisions contained in the Act as to the use of anaesthetics. Certificates E and EE permit experiments on dogs or cats; Certificate F permits experiments on horses, asses or mules. These certificates are linked with Certificate A (which allows experiments to be made without anaesthesia) or Certificate B (which permits the keeping alive of the animal after the initial operation).

Thus, in Great Britain experiments on animals may only be performed (1) by a duly licensed person; (2) in an approved and registered place of research; (3) for an approved specific purpose; (4) on specific kinds of vertebrate animals (the Act not applying to invertebrates); (5) within a specified period or on a specified number of animals; (6) the word "experiment" is not allowed to cover more than one animal.

The United States.—In the United States attempts have repeatedly been made since about 1890 to obtain special legislation limiting experiments on animals. Responsible heads of departments in medical schools and research institutes have consistently opposed these attempts. They have argued that there has been no demonstrated abuse of animals for experimental purposes in the laboratories of the United States, that if abuse should appear the existing laws against cruelty would suffice to correct it, and that until the general law is proved inadequate special legislation is unnecessary. Up to 1929 no special legislation had been passed restrictive of animal experimentation for purposes of scientific discovery. About 1910 a system of rules governing the treatment of animals used for research was drawn up by a committee of the American Medical Association. These rules have been adopted by corporate vote in practically all institutions engaged in medical research. They constitute a mode of self-regulation of investigators engaged in animal experimentation. In each instance the director of the laboratory is made responsible for the character of the experiments performed in his laboratory.

Classes of Experiment.—From this brief account of the chief provisions of the Act we come to consider the general method of experiments on animals. The animals most used for inoculations without anaesthetics are mice, rats, guinea-pigs and rabbits. The act of inoculation is not in itself painful. A small area of the skin is carefully shaved and cleansed; that it may be aseptic, the hypodermic needle is sterilized and the method of hypodermic injection or of vaccination is the same as it is in medical practice. In a few instances cultures of micro-organisms have been made in the anterior chamber of the eye, by the introduction of a needle behind the cornea. This might be thought painful, but cocaine renders the surface of the eye wholly insensitive. Many operations of ophthalmic surgery are done under cocaine alone, and the anterior chamber of the eye is so far insensitive that a man may have blood or pus (*hypopyon*) in it, and hardly be conscious of the fact. The results of inoculation are in some cases negative, in others positive; the positive results are, in the great majority of cases, not a local change, but a general infection which may end in recovery, or in death.

The diseases thus induced may, in many cases, fairly be called painless—such are septicaemia in a mouse, snake-venom in a rat, the growth of cancer grafts beneath the skin of inoculated rats or mice, and malaria in a sparrow. Rabbits affected with rabies do not suffer in the same way as dogs and some other animals, but become subject to a painless kind of paralysis. It is probable that animals kept for inoculation have, on the whole, less pain than falls to the lot of a like number of animals in a state of nature or in subjection to work: they are well fed and sheltered, and escape the rapacity of larger animals, the inevitable cruelties of sport, and the drudgery and sexual mutilation that man inflicts on the higher domestic animals.

We now come to experiments made under Certificate B (which must be linked with Certificate EE for any experiment on a dog or a cat). Three instances may be given: an operation on the brain, removal of part or the whole of a secreting gland, and the establishment of a fistula. It is to be noted that, for these and similar operations, profound anaesthesia and the strict observance of asepsis are necessary for the success of the experiment: the operation could not be performed without anaesthesia; and the experiment would fail if the wound suppurated. These operations are such as are daily performed in surgery.

As to operations on the brain we know from human cases that the surface of the brain is not sensitive. Therefore the removal or destruction of a portion of the surface of the brain, or the division of some tract of central nervous tissue, though it may entail some loss of power or of control, does not cause pain. Tension within the cranial cavity, as in cases of cerebral tumour or cerebral abscess, may indeed cause great pain; and, if the aseptic method fails in an experiment, inflammation and tension ensue: in that case the animal must be killed.

The removal of part or the whole of a secreting gland (*e.g.*, the thyroid, the spleen, the kidney) is performed by the same methods, and with the same precautions, as in human surgery. Profound anaesthesia, and strict asepsis are fundamental. The skin over the part to be removed must be shaved and carefully cleansed for the operation; the instruments, sponges and ligatures must be sterile, not capable of infecting the wound; and when the operation is over, the wound must be carefully closed with sutures, and left to heal under a proper surgical dressing.

The establishment of a fistula, again, is an operation practised in large numbers of surgical cases. The stomach, the gall-bladder and the large intestine are opened for the relief of obstruction, and kept open, either for a time or permanently, according to the nature of the case. Under anaesthesia, the organ that is to be opened is exposed through an incision made through the structures overlying it and is secured in the wound by means of fine sutures. When it has become adherent there, it is opened by an incision; no anaesthetic is needed for this purpose, because these

internal organs are so unlike the skin in sensitiveness that an incision is hardly felt: the patient may say that he "felt a prick," or he may be wholly unconscious that anything has been done. A fistula thus established is not afterwards painful, though there may be some discomfort now and again.

SCIENTIFIC RESULTS TRACEABLE TO ANIMAL EXPERIMENT

Here a summary account alone can be given; fuller information must be sought under the different diseases, etc. It must also be remembered that not man alone, but animals also owe a great debt to them. Great epizootic diseases like anthrax, swine-fever, chicken-cholera, distemper, pleuro-pneumonia, glanders, Texas cattle fever, blackleg, tuberculosis in cattle have killed yearly millions of animals, and have been brought under better control by these experiments. The advantages that have been obtained by man may be arranged under two heads—(A) Physiology, (B) Pathology, Bacteriology and Therapeutics.

(A) PHYSIOLOGY

Passing over the fundamental knowledge gained in this way on the heart and circulation by William Harvey, Stephen Hales and John Hunter we have learned by animal experiment to measure accurately the work done by the heart and, by studying the manner in which this work is affected by different conditions, we can increase or diminish it according to the needs of the organ. Experiments in that part of physiology which deals with muscle and nerve have thrown light on the wonderful process of "compensation" by which a diseased heart is able to keep up a normal circulation. Similarly, the flow of chyle along the lacteals and thoracic duct, the part played by the stomach, the liver, the pancreas and the intestinal glands, respectively, in digestion, the growth of bone, the functions of certain parts of the brain, of the sympathetic system, of nerves (including their regeneration after injury), reflex action, the mechanism of respiration, the influence of endocrine glands, the action of vitamins have all depended upon animal experiment. Indeed it is impossible to think of any advance in physiological knowledge which is not directly or indirectly traceable thereto. Even the recent isolation of insulin, in itself a matter of chemistry, was led up to by observation that removal of the pancreas in dogs is followed by permanent diabetes.

(B) PATHOLOGY, BACTERIOLOGY AND THERAPEUTICS

As examples of knowledge obtained in this sphere by animal experiment the following instances may be named:—

(1) **Inflammation.**—Every change in the tissues during inflammation—the slowing of the blood stream in the capillary vessels, the escape of the leucocytes through their walls into the surrounding tissues, the stagnation of the blood in the affected part—all these were observed in such transparent structures as the web or the mesentery of the frog, the bat's wing, or the tadpole's tail, irritated by a drop of acid, or a crystal of salt, or a scratch with a needle. It was in the course of observations of this kind that Wharton Jones observed the rhythmical contraction of veins, and Waller and Cohnheim observed the escape of the leucocytes, *diapedesis*, through the walls of the capillaries. From these simple experiments under the microscope arose all our present knowledge of the minute processes of inflammation. Later came the work of Metchnikoff and others, showing the importance of *diapedesis* in immunity.

(2) **Suppuration and Wound Infection.**—Lister's work on antiseptics and its modern extension—asepsis—depend upon knowledge gained in investigations of bacterial diseases produced experimentally in animals under diverse conditions.

(3) **Anthrax.**—In France between 1882 and 1893 over 3,000,000 sheep and nearly 500,000 cattle were inoculated against this disease by the preventive method discovered by Pasteur. The average mortality, before vaccination, for the whole of France, was 10% in sheep and 5% in cattle; with vaccination it fell to 0·94% in sheep and 0·34% in cattle. In rouget (swine-measles) the effect of preventive inoculation was even more striking, the mortality falling from an average of 20% to one of 1·45%. (Chamberland, *Ann. de l'Inst. Pasteur*, March 1894.)

(4) **Tuberculosis.**—To animal experiments is owed our knowledge of the nature of tuberculosis prior to discovery of the specific bacillus, proof that B. tuberculosis is the causal organism, the importance of associated suppurative micro-organisms in determining the type of the disease, and the use of tuberculin for detection of tuberculous cows.

(5) **Diphtheria.**—Proof that B. diphtheriae is the causal organism, immunization of animals against the disease, introduction of treatment by diphtheria antitoxic serum, discovery of the Schick preventive method of inoculation.

(6) **Tetanus.**—The bacterial nature of tetanus and the mode of action of tetanotoxin were discovered and an antitoxic serum was prepared which is of great value as a preventive agent in animals and man. In the laboratory curative effects can be obtained by administration of the serum which, so far, are not paralleled in the natural disease.

(7) **Rabies (hydrophobia).**—To Pasteur's animal experiments we owe the whole process of preventive inoculation with emulsions of brain and spinal cord of rabbits artificially infected with rabies.

(8) **Cholera.**—The "comma bacillus" was discovered in 1883 and ten years later preventive inoculation was first carried out on an extensive scale by Haffkine in India.

(9) **Bubonic Plague.**—B. pestis was discovered in 1894 and subsequently the entire history of the disease, its relation to the rat-flea, the variations in type to which it is liable and the methods of preventive inoculation and serum treatment were worked out.

(10) **Typhoid and Paratyphoid Fevers.**—The bacteriology of these began in 1880 when B. typhosus was discovered, B. paratyphosus C was found in Mesopotamia during the World War. Protective inoculation against typhoid carried out in 1896 by Almroth Wright and Semple quickly showed its value. In the British Army during the World War a typhoid vaccine alone was used at first, but later a mixed vaccine of B. typhosus, B. paratyphosus A and B. paratyphosus B. The results were a triumphant success. To animal experiment must also be ascribed discovery of agglutination as a means of diagnosis (Widal's reaction).

(11) **Malta or Mediterranean Fever.**—Discovery of the causal micro-organism, of an immunizing serum for treatment and tracing of the origin of the disease to the milk of infected goats by means of agglutination reactions.

(12) **Epidemic Meningitis (cerebro-spinal).**—Discovery of the meningococcus by inoculation experiments and separation of different types by agglutination methods. Introduction of serum treatment for the disease whereby its mortality has been reduced to about one-half.

(13) **Malaria.**—The bulk of our knowledge of this disease, including the life history of the malarial parasite and the elaboration of preventive measures founded thereupon, was obtained by observations on man, but was led up to by the study of closely similar blood parasites occurring in birds.

(14) **Yellow Fever.**—Discovery of a special mosquito (Stegomyia) which conveys the disease from man to man. Preparation of a specific anti-serum.

(15) **Sleeping Sickness.**—Experiments on animals have proved that this disease is due to specific parasites carried by tse-tse flies from man to man. By measures taken to obviate this method of infection the incidence of the disease has been reduced.

(16) **Infantile Paralysis.**—Flexner of the Rockefeller Institute has proved, by experiments on animals, the infective nature of this disease and its transmissibility by inoculation.

(17) **Myxoedema.**—Evidence that removal of the thyroid gland in animals produces the disease and that subsequent feeding with thyroid gland or thyroid extract effects a cure.

(18) **The Action of Drugs.**—A long list has been more or less fully worked out, of which the following are the chief: Aconite, amyl nitrite and the nitrites in general, belladonna, mem-

bers of the barbitone series, calcium chloride, cocain, chloral, digitalis, ergot, insulin, morphia, salicylic acid, strophanthus, the chief diuretics and diaphoretics.

(19) **Snake Venom.**—Experiment has shown that animals can be immunized against many times the fatal dose of the venom of various poisonous snakes and that the serum of an animal immunized against one type of snake venom is effective against other types. Anti-venomous serum is now used in many parts of the world on man and domestic animals for snake bite. (*See* VIVISECTION.) (S. PA.; W. S. L.-B.)

ANIMAL SOCIOLOGY. The distinctive note of an animal society is that a number of individuals of the same species act together as a unity, combining their efforts in defence or in attack or in work. Thus a troop of monkeys, a beaver village, a herd of horses or cattle, a pack of wolves, a colony of viscachas, a rookery, a flock of cranes, may serve as illustrations of corporate life, which is in a sense more than the sum of its parts. The mere living together of a multitude, like mites in the cavern of a cheese or rabbits in a warren, does not constitute a society; the criterion is some capacity for acting coherently and harmoniously as a unit. In a large societary form like an ant-hill there may be a number of simultaneously active units, each a corporate body. When beavers unite their efforts to make a canal through a large island in the middle of a river, or when rooks combine against a hawk, there is a distinctive social note. The degree of the sociality varies greatly; thus baboons show more concerted action than prairie dogs, and beavers than bisons, and rooks much more than parrots. Considered from the individual point of view, social life among animals implies some measure of self-subordination to communal activity and interests. The contrast is a solitary individualistic mode of life, an each-for-himself régime. There is no warrant for ethical imputations, which do not seem more than incipiently relevant among animals. An otter is self-sufficient as effectively as the beaver is co-operative; the two ways of living are suited for different conditions of existence. Another feature of the social and gregarious mode of life is some alleviation of the individual struggle for existence. To some extent, the communal life serves as a shield for types of individual that could not otherwise stand alone. This may go so far as to allow of the prolonged survival of non-viable types, such as queen termites, and of individuals that cannot find food for themselves, like the drones of the beehive.

There are two main groups of animal societies—(*a*) those mainly on an intelligent basis, as among monkeys, horses, cattle, elephants, beavers; and (*b*) those mainly on an instinctive basis, as among ants, bees, wasps, and termites. But this is not a hard and fast dichotomy, for beavers show much instinctive behaviour and bees may be occasionally intelligent. Social birds show both instinctive and intelligent behaviour. At the same time, there is an obvious contrast between a society mainly intelligent and a society mainly instinctive. If the concept of corporate unity among near kin be extended downwards in the animal kingdom, it naturally leads to colonies of physically united individuals, as in hydroids, sea-pens, reef-corals, Polyzoa and compound Tunicates. The occurrence of dimorphism or polymorphism is of interest, since this division of labour naturally leads from aggregates like a reef-coral to genuine integrates, like the Portuguese Man-of-War, a multitudinous colony of polymorphic individuals that can swim as if it were one animal. These physically continuous colonies, formed by repeated budding, might almost be termed vegetative societies—for many individuals act as one, there is physiological self-subordination, and there is a *modus vivendi* found for individual types which, in some cases, could not survive in isolation.

Advantages of Social Life.—The advantages of some form of social, communal, gregarious or co-operative life may be summed up: (1) Many small animals, with no strong individual foothold, become safe and indeed irresistible in their societies, as ants well show. (2) Operations impossible for a single individual may be effected by corporate effort, as when several ants combine to bring large booty to the nest, or when wolves surround their prey, or when pelicans form a living seine-net for fish. (3) There may be an economization of energy, at a high level, when one wild goose relieves another as leader of the flying phalanx, or, at a low level, when a number of ants reduce the loss of heat by huddling into a living ball. (4) Economy is enhanced when it is backed by division of labour, as among the specialized castes of ants and termites. (5) There is an opportunity for forming permanent products, such as ant-hill, termitary, bee-hive and beaver-dam, which doubtless operate as evolutionary factors. (6) Although one must postulate more or less kin-sympathy or the like in the initiation of a societary form, a *milieu* will be increasingly developed in which the psychical aspect has more chance to find expression than in the solitary mode of life. The social *milieu* is one in which there is likely to be a fostering of wits and kindly feelings, besides such anticipations as play and artistic products. The idiosyncrasies illustrated in ant-communities are manifold, such as keeping slaves, guests, and the analogues of domestic animals. In some cases, it must be admitted, the shield of the society allows of the survival of strange phenomena bordering on the pathological. Thus in a slave-making community of ants, the dominant caste may require to be not merely foraged for, but literally fed, by the so-called slaves. Some of the Coleopterous and Dipterous guests of termites pass into a practically diseased condition called physogastry, in which the abdomen becomes swollen, the wings drop off, the insects become quite or almost blind. According to Wheeler this is the Nemesis of life in the termitary with its close humid atmosphere, its cramped quarters, its narrow passages, and the superabundance of carbohydrate food. But the aegis of animal society is more often progressive than retrogressive. It is not maintained that the individual stimulations towards expertness and sympathy have entailed results which accumulate as part of the racial endowment. That is as it may be (*see* HEREDITY). What is suggested here is merely that the social *milieu* is one in which germinal variations in the direction of, say, better brains and stronger sympathies will have an increased chance to survive. (7) By itself, as most fundamental, must be ranked the shield that a society affords to its members, giving them a firmer foothold in the struggle for existence, and allowing variations and experimental initiatives to be tested without being subject to too severe external selection.

Pre-Conditions of Sociality.—If the social way of life has all the advantages indicated, the question naturally arises why it has not been adopted by a larger number of animal types. The answer is to be found in the pre-conditions which make sociality possible. First, there must be some capacity for kin-sympathy and fineness of brain. Fishes may swim in shoals but there is hardly any hint of integration. Mites may congregate in millions but they have not the brain for sociality. Secondly, there must be the possibility of large numbers. A small society is almost a contradiction in terms. Therefore an animal society demands either prolific multiplication, as in ants and bees and still more in termites, or a long period of reproductivity, as in elephants. Thirdly, the habits of the animal must be congruent with life in a community. Thus among spiders, which are highly evolved types, there are only two or three social species. Solitary hunters, such as otters, are precluded from social life. Thus we see that while the social way of living is very advantageous, and brings indirect as well as direct rewards, it is far from being open to all.

Social Activities.—The activities of an animal society find diverse expression:

(A) Some may be grouped as communal enterprises. There may be united defence, as of wasps against an intruder, wild cattle against a large beast of prey, rooks against a hawk. Or there may be concerted attack, as when small birds mob a hawk or an owl, or a pack of weasels attack a dog. There may be co-operation in securing food, as when monkeys raid an orchard, or wolves surround their victim, or pelicans in a half circle close in upon fishes. In some cases there is combined action in making a shelter, like a termitary, or a well-housed store, as in a hive. A beaver's dam or canal, necessarily a co-operative achievement, is accessory to transport and storing.

In many cases the corporate endeavour has considerable subtlety, as in the slave-making raids of the Amazon ants, in which

the existing slaves may play a major part in recruiting others of the same species. Migration is often a social phenomenon, with detailed features of interest, such as flying in a V-shaped formation, so familiar in wild geese but seen in many other birds. Gregarious nesting as in rooks is hardly in itself social, but the social note is sounded in the composite nest of Republican Birds. Some social activities of animals are very striking, such as the wars of some kinds of ants and the social plays of others; the drilling manoeuvres of penguins and their games; the choruses of some birds; and the community singing of the Howling Monkeys.

(B) Other expressions of social life are to be found in the evolution of means of communication. This is clearest, though not most primitive, in the case of sound-signals. The utterance of a kin-call may bring other members of the society to the rescue; a sentinel's danger-cry may save a crowd. But from such simple beginnings there is a gradual rise to the use of many "words" with specialized significance, sounds that come to be associated with particular stimuli, feelings, experiences, or even objects. In many cases, however, the medium of communication is by odours. Thus in the life of bees a part is played by the "queen-odour" and the "sting-odour." There is a visual and olfactory communication when a worker that has found a particular treasure of nectar executes on her return to the hive a specialized dance on the honeycomb and also betrays by the scent the kind of flower she had just visited. In the antennary communications between ants there is a mingling of tactile and olfactory stimuli. In many mammals there are often gestures as well as words.

(C) Social life is expressed also in what may be called customs, conventions or traditions, as the case may be. These have a mental or subjective aspect, namely certain instincts or predispositions with their attendant feelings; and they have an objective aspect in permanent products, like the termitary, and in the organization of the society, as in the existence of polymorphic castes. It seems possible to distinguish a hereditary compulsion, such as prompts the feeding of the hungry, and an environmental compulsion imposed by the nature of the home, the food, and the division of labour. A crowded hive must be kept clean; the soldier termites must be fed by the workers. But in some cases it seems necessary to postulate a social compulsion, remotely analogous to public opinion, such as that expressed in the gradual cold-shouldering of the drones in a bee-hive, accentuated into fatal stinging towards the end of the season.

It is a convention that the appeal of a hungry ant must be met by a neighbour who is full; that a cry for help must be answered; that stores must not be privately pillaged; that, after a certain stage, there must be no thieving of nest-sticks in a rookery. Very suggestive, in an instinctive community, is the graduated apprenticeship of worker-bees. Very suggestive in an incipient intelligent community is that among chimpanzees a cry of protest may arouse an uproar of indignation in the whole company. But it is not possible as yet to do more than illustrate the activities that find expression in the social life of animals.

Different Forms of Family.—The sociological study of animals must include an inquiry into the different forms of family. Many animals have abundant progeny, and yet show no hint of family life. This is generally the case with animals which illustrate the spawning method of multiplication, as in fishes that liberate eggs and sperms somewhat fortuitously in the water. Similarly in frogs, the spawn in the ditch is left to itself, and the tadpoles that hatch out from the clump do not remain together in any coherent way. It is noteworthy, however, that in expression of different constitutions and in adaptation to different conditions of life, types that are structurally not remote from one another may exhibit very different relations as regards their offspring. The starfish *Luidia* is credited with producing two hundred million eggs in a year, and could hardly be expected to have a family circle; and yet Müller's starfish carries its comparatively large eggs about until the development is completed. Miniatures of this species are sometimes seen clambering on the body of the mother —obviously the beginning of family life.

Four types of family occur among animals: (1) The typical bi-parental family is that in which both parents remain for some time in helpful company with their offspring. According to Reichenow, a band of twenty or thirty gorillas may consist of five families—each with a father, a mother and a number of offspring. In the Common Wren (*Troglodytes troglodytes*) both parents share the family duties and may use the old nest as a shelter in winter, not for themselves alone, but for a number of young birds as well. In some ducks and geese the offspring remain for the greater part of a year under the protection and tutelage of their parents. Even in some pronouncedly predatory mammals, such as lion and fox, the father stands by the mother and the family for a long time, helping not only in defence, but in providing food. At a much lower level, in a few fishes, such as *Labrus* and *Eupomotis*, there is the beginning of a bi-parental family.

(2) The second kind of family is maternal, where the mother takes sole charge. Thus the female spider may not only carry the developing eggs in a silken cocoon, but may bear the hatched young ones on her back until they are able to fend for themselves. A hen with her chickens illustrates a maternal family under man's shield, but there are many similar instances among polygamous birds in wild conditions. Small herds of eight or more elephants are said to consist, in some cases at least, of a mother and her offspring, whose births have been spaced out over many years. This approaches a small society. A distinction, though not a hard and fast one, should be drawn between parental care before birth and helpful association afterwards. Thus while some female fishes (African cichlids) carry their few eggs in their mouth, some go farther, for there are instances of the young ones returning after they have been hatched and liberated. Some illustrations are startling; thus it is recorded of certain kinds of scorpions that the mother catches insects for her offspring and even prepares the food by tearing it into small pieces.

(3) The third kind of family is paternal, where the father takes sole charge. Remarkable paternal care is illustrated by the male Sea-Horse which carries the eggs in a ventral pouch, or the New Guinea *Kurtus* which carries them attached to a hook on the top of the skull, or the American Gaff-Topsail which carries them in his mouth,—a procedure that seems to involve fasting for about two months; but this is transcended by the nest-making male sticklebacks which guard the progeny for some time after they are hatched. The male *Arius* not only incubates the eggs in his mouth, but after the young ones are liberated opens his jaws for them to return when danger is imminent. The male of the American Bow-Fin mounts guard over a rough and ready "nest" that has been cleared among the waterweeds; and after the young are hatched and leave their cradle he shepherds them for about four months. This is the beginning of a simple kind of family life.

(4) There is a fourth type of animal family, approaching a small society, and that is the "children-family." It consists of an association of young animals of the same age, but the association is not helped by the presence of parents. It is said to be illustrated at various levels, *e.g.*, by reindeer, certain cetaceans, some of the pythons, various fishes such as herring, and some caterpillars like those that form processions. But it is possible that these associations of young animals of the same age should be ranked as incipient societies rather than as families. In any case they must be considered by the comparative sociologist. The same may be said in regard to such phenomena as the property sense in some animals, the "territories" of some birds, the "preserves" of some predatory types, and the various relations of mates, such as monogamy and polygamy.

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ANIMAL WORSHIP, an ill-defined term, covering facts ranging from the worship of the real divine animal, commonly conceived as a "god-body," at one end of the scale, to respect

for the bones of a slain animal or even the use of a respectful name for the living animal at the other end.

Classification.—Animal cults may be classified in two ways: (A) according to their outward form; (B) according to their inward meaning, which may of course undergo transformations.

(A) There are two broad divisions: (1) all animals of a given species are sacred; (2) one or a fixed number of a species are sacred. It is probable that the first of these forms is the primary one and the second in most cases a development from it due to (i.) the influence of other individual cults; (ii.) anthropomorphic tendencies; (iii.) the influence of chieftainship, hereditary, and otherwise; (iv.) annual sacrifice of the sacred animal and mystical ideas connected therewith; (v.) syncretism, due either to unity of function or to a philosophic unification; (vi.) the desire to do honour to the species in the person of one of its members, and possibly other causes.



THE LION GODDESS SEKHET, AFTER A STATUE FOUND IN RUINS OF THE EGYPTIAN TEMPLES AT KARNAK

(B) Cults may be classified according to their meaning under ten specific heads: (i.) pastoral cults; (ii.) hunting cults; (iii.) cults of dangerous or noxious animals; (iv.) cults of animals regarded as human souls or their embodiment; (v.) totemistic cults; (vi.) cults of secret societies, and individual cults of tutelary animals; (vii.) cults of tree and vegetation spirits; (viii.) cults of ominous animals; (ix.) cults, probably derivative, of animals associated with certain deities; (x.) cults of animals used in magic.

(i.) The pastoral type falls into two sub-types, in which the species (*a*) is spared and (*b*) sometimes receives special honour at intervals in the person of an individual.

(ii.) In hunting cults the species is habitually killed, but (*a*) occasionally honoured in the person of a single individual, or (*b*) each slaughtered animal receives divine honours.

(iii.) The cult of dangerous animals is due (*a*) to the fear that the soul of the slain beast may take vengeance on the hunter, (*b*) to a desire to placate the rest of the species.

(iv.) Animals are frequently regarded as the abode, temporary or permanent, of the souls of the dead, sometimes as the actual souls of the dead. Respect for them is due to two main reasons: (*a*) the kinsmen of the dead desire to preserve the good will of their dead relatives; (*b*) they wish at the same time to secure that their kinsmen are not molested and caused to undergo unnecessary suffering.

(v.) One of the most widely found modes of showing respect to animals is known as totemism (*see* TOTEMISM), but except in decadent forms there is but little positive worship.

(vi.) In secret societies we find bodies of men grouped together with a single tutelary animal; the individual, in the same way, acquires the nagual or individual totem, sometimes by ceremonies of the nature of the bloodbond.

(vii.) Spirits of vegetation in ancient and modern Europe and in China are conceived in animal form.

(viii.) The ominous animal or bird may develop into a deity.

(ix.) In certain instances the animals associated with certain deities are sacred because the god was originally conceived in the shape of an animal; but the god may have been appealed to for help and thus become associated with the animals from which he protected the crops, etc.

(x.) The use of animals in magic may sometimes give rise to a kind of respect for them, but this is of a negative nature.

BIBLIOGRAPHY.—*See* articles in *E.R.E.* and authorities quoted in Sir James Frazer, *Golden Bough* (3rd ed., 1909–12), and the full bibliography given in vol. xii.

ANIMATISM is the tendency of the primitive mind to regard and treat the inanimate, in so far as it is held to be sacred, as if it were animated—that is, alive and endowed with feelings and a will of its own. In imputing animatism to the savage, due allowance must be made for the fact that he is largely unconscious of the theory underlying his practice. Thus when a Toda of the Nilgiri hills in India feeds his sacred cattle-bell with milk, the civilized observer might justly draw the inference that the bell was supposed somehow to enjoy the milk; and yet it would probably be the fact that a given Toda who carries out this act of respect is blindly following religious custom, and has never troubled his head to think whether the bell, which obviously cannot drink in the ordinary manner, can nevertheless in some miraculous way get much the same satisfaction out of the milk as could a man or a cat. The word animatism was coined by Marett in 1899 to mark off a distinguishable phase of belief concerning whatever is deemed sacred and as such becomes the object of religious or quasi-religious attention and behaviour. Marett pointed out that Sir E. B. Tylor, when in *Primitive Culture* (1871), chap. xi., he suggested the term animism (*q.v.*), in the sense of "the belief in spiritual beings," as a "minimum definition of religion," had already in a previous chapter on mythology (chap. viii.) used the word animism in a different sense, namely, as the "theory of the universal animation of nature." The latter meaning is thus different and ought to be kept clear of the former. Marett therefore proposes that a separate word "animatism" should be used to express it. He argues that the notion of being alive is logically distinct from and historically and psychologically more rudimentary than the notion of being associated with a spiritual or soul-like being. He is, however, for limiting the application of the notion in question more narrowly than Tylor, who imputes to the savage a tendency to imagine nature as universally animated or alive. For can there ever have existed a savage who was mentally incapable of regarding anything whatever, an ordinary stone for instance, as unalive? Does not even the baby soon learn to distinguish its nurse by her relatively arbitrary proceedings from the chair with its thoroughly wooden way of reacting to the baby's way of thumping it? On the other hand, if the chair creaked in a peculiar manner it might frighten the baby, and might thereupon pass over into the class of objects that act arbitrarily, such as nurse with her uneven temper, or pussy that sometimes purrs and sometimes scratches. So too, then, the savage tends to put the stone into another category if it behaves queerly—if it refuses to be chipped into shape and cuts his finger, or emerges in the midst of the rapids and upsets his canoe. Nay, it need not act queerly; it is enough if it seems about to do so by looking queer. Just so the hunted animal perceives danger lurking in every unusual sight, or sound, or smell. The savage, however, being mentally a long way in advance of the animal, has generalized the unusual in a dim fashion, and has words of the type of *mana* (*q.v.*) to connote in the unfamiliar object a power of affecting man for better or worse—mostly, perhaps, for worse—in ways that defeat reasonable expectation. Animatism is therefore limited to the attribution of life to the unfamiliar, since it is an exaggeration to say that there is no room within the savage mind for any apprehension of the unalive. Further, for the purposes of the comparative study of religion in all its phases, including the most rudimentary, the unfamiliar may be identified with the sacred—that which is positively *mana*, or instinct with power to help or hurt in an unusual degree, and negatively is *tabu* (*q.v.*), that is, not lightly to be approached. Correspondingly, a "pre-animistic" type of religious belief and observance is distinguished in which no animism is involved in Tylor's second sense of the recognition of soul or spirit with a being of its own, distinct from bodily substance. In this pre-animistic theory a question of minor importance is whether *mana* and *animatism* go strictly together—that is to say, whether whatever has wonder-working power must necessarily seem likewise alive. It is rather a doubtful point, seeing that *mana* is often treated as if it were transmissible or contagious, like electricity or the influenza; whereas to think of a man's life as extending to his belongings is perhaps not so natural or easy. As a matter of fact, however, magic is practised on a man's clothes or on the clippings of his hair or nails, or on his personal name, or in fact on anything that can be identified with the man so far as to call him up to mind and conjure up a sense of his real

presence, in the belief that thereby the man will be deprived of his very life. Thus life would seem on this vague view of it to be no less contagious than *mana*, one or the other being alike a sort of communicable energy. Now, because such energy is communicable, it does not follow that there are not appropriate centres at which it originates; just as a push started by one man in a row may make itself felt right down the line. Some objects, for instance, would appear to be intrinsically sacred in the eyes of the savage, while in the case of anything else the sacredness is but acquired by association with such things as are sacred in themselves. In particular, certain types of persons, medicine-men, kings, women, strangers and so on, are considered sacred in their own right; and in such cases their *mana* may very naturally be treated as much the same as their will-power—an energy that is bound up with such personal initiative as they display. Indeed, in any case the unfamiliar is bound to strike the mind that is in awe of it as more or less self-active, since it does the threatening and he knocks under to it. In all magical conflict the result depends on which of the two has the initiative; for if I see the wolf before he sees me he cannot cast his spell over me but slinks off powerless. Thus *mana* implies life as manifested in initiative; so that John Murphy in *Primitive Man: his Essential Quest* (1927) is fully justified in representing the content of the confused notion at the back of animatism by the triad, "power-life-will." Further, the body or external appearance in and through which such power-life-will is exerted forms part of the same complex; the driving force and its vehicle, the god and the god's car, not being yet held apart in thought. At the pre-animistic stage the mind takes in the live wire, but has not yet taken in that electricity is the live thing in the wire and the rest but consentient matter. Of course these distinctions are made by the civilized man for his own classificatory purposes. The savage is unaware of stages in his thought, nay, mostly of the very fact that he thinks at all; and he does not change gear with any noticeable jerk when he shifts by slow degrees to a higher plane of analytic consciousness. If, however, the student of comparative religion hopes to make anything of what William James has called the "big buzzing booming confusion" of dawning reflection about the sacred and divine, he must boldly differentiate certain leading types, and may well find "animatism" to be a convenient way of representing the most rudimentary type of all.

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ANIMATO (Ital.), a musical term signifying that the piece or passage so marked is to be played with animation and spirit. "Con anima" and "con spirito" have the same meaning.

ANIMÉ, an oleo-resin (said to be so called because in its natural state it is infested with insects) which is exuded from the locust tree, *Hymenaea courbaril* (family Leguminosae), and other species of *Hymenaea* growing in tropical South America. It is of a pale brown colour, transparent, brittle, and in consequence of its agreeable odour is used for fumigation and in perfumery. It is allied to copal in its nature and appearance, and is much used by varnish-makers. The name animé is also given to Zanzibar copal (*q.v.*).

ANIMISM is derived from *anima,* "breath," which in Latin came to have the secondary sense of "soul," very much as did the equivalent word *spiritus,* whence our "spirit." Hence animism might stand for any doctrine having to do with soul or spirit and, later, with souls or spirits. The word was coined early in the 18th century by Georg Ernst Stahl to describe his philosophy of a world-soul. More recently, William McDougall in *Body and Mind: a history and a defence of Animism* (1911) has used it to designate the "interaction-theory" of mind as an independent factor co-operating with the brain, as opposed to the various versions of what has been nicknamed "a psychology without a soul." Animism, however, will always be chiefly known as the term in which Sir Edward Burnett Tylor in *Primitive Culture* (1st ed. 1871) summed up his account of the origin of religion. Among anthropologists Tylor's animistic theory of religion stood unchallenged for nearly 30 years.

Although to-day the Tylorian explanation of religious origins has to be taken as subject to various important qualifications, it remains of great value; while the help it afforded at the time of its first appearance to anthropological research alike in the study and in the field can hardly be exaggerated. A whole generation of students of primitive culture sat at Tylor's feet, and more especially those whose interest lay chiefly in the history of religion.

The Minimum Definition of Religion.—In what follows, then, Tylor's animistic hypothesis need be considered solely in so far as it claims to supply "a minimum definition of religion." On this view, religion begins with a soul or spirit and ends with a god; a god being historically an evolved spirit, or conversely, a spirit being a god in the making. For the "belief in spiritual beings" comprises, firstly, "souls of individual creatures, capable of continued existence after the death or destruction of the body"; and, secondly, "other spirits, upward to the rank of powerful deities."

Given the idea of soul, the rest follows by a sort of logical extension; seeing that "the ideas of souls, demons, deities and any other classes of spiritual beings, are conceptions of similar nature throughout, the conceptions of souls being the original ones in the series." Thus, in order to make clear the origin and whole subsequent development, all that is still required is to explain the origin of the belief in a soul. Tylor proceeds to do it thus: "It seems as though thinking men, as yet at a low level of culture, were deeply impressed by two groups of biological problems. In the first place, what is it that makes the difference between a living body and a dead one; what causes waking, sleep, trance, disease, death? In the second place, what are those human shapes which appear in dreams and visions?" He goes on to suggest that the answer to the first riddle seemed to these primitive thinkers to be that every one has a life-principle that causes his body to feel, think and act but is capable of leaving it; and the answer to the second riddle that every one has a phantom, which can also leave the body since it appears to others at a distance. Putting the two notions together, the life-principle and the phantom, they created the idea of the *anima* or "ghost-soul"—a separable life-principle with an unsubstantial, wraith-like form of its own. Now this is much more than a crude statement to the effect that the origin of religion is a belief in ghosts.

Herbert Spencer had not much reason on his side when he asserted that he had long before anticipated the Tylorian theory when he put forward the view that "the aboriginal god is the dead chief" (*Mind,* ii. 1877, 415 et seq. citing *Westminster Review,* 1854, 360 et seq.). For Tylor's point is not merely that visionary shapes are seen but likewise that the consciousness of being alive, of moving the body, of leaving it temporarily and so on, is associated with these shapes.

If we describe the Tylorian explanation as "the dream-theory of religion," as is sometimes done, though very inadequately, we must not, at any rate, forget that the argument embraces both these aspects of dream; and that the aspect in which a man is aware of himself as going away to a distance during sleep should at least be as strongly emphasized as the other one in which he seems to be visited by others from a distance. Moreover, Tylor would be the first to allow that in advanced religion when God is said to be a spirit the personality alone is insisted on; whereas the outward appearance, whether man-like, wraith-like or what not, is treated as little more than a matter of symbolic imagery.

So, too, philosophers, from Plato in the *Phaedo* onwards, have deduced the soul's self-existence and immortality from certain data of consciousness, the faculty of reason, the feeling of self-activity, the moral sense and so on; whereas they have ever tended to regard the appeal to so-called objective manifestations of the spiritualistic order as smacking of superstition. To return to the savage, the objection to Tylor's theory is not that it is defective as a piece of reasoning but that, on the contrary, it is much too rational a view for the human mind to have adopted at the very outset of its experience of religion. The modern psychologist utterly disbelieves in Tylor's "thinking men," who begin by conceiving an idea and thereupon proceed to mould their practice in accordance with it, and terms this the fallacy of intel-

lectualism—the error of subordinating action to thought instead of thought to action. Man always thinks while acting, and in some sense after acting, since the function of thought is to be rudder, not propeller—to direct, while impulse drives.

Modern Attitude.—The modern method, therefore, of conceiving the development of man's religious activity would be to presuppose that he was well on his way towards religion before he thought about it at all. Thus, supposing Tylor to be right in taking the ghost-soul to be the earliest notion in the animistic series, the modern way would be to try to find some already current activity—say, funeral custom—in connection with which the idea in question might have grown up, as being in the first instance effect rather than cause. If, for instance, the custom was, as the Australian natives sometimes did, to abandon for the time being their cave-shelter, leaving the corpse there, or possibly the sick or aged man about to die, it might well happen that food and weapons would be left at the side of the body. Whereupon, by a sort of justification after the event the definite idea might grow up of a life after death in which food and weapons were needed; though at first the impulse to leave such things with the body might be almost unreasoning, amounting perhaps to no more than a dread of going near it or removing anything in contact with it. Whatever be the value of such an illustration, there can be little doubt in regard to psychological method that the Tylorian theory of the origin of religion in the idea of soul tends to put the cart before the horse. When, in 1899, the pre-animistic theory was put forward in opposition to Tylor's account of the earliest type of religion (*see* ANIMATISM and MANA), this was chiefly the point at issue; while it was at the same time suggested that the notion first generated by reaction to the object of religious awe was something much vaguer than that of soul as distinct from body, namely, that of *mana*, or, so to speak, the bare notion of awfulness in action. On the other hand, in the previous year Andrew Lang in *The Making of Religion* (1st ed. 1908) had attacked Tylor's animistic theory of the origin of religion from another side. He brought forward numerous examples of what he called "high gods of low races" who seemed to have nothing of the *anima* about them, but to be more like "magnified non-natural men." There is certainly nothing wraith-like about such beings, who rather resemble glorified human beings such as were the Greek gods. Lang's suggestion as to the origin of such anthropomorphic theism, as it might be termed, was that the notion of a maker or creator of the world might be chiefly responsible for it. This explanation, however, which he put forward quite tentatively in the introduction to the second edition, is also somewhat open to the charge of intellectualism; and it is surely more probable that the respect felt for the great chief or medicine-man—the man with *mana*—might continue to attach to his memory and so generate gods of the anthropomorphic or "man-like" pattern.

Conclusion.—Primitive religion, on fuller investigation than was possible in Tylor's time, turns out to comprise many types of divine being that the savage does not bring under one idea at all unless it is simply that of being divine, that is to say, worshipful; his consciousness of their being worshipful growing out of the very fact that he worships them by impulse precipitated in custom. Thus the Tylorian animism hardly provides a basis for primitive religion, but at most will serve as a key to primitive theology. Undoubtedly, when religion has reached the stage of trying to put its ideas into order, a certain uniformity of doctrine is obtained by assuming a hierarchy of spiritual beings, gods and godlings, demons and fairies, goblins and ghosts, all of which are supposed to have enough in common in respect to their nature to be dealt with by man by methods no less fundamentally alike. Like the soul or mind of which a man is aware in himself, they belong to the unseen; whereas the seen, like a man's body, is but the outward manifestation of a purpose that is essentially spiritual; that is, comes forth from the unseen. Such a theory paves the way for the moralization of religion, because by interpreting that which excites awe and reverence as, whatever the physical manifestation may be, an expression of will at bottom, it makes it easier to reach the position of advanced religion which tends to sum up all the good will in the universe with which man can commune and co-operate in the notion of a single and personal God.

BIBLIOGRAPHY.—E. B. Tylor, *Primitive Culture* (1871); J. G. Frazer, *The Belief in Immortality* (in course of publication); E. Clodd, *Animism*; A. Borchest, *Der Animismus*; A. Lang, *The Making of Religion* (1898); R. R. Marett, *The Threshold of Religion* (1914).

Animism is especially prominent in the religions of certain regions, such as Indonesia and South America. For Indonesia *see* G. A. Wilken, *Het Animisme bij de Volker van der Indischen Archipel*; A. C. Kruyt, *Het Animisme in der Indischen Archipel*; "L'Animisme chez les Peuples de l'Archipel Indien," in *Melusine* (1886). For South America *see* E. im Thurn, *Among the Indians of Guiana*; R. Karsten, *The Civilization of the South American Indians* (1926). (R. R. M.)

ANIMUCCIA, GIOVANNI, Italian musical composer was born at Florence in the last years of the 15th century. At the request of St. Filippo Neri he composed a number of *Laudi* or hymns of praise, to be sung after sermon time, which have given him an accidental prominence in musical history, since their performance in St. Filippo's Oratory eventually gave rise (on the disruption of 16th century schools of composition) to some of the earlier forms of "oratorio." In 1555 Animuccia was appointed *maestro di capella* at St. Peter's, an office which he held until his death in 1571. He was succeeded by Palestrina who had been his friend and probably his pupil. The manuscript of many of Animuccia's compositions is still preserved in the Vatican Library.

BIBLIOGRAPHY.—His chief published works were *Madrigali e Motetti a quattro e cinque voci* (Venice, 1548) and *Il primo Libro di Messe* (Rome, 1567). From the latter Padre Martini has taken two specimens for his *Saggio di Contrapunto*. A mass from the *Primo Libro di Messe* on the *canto fermo* of the hymn *Conditor alme siderum* is published in modern notation in the *Anthologie des maîtres religieux primitifs* of the *Chanteurs de Saint Gervais*.

ANIO, a river of Italy about 75 miles long; the principal tributary of the Tiber in its lower course. It rises in the limestone mountains east of Subiaco, and thence to Tivoli the road follows its narrow valley. The water of the river supplied Rome in ancient times (*see* AQUEDUCT), while the pure and copious springs which served for the ancient Aqua Marcia and Aqua Claudia, and still form the city's main supply, are in its valley. But the *praeceps* (hurrying) Anio of Horace has been transformed by hydro-electric power-plants for the supply of Rome, and the famous waterfalls at Tivoli (*q.v.*) will be largely curtailed. From Tivoli to its junction with the Tiber it pursues a winding course through the low ground, and formed an effective protection to Latium from the north.

See Colasanti, *L'Aniene* (well illustrated, Bergamo, 1906).

ANION, the constituent of an electrolyte (*see* ELECTROLYSIS) deposited at the anode (*q.v.*) by an electric current. When a molecule (*q.v.*) splits into electrically charged parts these are called *ions* (*see* IONIZATION). In the case of a liquid the negative ion is termed the *anion* and is non-metallic in character. It consists of one or more atoms carrying a definite number of negative electric charges (*see* ELECTRON, THE), this number being called its valency (*q.v.*); *e.g.*, the chlorine ion (Cl^-) and the group NO_3 are both monovalent anions, while the group SO_4 is a divalent anion. (*See* also CATION.)

ANISE (*Pimpinella Anisum*), an umbelliferous plant found in Egypt and the Levant, and cultivated on the continent of Europe for medicinal purposes. The officinal part of the plant is the fruit, which consists of two united carpels, called a cremocarp. It is known by the name of aniseed, and has a strong aromatic taste and a powerful odour. By distillation the fruit yields the volatile oil of anise. Most of the oil of commerce, however, of which anethol is also the chief constituent, comes from *Illicium verum* (family Magnoliaceae, sub-family *Wintereae*), indigenous in north-east China, the star-anise of liqueur makers. It receives its name from its flavour, and from its fruit spreading out like a star. The anise of the Bible (Matt. xxiii. 23) is *Anethum* or *Peucedanum graveolens*; *i.e.*, dill (*q.v.*).

ANJAR, a fortified town of India and the capital of a district of the same name in the native State of Cutch in the presidency of Bombay. The country is arid and is supplied with water by well irrigation. The town is situated nearly 10m. from the Gulf of Cutch. In 1921 the population was 13,510. The town and district

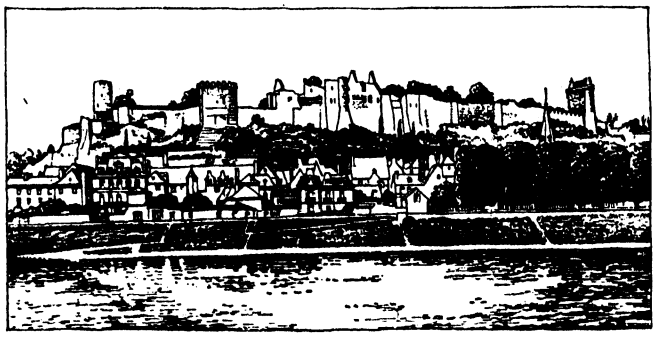
of Anjar were ceded to the British in 1816, but in 1822 were transferred to the Cutch Government in consideration of an annual money payment which was subsequently remitted.

ANJOU, the old name of a French territory representing the ancient Gallic State of the *Andes,* re-organized as the Roman *civitas* of the *Andecavi,* and preserved as an administrative district under the Franks with the name first of *Pagus,* then of *comitatus,* or countship of Anjou. This countship, nearly identical with the ecclesiastical diocese of Angers, occupied the greater part of what is now the department of Maine-et-Loire. It was bounded on the north by the countship of Maine, on the east by that of Touraine, on the south by that of Poitiers and by the Mauges and on the west by the countship of Nantes.

From the outset of the reign of Charles the Bald, the integrity of Anjou was seriously menaced by a two-fold danger: from Brittany and from Normandy. Lambert, a former count of Nantes, after devastating Anjou in concert with Nominoé, duke of Brittany, had by the end of the year 851 succeeded in occupying all the western part as far as the Mayenne. This principality was occupied, on his death, by Erispoé, duke of Brittany; by him it was handed down to his successors, in whose hands it remained till the beginning of the 10th century. Meanwhile the Normans were ravaging the country, and towards 861, Charles the Bald entrusted it to Robert the Strong (*q.v.*), but he unfortunately met with his death in 866 in a battle against the Normans at Brissarthe. Hugh the Abbot succeeded him in the countship of Anjou as in most of his other duties, and on his death (886) it passed to Odo (*q.v.*), the eldest son of Robert the Strong, who, on his accession to the throne of France (888), probably handed it over to his brother Robert. In any case, during the last years of the 9th century, in Anjou as elsewhere the power was delegated to a viscount, Fulk the Red (mentioned under this title after 898), son of a certain Ingelgerius.

In the second quarter of the 10th century Fulk the Red had already usurped the title of count, which his descendants kept for three centuries. He was succeeded first by his son Fulk II. the Good (941 or 942-*c.* 960), and then by Fulk's son, Geoffrey I. *Grisegonelle* (*c.* 960–987), who inaugurated a policy of expansion, aiming at the extension of the boundaries of the ancient countship and the reconquest of those parts of it which had been annexed by the neighbouring states; for, though western Anjou had been recovered from the dukes of Brittany since the beginning of the 10th century, in the east all the district of Saumur had fallen into the hands of the counts of Blois and Tours. Geoffrey succeeded in making the count of Nantes his vassal, and in obtaining from the duke of Aquitaine a grant of the district of Loudun. His son Fulk III. Nerra (*q.v.*) (987–1040) was confronted on his accession by a coalition of Odo I., count of Blois, and Conan I., count of Rennes. The latter having seized upon Nantes, of which the counts of Anjou held themselves to be suzerains, Fulk Nerra came and laid siege to it, routing Conan's army at Conquereuil (June 27, 992) and re-establishing Nantes under his own suzerainty. Then turning against the count of Blois, he established a fortress at Langeais, a few miles from Tours, from which, thanks to the intervention of the king, Hugh Capet, Odo failed to oust him. On the death of Odo. I., Fulk seized Tours (996); but King Robert the Pious turned against him and took the town again (997). In 1016 Odo II. of Blois was utterly defeated at Pontlevoy, and a few years later, while Odo was besieging Montboyau, Fulk surprised and took Saumur (1026). Finally, the victory gained by Geoffrey Martel (*q.v.*) (1040–60), the son and successor of Fulk, over Theobald III., count of Blois, at Nouy (Aug. 21, 1044), assured to the Angevins the possession of the countship of Touraine. At the same time, continuing in this quarter the work of his father, Geoffrey succeeded in reducing the countship of Maine to complete dependence on himself. During his father's life-time he had been beaten by Gervais, bishop of Le Mans (1038), but now (1047 or 1048) succeeded in taking the latter prisoner, and in spite of the concerted attacks of William, duke of Normandy, and Henry I., king of France, he was able in 1051 to force Maine to recognize his authority.

On his death (Nov. 14, 1060) there was a dispute as to the succession. Having no children he had bequeathed the countship to his eldest nephew, Geoffrey III. the Bearded, son of Geoffrey, count of Gâtinais, and of Ermengarde, daughter of Fulk Nerra. But Fulk le Réchin, brother of Geoffrey the Bearded, who had at first been contented with an appanage consisting of Saintonge and the *châtellenie* of Vihiers, having allowed Saintonge to be taken in 1062 by the duke of Aquitaine, took advantage of the general discontent aroused in the countship by the unskilful policy of Geoffrey to make himself master of Saumur (Feb. 25, 1067) and



BY COURTESY OF THE FRENCH BUREAU OF TRAVEL

THE FORTRESS AT CHINON, AN IMPORTANT STRONGHOLD FOR THE MEDIAEVAL RULERS OF ANJOU, OVERLOOKING THE MODERN TOWN THAT LIES ON THE BANKS OF THE VIENNE

Angers (April 4) and cast Geoffrey into prison at Sablé. Compelled by the papal authority to release and restore him, he soon renewed the struggle, beat Geoffrey near Brissac and shut him up in the castle of Chinon (1068). In order, however, to obtain his recognition as count, Fulk IV. Réchin (1068-1109) had to carry on a long struggle with his barons, to cede Gâtinais to King Philip I., and to do homage to the count of Blois for Touraine. On the other hand, he was successful on the whole in pursuing the policy of Geoffrey Martel in Maine: after destroying La Flèche, by the Peace of Blanchelande (1081), he received the homage of Robert, son of William the Conqueror, for Maine. Later, he upheld Elias, lord of La Flèche, against William Rufus, king of England, and on the recognition of Elias as count of Maine in 1100, obtained for Fulk the Young, his son by Bertrade de Montfort, the hand of Eremburge, Elias's daughter and sole heiress.

Fulk V. the Young (1109–29) succeeded to the countship of Maine on the death of Elias (July 11, 1110); but this increase of Angevin territory came into such direct collision with the interests of Henry I., king of England, who was also duke of Normandy, that a struggle between the two powers became inevitable. In 1112 it broke out, and Fulk, being unable to prevent Henry I. from taking Alençon and making Robert, lord of Bellême, prisoner, was forced, at the treaty of Pierre Pecoulée, near Alençon (Feb. 23, 1113), to do homage to Henry for Maine. In revenge for this, while Louis VI. was overrunning the Vexin in 1118, he routed Henry's army at Alençon (Nov.), and in May 1119 Henry demanded a peace, which was sealed in June by the marriage of his eldest son, William, with Matilda, Fulk's daughter. William having perished in the wreck of the "White Ship" (Nov. 25, 1120), Fulk, on his return from a pilgrimage to the Holy Land (1120–21), married his second daughter Sibyl, at the instigation of Louis VI., to William Clito, son of Robert Courteheuse, and a claimant to the duchy of Normandy, giving her Maine for a dowry (1122 or 1123). Henry I. managed to have the marriage annulled, on the plea of kinship between the parties (1123 or 1124). But in 1127 a new alliance was made, and on May 22, at Rouen, Henry I. betrothed his daughter Matilda to Geoffrey the Handsome, son of Fulk, the marriage being celebrated at Le Mans on June 2, 1129. Shortly after, on the invitation of Baldwin II., king of Jerusalem, Fulk departed to the Holy Land, married Melisinda, Baldwin's daughter and heiress, and succeeded to the throne of Jerusalem (Sept. 14, 1131). His eldest son, Geoffrey IV. the Handsome or "Plantagenet," succeeded him as count of Anjou (1129–51). From the first he tried to profit by his marriage, and after the death of Henry I. (Dec. 1, 1135), laid the foundation of the conquest of Normandy by a series of cam-

paigns: about the end of 1135 or the beginning of 1136 he entered that country and rejoined his wife, the countess Matilda, who had received the submission of Argentan, Domfront and Exmes. Recalled into Anjou by a revolt of his barons, he returned to the charge in Sept. 1136 with a strong army, but after a few successes was wounded in the foot at the siege of Le Sap (Oct. 1) and had to fall back. In May 1137 began a fresh campaign in which he devastated the district of Hiémois (round Exmes) and burnt Bazoches. In June 1138, with the aid of Robert of Gloucester, Geoffrey obtained the submission of Bayeux and Caen; in October he devastated the neighbourhood of Falaise; finally, in March 1141, on hearing of his wife's success in England, he again entered Normandy. Many towns surrendered; in 1144 he entered Rouen, and received the ducal crown in its cathedral. Finally, in 1149, after crushing a last attempt at revolt, he handed over the duchy to his son Henry, who received the investiture at the hands of the king of France.

Meanwhile, the counts were strengthening their authority at home. Of Fulk the Young we know only a few isolated facts and dates. Geoffrey the Handsome was eminently fitted to suppress the coalitions of his vassals, and on his death his son Henry found himself heir to a great empire, strong and consolidated, to which his marriage with Eleanor of Aquitaine (May 1152) further added Aquitaine.

On the death of King Stephen, Henry was recognized as king of England (Dec. 19, 1154). His brother Geoffrey, who had received as appanage the three fortresses of Chinon, Loudun and Mirebeau, tried to seize upon Anjou, on the pretext that, by the will of their father, all the paternal inheritance ought to descend to him, if Henry succeeded in obtaining possession of the maternal inheritance. On hearing of this, Henry marched against his brother, from whom in the beginning of 1156 he succeeded in taking Chinon and Mirebeau; and in July he forced Geoffrey to give up even his three fortresses in return for an annual pension. Henceforward Henry succeeded in keeping the countship of Anjou all his life; for though he granted it in 1168 to his son Henry, he absolutely refused to allow him to enjoy his power. After Henry II 's death in 1189 the countship passed to his son Richard I. of England, but on the death of the latter in 1199, Arthur of Brittany (born in 1187) laid claim to the inheritance, which ought, according to him, to have fallen to his father Geoffrey, fourth son of Henry II., in accordance with the custom by which "the son of the eldest brother should succeed to his father's patrimony." Supported by Philip Augustus of France, and William des Roches, seneschal of Anjou, he managed to enter Angers (April 18, 1199) and obtain recognition as count of Anjou, Maine and Touraine, for which he did homage to the king of France. Philip Augustus having deserted Arthur by the treaty of Le Goulet (May 22, 1200), John made his way into Anjou; and on June 18, 1200 was recognized as count at Angers. In 1202 he refused to do homage to Philip Augustus, who, in consequence, confiscated all his continental possessions, including Anjou, which was allotted by the king of France to Arthur. The defeat of the latter, who was taken prisoner at Mirebeau on Aug. 1, 1202, seemed to ensure John's success, but he was abandoned by William des Roches, who in 1203 assisted Philip Augustus in subduing the whole of Anjou. A last effort on the part of John in 1214 led to the taking of Angers (June 17) but broke down lamentably at the battle of La Roche-aux-Moines (July 2), and the countship was attached to the crown of France.

In Aug. 1246 King Louis IX. gave it as an appanage to his son Charles, count of Provence, soon to become king of Naples and Sicily (*see* NAPLES). On Aug. 16, 1290 his son, Charles II. married his daughter Margaret to Charles of Valois, son of Philip III. of France giving her Anjou and Maine for dowry, in exchange for the kingdoms of Aragon and Valentia and the countship of Barcelona. Charles of Valois at once entered into possession of the countship of Anjou, to which Philip IV., in Sept. 1297, attached a peerage of France. On Dec. 16, 1325, Charles died, leaving Anjou to his eldest son Philip of Valois, on whose recognition as king of France (Philip VI.) on April 1, 1328, the countship of Anjou was again united to the crown. On Feb. 17, 1332, Philip VI. bestowed it on his son John the Good, who, when he became king (Aug. 22, 1350), gave the countship to his second son Louis I., raising it to a duchy in the peerage of France by letters patent of Oct. 25, 1360. Louis I., who became in time count of Provence and king of Naples (*see* LOUIS I., king of Naples), died in 1384, and was succeeded by his son Louis II., who devoted most of his energies to his kingdom of Naples, and left the administration of Anjou almost entirely in the hands of his wife, Yolande of Aragon. On his death (April 29, 1417) she took upon herself the guardianship of their young son Louis III., and in her capacity of regent defended the duchy against the English. Louis III., who also succeeded his father as king of Naples, died on Nov. 15, 1434, leaving no children The duchy of Anjou then passed to his cousin René, second son of Louis II. and Yolande of Aragon, and king of Naples and Sicily (*see* NAPLES).

Unlike his predecessors, who had rarely stayed long in Anjou, René from 1443 onwards, paid long visits to it, and his court at Angers became one of the most brilliant in the kingdom of France. But after the sudden death of his son John in Dec. 1470, René, for reasons which are not altogether clear, decided to move his residence to Provence and leave Anjou for good (Oct. 1471). On July 22, 1474, he drew up a will by which he divided the succession between his grandson René II of Lorraine and his nephew Charles II., count of Maine, but on his death (July 10, 1480) King Louis XI. annexed Anjou to the royal domain. King Francis I. again gave the duchy as an appanage to his mother, Louise of Savoy, by letters patent of Feb. 4, 1515. On her death, in Sept. 1531, it reverted to the king. In 1552 it was given by Henry II. to his son Henry who, on becoming king in 1574, conceded it to his brother Francis, duke of Alençon, at the treaty of Beaulieu near Loches (May 6, 1576). Francis died on June 10, 1584, and the vacant appanage definitively became part of the royal domain.

At first Anjou was included in the *gouvernement* of Orléanais, but in the 17th century it was made into a separate one. Saumur, however, and the Saumurois, for which King Henry IV. had in 1589 created an independent military governor-generalship in favour of Duplessis-Mornay, continued till the Revolution to form a separate *gouvernement*, which included, besides Anjou, portions of Poitou and Mirebalais. Attached to the *généralité* (administrative circumscription) of Tours, Anjou on the eve of the Revolution comprised five *élections* (judicial districts): Angers, Beaugé, Saumur, Château-Gontier, Montreuil-Bellay and part of the *élections* of La Flèche and Richelieu. Financially it formed part of the so-called *pays de grande gabelle* (*see* GABELLE), and comprised 16 special tribunals, or *greniers à sel* (salt warehouses): Angers, Beaugé, Beaufort, Bourgueil, Candé, Château-Gontier, Cholet, Craon, La Flèche, Saint-Florent-le-Vieil, Ingrandes, Le Lude, Pouancé, Saint-Remy-la-Varenne, Richelieu, Saumur. As regards purely judicial administration, Anjou was subject to the parlement of Paris; Angers was the seat of a presidial court, of which the jurisdiction comprised the *sénéchaussées* of Angers, Saumur, Beaugé, Beaufort and the duchy of Richelieu; there were besides presidial courts at Château-Gontier and La Flèche. When the Constituent Assembly, on Feb. 26, 1790, decreed the division of France into departments, Anjou and the Saumurois, with the exception of certain territories, formed the department of Maine-et-Loire.

BIBLIOGRAPHY.—(1) *Principal Sources:* The history of Anjou may be told partly with the aid of the chroniclers of the neighbouring provinces, in particular those of Normandy and of Maine (especially *Actus pontificum Cenomannis in urbe degentium*). For the 10th, 11th and 12th centuries there are some important texts dealing entirely with Anjou. The most important is the chronicle called *Gesta consulum Andegavorum* (*Chroniques des comtes d'Anjou*, published by Marchegay and Salmon, with an introduction by E. Mabille, Paris, 1856–71 collection of the *Société de l'histoire de France*). *See* also with reference to this text Louis Halphen, *Étude sur les chroniques des comtes d'Anjou et des seigneurs d'Amboise* (1906). The above may be supplemented by some valuable annals published by Louis Halphen, *Recueil d'annales angevines et vendômoises* (1903), (in the series *Collection de textes pour servir a l'étude et à l'enseignement de l'histoire*). For further details *see* Auguste Molinier, *Les Sources de l'histoire de France* (1902), ii. 1276–1310, and the book of Louis Halphen mentioned above.

(2) *Works*: The *Art de vérifier les dates* contains a history of

Anjou which is very much out of date. The 11th century only has been treated in detail by Louis Halphen, in *Le Comté d'Anjou au XIe siècle* (1906), which has a preface with bibliography and an introduction dealing with the history of Anjou in the 10th century. For the 10th, 11th and 12th centuries, a good summary will be found in Kate Norgate, *England under the Angevin Kings* (1887). On René of Anjou, there is a book by A. Lecoy de la Marche, *Le Roi René* (1875). Lastly, the work of Célestin Port, *Dictionnaire historique, géographique et biographique de Maine-et-Loire* (1874-78), and its small volume of *Prélîminaires* (including a summary of the history of Anjou), contain a mass of information concerning everything connected with Angevin history. (L. Ha.)

ANKERITE, a member of the mineral group of rhombohedral carbonates. In composition it is closely related to dolomite, but differs from this in having magnesia replaced by varying amounts of ferrous and manganous oxides, the general formula being $Ca(Mg,Fe,Mn)(CO_3)_2$. The colour is white, grey, or reddish. Ankerite occurs with chalybite in deposits of iron-ore.

ANKLAM or **ANCLAM,** Germany, 5m. above the mouth of the river Peene in the Kleines Haff, and 53m. N.W. of Stettin. Pop. (1925) 14,788. Anklam or Tanglim, originally a Slav fortress, joined the Hanseatic League in 1244. It was Swedish from 1648–76. It suffered in the Thirty Years' and Seven Years' Wars owing to its military importance, but still has its old walls and some quaint buildings. Foundries, mills and the making of agricultural machinery, furniture and sugar are carried on.

ANKLE or **ANCLE,** the joint which connects the foot with the leg (*see* Joints).

ANKOBER, a town in, and at one time capital of, the kingdom of Shoa, Abyssinia, 90 m. N.E. of Adis Ababa, in 9° 34′ N., 39° 54′ E., on a mountain about 8500 ft. above the sea. Ankober was made (*c.* 1890) by Menelek II. the place of detention of political prisoners. Pop. *c.* 3,000.

ANKOLE, a term used to designate a plateau of the Uganda Protectorate, British East Africa, and the people (Hima and Iro) occupying it. There has been little except linguistic assimilation here between the Hamitic intruders and the indigenous population. The former, known as Hima, and distinguished by fine features, small, almost Caucasian hands and feet and a light skin, comprise the autocracy. The latter, called Iro, a Hamitic word meaning slaves, with features characterized by rather projecting brow ridges, are the serfs or peasants. Both Hima and Iro wear skins and barkcloth but the latter are more careful about conventional decency, and an Iro married woman in addition to a number of skins worn round the waist must always wear heavy metal anklets. Apart from cicatrisation they do not mutilate their bodies in any way. The Hima are cow-people and are subdivided into two classes, the rich and the poor. The former who own the cattle (a long-horned Galla type, sometimes humped owing to crossbreeding) are now sedentary, but the latter, who act as servants and herdsmen to the former (who provide them with wives and a few cattle) are nomads and move from place to place with the cattle. The Iro are purely agricultural and were rarely allowed to possess cattle as they do now; they have to supply the Hima with grain and beer. They are also the hunters of the tribe, as well as the smiths, potters (male and female) and carpenters, members of each craft being attached to the royal court, where they are generously rewarded for their services. War prisoners form a separate class of slaves, distinguished by the amputation of one or both ears.

The Hima live in collections of from ten to twenty houses inside a strong fence of thorn or euphorbia. There is a large courtyard and an inner fence secludes the living quarters, where there is a separate house for bachelors. The royal residence is a larger and more elaborate structure, including a house for pages, another for especially favoured wives, another for women who attend the ruler on his travels, a general house for the wives and a house for the wives who have borne children, all the houses being connected by covered passages. There would also be in the enclosure about a hundred other circular mud and wattle huts for women and attendants. The nomad herdsmen are content with much cruder huts and the bee-hive huts of the Iro are of much smaller dimensions and are scattered singly or in groups in or near plantations.

Polygamy is permitted but monogamy is customary. Marriage is regulated by totemic clans, which are subdivided into sub-clans distinguished by secondary and tertiary totems, and marriage is permitted within the three main clans if at least one totem differs. Princes formerly practised complete clan endogamy. There is an elaborate ceremonial of blood-brotherhood. The ruler's mother and sister have a special importance, and while among the Ganda the *kabaka's* sister has to marry her half-brother, here the *mugabe's* sister may marry whom she likes. Hima women are fattened almost to immobility before marriage, which takes place early in life. Pre-nuptial chastity is essential, followed by considerable post-nuptial license, both among Hima and Iro. Daughters must be married in order of age. Inheritance is by bequest, but the heir must be a son, who inherits the wives as well as the property. Intestate property goes to the ruler.

The Hima live mainly on milk, meat and beer; the Iro on their agricultural products and wild game. Their weapons are throwing spears, small oval shields with a central boss of wood or iron, bows and slings. The Iro shield is slightly larger and is often made of hippopotamus hide instead of basketwork, and they carry clubs instead of slings.

Offerings of beer, milk and cattle are made to the sacred royal drums, which are the only drums in the tribe, and are kept in a special enclosure, which is a sanctuary for malefactors. Music is provided by a primitive harp and by water jars filled to different levels. The Iro use square-shaped canoes on the lake, constructed of wooden boards laced together, but without the Ganda keel or prow.

The *mugabe* or ruler (who used to be called *mukama* like the Nyoro ruler) is the centre of social and political life. He holds all the tribal land in trust and distributes estates to the chiefs and theoretically all property is his. Cattle may not be sold to anyone outside the tribe without his permission and herdsmen may only kill bull-calves up to a given number. All land is free to the cattle-owners and their herdsmen, and the Iro may cultivate where they like, but are attached to cowmen as their agricultural workers, a chief retaining as many as three hundred. The *mugabe* is an absolute ruler with autocratic powers which he may delegate to chiefs. Next in importance to him is his minister called *nganzi* or "favourite." There are 16 districts presided over by chiefs called *bakungu* or *abamangi,* who are appointed by the *mugabe* on his accession, each with a different title and special duties and status. The chiefs are always pastoral They settle disputes, keep peace and order, guard the royal cattle, and their sons act as pages at the *mugabe's* court. There are also inferior chiefs in each district who are almost independent of the *bakungu.* Pages who are too old for such service are appointed *galagwa,* a title which carries the rank of chief, are given estates, cows and serfs and form an autonomous community in each district. All taxation is in the hands of the *mugabe* who collects a percentage of cattle every year on all herds of 50 or more. The *mugabe* commits suicide by taking a special royal poison when too old or suffering from an incurable illness, and his widows are expected to commit suicide at his grave. The milk ceremonies are extremely important to the tribe and in them the *mugabe's* milk vessels play a dominant part.

There is no priestly caste or formulated religion. *Ruhanga,* the Creator, was probably an ancient hero or ruler and is reverenced with fourteen other sanctified kings, but neither these nor certain natural phenomena which are treated as divine, like *Omusisi* the Earthquake, have shrines or receive sacrifice. The ghosts or spirits of family ancestors are more important, and their religious eminence is recognized by family shrines, prayers and offerings. Spirits of dead rulers are supposed to enter lions. Rainmakers (*abaisi*) belong exclusively to the serf class, but they receive generous gifts not only from the Iro, but also from the Hima including the *mugabe* himself.

See Sir H. H. Johnston, *The Uganda Protectorate* (1902); J. Roscoe, *The Banyankole* (1923). (J. H. D.)

ANKYLOSIS or **ANCHYLOSIS,** a stiffness of a joint, the result of injury or disease. The rigidity may be complete or partial and may be due to inflammation of the tendinous or

muscular structures outside the joint or of the tissues of the joint itself. When the structures outside the joint are affected, the term "false" ankylosis has been used in contradistinction to "true" ankylosis, in which the disease is within the joint. When inflammation has caused the joint-ends of the bones to be fused together the ankylosis is termed *osseous* or complete. Excision of a completely ankylosed shoulder or elbow may restore free mobility and usefulness to the limb. "Ankylosis" is also used as an anatomical term, bones being said to ankylose when, from being originally distinct, they coalesce, or become so joined together that no motion can take place between them.

ANKYLOSTOMIASIS or **ANCHYLOSTOMIASIS** is also called helminthiasis, "miner's anaemia," and in Germany *Wurmkrankheit*. (*See* HOOKWORM.)

ANNA, BALDASARRE, Italian painter, who flourished during part of the 16th and 17th centuries, was born at Venice, probably about 1560, and seems to have been alive in 1639. He studied under Leonardo Corona, and completed several works left unfinished by him. The old guide-books and descriptions of Venice notice a considerable number of paintings by him. Scarcely any of these, however, have survived.

ANNA (Hindustani *Ana*), an Indian penny, the 16th part of a rupee. The term belongs to the Mohammedan monetary system (*see* RUPEE). There is no coin of one anna, but there are half-annas of copper and two-anna pieces of silver. The term anna is frequently used to express a fraction. Thus an Anglo-Indian speaks of two annas of dark blood (an octoroon), a four-anna (quarter) crop, an eight-anna (half) gallop.

ANNA AMALIA (1739–1807), duchess of Saxe-Weimar, daughter of Charles I., duke of Brunswick-Wolfenbüttel, was born at Wolfenbüttel on Oct. 24, 1739, and married Ernest, duke of Saxe-Weimar, 1756. Her husband died in 1758, leaving her regent for their infant son, Charles Augustus. She was a patroness of art and literature and attracted to Weimar many of the most eminent men in Germany. Wieland was appointed tutor to her son, and the names of Herder, Goethe, and Schiller shed an undying lustre on her court. In 1775 she retired into private life, her son having attained his majority. In 1788 she set out on a lengthened tour through Italy, accompanied by Goethe. She died on April 10, 1807. A memorial of the duchess is included in Goethe's works under the title *Zum Andenken der Fürstin Anna-Amalia.*

See F. Bornhak, *Anna Amalia, Herzogin von Saxe-Weimar-Eisenach* (1892).

ANNABERG, a town in the republic of Saxony, Germany, in the Erzgebirge, 1,894ft. above the sea, 18m. S. by E. of Chemnitz. Pop. (1925) 18,204. The Annenkirche (1499–1525) possesses fine sculptures and early 16th century works of art. Annaberg, together with the suburb of Buchholz, is the chief seat of the braid and lace-making industry in Germany, and makes cardboard boxes, buttons, silk goods, etc.; the industry was introduced here by Barbara Uttmann in 1561, and further developed by Belgian refugees, who settled here in 1590. The mining of tin, silver and cobalt has now ceased.

ANNABERGITE, a mineral consisting of a hydrous nickel arsenate, $Ni_3(AsO_4)_2+8H_2O$, crystallizing in the monoclinic system. Crystals are minute and capillary and rarely met with, the mineral occurring usually as soft earthy masses and incrustations. A fine apple-green colour is its characteristic feature. It was long known under the name nickel-ochre; the name annabergite being from Annaberg in Saxony, one of the localities of the mineral.

ANNA COMNENA, Byzantine historian, daughter of the Emperor Alexius I. Comnenus, was born on Dec. 1 1083. She was carefully trained in the study of poetry, science and Greek philosophy. She united with the Empress Irene in a vain attempt to prevail upon her father during his last illness to disinherit his son and give the crown to her husband, Nicephorus Bryennius. She then conspired to depose her brother after his accession; and when her husband refused to join in the enterprise, she exclaimed that "nature had mistaken their sexes, for he ought to have been the woman." The plot being discovered, Anna forfeited her property and fortune. Shortly afterwards, she retired into a convent and employed her leisure in writing the *Alexiad*—a history, in Greek, of her father's life and reign (1081–1118), supplementing the historical work of her husband. It is rather a family panegyric than a scientific history. Anna died in 1148.

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ANNA LEOPOLDOVNA, sometimes called ANNA CARLOVNA (1718–1746), duchess of Brunswick, regent of Russia for a few months during the minority of her son Ivan, was the daughter of Catherine, sister of the empress Anne, and Charles Leopold, duke of Mecklenburg-Schwerin. In 1739 she married Prince Antony Ulrich of Brunswick-Wolfenbüttel, son of Ferdinand Albert, duke of Brunswick, and their son Ivan was adopted in 1740 by the empress and proclaimed heir to the Russian throne. A few days after the proclamation the empress died, leaving directions regarding the succession and appointing her favourite Ernest Biren, duke of Courland, as regent. Biren was detested by the Russian people, and Anna assumed the regency. In Dec. 1741, Elizabeth, daughter of Peter the Great, excited the guards to revolt, overcame the slight opposition that was offered, and was proclaimed empress. Ivan was thrown into prison, where he soon afterwards perished. Anna and her husband were banished to a small island in the river Dvina, where on March 18, 1746, she died in childbed.

ANNALISTS, writers of annals (*annales*, chronicles, properly year-books); a name commonly given to a group of Roman writers to whom is due the formation of the conventional history of Rome from the earliest times. It is alleged that from the beginning it was customary to keep a record of all important events; that these records, restored as far as possible after the Gaulish invasion, were continued down to the pontificate of P. Mucius Scaevola; and that the 80 books of the *annales maximi* embodied the substance of them. In modern times, great and well-founded doubt has been expressed as to the age and accuracy of these supposed chronicles (*cf.* ROMAN HISTORY: *Authorities*). At all events, the oldest annalists, from the time of the Second Punic War, used such public records as they could find, supplementing them with family traditions and, in all probability, filling gaps largely from their own or their Greek preceptors' imaginations, since Rome seems to have been extraordinarily poor in sagas and myths of all kinds. In course of time a sort of orthodox pseudo-tradition grew up concerning the earliest history of Rome (*cf.* EVANDER, ROMULUS). The annalists may be divided into two groups, the earlier, from Fabius Pictor (*q.v.*) to Piso, being, on the evidence of Cicero (*de orat.*, ii. 53) very plain and unadorned in style, while the later, mostly of the time of Sulla, were more literary and rhetorical. Caelius Antipater (*see* below) seems to mark the turning-point; he had, says Cicero, little learning and no great stylistic ability, but he polished his work as well as he could. Some of the chief names are as follows: Q. Fabius Pictor and L. Cincius Alimentus, contemporaries of Hannibal, who took the latter prisoner; both wrote histories of Rome from the foundation to their own day, and both wrote in Greek. M. Porcius Cato (*q.v.*) who wrote in Latin; L. Cassius Hemina, about 146 B.C.; L. Calpurnius Piso Censorius Fruci, consul 133 B.C. It is noteworthy that Livy thinks him less trustworthy than Fabius, and that he is often cited for details plainly fictitious (*cf.* PISO). Of the later group Quintus Claudius Quadrigarius (about 80 B.C.) wrote a history, in at least 23 books, which began with the conquest of Rome by the Gauls and went down to the death of Sulla or perhaps later. He was freely used by Livy in part of his work (from the sixth book onwards). A long fragment is preserved in Aulus Gellius (ix. 13), giving an account of the single combat between Manlius Torquatus and the Gaul. His language was antiquated and his style dry, but his

work was considered important. Valerius Antias, a younger contemporary of Quadrigarius, wrote the history of Rome from the earliest times, in a voluminous work consisting of 75 books. He is notorious for his wilful exaggeration, both in narrative and numerical statements. Nevertheless, Livy at first made use of him as one of his chief authorities, until he became convinced of his untrustworthiness. C. Licinius Macer (died 66), who has been called the last of the annalists, wrote a voluminous work full of rhetoric and of authorities anything but certainly authentic. Having been convicted of extortion, he committed suicide (Cicero, *De Legibus*, i. 2, *Brutus*, 67; Plutarch, *Cicero*, 9).

The writers mentioned dealt with Roman history as a whole; some of the annalists, however, confined themselves to shorter periods. Thus, L. Caelius Antipater (about 120) limited himself to the Second Punic War. He was regarded as the most careful writer on the war with Hannibal, and one who did not allow himself to be blinded by partiality in considering the evidence of other writers (Cicero, *De Oratore*, ii. 12). Livy made great use of him in his third decade. Sempronius Asellio (about 100 B.C.) military tribune of Scipio Africanus at the siege of Numantia, composed *Rerum Gestarum Libri* in at least 14 books. As he himself took part in the events he describes, his work was a kind of memoirs. He was the first of his class who endeavoured to trace the causes of events, instead of contenting himself with a bare statement of facts. L. Cornelius Sisenna (119–67), wrote 23 books on the period between the Social War and the dictatorship of Sulla. His work was commended by Sallust (*Jugurtha*, 95), who, however, blames him for not speaking out sufficiently. Cicero remarks upon his fondness for archaisms (*Brutus*, 74, 259). Sisenna also translated the tales of Aristides of Miletus. The autobiography of Sulla may also be mentioned.

BIBLIOGRAPHY.—*Historicorum Romanorum Fragmenta* (1883). *See* also Fragments in H. Peter, *Historicorum Romanorum Reliquiae* (1870, 1906), and ROME, *History* (ancient) *ad. fin.*, section "Authorities," and LIVY, where the use made of the annalists by the historian is discussed; Pauly-Wissowa, *Realencyclopädie*, art. "Annales"; the histories of Roman Literature by Teuffel-Schwabe and Schanz-Hosius (bibl.)

(H. J. R.)

ANNALS, a concise historical record in which events are arranged chronologically, year by year (*annales*, from *annus*, a year). The chief sources of information about the annals of ancient Rome are two passages in Cicero (*De Oratore*, ii. 12, 52) and in Servius (*ad Aen.*, i. 373) which have been the subject of much discussion. Cicero states that from the earliest period down to the pontificate of Publius Mucius Scaevola (*c.* 131 B.C.) it was usual for the pontifex maximus to record on a white tablet (*album*), which was exhibited in an open place at his house, so that the people might read it, first, the name of the consuls and other magistrates, and then the noteworthy events that had occurred during the year (*per singulos dies*, as Servius says). These records were called in Cicero's time *Annales Maximi*. The nature of the distinction between annals and history is a subject that has received more attention from critics than its intrinsic importance deserves. The basis of discussion is furnished chiefly by the above-quoted passage from Cicero, and by the common division of the work of Tacitus into *Annales* and *Historiae*. Aulus Gellius, in the *Noctes Atticae* (v. 18), quotes the grammarian Verrius Flaccus to the effect that history, according to its etymology (ἱστορεῖν, *inspicere*, to inquire in person), is a record of events that have come under the author's own observation, while annals are a record of the events of earlier times arranged according to years. This view of the distinction seems to be borne out by the division of the work of Tacitus into the *Historiae*, relating the events of his own time, and the *Annales*, containing the history of earlier periods. It is more than questionable, however, whether Tacitus himself divided his work under these titles. The probability is, either that he called the whole *Annales*, or that he used neither designation.

In the middle ages, when the order of the liturgical feasts was partly determined by the date of Easter, the custom was early established in the Western Church of drawing up tables to indicate that date for a certain number of years or even centuries. These Paschal tables were thin books in which each annual date was separated from the next by a more or less considerable blank space in which the important events of the year were briefly noted. Among the Anglo-Saxons the compiling of these annals was begun at the end of the 7th century. Introduced by missionaries on the continent, they were augmented and continued, especially in the kingdom of Austrasia. In the 9th century, during the great movement termed the Carolingian Renaissance, these annals became the usual form of contemporary history; it suffices to mention the *Annales Einhardi*, the *Annales Laureshamenses* (or "of Lorsch"), and the *Annales S. Bertini*, officially compiled in order to preserve the memory of the more interesting acts of Charlemagne, his ancestors and his successors. Arrived at this stage of development, the annals now began to lose their primitive character, and henceforward became more and more indistinguishable from the chronicles.

In modern literature the title annals has been given to a large number of standard works which adhere more or less strictly to the order of years. The best known are the *Annales Ecclesiastici*, written by Cardinal Baronius as a rejoinder to and refutation of the *Historia ecclesiastica* or "Centuries" of the Protestant theologians of Magdeburg (Rome, 1788–93; Baronius's work stops at the year 1197). From the 19th century on the annalistic form has been again employed, either to preserve year by year the memory of passing events (*Annual Register*, *Annuaire de la Revue des deux mondes*, *The Year's Work in Classical Studies*, etc.) or in writing the history of obscure mediaeval periods (*Jahrbücher der deutschen Geschichte*, Richter's *Reichsannalen*, etc.).

ANNAM, a country of south-east Asia, the eastern coastal belt of the peninsula of Indo-China (*see* INDO-CHINA, FRENCH), forming a French protectorate with frontiers fixed by treaty (June 6, 1884). It is bounded on the north by Tongking, east and south-east by the China sea, south-west by Cochin China, and west by Cambodia and Laos. It is 750–800m. long and has an area of nearly 59,000sq.m. Pop. (1924) 5,171,986, with 2,466 Europeans, apart from the military. The north of Annam, with plains really belonging to the delta of the Red river, is but a prolongation of south Tongking; yet Annam has marked characteristics of its own in situation, climate and people, quite 90% of whom are indigenous.



AN ANNAMITE COMEDIAN OF TONGKING, INDO-CHINA, ATTIRED IN STAGE COSTUME

The country is traversed longitudinally by the Annamese cordillera which extends south from the high mass of Laos and bends eastward, just as the cordillera of Burma bends westward, under the influence of the Cambodian block between them. A granitic axis is flanked by ancient rocks; which again have Devonian or Carboniferous limestone on their flanks, and there are narrow strips of newer rock along the east coast, while the granitic rocks form most of the south coast and some vulcanicity is indicated. The dissection of the cordillera by rivers has produced the general form of a high axis with high coastward projecting buttresses that separate successive valleys and actually reach the coast here and there. Broadly, the lower ends of the rivers are often consequent, *i.e.*, at right angles to the high axis, but they have worked back into the cordillera and have subsequent, or longitudinal, sections parallel to the axis. As a result of dissection there are fragments of chains in the north and larger plateaux in the south, and some high peaks (Pu Hak, 6,560ft., Pu Atwat, 8,200ft., Mother and Child, 6,888ft.) delimited by deep valleys. The general slope to the east is far sharper than that to the west, and the rivers are short, with courses broken by many rapids. The different parts of the coastal zone are linked by cols such as the Assam Gate (390ft.) in the north, the Col des Nuages (1,540ft.) in the centre and the Deo Ca (1,310ft.) in the south. Apart from the fine Tourane bay the coast has little shelter; it is low and flat to Cape Mui-Dong, which stands out; beyond this it remains flat and alluvial southward to Cape Chu May. South again it is more

irregular, and very irregular in the far south, but the bays there are too open to offer good anchorage.

The climate is monsoonal, but the period of the south-west monsoon (mid-April to the end of August), blowing from the land to the sea, is the dry season, with temperatures averaging 82° to 86°, whereas the period of the north-east monsoon (September to April), blowing off the China sea, is the wet season, with temperatures averaging about 73°. Typhoons are very frequent, coming almost due west from the sea, and usually following a more southerly course when the sun is far south. The rainfall is about 70in. per annum.

The cultivation of rice, chiefly in the small deltas along the coast, in some places gives two crops per annum, and constitutes the country's chief harvest. Other vegetable products include maize, tea, tobacco, cotton, precious woods, spices, dyes, drugs and sugar cane. Rubber (*Hevea*) cultivation occupies about 10 sq.m. in the south. As the mulberry is indigenous, silkworm rearing is very old established. Primitive methods of exploitation are being improved; there are about 11sq.m. of mulberry trees with a production of 920,000kg. of cocoons. Annam exported 2,577,937 francs worth of raw silk and 1,872,700 francs worth of silk tissues in 1924. In 1920 there were 461,333 head of cattle in Annam.

There is a coalfield at Nong Son near Tourane. Gold, silver, copper, zinc, lead, iron and other metals are frequently met with in the mountains, and there is an important haematite seam at Thanhhoa. There are also numerous salt works. Fisheries are an important native industry, and dried fish and rice are the mainstays of the native diet. Trade is mostly by sea and uses chiefly the port of Tourane (pop 25,000). The total tonnage of the port is said to be 843,906 including the boats of the French companies: Chargeurs Réunis and Messageries Maritimes. The imports (49,298,171 francs in 1925) include cotton yarn, cottons, tea, petroleum, paper goods and tobacco. Exports (40,620,041 francs in 1925) are sugar, rice, cotton and silk tissues, cinnamon, tea and paper. The ports of Tourane, Kwi-Nhon and Xuan (Chuan) Day bay are open to European commerce; and the customs revenue is ceded to France.

Annam is ruled in theory by its emperor, assisted by the "comat" or secret council, composed of the ministers of the interior, finance, war, ritual, justice and public works nominated by himself. The French resident superior, at Hué (pop. 60,611), is the virtual ruler and advises the emperor with the help of a council (*conseil de protectorat*). Local administration is in the hands of mandarins chosen by competitive examination. In the province of Tourane a French tribunal alone exercises jurisdiction, but it administers native law where natives are concerned. Outside this province native tribunals are maintained. The Annamese village is self-governing. It has its council of notables, forming a sort of oligarchy which, through the medium of a mayor and two subordinates, directs the interior affairs of the community—policing, recruiting, the assignment and collection of taxes, etc.—and has judicial power in less important suits and crimes. More serious cases come within the purview of the *an-sat*, a judicial auxiliary of the governor. An assembly of notables from villages grouped together in a canton chooses a cantonal representative, who is the mouthpiece of the people and the intermediary between the Government and its subjects. The direct taxes, which go to the local budget of Annam, consist primarily of a poll-tax levied on all males over 18 and below 60 years of age, and of a land-tax levied according to the quality and the produce of the holding. Native collaboration in administration is secured to a considerable extent and the French are working for the increase of that collaboration in economic, political and administrative matters. A chamber of representatives of the people was established in 1926. Education is both French and Franco-Annamese and is considerably developed.

The coastal mandarin road, 1,200km. long, is the chief means of communication, linking all the chief towns. Vinh in the north is linked by rail with Hanoi, the capital of Tongking, and is the starting place of roads into Laos. Phan-Tiet, Phan-Rang, with irrigated areas near by, and Nha-Trang are linked by rail with Saigon, the capital of Cambodia. Bhin-Dinh, the largest town, has 70,000 people, and is near the open port of Kwi-Nhon. Tourane has a railway to Hué and beyond, towards Dong-Hoi. Fai-Fo is a little south of Tourane.

History.—The ancient tribe of the Giao-Chi, on the confines of South China and in what is now Tongking and northern Annam, are regarded by the Annamese as their ancestors, and tradition ascribes to their first rulers descent from the Chinese imperial family. These sovereigns were succeeded by another dynasty, during whose rule, at the end of the 3rd century B.C., the Chinese invaded the country, and eventually established there a supremacy destined to last, with little interruption, till the 10th century A.D. In 968 Dinh-Bo-Lanh succeeded in ousting the Chinese and founded an independent dynasty of Dinh. Till this period the greater part of Annam had been occupied by the Chams, a nation of Hindu civilization, which has left many monuments to testify to its greatness, but the encroachment of the Annamese during the next six centuries at last left to it only a small territory in the south of the country. About 1407 Annam again fell under the Chinese yoke. In 1428 an Annamese general Lê-Loi succeeded in freeing the country once more, and founded a dynasty which lasted till the end of the 18th century. During the greater part of this period, however, the titular sovereigns were mere puppets, the real power being in the hands of the family of Trinh in Tongking and that of Nguyen in southern Annam, which in 1568 became a separate principality under the name of Cochin-China. Towards the end of the 18th century a rebellion overthrew the Nguyen, but one of its members, Gia-long, by the aid of a French force, in 1801 acquired sway over the whole of Annam, Tongking and Cochin-China. This force was procured for him by Pigneau de Béhaine, bishop of Adran, who saw in the political condition of Annam a means of establishing French influence in Indo-China. Before this, in 1787, Gia-long had concluded a treaty with Louis XVI., whereby in return for a promise of aid he ceded Tourane and Pulo-Condore to the French. That treaty marks the beginning of French influence in Indo-China (*q.v.*).

See also Legrand de la Liraye, *Notes historiques sur la nation annamite* (1866?); E. Sombsthay, *Cours de législation et d'administration annamites* (1898); C. Gosselin, *L'Empire d'Annam* (1904).

ANNAN, royal and municipal burgh, Dumfriesshire, Scotland, on the Annan, nearly 2m. from its mouth and 15m. from Dumfries by the L.M.S.R. Pop. (1921) 3,928. There is a branch line from Kirtlebridge and a railway viaduct one mile long crosses the Solway Firth to Port Carlisle (Cumberland). The river Annan is crossed by a stone bridge (1824) and a railway bridge. The Harbour Trust, constituted in 1897, improved the shipping accommodation, giving 15ft. depth at high-water spring tides. The principal industries include bacon-curing, distilling, sandstone quarrying, corn-milling and nursery gardening. Large marine engineering works are in the vicinity. Roman remains exist in the neighbourhood. Edward Irving was a native of the town.

ANNA PERENNA, an old Roman deity of the circle or "ring" of the year, as the name (*per annum*) clearly indicates. Her festival, characterized by revelry and licentiousness, fell on the full moon of the first month (March 15), and was held at the grove of the goddess at the first milestone on the Via Flaminia. Sacrifice was offered to her "that the circle of the year might be happily completed." This is all we know for certain about the goddess and her cult; but the name naturally suggested myth-making, and Anna became a figure in stories in Ovid (*Fasti*, iii., 523 *et seq.*) and in Silius Italicus (viii. 50 *et seq.*). The coarse myth told by Ovid, in which Anna plays a trick on Mars when in love with Minerva, is probably an old Italian folk-tale.

ANNAPOLIS, a city and seaport of Maryland, U.S.A., the capital of the State, the county seat of Anne Arundel county, a port of entry of the Maryland customs district, and the seat of the United States Naval Academy; on the Severn river about 2m. from its entrance into Chesapeake bay, 26 m. south by east from Baltimore and about the same distance east by north from Washington. The population was 11,214 in 1920, of whom 2,954 were negroes; and was estimated at 12,833 in 1925.

Annapolis is one of the most picturesque and historically interesting cities of America. The grounds and buildings of the United States Naval Academy occupy a beautiful site of 200 ac. on the bank of the Severn. On an elevation near the centre of the city stands the State House (1772) with its lofty white dome and pillared portico. Nearby are the State Treasury, erected late in the 17th century for the house of delegates; and St. Anne's Protestant Episcopal church, which was a State church in the later colonial days. A number of residences dating from the 18th century still stand, and colonial associations are further preserved by the names of some of the principal streets, such as King George's, Prince George's, Hanover and Duke of Gloucester.

St. John's college (chartered 1784 as a continuation of King William's school, which had been founded by an act of the legislature in 1696) occupies a campus of 26 ac. adjoining the grounds of the Naval Academy. One of the trees on the campus is believed to be over 600 years old. The main building, McDowell Hall, was built in the 18th century to be the governor's mansion, and was the scene of many historic events. In 1926 the college acquired the Matthias Hammond House (or Harwood House), a beautiful example of the southern Georgian architecture, and has refurnished it as it was in 1774, to be kept as a museum. The college is a non-sectarian institution for men, limited to 400 students. The State offers scholarships to students from each of the counties of Maryland and from the city of Baltimore.

Annapolis was settled in 1649 by Puritan exiles from Virginia. At first it was called Providence; later, Town at Proctor's, Town at the Severn, and Anne Arundel Town; and in 1694 was named Annapolis, in honour of Princess Anne, then heir to the throne of Great Britain. In the same year it was made the seat of the new (royal) government. It was incorporated in 1708. From the middle of the 18th century until the Revolution it was noted for its wealthy and cultivated society, and had a considerable commerce, until Baltimore, in 1780, became a port of entry. Congress was in session in the State House from Nov. 26 1783 to June 3 1784; and it was here that Washington, on Dec. 23 1783, resigned his commission as commander-in-chief of the Continental Army. The "Annapolis Convention" of 1786 was a meeting to which all the States were invited to send delegates, to consider measures for the better regulation of commerce; but as only five States were represented (New York, Pennsylvania, Virginia, New Jersey and Delaware), the delegates merely passed a resolution calling for another convention to meet in Philadelphia the following year, to amend the articles of confederation; and it was this Philadelphia convention that framed the Constitution of the United States.

ANNAPOLIS CONVENTION, a gathering of delegates from several States, of great importance in the movement for a federal convention to revise the articles of confederation. From early colonial days there had been differences of opinion between citizens of Maryland and Virginia relative to the jurisdiction over the waters of Chesapeake Bay and the rivers common to both States. In March, 1785, commissioners representing Maryland and Virginia met at Alexandria for the purpose of arriving at some agreement for the regulation of trade upon these waters. After a session of four days they removed to Mt. Vernon where they finished drawing up a formal compact for joint control. On Dec. 5, 1785, the adhesion of Maryland to the compact was laid before the Virginia legislature, which thereupon promptly announced its approval. In the communication from the legislature of Maryland to the Virginia legislature, a proposal was made to invite commissioners from all the States to meet for the purpose of agreeing upon general commercial regulations. This led to the passage of the well-known resolution of the Virginia legislature (Jan. 21, 1786) which appointed commissioners to meet such commissioners as might be appointed by the other States in the Union to take into consideration the trade of the United States. In answer to this call, five States sent delegates to a convention to be held in Sept. 1786, in the city of Annapolis, Maryland. The States represented at the Annapolis convention were New York, New Jersey, Pennsylvania, Delaware and Virginia. The convention formally opened on Sept. 11, and adjourned on Sept. 14, 1786. New Jersey alone had been liberal in the matter of instructions. The delegates from the other States were given but little latitude as to their decisions. Because of these restrictions and also because less than half of the States were represented at Annapolis, it was soon apparent that the work of the convention could be merely of a preliminary character. On Sept. 14, the convention adopted an address framed by Alexander Hamilton which prepared the way for the federal convention of 1787. In a concluding paragraph, the delegates, "with the most respectful deference, beg leave to suggest their unanimous conviction, that it may essentially tend to advance the interests of the Union, if the States . . . would use their endeavors to procure the concurrence of the other States, in the appointment of commissioners, to meet at Philadelphia, on the second Monday in May next, to take into consideration the situation of the United States."

See J. Elliot, *Debates in the State Conventions* (1854); K. M. Rowland, *Life of George Mason* (1892); G. Bancroft, *History of the Formation of the Constitution* (1882); G. T. Curtis, *History of the Origin, Formation, and Adoption of the Constitution* (1854); and H. J. Ford, *Alexander Hamilton* (1920). (C. C. TA.)

ANNAPOLIS ROYAL, Nova Scotia, capital of Annapolis county and till 1750 of Nova Scotia; on an arm of the Bay of Fundy, at the mouth of the Annapolis river, 95m. W. of Halifax; on the main Canadian Pacific railway. Pop. (1921) 836. It is one of the oldest settlements in North America, founded in 1605 by the French, who called it Port Royal. It was captured by the British in 1710, ceded to them by the treaty of Utrecht in 1713, and renamed in honour of Queen Anne. Its good harbour and beautiful surroundings make it a summer resort. The town is surrounded by apple orchards; fruit is exported.

ANN ARBOR, a city of Michigan, U S A., on the Huron river, 38m. W. of Detroit; the county-seat of Washtenaw county. It is served by the Michigan Central and the Ann Arbor railways, and by electric trolley and motor-coach lines. The population was 19,516 in 1920, and was estimated locally at 30,000 in 1927.

Ann Arbor is the trade centre of a rich farming and fruit-growing region. The river provides good water-power, and there are substantial manufacturing industries. In 1925, 52 establishments produced commodities valued at $7,175,998, including auto-trucks and trailers, furniture, agricultural implements, pianos and organs, pottery and flour. The University of Michigan (*q.v.*) is situated there, and brings to the city a transient population of 12,000 or more in the course of the year. Catering to their needs gives employment, directly or indirectly, to a considerable part of the permanent population. As the university has no dormitories for men, and not enough for women, the single item of providing lodging for students deserves to be mentioned as a major industry.

Ann Arbor was settled, laid out, and chosen as the county-seat in 1824; incorporated as a village in 1833; and chartered as a city in 1851. It was named in honour of Ann Allen and Ann Rumsey, wives of two of the founders.

ANNATES, in the strictest sense of the word, the whole of the first year's profits of a spiritual benefice which, in all countries of the Roman obedience, were formerly paid into the papal treasury (Lat. *annatae,* from *annus,* year; also *primitiae,* first-fruits). This custom was only of gradual growth. It had its origin in the right of the bishop to claim the first year's profits of the living from a newly inducted incumbent, of which the first mention is found under Pope Honorius (d. 1227). The earliest records show the *annata* to have been, sometimes a privilege conceded to the bishop for a term of years, sometimes a right based on immemorial precedent. In course of time the popes, under stress of financial crises, claimed the privilege for themselves, though at first only temporarily. Thus, in 1305, Clement V. claimed the first-fruits of all vacant benefices in England, and in 1319 John XXII. those of all Christendom vacated within the next two years. In those cases the rights of the bishops were frankly usurped by the Holy See, now regarded as the ultimate source of the episcopal jurisdiction; the more usual custom was for the pope to claim the first-fruits only of those benefices of which he had reserved the patronage to himself. It was from these claims that the papal annates, in the strict sense, in course of time developed.

The system of annates was at no time worked with absolute

uniformity and completeness throughout the various parts of the church owning obedience to the Holy See, and it was never willingly submitted to by the clergy. Disagreements and disputes were continual, and the easy expedient of rewarding the officials of the Curia and increasing the papal revenue by "reserving" more and more benefices was met by repeated protests, such as that of the bishops and barons of England (the chief sufferers), headed by Robert Grosseteste of Lincoln, at the Council of Lyons in 1245. The subject, indeed, frequently became one of national interest, on account of the alarming amount of specie which was thus drained away, and hence numerous enactments exist in regard to it by the various national governments. In England the collection and payment of annates to the pope was prohibited in 1531 by statute. At that time the sum amounted to about £3,000 a year. In 1534 the annates were, along with the supremacy over the church in England, bestowed on the Crown; but in Feb. 1704 they were appropriated by Queen Anne to the assistance of the poorer clergy, and thus form what has since been known as "Queen Anne's Bounty" (q.v.).

ANNATTO (*anatto, arnotto*), a colouring matter produced from the seeds of *Bixa orellana* (family *Bixaceae*), a small tree which grows in Central and South America. The seeds are surrounded with a thin coating of a waxy pulp, which is separated from them by washing in water, passing the liquid through a sieve and allowing the suspended pulp to deposit. The water is then drained away and the paste dried, till it is a thick, stiff unctuous mass. In this state it has a dark orange-red colour and is known as "roll" or "flag" arnotto, according to the form in which it is put up; when further dried it is called "cake" arnotto. Arnotto is much used by South American Indians for painting their bodies; among civilized communities its principal use is for colouring butter, cheese and varnishes. It yields a fugitive bright orange colour, and is used alone, or with other dyes, in the dyeing of silks and in calico printing. It contains a yellow colouring matter, bixin, $C_{16}H_{20}O_2$.

ANNE (1693–1740), empress of Russia, second daughter of Ivan V., Peter the Great's imbecile brother, and Praskovia Saltuikova. Her girlhood was passed at Ismailovo near Moscow, with her mother, an ignorant, bigoted tsaritsa of the old school, who neglected and even hated her daughters. Peter acted as a second father to the Ivanovs, as Praskovia and her family were called. In 1710 he married Anne to Frederick William, duke of Courland, who died of surfeit on his journey home from St. Petersburg (Leningrad). The reluctant young widow was ordered to proceed on her way to Mittau to take over the government of Courland, with the Russian resident, Count Peter Bestuzhev, as her adviser. He was subsequently her lover, till supplanted by Biren (*q.v.*). Anne's residence at Mittau was embittered by the utter inadequacy of her revenue. On her acceptance of the Russian crown, as the next heir after the death of Peter II. (Jan. 30, 1730), she subscribed to nine articles which would have reduced her from an absolute to a very limited monarch. On Feb. 26 she made her public entry into Moscow under strict surveillance. On March 8 a *coup d'état,* engineered by a party of her personal friends, overthrew the supreme privy council and she was hailed as autocrat. Her government, though in many respects excellent, became at last universally unpopular. This was due in the main to the outrageous insolence of her all-powerful favourite Biren, who hated the Russian nobility and trampled upon them mercilessly. Fortunately foreign affairs and the army were in the able hands of two other foreigners, who thoroughly identified themselves with Russia, Andrei Osterman (*q.v.*) and Burkhardt Münnich (*q.v.*). The chief political events of the period were the War of the Polish Succession and the second[1] Crimean War. The former was caused by the reappearance of Stanislaus Leszczynski as a candidate for the Polish throne after the death of Augustus II. (Feb. 1, 1733). The interests of Russia would not permit her to recognize a candidate dependent directly on France and indirectly upon Sweden and Turkey, all three powers being at that time opposed to Russia's "system." She accordingly united with Austria to support the candidature of the late king's son, Augustus of Saxony. So far as Russia was concerned, the War of the Polish Succession was quickly over. Much more important was the Crimean War of 1736–39, which marks the beginning of that systematic struggle on the part of Russia to recover her natural and legitimate southern boundaries. It lasted four years and a half and cost her a hundred thousand men and millions of roubles, and, though invariably successful, she had to be content with the acquisition of a single city (Azov) with a small district at the mouth of the Don. Yet more had been gained than was immediately apparent. In the first place, it was the only war hitherto waged by Russia against Turkey which had not ended in crushing disaster. Münnich had at least dissipated the illusion of Ottoman invincibility and taught the Russian soldier that 100,000 janissaries and spahis were no match, in a fair field, for half that number of grenadiers and hussars. In the second place the Tatar hordes had been well nigh exterminated. In the third place Russia's signal and unexpected successes in the Steppe had immensely increased her prestige on the Continent. "This court begins to have a great deal to say in the affairs of Europe," remarked the English minister, Sir Claudius Rondeau, a year later.

The last days of Anne were absorbed by the endeavour to strengthen the position of the heir to the throne, the baby tsarevich Ivan, afterwards Ivan VI., the son of the empress's niece, Anna Leopoldovna, against the superior claims of her cousin the tsarevna Elizabeth. The empress herself died three months later (Oct. 28, 1740). Her last act was to appoint Biren regent during the infancy of her great-nephew.

Anne was a grim, sullen woman, frankly sensual, but as well-meaning as ignorance and vindictiveness would allow her to be. But she had much natural good sense, was a true friend and, in her more cheerful moments, an amiable companion. Lady Rondeau's portrait of the empress shows her to the best advantage.

See *Letters from a Lady who resided some years in Russia* (*i.e.*, Lady Rondeau) (1775); Christoph Hermann Manstein, *Mémoires sur la Russie* (Amsterdam, 1771; English edition, London, 1856); Gerhard Anton von Halem, *Lebensschreibung des Feldm. B. C. Grafen von Munnich* (Oldenburg, 1803); Claudius Rondeau, *Diplomatic Despatches from Russia, 1728–1739* (St. Petersburg, 1889–92); R. Nisbet Bain, *The Pupils of Peter the Great* (1897); also the chapter in his vol. vi. of the *Cambridge Modern History* (1925).

ANNE (1665–1714), queen of Great Britain and Ireland, second daughter of James, duke of York, afterwards James II., and of Anne Hyde, daughter of the 1st earl of Clarendon, was born on Feb. 6 1665. As a child she resided in France with her grandmother, Henrietta Maria, and, on her death, with her aunt, the duchess of Orleans, and returned to England in 1670. She was brought up, together with her sister Mary, by the direction of Charles II., as a strict Protestant, and as a child she made the friendship of Sarah Jennings (afterwards duchess of Marlborough). On July 28 1683 she married prince George of Denmark, brother of King Christian V., an unpopular union politically, but one of great domestic happiness, the prince and princess being conformable in temper and both preferring retirement and quiet to life in the great world. Sarah Churchill became Anne's lady of the bedchamber and intimate friend. All deference due to the princess's rank was abandoned and the two ladies called each other Mrs. Morley and Mrs. Freeman.

On Feb. 6, 1685, James became king of England. In 1687 a project of settling the crown on the princess, to the exclusion of Mary, on the condition of Anne's embracing Roman Catholicism failed, and beyond sending her books and papers, James appears to have made no attempt to coerce his daughter into a change of faith, and to have treated her with kindness. In any case the birth of his son, June 10 1688, made the religion of his daughters a matter of less importance. Anne was not present on the occasion, having gone to Bath. "I shall never now be satisfied," Anne wrote to Mary, "whether the child be true or false. It may be it is our brother, but God only knows . . one cannot help having a thousand fears and melancholy thoughts, but whatever changes may happen you shall ever find me firm to my religion and faithfully yours." In later years, however, she had no doubt that the Old Pretender was her brother.

[1] Vasily Golitsuin's expedition under the regency of Sophia was the first Crimean War (1687–89).

During the events immediately preceding the revolution Anne remained in seclusion. Though forbidden by James to pay Mary a projected visit in the spring of 1688, she corresponded with her, and was no doubt aware of William's plans. She refused to show any sympathy with the king after William had landed in November and wrote, with the advice of the Churchills, to the prince, declaring her approval of his action. Churchill abandoned the king on the 24th, Prince George on the 25th, and when James returned to London on the 26th he found that Anne and her lady-in-waiting had escaped from Whitehall. They arrived on Dec. 1 at Nottingham, where the princess first made herself known and appointed a council. She returned to London on Dec. 19, when she was at once visited by William. Subsequently the Declaration of Rights settled the succession of the crown upon her after William and Mary and their children.

Meanwhile Anne had suffered a series of maternal disappointments. Between 1684 and 1688 she had miscarried four times and given birth to two children who died infants. On July 24 1689, however, the birth of a son, William, created duke of Gloucester, who survived his infancy, gave hopes that heirs to the throne under the Bill of Rights might be forthcoming. But Anne's happiness was soon troubled by quarrels with the king and queen.

According to the Duchess of Marlborough the two sisters, who had lived hitherto while apart on extremely affectionate terms, found no enjoyment in each other's society. Mary talked too much for Anne's comfort, and Anne too little for Mary's satisfaction. But money appears to have been the first cause of ill-feeling. The granting away by William of the private estate of James, amounting to £22,000 a year, to which Anne had some claim, was a grievance, and a motion brought forward in the House to increase her civil list pension of £30,000, which she enjoyed in addition to £20,000 under her marriage settlement, greatly displeased William and Mary, who regarded it as a plot to make Anne independent and the chief of a separate interest in the state. The Marlboroughs had been active in the affair and had benefited by it, the countess (as she then was) receiving a pension of £1,000. At the close of 1691 Anne had declared her approval of the naval expedition in favour of her father, and expressed grief at its failure The same year the breach between the royal sisters was made final by the dismissal of Marlborough, justly suspected of Jacobite intrigues, from all his appointments. Anne took the part of her favourites with great zeal against the court, though in all probability unaware of Marlborough's treason; she refused to part with the duchess, and retired with Lady Marlborough to the duke of Somerset's residence at Sion House. Anne was now in disgrace. In May, Marlborough was arrested on a charge of high treason which subsequently broke down, and Anne persisted in regarding his disgrace as a personal injury to herself. In Aug. 1693, however, the two sisters were temporarily reconciled, and on the occasion of Mary's last illness and death Anne showed an affectionate consideration.

The death of Mary weakened William's position and made it necessary to cultivate good relations with the princess. She was now treated with every honour and civility, and finally established with her own court at St. James's Palace. At the same time William kept her in the background and refrained from appointing her regent during his absence. In March 1695 after the reinstatement of Marlborough at court Anne gave her support to William's government. Meanwhile, since the birth of the duke of Gloucester, the princess had experienced six more miscarriages, and had given birth to two children who only survived a few hours, and the last maternal hope flickered out on the death of the young prince on July 29 1700. In default of her own issue, Anne's personal choice would probably have inclined at this time to her own family at St. Germains, but she acquiesced in the act of Settlement in 1701 and the substitution of the Hanoverian branch.

On March 8 1702, Anne became, by King William's death, queen of Great Britain, being crowned on April 23. Her reign was destined to be one of the most brilliant in the annals of England.

In her first speech to Parliament, like George III. afterwards, Anne declared her "heart to be entirely English," words which were resented by some as a reflection on the late king. A ministry, mostly Tory, with Godolphin at its head, was established. She obtained a grant of £700,000 a year, and hastened to bestow a pension of £100,000 on her husband, whom she created generalissimo of her forces and lord high admiral, while Marlborough obtained the Garter, with the captain-generalship and other prizes, including a dukedom, and the duchess was made mistress of the robes with the control of the privy purse.

The queen showed from the first a strong interest in church matters, and declared her intention to keep church appointments in her own hands.

She detested equally Roman Catholics and dissenters, showed a strong leaning towards the high-church party, and gave zealous support to the bill forbidding occasional conformity. In 1704 she announced to the Commons her intention of granting to the church the Crown revenues, amounting to about £16,000 or £17,000 a year, from tenths and first-fruits (paid originally by the clergy to the Pope, but appropriated by the Crown in 1534), for the increase of poor livings; her gift, under the name of "Queen Anne's Bounty," still remaining as a testimony of her piety. This devotion to the church, the strongest of all motives in Anne's conduct, dictated her hesitating attitude towards the two great parties in the state. The Tories had for this reason her personal preference, while the Whigs, who included her powerful favourites the Marlboroughs, identified their interests with the war and its glorious successes, the queen slowly and unwillingly, but inevitably, gravitating towards the latter.

In 1704 Anne acquiesced in the resignation of Lord Nottingham, the leader of the high Tory party. In the same year the great victory of Blenheim further consolidated the power of the Whigs and increased the influence of Marlborough, but she long resisted the influence and claims of the *Junta*, as the Whig leaders, Somers, Halifax, Orford, Wharton and Sunderland, were named. Marlborough's successive victories, and the factious conduct of the Tories, who in Nov. 1705 moved in Parliament that the Electress Sophia should be invited to England, drove Anne farther to the side of the Whigs. But she opposed for some time the inclusion in the government of Sunderland, yielded, after a struggle, and only to the appointment of Whigs to bishoprics. In 1708 she was forced to dismiss Harley, who, with the aid of Mrs. Masham, had been intriguing against the government and projecting the creation of a third party. Abigail Hill, Mrs. Masham, a cousin of the duchess of Marlborough, had been introduced by the latter as a poor relation into Anne's service, while still princess of Denmark. The queen found relief in the quiet and respectful demeanour of her attendant, and gradually came to prefer her society to that of the termagant and tempestuous duchess. In the summer of 1707 the duchess discovered to her indignation that her protégée had already undermined her influence with the queen, and had become the instrument of Harley's intrigue.

Even after his retirement, Harley remained Anne's secret adviser and supporter against the faction and the duchess never regained her former influence. The inclusion in the cabinet of Somers, whom she especially disliked as the hostile critic of Prince George's Admiralty administration, was the subject of another prolonged struggle, ending again in the queen's submission after a futile appeal to Marlborough in Oct. 1708, to which she brought herself only to avoid a motion from the Whigs for the removal of the prince, then actually on his deathbed. He died Oct. 28. But no reconciliation with the duchess took place. The queen showed her antagonism to the Whig administration on the occasion of the prosecution of Sacheverell. She was present at his trial, and gave him, immediately on the expiration of his sentence, the living of St. Andrew's, Holborn. Subsequently the duchess, in a final interview which she had forced upon the queen, found her tears and reproaches unavailing. The fall of the Whigs followed.

The queen rejoiced at being freed from what she called a long captivity, and the new Parliament was returned with a Tory majority. On Jan. 17 1711, in spite of Marlborough's efforts to ward off the blow, the duchess was compelled to give up her key

of office. The Queen was now able once more to indulge in her favourite patronage of the church, and by her influence an act was passed in 1712 for building 50 new churches in London. Later, in 1714, she approved of the Schism Bill. She gave strong support to Harley, now earl of Oxford and lord treasurer, in the intrigues and negotiations for peace. To break down the opposition to the terms of the peace of Utrecht Marlborough was dismissed on the 31st from all his employments, while the House of Lords was "swamped" by Anne's creation of 12 peers, including Mrs. Masham's husband. The Queen's conduct was generally approved, for the nation was now violently adverse to the Whigs and war party; and the peace of Utrecht was finally signed on March 31 1713, and proclaimed on May 5 in London.

As the Queen's reign drew to its close, rumours were rife on the subject of the succession to the throne. Both Oxford and Bolingbroke were in communication with the Pretender's party, and on July 27 Oxford, who had gradually lost influence and quarrelled with Bolingbroke, resigned, leaving the supreme power in the hands of Bolingbroke. Anne herself had a natural feeling for her brother. On March 3 1714 James wrote to Anne, Oxford and Bolingbroke, promising, on the condition of his recognition, to make no further attempts against the Queen's Government; and in April a report was circulated in Holland that Anne had secretly determined to associate James with her in the Government. The wish expressed by the Whigs, that a member of the electoral family should be invited to England, had already aroused the Queen's indignation in 1708; and now, in 1714, a writ of summons for the electoral prince as Duke of Cambridge having been obtained, Anne forbade the Hanoverian envoy, Baron Schütz, her presence, and declared all who supported the project her enemies; while to a memorial on the same subject from the Electress Sophia and her grandson in May, Anne replied in an angry letter.

These demonstrations, however, were the outcome merely of her intense dislike of any "successor," "it being a thing I cannot bear to have any successor here though but for a week"; and it is certain that religion and political wisdom kept Anne firm to the Protestant succession. A proclamation was issued (June 23) for the apprehension of James. On April 27, Anne gave a solemn assurance of her fidelity to the Hanoverian succession to Sir William Dawes, Archbishop of York; in June she sent Lord Clarendon to Hanover to satisfy the elector.

The sudden illness and death of the Queen now frustrated any schemes which Bolingbroke or others might have been contemplating. Anne was seized with fatal illness on retiring from a council meeting at two o'clock in the morning. The final act of her life was to secure the Revolution settlement and the Protestant succession. During a last moment of returning consciousness, she placed the lord treasurer's staff in the hands of the Whig duke of Shrewsbury, and measures were immediately taken for assuring the succession of the elector. Her death took place on Aug. 1. She was buried on the south side of Henry VII.'s chapel in Westminster Abbey, in the same tomb as her husband and children. The elector of Hanover, George Louis, son of the Electress Sophia (daughter of Elizabeth, daughter of James I.), peacefully succeeded to the throne as George I. (q.v.).

According to her physician Arbuthnot, Anne's life was shortened by the "scene of contention among her servants. I believe sleep was never more welcome to a weary traveller than death was to her."

By character and temperament unfitted to stand alone, her life had been unhappy and tragical from its isolation. Separated in early years from her parents and sister, her one great friendship had proved only baneful and ensnaring. Marriage had only brought a mournful series of infant funerals. Constant ill-health and suffering had darkened her career. The claims of family attachment, of religion, of duty, of patriotism and of interest, had dragged her in opposite directions, and her whole life had been a prey to jealousies and factions which closed around her at her accession to the throne, and surged to their height when she lay on her deathbed. The modern theory of the relations between the sovereign and the parties, had not then been invented; and Anne, like her Hanoverian successors, maintained the struggle, though without success, to rule independently, finding support in Harley. Her motive for getting rid of the Whigs was not any real dislike of their administration, but the wish to escape from the domination of the party[1], and on the advent to power of the Tories she carefully left some Whigs in their employments, with the aim of breaking up the party system and acting upon what was called "a moderate scheme."

Anne was a woman of small ability, of dull mind, and of that kind of obstinacy which accompanies weakness of character. According to the duchess she had "a certain knack of sticking to what had been dictated to her to a degree often very disagreeable, and without the least sign of understanding or judgment."[2] "I desire you would not have so ill an opinion of me," Anne writes to Oxford, "as to think when I have determined anything in my mind I will alter it."[3] Burnet considered that "she laid down the splendour of a court too much," which was "as it were abandoned." She dined alone after her husband's death, but it was reported by no means abstemiously, the royal family being characterized in the lines:—

> King William thinks all,
> Queen Mary talks all,
> Prince George drinks all,
> And Princess Anne eats all.[4]

She took no interest in the art, the drama or the literature of her day. But she possessed the homely virtues; she was deeply religious, attached to the Church of England and concerned for the efficiency of the ministry. One of the first acts of her reign was a proclamation against vice, and Lord Chesterfield regretted the strict morality of her court. Instances abound of her kindness and consideration for others. Her moderation towards the Jacobites in Scotland, after the Pretender's expedition in 1708, was much praised by Saint Simon.

According to her small ability she served the State well, and was zealous and conscientious in the fulfilment of public duties. Marlborough testifies to her energy in finding money for the war. She surrendered £10,000 a year for public purposes, and in 1706 she presented £30,000 to the officers and soldiers who had lost their horses.

Anne's husband, Prince George (1653–1708), was the second son of Frederick III., king of Denmark. Before marrying Anne he had been a candidate for the throne of Poland. He was created earl of Kendal and duke of Cumberland in 1689.

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[1] *See* Bolingbroke's *Letter to Sir W. Wyndham.*
[2] *Private Correspondence,* ii. 120.
[3] *Hist. MSS. Comm., MSS. of Marq. of Bath at Longleat,* i. 237.
[4] *Notes and Queries,* xi. 254.

of Queen Anne's Bounty (1867); *Somers Tracts*, xii. xiii. (1814–15); H. Paul, *Queen Anne* (London, 1907). (P. C. Y., X.)

ANNE OF BRITTANY (1477–1514), duchess of Brittany and queen consort of France, daughter of Francis II., duke of Brittany, and Marguerite de Foix. She was scarcely 12 years old when she succeeded her father as duchess, Sept. 9 1488. Charles VIII. aimed at establishing his authority over her; Alain d'Albret wished to marry her; Jean de Rohan claimed the duchy; and her guardian, the marshal de Rieux, was soon in open revolt against his sovereign. In 1489 the French Army invaded Brittany.

In order to protect her independence, Anne concluded an alliance with Maximilian of Austria, who married her by proxy (Dec. 1490). But Maximilian was immersed in Austrian affairs and could not defend his bride, and in 1491 the young duchess was besieged at Rennes, and compelled to treat with Charles VIII. The terms of peace included the rupture of her marriage with Maximilian, and marriage with Charles. The two sovereigns made a reciprocal arrangement as to their rights and pretensions to the crown of Brittany, but in the event of Charles predeceasing her, Anne undertook to marry the heir to the throne. Nevertheless, in 1492, after the conspiracy of Jean de Rohan, who had endeavoured to hand over the duchy to the king of England, Charles VIII. confirmed the privileges of Brittany, and in particular guaranteed to the Bretons the right of paying only those taxes to which the Assembly of Estates consented.

After the death of Charles VIII. in 1498, without issue, Anne ruled in Brittany, and in Jan. 1499 she married Louis XII., who had just repudiated Joan of France. The marriage contract was ostensibly directed in favour of the independence of Brittany, for it declared that Brittany should revert to the second son or to the eldest daughter of the two sovereigns, and, failing issue, to the natural heirs of the duchess. Until her death Anne occupied herself personally with the administration of the duchy. In 1504 she made an agreement for the marriage of her daughter, Claude of France, to Charles of Austria (the future Emperor Charles V.). But this unpopular agreement was broken and the queen had to consent to the betrothal of Claude to Francis of Angoulême, who in 1515 became king of France as Francis I. Thus the way was prepared for the definitive reunion of Brittany and France.

See A. de la Borderie, *Choix de documents inédits sur le règne de la duchesse Anne en Bretagne* (Rennes, 1866 and 1902)—extracts from the *Mémoires de la Société Archéologique du département d'Ille-et-Vilaine*, vol. iv. and vi. (1866 and 1868); P. A. N. B. Daru, *Histoire de Bretagne* (1816); Leroux de Lincy, *Vie de la reine Anne de Bretagne* (1860–61); A. Dupuy, *Histoire de La Réunion de la Bretagne à la France* (1880); A. de la Borderie, *La Bretagne aux derniers siècles du moyen âge* (1893), and *La Bretagne aux temps modernes* (1894). (H. S.)

ANNE OF CLEVES (1515–1557), fourth wife of Henry VIII., king of England, daughter of John, duke of Cleves, and Mary, only daughter of William, duke of Juliers, was born on Sept. 22, 1515. Her father was the leader of the German Protestants, and the princess, after the death of Jane Seymour, was regarded by Cromwell as a suitable wife for Henry VIII. She had been brought up in a narrow retirement, could speak no language but her own, had no looks, no accomplishments and no dowry, her only recommendations being her proficiency in needlework and her meek and gentle temper. The marriage treaty was signed on Sept. 24, 1539. The princess landed at Deal on Dec. 27; Henry met her at Rochester on Jan. 1, 1540. The next day he expressed openly his dissatisfaction at her looks; "she was no better than a Flanders mare." The attempt to prove a pre-contract with the son of the duke of Lorraine broke down. On the wedding morning, however, Jan. 6, 1540, he declared that no earthly thing would have induced him to marry her but the fear of driving the duke of Cleves into the arms of the emperor. Shortly afterwards Henry had reason to regret the policy which had identified him so closely with the German Protestantism and denied reconciliation with the emperor. Henry then declared the marriage had not been and could not be consummated, and did not scruple to cast doubts on his wife's honour. On July 9 the marriage was declared null and void by convocation and, subsequently, by an act of parliament. Anne spent the rest of her life happily in England at Richmond or Bletchingley, occasionally visiting the court, and being described as joyous as ever and wearing new dresses every day. She died on July 28, 1557, at Chelsea, and was buried in Westminster Abbey.

See A. Strickland, *Lives of the Queens of England*, iii. (1851); *Four Original Documents relating to the Marriage of Henry VIII. to Anne of Cleves*, ed. by E. and G. Goldsmid (1884); M. Hume, *The Wives of Henry VIII.* (1905); A. F. Pollard, *Henry VIII.* (1905); for the pseudo Anne of Cleves see *Allgemeine deutsche Biographie*, i. 467. A miniature by Holbein is in South Kensington Museum.

ANNE OF DENMARK (1574–1619), queen of James I. of England and VI. of Scotland, daughter of King Frederick II. of Denmark and Norway and of Sophia, daughter of Ulric III., duke of Mecklenburg, was born on Dec. 12 1574. On Aug. 20 1589, in spite of Queen Elizabeth's opposition, she was married by proxy to King James, without dower, the alliance, however, settling definitely the Scottish claims to the Orkney and Shetland islands. The birth of an heir to the throne (Prince Henry) in 1594 strengthened her position and influence; but the young prince was immediately withdrawn from her care and entrusted to the keeping of the Earl and Countess of Mar at Stirling Castle; in 1595 James gave a written command, forbidding them in case of his death to give up the prince to the queen till he reached the age of 18 years.

On the death of Queen Elizabeth, on March 24 1603, Anne took advantage of James's absence to demand possession of the prince, and, at the "flat refusal" of the Countess of Mar, fell into a passion, the violence of which occasioned a miscarriage and endangered her life. In June she followed the King to England with the prince and the coffin containing the body of her dead infant, and reached Windsor on July 2.

On July 24 Anne was crowned with the King, when her refusal to take the sacrament according to the Anglican use created some sensation. Notwithstanding religious differences she lived in great harmony and affection with the King, latterly, however, residing mostly apart. She helped to raise Buckingham to power in the place of Somerset, maintained friendly relations with him, and approved of his guidance and control of the King. In spite of her birth and family she was at first favourably inclined to Spain, disapproved of her daughter Elizabeth's marriage with the elector palatine, and supported the Spanish marriages for her sons, but subsequently veered around towards France.

She used all her influence in favour of the unfortunate Raleigh, answering his petition to her for protection with a personal letter of appeal to Buckingham to save his life. Her interest in State matters was only occasional, and secondary to the preoccupations of court festivities, dresses, jewels, which she much enjoyed; the court being, says Wilson—whose severity cannot entirely suppress his admiration—"a continued maskarado, where she and her ladies, like so many nymphs or Nereides, appeared . . . to the ravishment of the beholders," and "made the night more glorious than the day." Her extravagant expenditure, returned by Chamberlain at her death at more than £84,000, was unfavourably contrasted with the economy of Queen Elizabeth; her debts in 1616 were reckoned at nearly £10,000, while her jewellery and her plate were valued at her death at nearly £500,000. Anne died after a long illness on March 2 1619, and was buried in Westminster Abbey. She was generally regretted. She was intelligent and tactful, a faithful wife, a devoted mother, and a staunch friend. Besides several children who died in infancy she had Henry, Prince of Wales, who died in 1612, Charles, afterwards King Charles I., and Elizabeth, electress palatine and queen of Bohemia.

BIBLIOGRAPHY.—*See* Dr. A. W. Ward's article in the *Dict. of Nat. Biography*, with authorities; *Lives of the Queens of England*, by A. Strickland (1844), vii.; "Life and Reign of King James I.," by A. Wilson, in *History of England* (1706); *Istoria del Granducato di Toscana*, by R. Galluzzi (1781), lib. vi. cap. ii.; *Cal. of State Papers—Domestic and Venetian; Hist. mss. Comm. Series, mss. of Marq. of Salisbury*, iii. 420, 438, 454, ix. 54; *Harleian mss.* 5176, art. 22, 293, art. 106. Also *see* bibliography to the article on James I.

ANNE OF FRANCE (1460–1522), dame de Beaujeu, was the eldest daughter of Louis XI. and Charlotte of Savoy. Louis XI. betrothed her at first to Nicholas of Anjou, and afterwards offered her hand successively to Charles the Bold, to the duke of

Brittany, and even to his own brother, Charles of France. Finally she married Pierre de Beaujeu, a younger brother of the duke of Bourbon. Before his death Louis XI. entrusted to Pierre de Beaujeu and Anne the entire charge of his son, Charles VIII., a lad of 13; and from 1483 to 1492 the Beaujeus exercised a virtual regency. Anne was a true daughter of Louis XI. Energetic, obstinate, cunning and unscrupulous, she inherited, too, her father's avarice and rapacity.

Although they made some concessions, the Beaujeus succeeded in maintaining the results of the previous reign, and in triumphing over the feudal intrigues and coalitions, as was seen from the meeting of the Estates General in 1484, and the results of the "Mad War" (1485) and the war with Brittany (1488); and in spite of the efforts of Maximilian of Austria and Henry VII. of England they concluded the marriage of Charles VIII. and Anne, duchess of Brittany (1491). But a short time afterwards the king disengaged himself completely from their tutelage, to the great detriment of the kingdom. In 1488 Pierre de Beaujeu had succeeded to the Bourbonnais, the last great fief of France. He died in 1503, but Anne survived him 20 years. From her establishments at Moulins and Chantelle in the Bourbonnais she defended the Bourbon cause against the royal family.

Anne's only daughter, Suzanne, had married in 1505 her cousin, Charles of Bourbon, count of Montpensier, the future constable; and the question of the succession of Suzanne, who died in 1521, was the determining factor of the treason of the Constable de Bourbon (1523). Anne had died on Nov. 14 1522.

See P. Pelicier, *Essai sur le governement de la Dame de Beaujeu* (Chartres, 1882). (J. I.)

ANNEALING, a process of heating and cooling applied to glass and various metals and alloys, with the object of relieving stresses, or of altering the properties of the material. The result is softening, due to rearrangement. In its modern form the process is effected in closed furnaces. Another class of annealing is chemical in nature, being practised in the production of malleable iron castings. The chemical action occurs through the agency of substances, containing oxygen, packed with the castings in boxes and left for many days in the furnace. These substances extract the carbon from the castings.

Annealing Tool Steels.—Annealing becomes necessary for a variety of reasons in numerous manufactures. An early primary reason was and is to soften steel used to make tools, so that it can be cut, filed, turned, and so on, tools having no effect on hardened steel, though it may be ground with an abrasive wheel. Hence any hard bar or tool, if it cannot be worked up or sharpened by grinding, must be softened or annealed first. Bars and tools likewise require annealing after certain processes in manufacture, as casting, rolling, forging, and machining, in order to relieve the internal stresses caused thereby, otherwise the tools made therefrom would crack in hardening or in use. Annealing temperatures vary from 700° to 800° C. for carbon tool-steels, and from about 750° to 900° C. for high-speed tool-steels.

Annealing is also used in processes of manufacturing glass and many other materials. Not only relieving the strain, the annealing causes a rearrangement of the micro-constituents, improving homogeneity. An important essential is to avoid such application of heat as will cause scaling of the metal or alloy. Entire protection in a box or a muffle is sometimes given, or if direct flame impinges on the article, the quality of flame is regulated suitably to avoid fierce action. What is termed bright annealing is the most remarkable attainment in this direction, whereby stampings and other objects of steel, copper, brass, German-silver, etc., may be annealed once or several times with entire freedom from oxidation, scaling or discolouration. Polished surfaces left from rolling, drawing or other machines thus remain clean and bright, and cleansing treatments are rendered unnecessary.

An important application of annealing is its use on chains for pulley-blocks, cranes and other hoisting tackle, as well as some sorts of couplings subject to incessant duty. These become crystalline and fatigued if kept in service too long, and they are liable to fracture; but if the chains are annealed at intervals, this danger disappears.

Annealing Furnaces.—Furnaces for annealing are heated by coal, coke, town or producer gas or oil. The two first-mentioned fuels are not employed much for small furnaces. The smallest furnaces are but a few inches inside capacity, the largest will take steel plates, as much as 60ft. in length. Pieces of work go direct on the floor of the furnace, or in closed boxes, or the furnace is of muffle type, the flame being kept outside the heating chamber. Insertion and removal of the smaller specimens is performed by hand methods, but large units or batches of stampings, coils of wire, etc. require the help of a trolley or a crane. Special charging machines are also used that push the articles in by electric power, or hand gearing. In the case of the 60ft. plates referred to insertion or removal may be effected in 1½ minutes, leaving no risk of overheating of the end of the plate which enters the furnace first and leaves it last.

Large quantities of articles of small or moderate size are dealt with continuously by some form of conveyor system. For cartridges a rotary machine is utilised, having gas-burners which impinge on the shells whilst these are carried around automatically, and afterwards discharged down a chute. Closed furnaces have a spiral retort that passes the components through in a certain time, or a conveyor chain takes these through the length of the furnace. Bright annealing is largely done with conveyors.

Variations in Furnace Types.—In some furnaces the flames are kept away from the work, being carried round hollow walls. If the reverberatory construction is adopted, the heat descends directly on to the objects. Gas furnaces operate by natural draught or by blast, the latter giving a quicker heating up, and greater

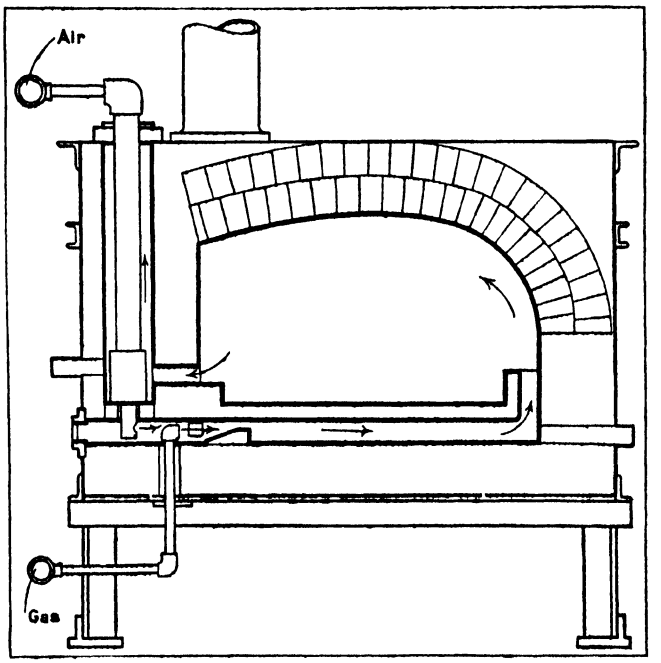


FIG. 1.—SECTION OF A BRAYSHAW, OVEN TYPE, ANNEALING FURNACE SHOWING ONE OF THE BURNERS AND ONE AIR-PIPE
The body is of fire-brick. Waste products, passing in the direction shown by the arrows, heat the air-pipes and thus assist combustion

temperature. Oil may be used in such furnaces, with a difference in the form of burner. Fig. 1 may be studied to understand the arrangement of an oven type annealing furnace. The body is composed of fire-brick bound together with plates and bars, and the design is of the recuperative style; the waste products pass in the direction of the arrows, and so heat the air-pipes, thus assisting combustion. In another design the incoming air is pre-heated by first passing under the furnace floor. In either class there is a marked saving in fuel. The twin-chamber furnace affords another example of economy, this having an upper chamber heated by waste products from the main one below; the work consequently may be pre-heated before being put into the main chamber. A section of a Manchester furnace (fig. 2, p. 988) shows the grate and flue arrangements; heating can be done by coal or coke or

both mixed. Special recuperative flues are built in alongside the fire-box for pre-heating the air, these not in the section. Temperatures up to 1100° C are easily maintained. It may be mentioned that uniformity of heating is imperative for good work, while maintenance of the correct temperature (within a few degrees) should be guaranteed. *See* also MATERIALS, STRENGTH OF and FORGING. (F. H.)

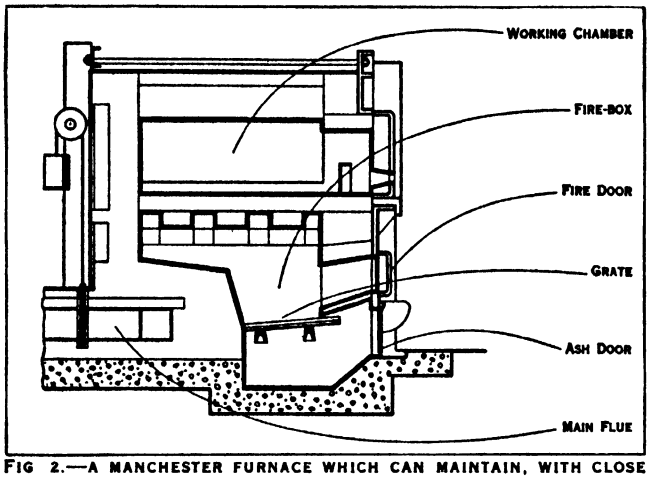


FIG 2.—A MANCHESTER FURNACE WHICH CAN MAINTAIN, WITH CLOSE UNIFORMITY, A TEMPERATURE OF 1100° C

ANNECY, a chief town of the department of Haute Savoie, France. Pop. (1926) 15,389. It is situated at a height of 1,470ft, amid fine scenery under the Crêt du Maure at the north end of the Lake of Annecy, 25m by rail N.E. of Aix-les-Bains. Annecy was in the 10th century the capital of the counts of the Genevois, from whom it passed in 1401 to the counts of Savoy, becoming French in 1860 on the annexation of Savoy. The town, with its arcaded streets, is intersected by canals, and contains a 16th century cathedral church, an 18th century bishop's palace, and 14th–16th century castle (formerly the residence of the counts of the Genevois), and the reconstructed convent of the Visitation (19th century), which contains the body of St François de Sales, born at Sales, close by, who held the see from 1602–22. The bishop's see of Geneva was transferred hither in 1535, after the reformation, but suppressed in 1801, though revived in 1822. Linen and cotton goods, chocolate, leather, paper and small mechanical fittings are made; and a bell foundry at Annecy-le-Vieux is celebrated. This last-named place existed in Roman times.

The lake of Annecy, about 9m. by 2m, is 1,465ft. above sea level. It discharges, by means of the Thioux canal, into the Fier, which flows through remarkable gorges cut in the soft local sandstone, west of the town, to join the Rhône.

ANNELIDA. The Phylum Annelida includes the segmented worms. They differ from the Arthropoda in the possession of a perivisceral cavity which is a part of the coelom and from the Mollusca in the fact that the body is segmented. This segmentation has its origin in the mesoblastic somites of the embryo, just as the perivisceral coelom is derived from the paired cavities of the embryonic mesoblast. Except for the majority of the Hirudinea, a few Archiannelida and Oligochaeta, the whole phylum possesses segmentally arranged chitinous chaetae or bristles, from which the name Chaetopoda or bristle-footed worms is derived.

They are with few exceptions elongated, bilaterally symmetrical animals with a body composed of a series of similar segments, not modified to form different parts of the body as in the Arthropods, from which the Annelids differ also in the unjointed character of their locomotory appendages. A head-region is however normally distinguished, and the thorax is often marked off from the abdomen.

Chaetae.—The chaetae (*setae*) or bristles which are, except for the Brachiopoda (*q.v.*), specific to this group, are delicate chitinous structures showing immense variability in size and shape.

Coelom.—In its simplest form the coelom consists of a series of chambers which correspond to the segments of the body and are separated from one another by intersegmental septa extending from the body-wall to the gut. This condition may be modified either in the direction of the suppression of the septa as in some Polychaeta, or of the further sub-division of the coelom as in the more modified Oligochaeta. The latter tendency is most marked in the Hirudinea in which the coelom is partially suppressed. The coelom communicates with the exterior by a number of ways; by the dorsal pores of the Oligochaeta, by the nephridia and by the coelomoducts.

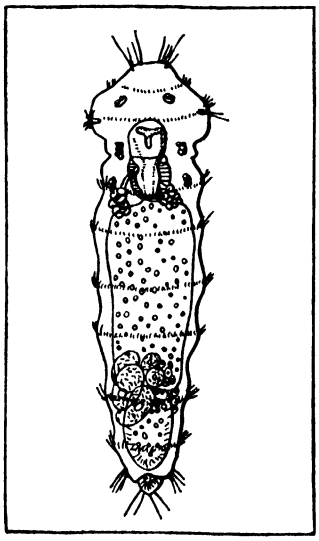
Nephridia and Coelomoducts.—A nephridium is typically a ciliated tube from the coelom to the exterior, consisting of a chain of cells in which a continuous lumen is pierced, and ending internally in a ciliated funnel. Its function is to remove excretory products from the coelom. The coelomoducts, which include the majority of the genital ducts of the Annelids, are somewhat similar structures but the lumen of the tube is intercellular. Moreover according to E. S. Goodrich the true nephridium is an ingrowth from the ectoderm, whereas the coelomoduct is a coelomic outgrowth. These distinctions are only valid within limits.

The Vascular System.—This system in the Annelids is typically closed, that is to say there is in addition to the coelom a further system of closed spaces, the haemal system, between the gut and the body-wall. A dorsal and a ventral vessel joined by a number of connectives are usually present.

Nervous System.—The nervous system consists of a ventral ganglionated cord joining the cerebral ganglia or brain by a circumoesophageal commissure. The cord normally lies in the coelom but in a few forms it is embedded in the epidermis.

Gonads.—The gonads are segmental proliferations of the coelomic epithelium.

Classification.—The Phylum Annelida is usually divided into the following classes:—The Archiannelida, the Polychaeta or marine bristle-worms, the Oligochaeta or aquatic and terrestrial bristle-worms, the Myzostomaria, and the Hirudinea or leeches. If we except the Echiuroidea, the Chaetopoda are co-extensive with the Annelids.



AFTER KORSCHELT FROM FAUVEL, "POLYCHETES SEDENTAIRES," BY COURTESY OF FED. FRANC. DES SOCS. DE SCIEN. NAT.

FIG. 1.—DINOPHILUS GYROCILIATUS, ENLARGED

ARCHIANNELIDA

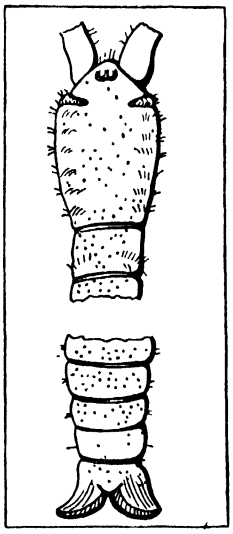
The Archiannelida or Haplodrili are a small group of simply organized marine, aquatic and terrestrial worms, which have been affiliated by various authors with the Rotifera, the Turbellaria and the Annelida. The most recent opinion is that they are modified and often degenerate Annelids allied to the Polychaeta. The view taken of the group as a whole must depend upon the number of forms the student elects to include in it. For example E. Reisinger in his survey of the group published in 1925 claims as Archiannelids the genera *Aeolosoma* and *Pleurophleps* usually attributed to the Oligochaeta; similarly he includes in that group as the family *Ctenodrilidae* the genera *Zeppelinia, Ctenodrilus* and *Raphidrilus,* which P. Fauvel treats as a sub-division of the Polychaete family *Cirratulidae,* and again Fauvel regards as a true Polychaete *Histriobdella,* which Reisinger put among the Archiannelida.

The older view that the Archiannelida are primitive forms is no longer generally held: many of the features regarded by the older authors as primitive are due to the persistence into adult life of larval characters or to degeneration, the outcome of a parasitic habit of life. Moreover these putatively primitive features are in most cases equally found in well characterized Polychaetes. Thus the fusion of the nervous system with the epidermis, the presence of bands of cilia, a very simple vascular system, even

the absence of chaetae have their counterpart in the Polychaeta. A definition of the group as a whole is rendered impracticable by its heterogeneous nature, and the families are best treated separately.

Fauvel recognizes four families: I. The *Dinophilidae;* II. The *Parergodrilidae;* III. The *Polygordiidae;* IV. The *Nerillidae.*

The *Dinophilidae* are small marine Archiannelida without either appendages or chaetae, with bands of cilia and with a short caudal region provided with adhesive glands: there is an unarmed exsertile proboscis; the sexes are separate and often a marked sexual dimorphism exists. They have been affiliated with both the Rotifera and the Turbellaria: E. Perrier who created for them the class Trichotoma, regarded them as intermediate between the Turbellaria and the Nemertea. They are probably Annelids which have retained their larval characters. The reproductive processes of *Dinophilus gyrociliatus* are of great interest and have been much studied.



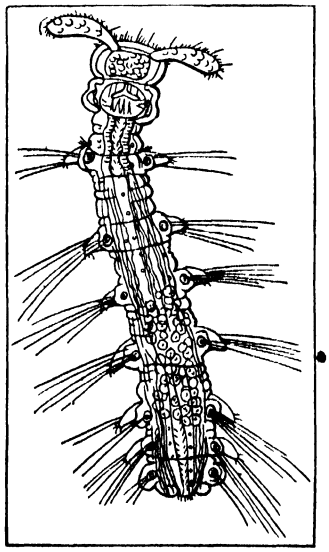
FROM FAUVEL, "POLYCHETES SEDENTAIRES"

FIG. 2.—PROTODRILUS HATSCHEKI

At the top, the dorsal view of the anterior region. At the bottom, the dorsal view of the caudal region

The *Parergodrilidae* are terrestrial Archiannelids living in humus and in damp leaves: only one species, *Parergodrilus heideri,* is known. They are distinctly segmented, without appendages or bands of cilia, with segmental dorsal glands, with two rows of chaetae of an Oligichaetous type, with a cerebral ganglion, an unsegmented unpaired nerve-cord in direct contact with the epidermis, a well developed digestive system and several pairs of nephridia. They are hermaphrodite; and they use their exsertile proboscis and chaetae for climbing.

The *Polygordiidae* are relatively large marine, rarely freshwater, vermiform Archiannelids, more or less cylindrical in shape, usually with a ventral ciliated groove and segmental bands of cilia; with two tentacles and with a pygidium provided with adhesive glands. *Polygordius,* distinguished from *Protodrilus* by the absence of the ventral ciliated groove and of distinct lobes to the pygidium, has a very remarkable development which has given rise to an immense amount of discussion. *Protodrilus* has hollow tentacles connected with an ampulla at their base, both intercellular and intra-cellular nephridia and large salivary glands. It is hermaphrodite and there are also complementary males; the development of the sperm is very unusual. In *Saccocirrus* the male has in each sexual segment two seminal vesicles and two exsertile penes. *Chaetogordius* and one species of *Protodrilus* are provided with chaetae



FROM FAUVEL, "POLYCHETES SEDENTAIRES"

FIG. 3.—DORSAL VIEW, ENLARGED, OF TROGLOCHAETUS BERANECKI

The *Nerillidae* are distinctly segmented freshwater and marine Archiannelids with palps and often with tentacles; with parapodia carrying two bundles of chaetae, between which there is often a cirrus. *Troglochaetus* is a freshwater worm found in caves. *Nerilla* and *Nerillidium* are both marine forms. *Nerilla* has many points of resemblance to *Protodrilus* and *Saccocirrus. Nerillidium* is an intermediate form between *Troglochaetus* and *Nerilla.*

BIBLIOGRAPHY.—The more recent comprehensive works on the group are: K. Heider, "Über Archianneliden" *Sitber. Ak. Wiss. Berlin,* VI. (1922); E. Reisinger, "Ein landbewohnender Archiannelide. (Zugleich ein Beitrag zur Systematik der Archianneliden"); *Zs. Morphol. Oekol. Tiere,* Bd. III. (1925); P. Fauvel, "Archiannélides" in "Polychètes sédentaires," etc, *Faune de France* XVI. (1927), containing a large bibl. incorporated with the general Polychaete bibl.; the extensive specific synonymies make it easy to pick out the works dealing with the Archiannelida. (C. C. A. M.)

POLYCHAETA

The Polychaeta include the marine bristle-worms. A very few species have adopted a freshwater habitat. They differ from the other great subdivision of the Annelida, the Oligochaeta, in the following ways. In the Oligochaeta there are no appendages, and the bristles are embedded directly in the body-wall; there is a clitellum and hermaphroditism is the normal condition. In the Polychaeta there are almost always appendages of various kinds, the numerous bristles are borne by special organs, the parapodia; there is no clitellum and the sexes are separate.

External Anatomy.—The general form varies greatly according to the mode of life of the animal, which may be active or sedentary. The body is usually divided into the cephalic lobe or prostomium, the buccal segment or peristomium, together usually called the head (fig. 4) (in forms where cephalization is advanced this term includes additional elements), the metastomium or body proper which is often marked off into thorax and abdomen, and the pygidium or terminal segment. The prostomium may assume a variety of forms, square, conical, complex or annulated. It is

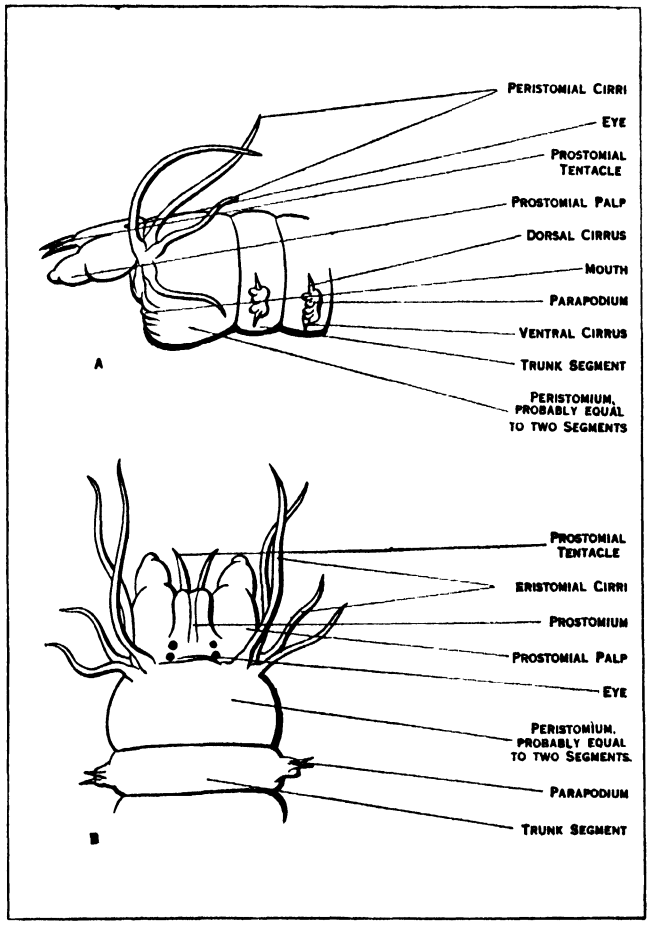
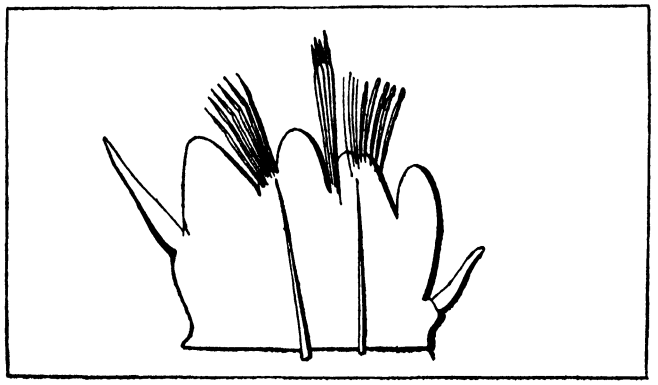


FIG. 4.—A. SIDE VIEW OF THE HEAD REGION OF NEREIS CULTRIFERA. B. DORSAL VIEW

usually provided with eyes, which range from simple pigment spots to complex organs with a crystalline lens. The head often carries a number of appendages, the tentacles, palps, tentacular cirri, which are innervated from different sources Morphologically the appendages in the Polychaeta are divisible into two groups, those which are purely epidermal and solid and those which are hollow and contain all the elements of the body-wall. In the majority of the appendages these two groups are com-

bined, the hollow basal portion being designated by the termination—phore, and the solid terminal portion by the termination—style. Thus there are palpostyle and palpophore, cirrostyle and cirrophore.

Parapodia.—The parapodia or feet in which the bristles are implanted are hollow outgrowths of the body-wall. They are typically composed of two branches, the dorsal or notopodium



FROM "BRITISH ANNELIDS," BY COURTESY OF THE RAY SOCIETY

FIG. 5—FOOT OF NEREIS CULTRIFERA

and the ventral or neuropodium. The foot may be a very complex structure as in the *Nereidae*, with various membranous expansions and lamellae. (Fig. 5.) Each branch of the parapodium is supported internally by stout chitinous rods, the acicula, and there are usually a dorsal and a ventral cirrus: on the upper surface of the foot in some groups simple or ramified branchiae are present. In the sedentary orders the ventral lobe is reduced to a transverse ridge or torus uncinigerus, in which are embedded numerous small hooks.

Bristles.—The chaetae or bristles display an immense variety of form. They are divisible into bristles proper and hooks. The bristles proper may be simple or compound. Simple bristles may be smooth and capillary, or toothed in an almost indefinite number of ways. They may be shaped like a paintbrush as in *Panthalis;* pectinate as in the *Eunicidae;* winged as in the *Terebellidae;* transversely excavated as in *Nephthys;* or paddle-shaped as in the heteronereids. The compound bristles consist of a basal article with which is articulated a terminal piece. The uncini or hooks of the Sedentaria are small chitinous plates the external edge of which is broken up into a series of minute teeth; or there may be one main tooth with rows of smaller teeth above it. (Fig. 6, a to h.)

Morphology.—The outer layer of the body-wall consists of an epidermis, which is sometimes ciliated, and a cuticle. The epidermis is composed of supporting cells and gland cells. The bases of the supporting cells may form a basal layer, and in certain regions the epidermis may be greatly thickened as in the gland shields of the Terebellids which secrete the mucus employed in the building of their tubes. Beneath the epidermis there are three muscle-layers, a circular, a longitudinal, and an oblique, of which the longitudinal is the most important. The muscles are unstriped. The body-wall is lined by a coelomic epithelium and besides the sexual elements the coelom contains amoebocytes, leucocytes, phagocytes, etc. In the Sedentaria there is a tendency for the segmental septa to break down and for the coelom especially in the thoracic region to become a continuous cavity extending over many segments, as in *Arenicola.*

Alimentary Canal.—The alimentary canal is usually a straight tube from mouth to anus; but in some of the Sedentaria, notably in the *Amphictenidae,* it is much coiled. In a number of families the digestive tube begins with an exsertile proboscis provided sometimes with complex chitinous jaws and sometimes with soft papillae. It can often be divided up macroscopically into a number of regions, a pharynx, gizzard, stomach, intestine, etc. *Nereis* for example has a stout armed proboscis, an oesophagus, a thick walled gizzard with caeca and a moniliform intestine. *Syllis* has a buccal bulb followed by a pharynx armed with a tooth; then comes a curious barrel-shaped proventriculus, a ventriculus with a pair of T-shaped caeca and a moniliform intestine. In the *Capitellidae* there occurs an accessory intestine or siphon similar to that in the *Echiuridae.*

Vascular System.—This system is very variable. It is normally closed, and in the widest terms consists of a dorsal and a ventral vessel with a number of transverse connectives. In some groups it is rudimentary or even absent as in the *Glyceridae* and the *Capitellidae.* In certain families of the Sedentaria there is a special contractile body known as the heart which may enclose a cardiac body. The blood is usually bright red: it may be colourless as in the Syllids, or green as in the *Serpulidae.* The latter colour is due to the presence of chlorocruorin in solution in the

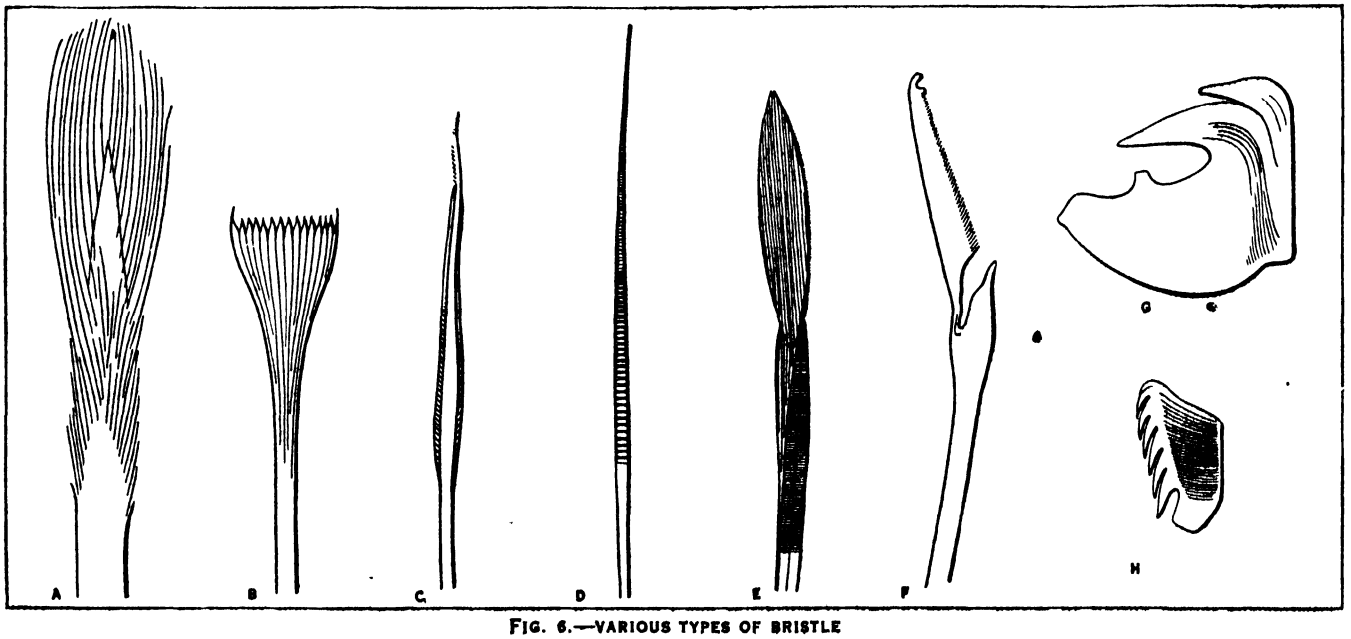
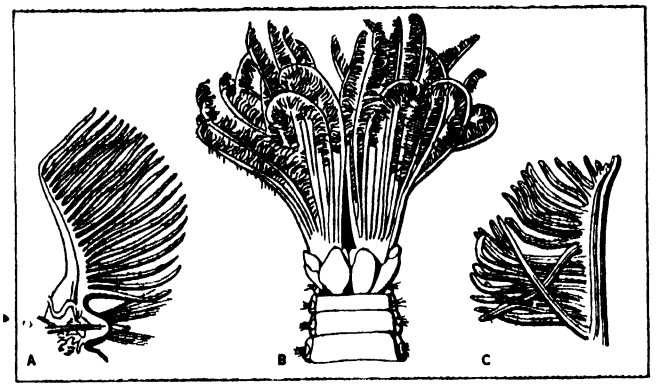


FIG. 6.—VARIOUS TYPES OF BRISTLE

A. Brush-shaped bristle from the superior border of the foot of "Panthalis oerstadi" (After McIntosh)
B. Comb-chaeta of "Hyalinoecia tubicola" (After McIntosh)
C. Bristle of "Amphitrita gigantea" (After McIntosh)
D. Bristle of "Nephthys ciliata" (After McIntosh)
E. Bristle of heteronereid form of "Nereis pelagica" (After McIntosh)
F. Bristle of "Pionosyllis malmgreni"
G. Hook of "Terebella"
H. Hook of "Hydroides norvegica" (After McIntosh)

plasma. In a few species in addition to a closed vascular system there are red blood corpuscles in the coelomic fluid. A similar condition is found in certain echiuroids.

Respiration.—In many Polychaeta there are no special organs of respiration, this function being performed by the vascularized integument of the entire body. In those groups in which there is no differentiated vascular system the hollow outgrowths



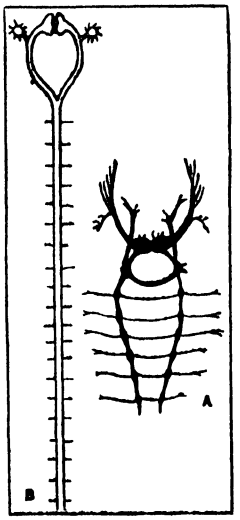
FROM "BRITISH ANNELIDS," BY COURTESY OF THE RAY SOCIETY

FIG 7.—VARIOUS TYPES OF GILLS

A. Foot of "Marphysa Kinbergi" showing gill
B. Ventral view of anterior end of "Branchiomma vesiculosum" showing branchial plume
C. Branchial filament of "Potamilla torelli"

of the body-wall filled with coelomic fluid only are known as lymphatic branchiae. The true branchiae enclose an expansion of the vascular system in the form of a loop. Branchiae may be simple filaments as in *Nephthys*, ramified as in *Terebella* or pectinate as in *Eunice*. In the *Sabellidae* and *Serpulidae* they form in front of the head a large plume composed of numerous filaments provided with ciliated barbules. Generally in the Sedentaria they are confined to the anterior end of the body and in the Errantia they are metamerically arranged on the dorsal surface of the feet and may occur on a large number of the body-segments (Fig. 7, a to c.)

Excretion.—Excretion is principally carried out by the segmental organs or nephridia. These consist typically of a ciliated tube often with an intercellular lumen opening into the coelom by a vibratile funnel and to the exterior by a small pore, the nephridiopore. The segmental organs are as a rule complex organs formed by the junction of an excretory tube with a genital funnel. (Fig. 8, a and b.) In *Nephthys* in addition to the segmental organ there is a large ciliated organ in close connection with it. E. S. Goodrich considers this to be a genital funnel modified to form a phagocytic organ, for it acts as a leucocyte-collector. The leucocytes gather together the waste products and there may be a physiological connection between it and the nephridium. In *Nephthys* as in the *Glyceridae* and *Phyllodocidae* the nephridium ends blindly in branches provided with vibratile flame-cells or solenocytes. In the *Phyllodocidae* at the time of sexual maturity this blindly ending nephridium fuses with the large ciliated funnel and thus forms a passage for the escape of the genital products. In the *Capitellidae* the genital and excretory passages remain separated, and in many of the Sedentaria the nephridia are reduced in number and confined to the thoracic region. In the *Terebellidae* also the anterior pairs are purely excretory and the posterior act as gonoducts, a specialization of function having taken place.



FROM FAUVEL, "POLYCHETES ERRANTES"

FIG 9.—NERVOUS SYSTEM

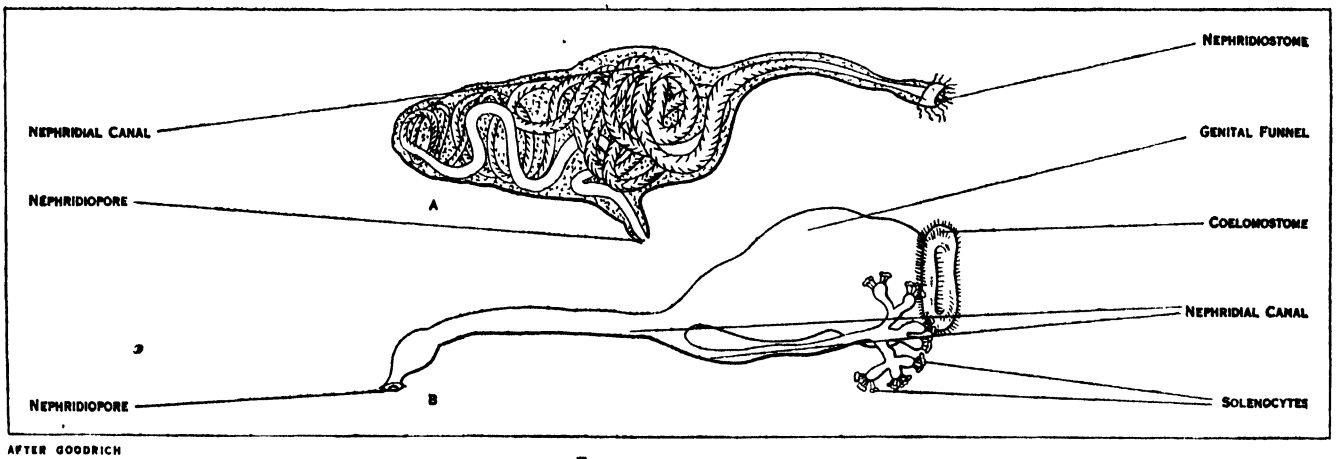
A. Nervous system of "Serpula"
B. Nervous system of "Arenicola" with the two otocysts

Nervous System.—The nervous system consists of a dorsal nerve mass or brain which may be formed by the fusion of several pairs of ganglia, and the perioesophageal commissure or nerve loop joining the brain to the main system, the ventral nerve-chain. This chain consists of two longitudinal cords with segmental ganglionic swellings and segmental lateral nerves. The two ventral cords may be widely separated as in *Serpula* or completely fused into one as in *Arenicola*, which has no ganglionic swellings in its nerve cord. There are many intermediate stages between these two extreme conditions. (Fig. 9, a and b.)

Sense Organs.—Under this heading may be classed the eyes, the nuchal organs, the lateral organs and the tactile organs. Eyes are present in most Polychaeta dorsally on the prostomium; they occur also in other parts of the body. In certain *Opheliidae* they are ranged segmentally on the side of the body. In *Amphiglene* the pygidium is furnished with eyes. In many *Serpulidae* the branchiae are provided with eyespots. The eyes themselves show every stage of development between the simple pigment spot and the complex organs of the pelagic *Alciopidae*, which have a crystalline lens, a retina and a vitreous body.

The otocysts, which are really organs of equilibrium rather than of hearing, are confined to the Sedentaria. There are three types of this organ, a sac communicating with the exterior by a ciliated canal and containing a foreign body such as a grain of sand, which functions as an otolith (*Arenicola marina, Branchiomma*); a closed ciliated cavity containing an otolith which has been secreted (*Jasmineira*); a closed cavity without cilia which contains a number of secreted otoliths (*Arenicola ecaudata*).

The nuchal organs are ciliated pockets above the hinder portion of the brain. They are paired and sometimes eversible as in the *Glyceridae*. The lateral organs are richly innervated segmental



AFTER GOODRICH

FIG. 8.—NEPHRIDIA

A. Diagram of the nephridium of "Nereis diversicolor"
B. Diagram of the nephridium of "Alciope" into which opens the large genital funnel (coelomostome)

ciliated pads found along the side of the body in a number of families. Ciliated organs may occur as in the *Spionidae* in very different parts of the body, and Söderström thinks that certain dorsal sense organs in the latter family may function as olfactory organs and help to bring the males and females together at the time of sexual maturity.

The tactile organs are the palps, tentacles, cirri and various papillae.

Reproduction.—The Polychaeta are normally dioecious. Hermaphroditism is confined to a few species mostly belonging to the *Serpulidae*. The cosmopolitan Nereid, *Platynereis dumerilii* is notable in being polymorphic and having a hermaphrodite form. Except for the copulatory chaetae in the *Capitellidae* and for the differentiated gonad in *Arenicola ecaudata* and *Hesione sicula*, the Polychaeta do not possess specialized genital organs. The germ-cells are proliferated from the coelomic epithelium lining the parapodial blood-vessels and drop off into the coelom in which their development is completed. There is a variety of ways by which the ripe germ-cells are released, of which the commonest is by way of the segmental organs. In a few instances (*Owenia fusiformis, Micronereis variegata*) the eggs and sperm are set free through special anal pores, and in *Perinereis cultrifera* (male) through the anus itself. Often the body-wall is ruptured, and sometimes as in *Clistomastus lineatus* and the Palolos the modified part of the body bearing the sexual elements breaks off in its entirety from the rest. Sexual dimorphism is the exception in the Polychaeta. Those groups which pass through an epitokous phase at the time of sexual maturity, a phase which involves a kind of metamorphosis, and those groups in which reproduction takes place by budding show external differences between the sexes. Otherwise except for the copulatory chaetae in the Capitellids and the genital papillae in the Terebellids the sexes are distinguished by their germ cells alone. (Fig. 10, a to c.)

Epitoky or sexual metamorphosis is most marked in the Nereids, but it occurs also in several other families. At the time of sexual maturity a great change both external and internal takes place. The appearance of the head is much altered, the eyes grow

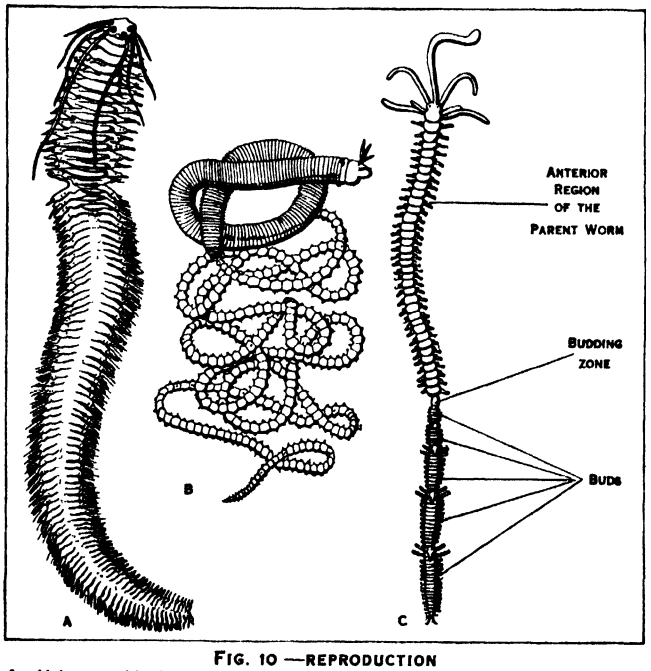
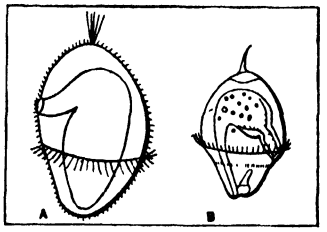


FIG. 10 —REPRODUCTION
A. Heteronereid phase of "Nereis dumerilii" (After McIntosh)
B. The Pacific Palolo, or the epitokous phase in "Eunice viridis" (After Gravier)
C. "Aotolytus" with numerous buds (After Mensch)

to a great size and the palps shrink. The body appears to be made up of two distinct parts, the anterior end, sometimes filled with genital cells, in which the feet remain unmodified, and the posterior end in which the feet are furnished with enormous foliaceous lobes and with special paddle-shaped swimming chaetae. At the same time great internal changes take place. The muscles and digestive tube undergo histolysis, which is accompanied by a certain amount of histogenesis. According to A. Dehorne the coelomic leucocytes at this period take on the rôle of active phagocytes. The name *Heteronereis* is applied to Nereids undergoing the sexual phase. At this time the sexes are often distinguished by differences in the pygidium.

Among the Syllids reproduction takes place by budding and by fission or division of the body. To these processes the names blastogamy and schizogamy have been given. In blastogamy a parent individual, which is asexual, buds off at its posterior end a chain of sexual individuals or stolons which break away from the parent stock to lead an independent existence. Budding takes place just in front of the pygidium. The anterior segment forms a head and the remaining segments are intercalated between this and the pygidium. In *Autolytus* the male stolons are known as *Polybostrichus* and the female as *Sacconereis*. In schizogamy one of the segments of the parent individual forms a head with appendages and the stolon is formed at the expense of the posterior region of the parent's body. Often reproduction takes place by a combination of blastogamy and schizogamy, the schizogamous stolons themselves budding a number of segments before breaking away from the parent individual (*Procerastea*).

Development.—In the Polychaeta cell-division is normally spiral, and when the embryo leaves the egg-membrane and begins to lead a free larval existence it is called a Trochophore. The Trochophore is described as atrochous (*Terebella*), monotrochous (*Chaetopterus*), polytrochous (*Ophryotrocha*) according to the number and position of the ciliated bands which encircle it. (Fig. 11, a and b.) The trochophore stage is followed by a phase, often free-swimming, in which the young differs greatly from the adult. In the course of time the various appendages are developed, the larval bristles are replaced by the adult bristles and the fully grown worm is formed.



FROM FAUVEL, "POLYCHETES ERRANTES"
FIG. 11 —LARVAL FORMS
A. Trochophore of "Chaetopterus"
B. Trochophore of "Nephthys"

Classification.—For a historical account of the Polychaeta the reader is referred to the introduction to J. H. Ashworth's *Catalogue of the Chaetopoda in the British Museum* (Part 1, London, 1912), and to de Quatrefage's *Histoire des Annelés* (Paris, 1865); the works mentioned in our bibliographies on pp. 994 and 998 below, should also be consulted.

Fauvel following Audouin and Milne Edwards divides the Polychaeta into the Errantia and the Sedentaria. He defines the Errantia as Polychaeta in which the segments of the body are all similar except the segments adjoining the mouth and the terminal segment or pygidium; and the Sedentaria as Polychaeta in which the body is divided into several regions, the head is small or profoundly modified, the feet are almost always simple, the ventral branches often in the form of a torus armed with hooks or uncini; the branchiae are normally confined to a definite region and the species are habitually tubicolous. W. B. Benham's arrangement of the group into seven sub-orders (Vol. II. of the *Cambridge Natural History*, 1896) is still commonly adopted.

Phylogeny.—There has been much speculation about the origin and affinities of the Annelids. The most recent is that of R. Woltereck based on his study of the development of the Archiannelid *Polygordius*. Before the separation of the mouth and the anus, the Annelid Trochophore bears some resemblance to a primitive Ctenophore, and Woltereck suggests that a primitive Ctenophore-like ancestor took to a burrowing mode of life in its adult stage; that segmentation was the result of the adoption of wriggling in place of a ciliary mode of locomotion. On this hypothesis the presence of segments in the free-swimming larva has to be attributed to a telescoping of the racial history. Objections to Woltereck's hypothesis are stated at length by Söderström in his *Das Problem der Polygordius-Endolarve* (Uppsala, 1924).

Ecology.—Except for about a dozen freshwater species, mostly *Nereidae,* and half that number of euryhaline species, the Polychaeta are marine. They occur most abundantly between tidemarks and in shallow water near the shore, but they have also been dredged from very great depths. Their mode of life is very variable. Some live in tubes in the mud or sand, others in holes in the rock, or fixed to stones and shells, and in every kind of crevice. A number of species are pelagic. Others again attach themselves to Echinoderms or sponges.

Coloration.—The majority of the Polychaeta are brilliantly coloured in life, and a number, chiefly Syllids, are phosphorescent. *Chaetopterus* is also exceedingly phosphorescent, and its normal green colour is derived from the Algae on which it feeds.

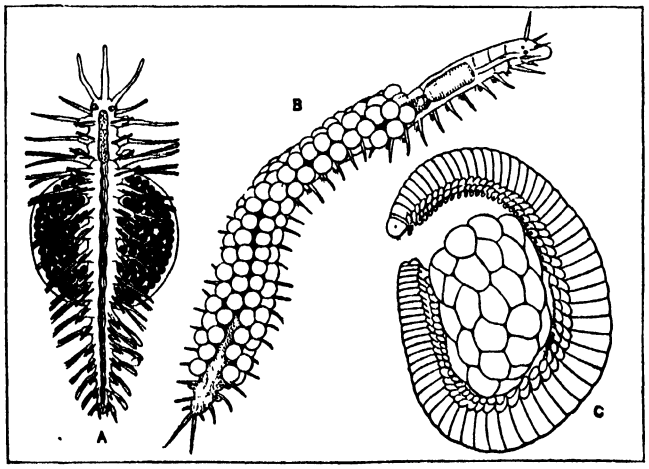
Regeneration.—Autotomy is of common occurrence in the group, especially among the Polynoids and the Eunicids. In fact it is usual on examination of a member of the latter group to find that it is regenerating or has regenerated its posterior end, and the Polynoids shed and regenerate their elytra or scales with great facility.

Food.—Some Polychaeta are active and predatory carnivores with large prehensile jaws, others feed on Algae.

Many of the Sedentaria feed on small organisms in suspension in the water, which become entangled in their tentacles and gill plumes. Some like the *Arenicolidae* ingest large quantities of mud and sand and derive nourishment from the organic matter mixed with them.

Parasitism.—Parasitism is uncommon in the group. The only internal parasites known belong to the *Eunicidae,* and, with the exception of *Oligognathus bonelliae* which is parasitic in the body-cavity of *Bonellia* and the doubtful *Ophiuricola cynips* in a deep-sea *Ophiuroid,* they attack other Polychaeta only. External parasites are even rarer. *Icthyotomus sanguinarius* is a parasite on the eel, *Myrus vulgaris,* and *Parasitosyllis* on other Polychaeta and on Nemertines.

Commensalism.—Commensalism is of common occurrence, and of all the families the *Polynoidae* are the most prone to this habit. *Polynoe rutilans* occurs with an Alcyonarian *Xenia, Scalisetosus communis* is found with an Ophiuroid, and *Scalisetosus echini* with *Echinus esculentus. Lepidasthenia pulchra* lives with a Holothurian, *Stichopus, Hololepidella commensalis*



FROM GRAVIER, "ANNALES DES SCIENCES NATURELLES"

FIG. 12.—INCUBATION

A. "Autolytus prolifer," female, showing brood sac
B. "Grubea limbata" carrying its eggs on its back
C. "Eteone gaini" surrounding its eggs

with a *Clypeaster* and *Acholoe astericola* in the ambulacral grooves of starfishes.

A large number of Polynoids also live in the tubes of other Polychaeta, chiefly Terebellids and Serpulids. Webster found *Harmothoe parasitica* living under the scales of *Lepidametria commensalis* which is itself a commensal with *Amphitrite ornata.*

Incubation.—Many Polychaeta shed their eggs and sperm in the surrounding water and this constitutes their total reproductive activity; but an increasing number of observations show that incubation and parental care are not uncommon in the group. Several species of Polynoids incubate their eggs on their backs beneath their scales. In the Syllid *Exogone gemmifera* the developing eggs are attached in longitudinal rows to the ventral surface of the mother, where they remain until they are capable of fending for themselves. Some Syllids carry their young on their backs: the Spionids lay their eggs in the tubes which they inhabit and in some species the young remain in the tubes of their parents until an advanced stage of growth. During this time a certain number of eggs and larvae cease to develop and serve as food for the others. According to Söderström in *Polydora nutrix* a portion of the maternal tissue undergoes histolysis and serves as a sort of nutritive mass in which the young develop. *Capitella capitata* and the hermaphrodite form of *Nereis dumerilii* build tubes at the time of sexual maturity, and do not leave them before their young are old enough to take care of themselves. In *Autolytus* and its allies the females at the moment of egg-laying secrete a viscous fluid which hardens on contact with the water and forms a sort of brood-pouch in which their fertilized eggs develop. C. Gravier observed a similar phenomenon in a Phyllodocid *Eteone gaini.* (Fig 12, a to c.)

Potamilla antarctica is said to keep its developing young inside its branchial plume The spirorbids are unique in incubating their young in their operculum, which is the dilated end of a single branchia, normally used as a sort of stopper to their tube. Finally a small number of Polychaeta are viviparous, that is to say incubation takes place actually within the body of the parent. The Syllids, *Syllis vivipara* and *Ehlersia nepiotica* are viviparous, as are also a few *Serpulidae.* M. Caullery and F. Mesnil have suggested that the so-called viviparous Syllids are immature forms reproducing themselves parthenogenetically, and that when mature they are normally dioecious and behave as the rest of the family.

Tube-building.—The tubes of the Polychaeta are varied in form Some secrete from their mucous glands, which in the Terebellids form the thick ventral gland shields, tough parchmenty envelopes, and others reinforce these with small particles from the surrounding medium. *Lanice conchilega* builds its tube with small shells and grains of sand, *Sabella* with small particles of mud. The *Serpulidae* secrete carbonate of lime with which their hard brittle tubes are built.

Economic.—The Polychaeta have little economic importance. *Arenicola,* the common lug-worm, several species of *Nereis, Marphysa sanguinea* and a *Nephthys* are used as bait by fishermen. The natives of Samoa and the adjacent islands eat the famous Palolo At certain times of the year the posterior modified segment of the body of *Eunice viridis,* which has undergone a sexual metamorphosis, breaks off from the anterior end and laden with ripe germ-cells swarms in enormous numbers at the surface. These are collected and eaten by the natives.

Palaeontology.—Our knowledge of the geological history of the group is largely based on the study of calcareous tubes found attached to stones and to other fossils. *Spirorbis* is found in the Silurian and other Palaeozoic strata. *Serpula* is very abundant in the Jurassic where its occurrence has given rise to Serpulite chalk. The Nereidiformia, of which several species have been described from the Jurassic slate of Bavaria and from Palaeozoic beds in Canada survive mostly in the form of jaws and acicula. Walcott however in 1911 described a number of very well preserved Middle Cambrian Polychaeta from the Burgess shale in British Columbia. Many tracks and burrows in the rock of doubtful interpretation have been attributed to the Polychaeta.

Distribution.—Fauvel's contention that no well-defined zoological regions exist for the Polychaeta is now generally accepted by students of that group. Out of the five most important families of the Errantia more than one half of the total number of species known from the coasts of France are common to the Channel, to the Atlantic and to the Mediterranean. Furthermore out of 122 species collected by the Prince of Monaco at the Azores, 40 or nearly one-third are also part of the Arctic fauna and 29 are equally found in the Antarctic. Out of a total of 300 species collected by him between the Azores and Spitzbergen

about 60 are common to both hemispheres. Again out of a collection of 72 species from Madagascar 46 or nearly two-thirds were common to the northern part of the Indian ocean and to the Philippines. Finally a certain number of species, of which the most well known are *Serpula vermicularis* and *Nereis dumerilii*, are cosmopolitan. An examination of the littoral Polychaet fauna of the tropics discloses a number of species which never desert the warm zones, but are found equally in the same latitudes all over the world. With regard to bathymetric distribution the greater majority of the Polychaeta are found between the tide-marks or within the 100 fathom zone. Beyond the continental shelf their number decreases rapidly.

Thus out of the Prince of Monaco's collections only 25% were found between the 1,000 and 2,000 metre line and only 5% between the 4,000 and 5,000 metre line. There are very few strictly abyssal forms, most of the examples found at great depths belonging to common littoral species.

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(C. C. A. M.)

OLIGOCHAETA

Next to the Polychaeta, the largest division of the Annelida, are the Oligochaeta. More than four-fifths of the species are earthworms; also comprised within the group are a number of small or minute worms, some of fresh-water habit, others (belonging to the family Enchytraeidae) plentifully present, though inconspicuous, in cultivated ground and under stones on the shore between tidemarks. Wholly marine Oligochaeta are rare.

Oligochaeta have the wormlike segmented body with spacious body-cavity characteristic of most members of the Annelid phylum. In common with the Polychaeta they possess organs of locomotion in the form of setae (chaetae); the bundles of setae are not, as in the Polychaeta, set in parapodia, they merely protrude from the general level of the body surface. The most important distinction of the Oligochaeta from the Polychaeta, however, is that they are hermaphrodite, and have a much more complicated system of reproductive organs.

The Oligochaeta are in all probability descended from marine ancestors belonging to the group Polychaeta; the Polychaete stock has remained marine, the Oligochaete branch has wandered inland and taken possession of the earth and fresh waters; those that are now found on the shore and below low-water mark are descendants of terrestrial or fresh-water worms which are, as it were, returning towards their ancestral home. On the other hand, the Oligochaeta have in turn given rise to the leeches (Hirudinea).

Classification.—A fairly definite line can be drawn between the larger forms, living mostly in the earth—the Megadrili ("earthworms")—and the smaller forms or Microdrili which live for the most part in water or mud (though many Enchytraeid genera are terrestrial). Five families of Megadrili are recognized; the Moniligastridae, confined to India, Ceylon, the Malay archipelago and East Africa; the Megascolecidae, the largest family of all, predominating in India, Farther India, the Australasian region, over much of Africa and part of South America; the Eudrilidae, mainly Central African; the Glossoscolecidae, in South and Central America, parts of Africa and of the Mediterranean region; and the Lumbricidae, to which most of the earthworms of Europe, North America and North Asia belong. The Microdrili comprise the delicate Aeolosomatidae and Naididae, fresh-water worms, cosmopolitan in distribution, of small size, fascinating objects of microscopical study; the Tubificidae, fresh-water and mud dwellers, mainly in the northern hemisphere and predominantly in the temperate zone; the Enchytraeidae, a numerous group, terrestrial, littoral, occasionally fresh-water, mainly in the Arctic and temperate regions of the northern hemisphere; the Lumbriculidae, fresh-water, in Europe, Siberia and North America north of Mexico; and the small families Phreodrilidae, Haplotaxidae, Alluroididae and Branchiobdellidae, the last named all external parasites of crayfish.

The terms Terricolae and Limicolae, *i.e.*, earth-dwellers and mud-dwellers, are sometimes used, rather loosely perhaps, and correspond generally to Megadrili and Microdrili (exclusive, perhaps, of the Enchytraeidae) respectively. There are however not a few Megadrili, "earthworms" by outward appearance and affinities, which live in marshy or even aquatic habitats.

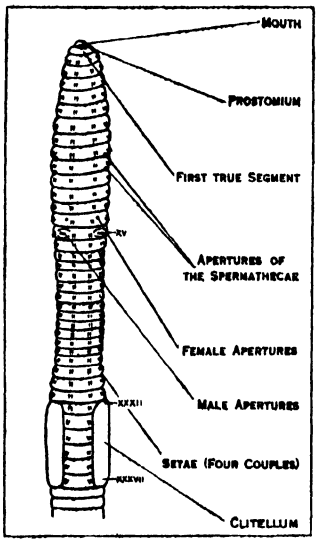

FIG. 13.—ANTERIOR END OF THE LUMBRICUS TERRESTRIS, THE COMMON BRITISH EARTHWORM (VENTRAL VIEW)
The mouth is overhung by the prostomium, a small lobe in front of the first true segment. The setae, four couples per segment begin in segment II. The swollen region embracing segments xxxii-xxxvii is the clitellum. Life size

Comparative Anatomy.—In fig. 13 a marked external ringing indicates the division of the body into a series of more or less similar segments. In size, selected individuals of some of the largest species measure between three and four feet, while *Megascolides australis* is recorded as having attained a length of six or even seven feet. But taking earthworms in general, the British Lumbricidae are perhaps rather above the average in size. The Microdrili are usually much smaller; some species of Aeolosomatidae and Naididae are only about one millimetre in length, while the majority of Enchytraeidae are less than an inch In fully mature worms the clitellum appears as a thickening of the body, girdle-like and extending over several segments; the surface cells of this region secrete, at the time of egg-laying, a cocoon in which the eggs are received, and in which the early stages of the development of the young are passed through.

The setae (fig. 14) are rodlike or sometimes hairlike structures implanted in the body-wall; the rodlike setae are relatively short and project only slightly, while the hairs are longer and project to a greater extent; the hairs are found only in a few families of Microdrili. The setae of earthworms are in general like that represented for *Lumbricus* (fig. 14*a*); a greater variety occurs among the Naididae and Tubificidae. They are organs of locomotion; an earthworm uses them for obtaining a hold on the substratum, and then draws up the hinder part of the body; it then extends the anterior end, takes a fresh purchase with the setae of its front region, pulls up the hinder part again, and so on. The Limicolae use their rodlike setae on the substratum in the same way; but the bundles of hair-setae are swimming organs. In most earthworms there are eight setae per segment, arranged as two couples on each side, one couple (ventral) low down, the other (dorsal or lateral) higher up on the side of the worm. In some earthworms the number of setae is much larger; there may be any number from eight to 100 or more, and they are then arranged in a ring round each segment. In the commoner forms of Microdrili the setae, while arranged, as in most earthworms, in dorsal and ventral bundles, are not limited to two per bundle; the number per bundle varies, but may be as many as 16 or occasionally even more.

The body-wall, body-cavity, vascular and nervous systems are of the general Annelid type. The excretory organs are nephridia.

In connection with the alimentary canal may be mentioned (*a*) the gizzard, a strongly muscular section of the gut, present in most earthworms, the function of which is to grind up the ingested earth and so facilitate digestion of the contained organic matter; it is absent in the Limicolae. (*b*) The calciferous glands appear in many forms; they are essentially a part of the oesophagus,

which is either merely dilated or pouched outwards so as to form saccular appendages; the lining of the oesophagus, or of the sacs, is thrown into an often very complex system of folds, within which there is a copious circulation of blood. The glands are present in many but by no means all earthworms; their function is hardly yet fully known. In the Lumbricidae, and in a few worms belonging to other families, small crystals of calcium carbonate are produced between the folds and are discharged into the main cavity of the alimentary tube; this may serve to neutralize the humus acids in the earth ingested by the worms; it may also be a means of getting rid of the carbon dioxide produced in the organism, and the glands may in this sense be respiratory organs. But it is not certain that such a secretion is produced by all the structures grouped together under the name calciferous glands.

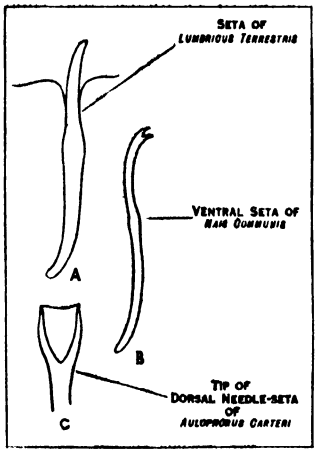

FIG 14.—SETAE OF CERTAIN OLIGOCHAETE WORMS

The seta of "Lumbricus terrestris" is shown implanted in the body wall. A fine transparent web stretches between the terminal prongs of the needle-seta of "Aulophorus carteri." Magnification is respectively X 45; X 400; X 625

A few aquatic Oligochaeta possess branchiae (gills), processes of the body-wall with a copious blood supply, as organs of respiration; but in general respiration is carried out through the unmodified body-wall. Sense organs are not well developed in the Oligochaeta. Earthworms avoid light, except of a very low intensity; the perceptive organs are certain specially constituted cells of the surface layer; the segments at the anterior and posterior ends are the most sensitive to light, and in these regions the sensory cells are most numerous. Some of the small freshwater Naididae have a pair of black eye-spots on the head. Other specially modified cells of the surface layer, in both Mega- and Microdrili, and the free endings of fine nerve-twigs between the surface cells, are also doubtless sensory, and may have to do with the perception of mechanical and chemical stimuli. Earthworms can distinguish between the taste of different vegetable foods; but no special organs are known. All Oligochaeta are hermaphrodite. The testes are either one or two pairs, the ovaries usually a single pair; they are situated in the anterior part of the body—in the Lumbricidae in segments x. and xi. (testes) and segment xiii. (ovaries). Before being shed, the male cells usually develop and ripen in sacs known as seminal vesicles, the female cells in the cavity of the ovarian segment or in special ovisacs; the genital products reach the exterior by special ducts, the endings of the male ducts being seen in the common Lumbricidae on segment xv. as slitlike apertures on prominent papillae. In many worms (but not in the Lumbricidae) glandular organs (so-called prostate glands) open near or in common with the endings of the male ducts. Spermathecae are generally present.

Reproduction and Development.—Though the Oligochaeta possess both male and female organs, fertilization of the eggs by the animal's own sperms never, so far as is known, occurs (except perhaps in the common fresh-water *Tubifex*). In copulation mutual transfer of sperms takes place, and the partners separate; at a subsequent period the eggs attain maturity; a secretion of the clitellum, soft at first but rapidly hardening to a hornlike consistence, forms the cocoon, which is passed forwards over the animal's head. As the cocoon passes over the female apertures the eggs are discharged into it, and as it passes over the apertures of the spermathecae sperms received in copulation are ejected into it; fertilization of the eggs takes place immediately. The ends of the cocoon close up, owing to elasticity, when it becomes free from the worm. The young are nourished by an albuminous fluid contained within the cocoon, produced by certain gland cells of the clitellum at the time the cocoon is formed. They hatch out as young worms after some weeks, the length of time varying with the temperature.

In the families Aeolosomatidae and Naididae the above (or sexual) mode of reproduction is largely replaced by fission, an asexual process, in which a worm divides into two, with the formation of a new tail in the case of the anterior, a new head in the case of the posterior of the two animals so produced.

Zoogeographical Distribution.—*Aeolosoma* and several genera of Naididae (small fresh-water forms) are cosmopolitan; even the same species is sometimes found in widely separated localities, even in different continents. This is due to the ease with which they or their cocoons can be transported; they can without difficulty colonize the whole of a river system once they gain an entry; they, or more often their cocoons, may be carried in the mud on the feet of water-birds from one pond or lake to another, or from one river-system to another. The same considerations apply to the Tubificidae and other Limicolae.

The species of earthworms are on the whole much more localized; instead of being passively carried by the stream, or casually transported (themselves or their cocoons) in mud, their migrations are in the main due to themselves alone, and largely to their slow tunnelling through the soil; streams, deserts, rocky or snow-clad mountain ranges form insuperable obstacles. Yet even among earthworms there are many species which have a wide distribution; some of the common Lumbricids are found in all parts of the world where European intercourse has penetrated (*e g., Allolobophora caliginosa,* perhaps the commonest of all earthworms); some species of the Far Eastern genus *Pheretima* are now circummundane in the warmer regions of the globe. It is evident that this can only have come about by their (or their cocoons) having been passively transported. Certain species, in fact, are now recognized as being very liable to accidental transportation, and as being able, when thus transported, to establish themselves with ease in new surroundings; insomuch that near South American and Australian towns with considerable European intercourse the indigenous earthworms have been entirely displaced by Lumbricid intruders, and have to be sought in the remoter parts of the country. Species which spread in this way are known as peregrine.

It is obvious that no general conclusions can be drawn from the distribution of the peregrine earthworms and the Limicolae. But the case is different with those genera of earthworms which do not bear artificial transportation readily, which spread slowly and which are limited by the physical features of the land; if, for example, the same genus is found in two regions now entirely cut off from each other by sea, this is presumably because these regions were at one time united by a land bridge. The Oligochaeta are thus of much value to the science of Palaeogeography.

Natural History and Behaviour.—Some degree of moisture to prevent their desiccation, and some admixture of organic matter in the soil to furnish them with food, are for earthworms necessary conditions of existence; they are therefore not found in desert tracts, nor in pure sand. They live principally in the surface layers of the soil, but penetrate more deeply in winter, since the temperature is higher and more constant at deeper levels; in hot weather also, especially in warm countries, they retreat downwards to avoid desiccation; Darwin met with burrows between five and six feet from the surface, and quotes other observers who found burrows going down to 6–8 feet.

The number of worms in the soil varies widely according to the nature of the soil, and may be very large; the numbers per square metre given by different observers range from about 30 to 2,000; in meadows and garden earth 300–1,000 seem to be usual But the small Enchytraeidae are much more numerous; in Switzerland, Bretscher found 1,650–8,000 per square metre.

Earthworms are nocturnal animals, retreating into their burrows in the daytime, and emerging at night. As a rule, while protruding and gathering the vegetable débris within their reach, they maintain their hold on their burrows by their tail. In forming their castings, however, the hinder end is protruded; the ejected earth is deposited with some care, first on one then on the other side around the mouth of the burrow. The castings thus surround and cover the aperture; the mouth of the same burrow is used for this purpose for some time, so that each mass is the product of several operations or of several worms. Castings may be of

considerable size; the largest Darwin could find at Down weighed nearly four ounces; in warmer countries they may be larger.

The burrows of earthworms are excavated in two ways, by pushing the earth away on all sides, and by swallowing it. The burrows run more or less perpendicularly, and seldom branch; they are lined with a firm smooth layer of fine earth voided by the worms, and so may be compared to tunnels lined with cement.

Earthworms drag leaves, seeds and other portions of plants into their holes, and parts of these, at least, they eat; they also ingest earth, utilizing the organic matter contained in it as food. They will devour raw fat, raw and roasted meat and dead worms if placed within their reach.

A number of earthworms are luminescent, among them the common *Eisenia foetida* (the brandling). The light is given off by a fluid which escapes from mouth and anus, or in some cases from the dorsal pores (apertures in the body-wall along the middle line of the back); the ultimate source of the fluid is in either case the body-cavity.

Economic and General.—Earthworms are continually engaged in swallowing earth below ground and evacuating it on the surface; Darwin calculated the quantity of earth thus brought up to be from 7½ to 18 tons per acre per year, equivalent in ten years to a layer 1–2 inches thick. Lime, flint, cinders, etc., and even larger stones and boulders, are gradually covered; ancient roads, pavements, tiled floors, walls and ruins are buried and preserved for the archaeologist. As to the soil itself, the mould is triturated and sifted, no particles larger than earthworms can swallow being left in it; it is periodically exposed to the air; organic matter is added to it from the leaves, etc., which are dragged into the burrows. The burrows admit of the aeration of the soil, and aid materially in its drainage; they facilitate the downward passage of roots. Many seeds owe their germination to having been covered by castings; in some cases earthworms act as actual tree-planters, by dragging seeds, *e.g.*, the winged seeds of the silver maple, into the ground.

The chief economic use of Oligochaeta at the present day is as bait in fishing. Worms from Thames mud, doubtless Tubificidae, used to be sold to feed fish in aquaria; and Tubificid worms are sold as food for goldfish in Japan. Certain earthworms were until recent times used as food by the Maoris. Earthworms have often been employed in medicine; passing over their use in antiquity and the middle ages, they are given at the present day in China and Japan in fever, in Burma in a variety of affections and in Gippsland in Australia for rheumatism.

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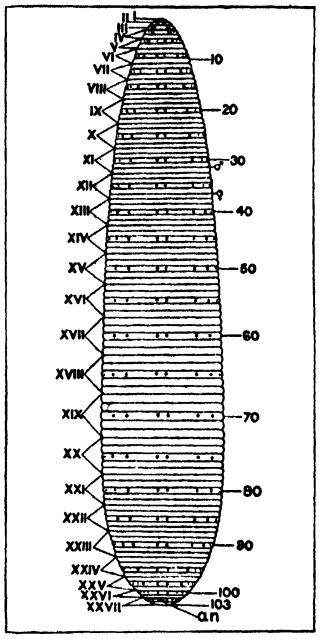
HIRUDINEA

The Hirudinea or, popularly, leeches, are hermaphrodite Annelids provided with a sucker at both ends. There are no parapodia or chaetae, except in *Acanthobdella*, a form which is assigned by some authorities to the Oligochaeta. There are no appendages except branchiae, which occur in a few species. The number of segments is constantly thirty-four. The coelom is reduced to a series of intercommunicating spaces except in *Acanthobdella*, where it consists of a series of segmental chambers as in the Oligochaeta. A clitellum is present and the testes are usually numerous and continuous with the sperm-ducts. There is a single pair of ovaries continuous with the oviducts and the sexual pores are median and single. The nephridia are paired, always with an intracellular lumen and often with closed funnels; rarely they form a network from segment to segment. Eyes are usually present and the nervous system lies in the coelom. The Hirudinea are aquatic, terrestrial and marine; they are carnivorous and parasitic.

Annulation.—The limits of the segments in the Hirudinea are obscured by the presence of annuli or rings, which in the fully developed segment of the middle body may vary in number from two to fourteen. The 34 segments correspond to and are innervated from 34 ganglia in the nervous system; and the number of segments and their limits is determined by the number and position of the ganglia. The ring in which the sensillae or segmental sense organs externally and the ganglia internally are located is normally the central ring of the segment.

External Anatomy.—Leeches vary in size from about 5 millimetres to 18 inches, and their shape changes according to their state of contraction; they may be linear, oviform, subcylindrical or foliaceous; in life many species are brilliantly coloured with a variety of elaborate colour patterns.



FROM HARDING AND MOORE, "HIRUDINEA"

FIG. 15.—EXTERNAL ANATOMY OF A TYPICAL TEN-EYED LEECH
The somites are indicated on the left side by Roman numerals and the annuli on the right by Arabic numbers. Eyes, metameric sensillae, nephropores, gonopores and anus are also shown

The body may be divided into five regions. The *cephalic region*, consisting of six segments, the majority of which are composed of a single ring, includes the anterior sucker, the mouth, the eyes and the jaws, when present. The anterior sucker may be discoid as in the majority of the *Icthyobdellidae* or spoon-shaped as in most *Arhynchobdellidae*. The eyes are often complex, consisting of an optic nerve and ganglion, a sheath of visual cells containing a vitreous body, the whole surrounded by a dense cup of pigment. The second region or *preclitellum* contains the pharynx and anterior nephridia, and is marked by the intermediate condition of development of the segments. The middle region, further divided into the *clitellum* and *post-clitellum*, contains the main part of the organs of the reproductive, digestive and excretory systems. The clitellum, which usually extends over three complete segments, consists of a thick layer of unicellular glands. The postclitellum is followed by the *anal region*, in which the segments are again incomplete. This leads to the posterior sucker, composed of segments 28 to 34, disc-like and directed ventrally except in the burrowing *Lumbricobdella;* it constitutes the *caudal region.*

The sensillae or segmental tactile organs are found on the sensory ring of each segment. They appear as round white patches on the skin, and there are usually four to six pairs to each ring; they are provided with sensory hairs and are retractile.

Internal Anatomy.—The nervous system is Annelidan in character, consisting of a double nerve cord with segmental ganglia and lateral nerves. The cords diverge in front to loop round the oesophagus and meet above in the supraoesophageal nerve mass or brain. The six ganglia of the cephalic region are fused into a suboesophageal ganglionic mass below the alimentary tract, and a similar condition prevails with the seven ganglia of the caudal region.

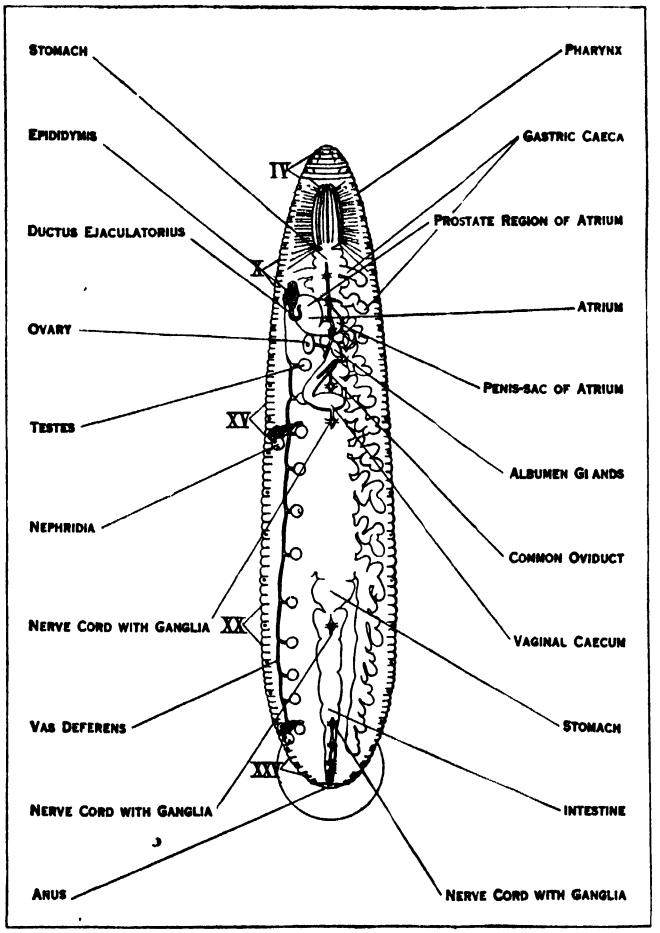
The musculature is very complex; besides the main oblique, circular and longitudinal layers, of which the last are the thickest, there are vertical and transverse sheets of fibres.

Coelom.—The most remarkable feature of leech morphology is the coelom or body-cavity. In *Acanthobdella* its condition resembles that found in the Oligochaeta, but in other leeches it is largely filled by the growth of connective tissue of various kinds and reduced to a series of canals or lacunae connected by an elaborate system of delicate branches. In the *Glossiphonidae* there are five main longitudinal lacunae; hypodermal lacunae are also present in the form of fine canals running round the body just beneath the skin. By bringing the contained coelomic fluid

close to the air they assist in respiration. Most of the *Icthyobdellidae* possess strongly contractile lateral lacunae, and certain members of the family have pulsating vesicles beneath the skin, resembling cutaneous sacs which are rhythmically inflated and deflated. These are filled with coelomic fluid from a branch of the segmental lacunae encircling the body, and the contraction of the muscular walls of the vesicles drives the fluid into the lateral lacunae; the vesicles are provided with a valve formed by an invagination of the wall, which opens and closes as they pulsate.

The *Rhynchobdellidae* have a closed vascular system in addition to the lacuna system, and in the *Arhynchobdellidae,* in which the obliteration of the coelom has advanced still farther, the lacuna system, wholly or in part, takes the place of the vascular system of the former family; in the *Arhynchobdellidae* the coelom is invaded by the so-called botryoidal tissue, consisting of curious pigmented and excavated cells, the precise function of which is still not fully understood.

Vascular System.—The true vascular system of the *Rhynchobdellidae* consists typically of a dorsal and a ventral vessel running the length of the body and connected at the extremities by a system of branches: anteriorly a part of the dorsal vessel is muscular and contractile, functioning as a heart; and the dorsal



FROM HARDING AND MOORE, "HIRUDINEA" FAUNA OF BRITISH INDIA, BY COURTESY OF THE SECRETARY OF STATE FOR INDIA IN COUNCIL

FIG. 16.—THE GENERAL INTERNAL ANATOMY OF A TYPICAL TEN-EYED LEECH, BASED ON HIRUDINARIA GRANULOSA THE ROMAN NUMERALS INDICATE THE SOMITES

vessel expands into an intestinal blood sinus surrounding the gut; the peristaltic contractions of the intestine drive the blood out of this sinus through a series of valves, which close behind it, into the heart-region, from which it receives a further impetus.

Alimentary Canal.—The alimentary canal is divided into oral chamber, buccal sinus, pharynx, oesophagus, stomach, intestine, rectum and anus. The oral chamber is the cavity of the anterior sucker leading into the buccal sinus, in the *Arhynchobdellidae* a shallow cavity containing the jaws, when present, and in the *Rhynchobdellidae* a large cavity surrounding the eversible pharynx or proboscis. The oesophagus leads into the stomach or crop, usually provided with caeca, and essentially an organ of storage; the crop is followed by the intestine, a long straight tube except in the *Hirudidae,* in which it is sacculated. The rectum is a simple tube leading to the anus.

Reproductive System.—The leeches are hermaphrodite with paired male and female organs. The testes are segmentally arranged, except in certain *Arhynchobdellidae* in which they are subdivided into numerous small ovoid bodies. A small segmental duct leads to the *vas deferens* on each side, which enlarges anteriorly to form an epididymis or sperm-vesicle; this leads into the *ductus ejaculatorius,* which finally empties into the common eversible male organ. The female organs consist essentially of two large ovisacs, containing the ovaries and leading to the exterior by a common female aperture.

The sperm is packed in spermatophores, in which it is conveyed from one individual to another. Copulation occurs in the *Hirudidae* by means of the eversible male organ, but in the other families impregnation is normally hypodermic. One leech plants a spermatophore upon the body of another leech; the sperm escapes and makes its way through the tissues into the ovisacs where fertilization takes place. In many groups the spermatophores have to be planted on a definite area of the body, beneath which lies the special conductive tissue through which the sperm passes.

Nephridia.—The convoluted nephridia are formed of rows of tubular cells set end to end like drain-pipes. Externally they open by a vesicle on the ventral surface of the segment, and the internal funnel communicates with the lacuna system.

Phylogeny and Classification.—There is much evidence to show that the leeches are derived from the Oligochaeta. Apart from *Acanthobdella,* to whose systematic position reference has already been made, the leeches are divided into two suborders:—the *Rhynchobdellidae,* marine and freshwater leeches with colourless blood, with an exsertile proboscis, without jaws; and the *Arhynchobdellidae* or *Gnathobdellidae,* freshwater and terrestrial leeches with no proboscis, typically with jaws, with red blood.

Development.—The eggs are laid in cocoons formed from glands in the clitellum; segmentation is unequal and in the *Arhynchobdellidae* the young hatch early and swim about inside the cocoon, feeding on the contained albumen. After leaving the cocoon the young often attach themselves to the ventral surface of their mother.

Distribution.—The Continental leeches are limited in range, both vertically and horizontally, by temperature alone. Below 40°F they cease to be active, and consequently they are not found in the polar regions or above certain altitudes in the mountain ranges. The marine leeches, however, are carried by their piscine hosts far into the polar seas.

Economics and Ecology.—A brief sketch of the economic relations of leeches is given in the article LEECH. For further information and for an account of their habits, with special reference to tropical forms, the reader is referred to Harding and Moore's "Hirudinea," *Fauna of British India* (London, 1927).

BIBLIOGRAPHY.—W. A. Harding and J. P. Moore, "Hirudinea," *Fauna of British India* (1927). (Contains a good historical account, a good but incomplete sketch of the morphology, much information regarding habits, distribution and economics, and an extensive bibliography.) W. A. Harding, "A revision of the British Leeches," *Parasitology,* III. (2) (1910; very good bibliography). An extensive bibliography is also to be found in C. Pinto, "Enseio Monographico dos Hirudineos," *Revista de Museum Paulista* (1923). (C. C. A. M.)

MYZOSTOMARIA

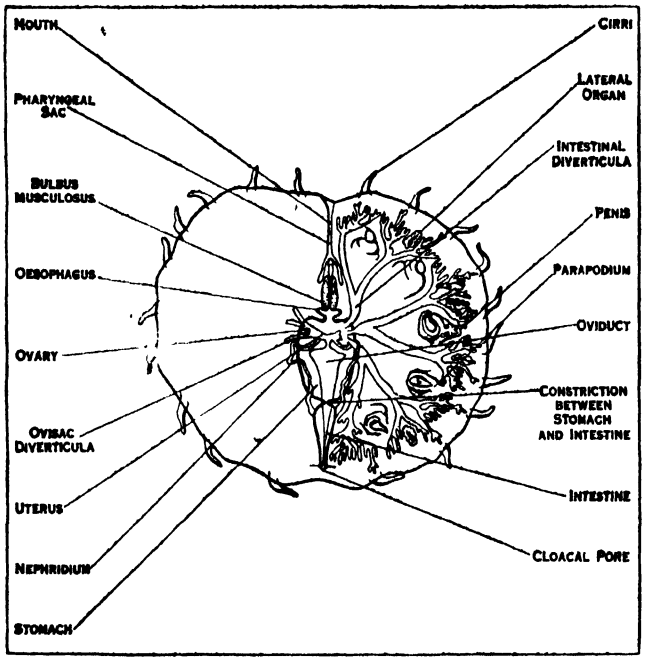
The Myzostomaria are small aberrant annelids living as external or internal parasites on echinoderms. The great majority of their hosts are crinoids; a few are among the ophiuroids and asteroids. Originally attributed by Leuckart to the trematodes, the Myzostomaria have been put by various authors among the turbellarians, the leeches, and even among the Crustacea; but their trochophore larva is undoubtedly annelidan, and they are now regarded as a modified branch of the Polychaeta.

Morphology.—The body is discoid, oval, or more rarely oblong, furnished along its edge with usually ten pairs of more or less well-developed cirri. On the ventral (very rarely on the lateral) surface there are five pairs of parapodia provided with acicula and hooks; the latter consist of a stout hooked chaeta supported by a bristle with a membranous or chitinous expansion at its tip. There are normally four pairs of suckers, homologous with the lateral sense-organs of the Polychaeta, and alternating with the parapodia. An anterior ventral mouth leads into an unarmed retractile pharynx provided with a bulbus musculosus. The pharynx is followed by a stomach and an intestine; the stomach sends off a varying number of caeca. There is a terminal cloaca.

The body cavity is reduced to a space above the mid-gut and a pair of latero-ventral cavities; the former serves as an ovisac from which comes off a duct opening into the common cloaca; the latter give rise to the testes and their ducts which end in penis-papillae at the root of the third parapodium of either side. The circulatory system consists of a series of intercellular lacunae filled with coelomic fluid. The nervous system, consisting of a ventral nerve-cord and an oesophageal loop, is of the rope-ladder kind. Except in *Protomyzostomum* there is only a single pair of nephridia.

Classification.—Von Stummer-Traunfels recognizes four families: The *Myzostomidae*, with 106 species; the *Protomyzostomidae*, with 3 species; the *Mesomyzostomidae*, with 1 species; and the *Stelechopidae* with 1 species. They are distinguished by the number of intestinal caeca, position of the parapodia, etc.

Ecology.—The Myzostomaria climb by means of their hooks on the disc and arms of their hosts or form a kind of gall upon them: sometimes they are internal parasites and live in the digestive tract or the gonad of their host They are normally protandric hermaphrodites. The young animal functions as a male and then, when the sperm has been discharged and the eggs are ripe, it becomes a female; when the eggs ripen before the total emission of the sperm a true hermaphroditic phase ensues; otherwise there is an immature stage between the male and female conditions. Certain species carry on their backs young forms still functioning as males.



AFTER VON STUMMER-TRAUNFELS IN KUKENTHAL AND KRUMBACH, "HANDBUCH DER ZOOLOGIE"

FIG. 17.—MYZOSTOMUM ANTARCTICUM

Semi-diagrammatic figure of the anatomy seen from the ventral surface. The nervous system is not shown

BIBLIOGRAPHY.—The best account of the group with an extensive bibliography is that of von Stummer-Traunfels in the *Handbuch der Zoologie*, W. Kukenthal and T. Krumbach, Band III., pp. 132–210, text-figs. (1926). P. Fauvel gives a good and concise account of the European forms in "Polychètes sédentaires," etc. *Faune de France*, are obscure 1-450, text-figs. (1927). (C. C. A. M.)

ANNEN, a town in the Arnsberg district of the Prussian province of Westphalia, 6m. S.W. of Dortmund. Pop. (1925) 17,831. Coal-mining is carried on and glass, soap, chemicals and metals manufactured.

ANNEXATION, a formal act of state (*see* ACT OF STATE), whereby a state claims *dominium* or sovereignty over territory which is unoccupied by civilized people, or which is occupied by its own subjects, or over which it has established a protectorate, or which it has occupied by treaty, or which has been subjugated by its armed forces. Annexation alone is incapable of giving a good title. In the case of territories which are no part of the possessions of any civilized state, annexation must be accompanied by settlement. It matters not which comes first, but there must be some formal act of annexation. This is usually the hoisting of the national flag and the reading of a proclamation declaring the intention of the annexing state to take the territory in question as its own If subordinate authorities perform the act of annexation their proceedings are invalid until ratified by their supreme government. Thus when Queensland in 1883 annexed the greater part of New Guinea together with New Britain, New Ireland and other islands, Great Britain only ratified the annexation of a portion of the south-east of New Guinea, after which Germany annexed another portion and established a protectorate over New Britain and New Ireland A protectorate has frequently been a first step to annexation. Thus France which had in 1885 acquired a protectorate of Madagascar by treaty, in 1896 annexed it as a colony of the republic. Thus in 1908 Austria formally annexed Bosnia and Hercegovina, which she had occupied by virtue of the Treaty of Berlin, 1878, and in 1914, on the outbreak of the war with Turkey, Great Britain annexed Cyprus, which she had administered under the suzerainty of the Sultan. The proclamations by Lord Roberts in 1900 of annexation of the Orange Free State and the South African republic were premature and invalid, since the war did not terminate for nearly two years. A good title was only acquired by the cession of these territories by the Boer generals by the Convention of Vereeniging, 1902 The surrender of territories by Germany and her allies in the peace treaties following the World War, although substantially annexation by conquest, was legally cession by agreement. Consequently the title of the succession States is founded on cession. For the legal effects of annexation *see* STATE SUCCESSION.

See C. F Randolph, *Law and Policy of Annexation* (1901); T. J. Lawrence, *The Principles of International Law*, 7th ed. 1923.

(H. H. L. B.)

ANNICERIS, a Greek philosopher of the Cyrenaic school. A follower of Aristippus, he denied that pleasure is the general end of human life. To each separate action there is a particular end, namely the pleasure which actually results from it. Secondly, pleasure is not merely the negation of pain. There is, however, an absolute pleasure in certain virtues such as belong to friendship. In these a man will have pleasure, even though it may result in painful consequences. He maintains, in opposition to most of the Cyrenaic school, that prudence alone is an insufficient guarantee against error. The wise man is he who has acquired a habit of wise action; human wisdom is liable to lapses at any moment.

ANNING, MARY (1799–1847), English fossil-collector, was born at Lyme Regis. When but a child in 1811 she discovered the first specimen of *Ichthyosaurus* which was brought into scientific notice; in 1821 she found remains of a new saurian, the *Plesiosaurus*, and in 1828 she procured, for the first time in England, remains of a pterodactyl (*Dimorphodon*).

ANNISTON, a city of Alabama, U.S.A., 56 m. E. by N. of Birmingham, on the slope of Blue mountain, the county seat of Calhoun county. It is on the Bankhead highway, and is served by the Southern and the Louisville and Nashville railways. The population was 17,734 in 1920, of whom 5,834 were negroes, and was estimated locally at 25,000 in 1927.

Anniston is a trade centre for cotton and other products, and has extensive manufactures, especially of iron, steel, cotton and chemical products. The output of the 45 establishments in 1925 was valued at $14,080,023. Camp McClellan, a permanent post of the U.S. Army, is situated here.

An iron furnace was built on the site of Anniston during the Civil War, and was destroyed by Federal troops in 1865. The city was founded in 1872 as a private enterprise by the Woodstock Iron Company, chartered as a city in 1879, and opened for general settlement in 1884.

ANNO or **HANNO, SAINT** (*c.* 1010–1075), archbishop of Cologne, belonged to a Suabian family, and was educated at Bamberg. He became confessor to the Emperor Henry III., who appointed him archbishop of Cologne in 1056. Anno was the leader of the party that abducted the young King Henry IV. from his mother Agnes. He then seized the regency, but was compelled to share it with Adalbert, the powerful archbishop of Bremen. In 1064 he left the court, but recovered some of his former influence on Henry when Adalbert fell in 1066. His most important service was his action at the Council of Mantua (May 1064) when he secured the recognition of Alexander II. as pope, against his rival Honorius, who was originally a nominee of the German Court. He was killed at Cologne on Dec. 4 1075, and canonized in 1183.

BIBLIOGRAPHY.—A *Vita Annonis*, written about 1100, appears in the *Monumenta Germaniae historica: Scriptores*, Bd. xi. (Hanover and Berlin, 1826–92). *See* also the *Annolied*, or *Incerti poetae Teutonici rhythmus de S. Annone*, written about 1180, and edited by J. Kehrein (Frankfort, 1865); Th. Lindner, *Anno II. der Heilige, Erzbischof von Köln* (Leipzig, 1869).

ANNOBON or **ANNO BOM,** an island in the Gulf of Guinea, in 1° 24′ S. and 5° 35′ E., belonging to Spain. Length about 4m., breadth 2m., and area 6¼ square miles. It presents a succession of beautiful valleys and steep mountains, covered with rich woods and luxuriant vegetation, and culminating in the Pico de Fogo (about 3,000ft.) an extinct volcano with a crater lake. The inhabitants number (1926) about 2,000, the chief settlement being San Antonio de Praia, which has a poor roadstead. Ships can obtain here water and fresh provisions. The island was discovered by the Portuguese on Jan. 1, 1473, from which circumstance it received its name (=New Year). Annobon, together with Fernando Po, was ceded to Spain by the Portuguese, by the treaty of El Parado, 1778, with a stipulation for the continuance of "free and open traffic and commerce in negroes." The Portuguese had valuable plantations, and in their hands Annobon was of some importance. The islanders are negroes, believed to be the descendants of a cargo of slaves shipwrecked there in the 16th century, with an admixture of Portuguese blood, and professedly Roman Catholics. They revolted against the Spaniards and kept practical independence until the time of the partition of Africa, when, about 1885, Spanish authority was established. The governor general of Spanish Guinea is represented by a native deputy.

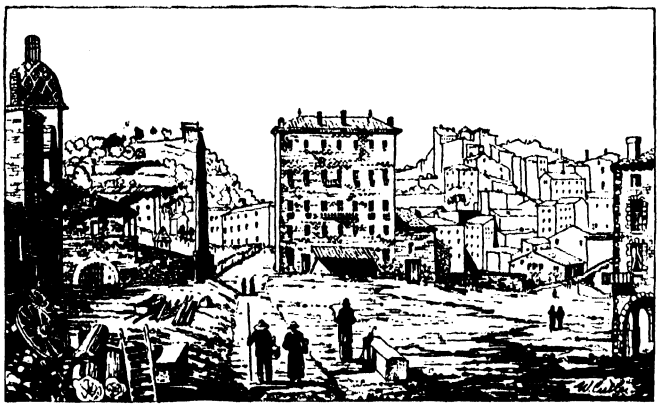
See Arnold Schultze, "Die Insel Annobon" in Petermann's *Mitteilungen*, band lix. (1913) with map.

ANNONA, in Roman mythology, the personification of the produce of the year (Lat. *annus*, year). Her attributes in works of art and on imperial coins were a corn-bushel, a ship's prow pointing to the transport of the grain over the sea, ears of corn, and a horn of plenty (*cornu copiae*).

The Latin word itself has various meanings: (1) the produce of the year's harvest; (2) all means of subsistence, especially grain stored in the public granaries for provisioning the city; (3) the market price of commodities, especially corn; (4) a direct tax in kind, levied in republican times in several provinces, chiefly employed in imperial times for distribution among officials and the support of the soldiery.

In order to ensure a supply of corn sufficient to enable it to be sold at a very low price, it was procured in large quantities from Umbria, Etruria and Sicily. Almost down to the time of the empire, the care of the corn-supply formed part of the duties of the aedile (q.v.), and possibly of certain special commissaries. As a consequence of the second Punic War, Roman agriculture was at a standstill; accordingly, recourse was had to Sicily and Sardinia (the first two Roman provinces) in order to keep up the supply of corn; a tax of one-tenth was imposed on it, and its export to any country except Italy forbidden. The price at which the corn was sold was always moderate; the corn law of Gracchus (123 B.C.) made it absurdly low, and Clodius (58 B.C.) bestowed it gratuitously. The number of the recipients of this free gift grew so enormously that both Caesar and Augustus were obliged to reduce it. From the time of Augustus to the end of the empire the number of those who were entitled to receive a monthly allowance of corn on presenting a ticket was 200,000. A *praefectus annonae* was appointed by Augustus to superintend the corn-supply, who was assisted by a large staff in Rome and the provinces. In the 3rd century bread formed the dole. The office lasted till the latest times of the empire.

ANNONAY, a town in France, dept. of Ardèche, 50m. S. of Lyons by the P.L.M. railway. Pop. (1926) 13,218. Annonay is built on a hill above the confluence of the deep gorges of Déôme and Cance (tributaries of the Rhône), which supply power to local factories. A reservoir constructed in the Ternay



BY COURTESY OF THE MUSEUM OF ANNONAY

THE CENTRAL SQUARE AT ANNONAY, NOW THE PLACE MONTGOLFIER, AS IT APPEARED IN 1783 AT THE TIME OF THE FAMOUS FLIGHT OF JOSEPH AND ÉTIENNE MONTGOLFIER, WHO INVENTED THE BALLOON

valley, an affluent of the Déôme, to the north-west of the town, provides water for industrial and domestic purposes. The brothers Montgolfier, inventors of the balloon, and Marc Seguin, engineer, were natives of Annonay. A tribunal of commerce, a board of trade-arbitrators, and chambers of commerce and of arts and manufactures are among the public institutions. Annonay is the principal industrial centre of its department, making paper, silk, leather, etc.

ANNOY, to vex. In the sense of "nuisance" (*q.v.*) "annoyance" is found in the English "Jury of Annoyance" appointed by an act of 1754 to report upon obstructions in the highways.

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